The social integration-health nexus for elderly migrants: evidence from China migrants dynamic survey

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The social integration-health nexus for elderly migrants: evidence from China migrants dynamic survey

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Abstract

As global aging accelerates, the health of vulnerable of older migrants has become a critical public health priority. Using the data from 2017 China Migrants Dynamic Survey (CMDS), this paper examines the impact of multi-dimensional social integration on the health outcomes of older migrants in China and explores the mediating mechanisms of social support, acceptance, and discrimination. The results show that social integration significantly improves self-rated health (SRH) among older migrants, although no statistically significant effect on the prevalence of chronic diseases was observed. Economic integration demonstrated the strongest positive effect on SRH, followed by behavioral adaptation, institutional integration, and psychological integration, while cultural acceptance had the weakest impact. The benefits of social integration were the most pronounced among individuals aged 65–69, those with a primary or secondary education, and those with a migration duration for 5–10 years. Further analysis indicates that social integration promotes SRH by increasing social support and social acceptance while reducing social perceived social discrimination. These findings provide valuable policy insights for improving the health and well-being of elderly migrants and contribute to the broader discussion on migrant social integration.

Keywords Elderly migrants, Social integration, Self-rated health, Underlying mechanisms, Endogeneity issues

Introduction

Health is fundamental to human development and forms the basis for social and economic progress. Following the paradigm shift from a purely biomedical model to a biopsychosocial approach, scholars have increasingly focused on the social determinants of health [4, 12, 30]. Within this context, social integration has developed as a key determinant of well-being for migrants [49]. Social integration is a multi-dimensional concept, including economic participation, behavioral adaptation, institutional inclusion, psychological belonging, and cultural acceptance [22, 31, 59]. For older migrants, these dimensions are particularly crucial,they collectively shape access to healthcare services, emotional well-being, and overall health status, making social integration a critical

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research area in public health and migration studies [35, 49].

A robust body of research has established social integration as a primary predictor of health across the life course. Previous studies have consistently linked higher levels of social integration to reduced mortality rates [39], and preserved cognitive function [60], and improved psychological well-being [8, 22, 35]. Furthermore, social integration has been identified as a key driver of subjective well-being [27, 43], and healthcare utilization behaviors [1]. While these studies provide a broad framework, recent scholarship has begun to specifically interrogate the health outcomes of migrant population [22, 48]. However, the unique intersection of senescence and migratory displacement presents a complex health profile that remains under-explored in the current literature.

Despite these advancements, several critical gaps remain in literature. First, existing research frequently treats migrant populations as a homogenous group, overlooking the unique physiological and psychosocial vulnerabilities of older migrants [47]. Second, empirical evidence on social integration and health outcome in the Chinese context has relied heavily on a single data source, 2014 China Migrants Dynamic Survey (CMDS). These earlier studies are limited by smaller sample sizes and limited geographic coverage, restricting the generalizability of their findings to the current socio-political climate [22, 28]. Furthermore, while previous studies have examined the direct impact of social integration on health [22, 49], the mediating pathways and underlying mechanisms, such as the roles of social support and discrimination, remain insufficiently explored. Consequently, there is a rising need to updated, large-scale empirical analysis to clarify how multi-dimensional integration impacts the health outcomes of this disadvantaged group.

Advancement in medical technology and rising living standards have significantly extended life expectancy, contributing to a rapid acceleration of global population aging [50]. Consequently, the rise in household-based migration has resulted in a rising population of older migrants. This demographic faces a "double burden" of disadvantage due to the combined challenges of aging and migration status [25]. Compared to younger migrants, older migrants are more likely to suffer from declining physiological functions, weakened immune systems, and reduced adaptability to unfamiliar or new environments, increasing their vulnerability to health problems [18, 19]. Additionally, settling in a new city often disrupts their existing social networks, limits access to healthcare, and diminishes their sense of belonging, all of which may exacerbate health challenges [25]. Despite these concerns, research on examining the relationship between social integration and elderly migrants' health outcomes remains limited.

To address these gaps, this study uses data from the 2017 China Migrants Dynamic Survey (CMDS), the most comprehensive and the most recent survey data capturing the social integration and health status of older migrants in China. We examine the multi-dimensional relationship between integration and health, as well as the underlying mechanisms. Our empirical results indicate that social integration significantly improves self-rated health (SRH) among older migrants, however, its impact on chronic disease prevalence was not statistically significant.

Among the various dimensions of social integration, economic integration demonstrated the most significant positive impact on SRH, followed by behavioral adaptation and institutional integration, while psychological integration and cultural acceptance have comparatively weaker effects. To ensure the robustness of these findings and address potential endogeneity issues arising from reverse causality and self-selection bias, we employ instrumental variable (IV) estimation and the propensity score matching (PSM) method. Further analysis reveals that social integration enhances SRH through multiple pathways, including increased social support and social acceptance, as well as reduced social discrimination. Additionally, the positive impact of social integration shows significant heterogeneity, appearing most pronounced among older migrants aged 65–69, those with primary or secondary education levels, and those with a migration duration for 5–10 years.

This study makes several significant contributions to the current literature. First, by synthesizing sequential interaction theory with Maslow's hierarchy of needs, we develop a robust, multi-dimensional framework specifically tailored to the social integration of older migrants. Second, we introduce institutional integration as a distinct dimension, recognizing its relevance within the Chinese socio-political context, such as the *hukou* system and social security portability that differentiate migrant experiences in China. Finally, by identifying these specific mediating roles and heterogeneous effects, the research moves beyond simple association to provide a deeper insights into how social integration benefits different subgroups within the aging migrant population.

By clarifying the relationship between social integration and geriatric health, this study provides a critical insights into the intersection of urbanization and aging in China. The findings not only offer evidence-based policy recommendations to enhance the well-being of older migrants' and contribute to global discussions on sustainable health aging.

The remainder of this paper is structured as follows. "Literature review" section reviews the relevant literature, "Theoretical framework and research hypothesis" section proposes the theoretical framework and research

hypothesis, "Data and methodology" section describes the data and methodology, "Empirical findings" section presents the empirical results and explanations, and "Discussion and conclusion" section discusses the findings and provides policy recommendations.

Literature review

The determinants of migrants' self-rated health

Self-rated health (SRH) is a well-established subjective measure of overall health status and a reliable predictor of morbidity and mortality in later life [38]. Among migrant populations, SRH is shaped by a dynamic set of sociodemographic, neighborhood and psychosocial factors that evolve throughout the migration trajectory [16].

Sociodemographic characteristics represent a primary determinant of these health outcomes; research consistently indicates that women, older adults, and those with lower socioeconomic status or significant linguistic and cultural barriers tend to report worse SRH [6, 18]. Furthermore, the volatility of social mobility, both upward and downward, posing distinct health risks compared to those in stable socioeconomic conditions [16]. Building on the foundational work of Marmot [26] regarding social gradients in health, recent studies affirm this occupational downgrading and employment instability are significant predictors of diminished health status among migrant populations [13].

Neighborhood characteristics also play an important role in shaping health and well-being. Features such as social cohesion and access to public transportation are particularly influential for foreign-born middle-aged and older adults [42]. Similarly, Eibich et al. [12] found that access to public transport and social support are positively associated with physical and mental health outcomes across different life stages.

Beyond physical environment, migration experience itself often involves substantial psychosocial stress, where perceived discrimination acts as a major toxic stressor. The negative health effects have been conceptualized in framework such as John Henryism hypothesis [17], and have been empirically supported by longitudinal data identifying social isolation and discrimination as critical public health challenges linked to adverse physical and mental health outcomes [4].

In China, the expanding literature on older migrants emphasize their unique position at the interconnection of rapid urbanization and population aging, highlighting their dual vulnerabilities as both older adults and migrants. Existing studies suggest that difficulties in social, economic, and cultural integration significantly undermine their health status [24, 28].

The impact of social integration on migrants' health

The theoretical foundation of the relationship between social integration and health can be traced back to the work of Durkheim [11], who proposed that social integration is a key determinant of individual health by shaping individual sociological dynamics. Durkheim argued that higher levels of social integration serves as a protective factor against adverse outcomes, such as suicide, by fostering essential social connections. Building upon this classical framework, many scholars have extensively evaluated the impact of social integration on various health dimensions. Evidence shows that greater social integration improves self-rated and psychological health, with a particularly strong effect on mental well-being [8]. Furthermore, social integration has been associated with reduced mortality rates, with few exceptions related to collective unionization levels [39], and a reduced risk of cognitive decline [60]. Recent studies have also identified that both formal and informal social integration contribute to spiritual well-being, as observed in the early stages of the COVID-19 in Germany [43]. Additionally, Aditi et al. [1] highlight the critical role of social networks and social integration in influencing healthcare decision-making, while Melanie et al. [27] demonstrate that older men and women living in both conventional housing and independent living facilities reported high levels of happiness, which were positively associated with thriving, social participation, community integration, and both self-directed and external forms of ageism.

Recent studies in the Chinese context further underscore the influence of social integration on migrant health. For instance, Lin et al. [22] utilized 2014 CMDS data and captured a positive relationship among economic status, cultural adaptation, integration willingness, and various health indicators, including SRH, subjective well-being, sense of stress, and psychological health. Similarly, Xia and Ma [49] utilized the same dataset and found that social integration improves SRH and life satisfaction while reducing the risk of mental disorders among young migrants.

Despite these contributions, research specifically focusing on older migrants remains limited. This population faces unique health challenges characterized by restricted access to healthcare and eldercare services, low health awareness, and significant barriers to social inclusion. Given that older migrants experience health vulnerabilities distinct from their younger counterparts, there is a critical need to investigate how multidimensional social integration influences their specific health trajectories.

Theoretical framework and research hypothesis

Based on the existing literature and relevant theories, the theoretical framework of this paper is shown in Fig. 1.

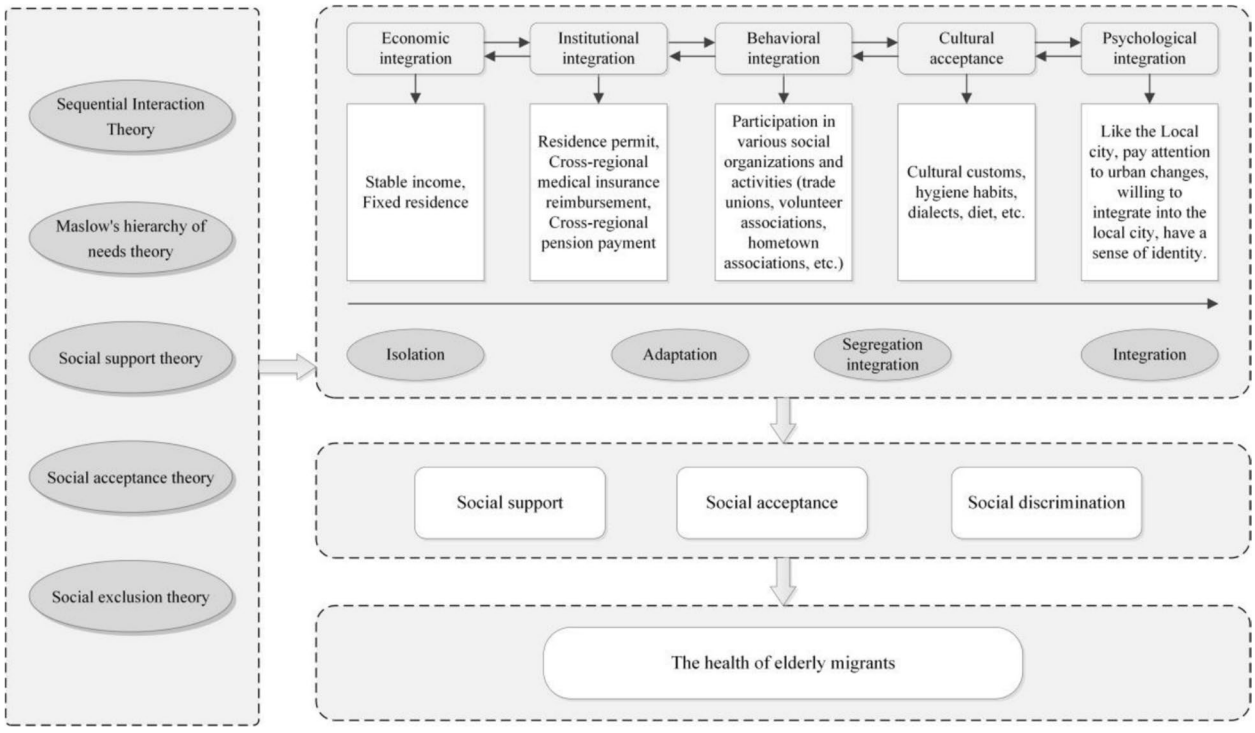

Fig. 1 The theoretical framework of this paper

The framework for the social integration of elderly migrants

Drawing on sequential interaction theory and Maslow's hierarchy of needs, this paper develops a theoretical framework to understand the social integration of older migrants in China across five dimensions: economic integration, institutional integration, behavioral adaptation, cultural acceptance, and psychological integration. Diverging from conventional four-dimensional models, this framework includes institutional integration, recognizing its critical role in ensuring migrants' equitable participation and access to social welfare [37]. In Chinese context, institutional barriers remain a major challenge for migrant integration, particularly for the elderly, who often face exclusion from urban healthcare and pension benefits.

Sequential interaction theory posits that social integration is a gradual interactive process, where different dimensions evolve and influence one another over time [52]. Older migrants transition through a continuum of stages, from isolation to adaptation, followed by segregated integration, and finally reaching full integration, this reflects their varying levels of need. Within this framework, the five dimensions represent progressive levels of integration, ascending from foundational economic integration to the higher-order psychological integration. True integration is achieved when migrants develop a strong psychological sense of belonging and identify closely with the local community [58, 59]. It is important to note, however, individuals may achieve varying degrees of integration across different dimensions, and the sequence of these dimension is not strictly linear.

Moreover, these dimensions are interconnected and mutually influential [54]. For example, behavioral adaptation and cultural acceptance can influence economic integration, as proficiency in local customs and language enhances economic participation and fosters a stronger psychological identity. In turn, an established sense of psychological belonging can further promote behavioral and cultural adaptation.

Finally, the aggregate level of social integration is determined by the breadth and depth of these integrated dimensions. Isolation is characterized by minimal or absent integration across all dimensions, whereas adaptation emerges when migrants integrate into two or three dimensions. When four dimensions are integrated, migrants achieve a state of segregated integration, and full integration is achieved only when all five dimensions are successfully integrated.

The theoretical framework of social integration on elderly migrants' health

Grounded in social support theory, social acceptance theory and social exclusion theory, as well as the previously discussed social integration framework, this paper examines how social integration influences elderly migrants' health outcome. Specifically, it explores three

key mediating mechanisms: social support, social acceptance and social discrimination.

Social support theory emphasizes the role of social relationships and networks in reducing stress, strengthening resilience, and promoting both physical and mental health. Social integration plays a crucial role in this process by fostering mutual understanding, respect, and cooperation, which in turn enhances overall social support. Additionally, integration expands individual's social network, providing access to support from a wider range of sources and channels.

The impact of social support on health has been explained through three models. The main effect model points out that higher levels of social support universally improve physical and mental health [34]. The buffering effect model suggests that social support serves as a protective factor, mitigating the negative impact of stressful events on physical health and overall well-being. Meanwhile, the dynamic model highlights that social support and stress interact in a nonlinear, stage-based process, indicating that their effects may vary over time [33]. Based on these theoretical frameworks, we propose the following hypothesis:

Hypothesis 1: Social integration improves the health outcomes of older migrants by increasing their level of social support.

Social acceptance theory suggests that an individual's sense of belonging and self-identity depends on the degree of social acceptance they experience, which significantly influences psychological health and overall well-being. Among the multi-dimensional framework of social integration, psychological integration is particularly important for health, as it enhances health outcome by fostering a sense of belonging, promoting social acceptance, and strengthening support networks. Research has shown that social acceptance, along with positive daily interactions, strong ethnic and family identification, contributes to improved psychological well-being [30].

Conversely, social discrimination represents the antithesis of social acceptance. Social exclusion theory argues that due to variations in social identity, characteristics, or background, certain groups face unfair treatment and restricted opportunities. As a particularly vulnerable group, older migrants often struggle with a weak sense of belonging and fragmented integration when settling in a new location. They may face barriers in employment, social services, healthcare, and resource allocation, all of which negatively impact their health status. Specifically, discriminatory experiences have been shown to induce psychological distress and reduce quality of life among rural-to-urban migrants [46]. Social exclusion also negatively affects individual's social relationships and living environment [2, 48]. Moreover, evidence suggests that racial and language discrimination are associated with increased chronic diseases [57], while experiences of marginalization lead to declines in both physical and mental health [10].

The social integration of older migrants is a gradual process that involves both assimilation and mitigation of exclusion. For non-dominant groups, identification and social exclusion are key components shaping their participation in mainstream socio-economic activities [5]. Recent research output by Xu et al. [51] further highlights that group identity and social exclusion interact significantly to affect levels of social participation. While a strong group identity enhances social participation, social exclusion acts as a barrier. Engaging in social activities promotes social interaction, enhances social support, and encourages positive emotions and healthy behaviors, all of which contribute to improved SRH and overall well-being. Consequently, we proposed the following hypotheses:

Hypothesis 2: The social integration of older migrants improves their health status by increasing their level of social acceptance.

Hypothesis 3: The social integration of older migrants improves their health status by reducing their level of social discrimination.

Data and methodology

Data and variables

This study uses data from the 2017 China Migrants Dynamic Survey (CMDS) to investigate the impact of social integration on the health outcomes of older migrants. The CMDS is a large-scale micro-level survey conducted by the National Health Commission of China. It employs a stratified, multi-stage sampling method with probability proportional to size (PPS), covering 31 provinces across China and targeting individuals who have resided outside their original district, city, or county for at least one month.

Based on previous studies and CMDS definitions, this study defines older migrants as individuals aged 60 and above who have relocated across counties, cities, or provinces and have resided in their current location for at least one month [25]. After applying these criteria, the working sample consists of 6,478 migrants.

Dependent variable

Health status is measured using two indicators: self-rated health (SRH) and the prevalence of chronic disease,

both derived from the 2017 CMDS questionnaire. SRH is generated through the question, "How is your health status?" with four response options: (1) healthy, (2) basically healthy, (3) unhealthy but able to live independently, and (4) unable to live independently. Following the existing literature [15], SRH is coded as 1 if the respondent chooses "healthy" or "basically healthy", and 0 otherwise. To ensure the robustness of the results, two alternatives of SRH measurements are also employed: First, a stricter definition codes SRH as 1 only if the respondent chooses "healthy" and 0 otherwise. Second, SRH is encoded as ordinal variable, assigned values from 1 to 4 to reflect increasing levels of health impairment. Chronic diseases prevalence is based on question, "Do you have a doctor-diagnosed condition of hypertension or type II diabetes?" and is coded as 1 if the respondent has either condition and 0 otherwise.

Independent variable

Drawing on the theoretical framework discussed above, we employed factor analysis to construct the social integration index. This approach is consistent with prior research [58] and aligns with the data availability. First, the suitability of the data was confirmed by a KMO value of 0.872 and a significant Bartlett's test of sphericity ($p < 0.001$). The factor analysis identified five dimensions, accounting for 63.42% of the total variance. As shown in Table 1, psychological integration (35.68) carries the highest weighting in the index, reflecting its role as a simulator of deep integration through the recognition and acceptance of the destination [52]. Behavioral adaptation and cultural acceptance follow, representing social activities and adaptation to local culture and customs, respectively. Finally, economic integration (14.17) and institutional integration (11.93) comprise the remaining components of the index, the latter reflecting access to formal support such as residence permits.

Table 1 Measurement of social integration

Composite Index	Dimensions	Indicators	Weighting (%)
Social integration	Psychological integration	Preference for the current city of residence	35.68
		Interest in the culture of the current city of residence	
		Willingness to integrate with local residents	
		Feeling like a local resident	
	Behavioral adaptation	Participation in activities of unions or other organizations	20.12
		Providing suggestions to workplace/community	
		Participation in activities such as charity donations and blood donation	
		Participation in party/youth league organizational activities	
	Cultural acceptance	Adherence to hometown customs and traditions	18.10
		Have different hygiene habits compared to local residents	
	Economic integration	Average monthly household income	14.17
		Housing conditions	
	Institutional integration	Status of temporary/residence permit application	11.93

Using the five dimensions and their respective factor weights, this study constructs a composite index to measure psychological integration, behavioral adaptation, cultural acceptance, economic integration, and institutional integration. To ensure comparability, all dimensions are normalized to a scale of 1 to 100. The mean social integration index for the sample was 51.13, indicating that older migrants exhibit significantly lower levels of integration compared to other migrant groups [7, 53, 58]. The results further reveal substantial disparities across individual dimensions, underscoring the uneven nature of integration for older migrants. Among the five dimensions, psychological integration scored the highest (77.66), followed by institutional integration (61.83). Cultural acceptance and economic integration had values of 56.13, 53.81, respectively, while behavioral adaptation exhibited the lowest value at 12.37. These findings suggest that while older migrants may achieve a degree of psychological belonging and institutional access, their active participation in local social behaviors remains significantly restricted.

Mediating variables

To explore the mechanisms through which social integration affects the health outcomes of elderly migrants, this study examines three mediating variables: social support, social acceptance, and social discrimination.

Social support is measured based on the 2017 CMDS survey question regarding social interaction: "In your residence area, who do you spend the most time with (excluding customers and other relatives)?" Response options, including "rarely interacts with others," "fellow villagers or townspersons," "locals," and "other migrants", are assigned values from 1 to 4, with higher values indicating higher levels of social interaction.

Social acceptance is measured using survey question, "Do you feel that local residents are willing to accept you?" Responses are measured on a 4-point Likert scale where higher values reflect a greater sense of inclusion.

Social discrimination is assessed through the question "Do you feel that local residents discriminate migrants?" Responses are recorded on a 4-point Likert scale, with higher values indicating more perceived discrimination.

Table 2 Descriptive statistics

Variable	Definition	Mean/Percentage
Dependent variables		
SRH	Binary variable; takes 1 if the respondent is "healthy" or "basically healthy"; 0 otherwise	81.26%
Chronic diseases	Binary variable; takes 1 if the respondent has hypertension or type II diabetes; 0 otherwise	35.05%
Independent variable		
Social integration	Composite index (numeric)	51.13
Mediating variables		
Social support	Ordinal variable (1–4); higher values indicate a broader and more diverse social network	3.33
Social acceptance	Ordinal variable (1–4); higher values indicate a greater sense of inclusion	3.27
Social discrimination	Ordinal variable (1–4); higher values indicate greater perceived discrimination	3.08
Control variables		
Gender	Binary variable; takes 1 if male; 0 otherwise	58.21%
Age	Continuous variable	66.05
Education level	Categorical variable; takes 1 for no schooling; 2 for primary school; 3 for junior; 4 for high school and above	7.49
Marital status	Binary variable; takes 1 if married; 0 otherwise	84.42%
Minority	Binary variable; takes 1 if is an ethnic minority; 0 otherwise	8.83%
Type of Hukou	Binary variable; takes 1 if holds rural hukou; 0 otherwise	57.74%
Member of the Communist Party of China (CPC)	Binary variable; takes 1 if is the member of Communist Party of China; 0 otherwise	14.54%
Employment status	Binary variable; takes 1 if employed; 0 otherwise	31.22%
Healthcare services	Continuous variable; Walking distances (minutes) to the nearest healthcare services	23 min
Migration range	Inter-county migration within a city	20.61%
	Inter-city migration within a province	34.52%
	Inter-provincial migration	44.87%
Migration duration	Less than 5 years	42.49%
	5–10 years	34.52%
	10 years or more	20.61%
Destination Region	Western regions	39.94%
	Central regions	23.17%
	Eastern regions	36.88%

Control variables

Following the health production model [14], the health outcomes of older migrants are influenced by a convergence of individual characteristics, socioeconomic status, healthcare services, and migration attributes. Accordingly, this study includes these factors as control variables. Detailed descriptions of these variables are provided in Table 2.

Methodology

This study examines the impact of social integration on the health of elderly migrants from a micro-level perspective. Given that SRH is a binary variable, this research employs the Probit model:

$$Pr\left(health_i = 1\right) = \Phi\left(\beta_0 + \beta_1 * integration_i + \sum_{i=2}^{N} \beta_i * X_i + \varepsilon_i\right) \quad (1)$$

$$Pr\left(chronic_i = 1\right) = \Phi\left(\gamma_0 + \gamma_1 * integration_i + \sum_{i=2}^{N} \gamma_i * X_i + \mu_i\right) \quad (2)$$

In Eq. (1), $health_i$ is a binary variable representing SRH, $integration_i$ denotes the composite index of social integration, X_i denotes control variables listed in Table 3, and ε_i is the random error term. The focus of this study is the coefficient β_1, where a positive β_1 indicates that social integration improves SRH of elderly migrants.

In Eq. (2), $chronic_i$ indicates the presence of hypertension or type II diabetes among elderly migrants, and the meanings of other variables remain the same as Eq. (1). The key coefficient of interest is γ_1, where a positive γ_1 suggests that social integration increases the prevalence of chronic diseases.

Social integration among elderly migrants is likely endogenous due to potential reverse causality and omitted variable bias. While social integration can affect health outcomes, an individual's health status may also influence their level of social integration. Furthermore, unobserved variables such as personality traits and individual preference may simultaneously affect both social integration and health. To address these endogeneity issues, this paper employs IV estimation. Additionally, propensity score matching (PSM) is used to address potential sample selection bias and improve the robustness of the results.

To explore the underlying mechanisms through which social integration affects the health of elderly migrants, this study follows [2] and adopts the stepwise approach to examine the mediating role of social support and social acceptance. The mediation models are as follows:

$$Y_i = \theta_0 + \theta_1 * integration_i + \theta_2 X_i + \zeta_i \quad (3)$$

$$Mediator_i = \alpha_0 + \alpha_1 integration_i + \alpha_2 X_i + \upsilon_i \quad (4)$$

Table 3 The baseline regression results

Variables	SRH	Chronic Diseases
Social Integration	0.063*** (0.012)	−0.015 (0.014)
Gender (Ref: Female)	0.018* (0.012)	−0.035*** (0.013)
Age (Ref: 60–64 years)		
65–69 years old	−0.039*** (0.012)	0.053*** (0.014)
70 years old and above	−0.073*** (0.012)	0.106*** (0.013)
Education Level (Ref: No schooling)		
Primary school	0.056*** (0.011)	−0.017 (0.018)
Junior high school	0.073*** (0.013)	−0.005 (0.017)
Senior high school and above	0.085*** (0.014)	−0.020 (0.023)
Marital status (Ref: Unmarried)	−0.018 (0.019)	0.033*** (0.014)
Ethnicity (Ref: Han ethnicity)	−0.007 (0.016)	−0.009 (0.021)
Type of Hukou (Ref: Non-agricultural Hukou)	−0.056*** (0.012)	−0.044*** (0.013)
CPC membership	0.009 (0.012)	0.056*** (0.014)
Employment status (Ref: Worklessness)	0.146*** (0.012)	−0.103*** (0.012)
Healthcare services	−0.032*** (0.010)	−0.003 (0.012)
Scope of Migration (Ref: Inter-county)		
Inter-provincial migration	0.023** (0.012)	−0.022 (0.014)
Inter-city migration	0.033*** (0.012)	−0.032 (0.013)
Duration of Migration (Ref: < 5 years)		
5–10 years	0.064*** (0.012)	−0.035 (0.015)
Over 10 years	−0.044*** (0.012)	−0.007 (0.015)
Destination Region (Ref: Western)		
Eastern region	0.063*** (0.013)	−0.035*** (0.012)
Central region	−0.044*** (0.013)	−0.007 (0.014)
N	6478	6478
Pseudo R^2	0.451	0.450

Coefficients reported for the Probit model represents average marginal effects. Results obtained from the Liner Probability Model and Logit models are consistent with the Probit estimates

*, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses. These conventions apply to all subsequent tables

$$Y_i = \eta_0 + \eta_1 integration_i + \eta_2 Mediator_i + \eta_3 X_i + \lambda_i \quad (5)$$

Where $Mediator_i$ represents the mechanism variable, the definition of $integration_i$ and X_i remain the same, θ_0, α_0, and η_0 are the intercept terms, θ_1, α_1, and η_1 are the coefficients for social integration, θ_2, α_2, and η_3 are the coefficients for the control variables, and ζ_i, υ_i, and λ_i are the random error terms.

While the benchmark regression model could effectively identify the impact of social integration on health under the assumption of complete exogenous, endogeneity remains a concern. Social integration may be influenced by both unobservable factors and observable characteristics (individual, mobility, and regional), leading to omitted variable bias. Furthermore, a potential reverse causality exists between social integration and health. To address this endogeneity, we utilizes an Instrumental Variable (IV) approach based on Two-Stage Least Squares (2SLS) estimation. The model is specified as follows:

$$integration_i = \alpha_0 + \alpha_1 * Z_i + \sum_{i=1}^{n} \alpha_i * X_i + \xi_i \quad (6)$$

$$Pr\left(health_i = 1\right) = \Phi\left(\beta_0 + \beta_1 * \widehat{integration}_i + \sum_{i=2}^{N} \beta_i * X_i + \varepsilon_i\right) \quad (7)$$

$$Pr\left(chronic_i = 1\right) = \Phi\left(\gamma_0 + \gamma_1 * \widehat{integration}_i + \sum_{i=2}^{N} \gamma_i * X_i + \mu_i\right) \quad (8)$$

In Eq. (6), Z_i denotes the instrumental variable (refer to Supplementary 1 for measurement details) and ξ_i is the error term. To be valid, Z_i must satisfy both the exclusion restriction, $\mathrm{cov}(Z_i, \xi_i) = 0$, and the relevance condition, $\mathrm{cov}(Z_i, integration_i) \neq 0$. Using 2SLS, we first estimate Eq. (6) to generate the fitted values, $\widehat{integration}_i$. These fitted values are subsequently used in Eqs. (7) and (8). All other variable definitions follow Eqs. (1) and (2).

Selection bias may arise if elderly migrants report their level of social integration based on their individual circumstances. To address this, PSM is employed to correct for selection bias [36]. PSM ensures comparability by matching individuals in the treatment and control groups based on observable characteristics prior to effect estimation. In this study, elderly migrants are categorized into treatment and control groups according to their level of social integration. Specifically, those with social integration scores above the median are assigned to the treatment group (high social integration), while those below the median constitute the control group (low social integration). By comparing health outcomes between matched samples with similar demographic characteristics, socioeconomic status, healthcare access, migration attributes and regional characteristics, this study reduces selection bias and provides a more robust estimate of the relationship between social integration and health outcomes. The detailed methodology of PSM treatment is presented in Supplementary 2.

Empirical findings

The baseline regression results

This study first explores the impact of social integration on the SRH and the chronic disease prevalence of elderly migrants (Table 3). Results reveal that social integration significantly increases the likelihood of positive SRH outcome among elderly migrants. However, its effect on chronic diseases prevalence is not statistically significant across all three models.

There are two potential factors contributing to this insignificant effect. First, chronic conditions such as hypertension and diabetes are largely influenced by genetic predispositions and long-term physiological factors, indicating that social integration may have a limited effect on their prevalence [20]. Second, lower education levels among elderly migrants may lead to delayed medical consultations and restricted awareness of chronic conditions. Previous studies have similarly noted that elderly migrants often have weak health awareness and low utilization of public health services, which may result in significant delays in the formal diagnosis of chronic ailments [47].

The analysis further examines the effects of control variables on health status. Significant gender differences are captured, with male elderly migrants reporting better SRH outcome compared to females, a finding consistent with existing studies [40]. Age is negatively associated with SRH, specifically, older migrants in the 65–70 and 70 + age cohorts reported significantly poorer health outcomes. This decline is likely due to age-related physical deterioration, reduced adaptability, and weakened immunity.

Education achievement is positively associated with SRH, as a higher education level often correlates with stable employment, higher income, and greater financial capacities. These resources facilitate greater investments in health-related needs such as nutritious security, health insurance, and specialized medical equipment [23]. Employment not only provides financial stability but also fosters social engagement and a sense of purpose, both of which contribute to improved well-being. Furthermore, elderly migrants who are employed or have not experienced recent acute illnesses report better SRH.

Older migrants hold rural *hukou* show poorer SRH outcome compared to those with urban registration. This disparity is largely due to institutional barriers, as rural *hukou* holders have restricted access to urban healthcare insurance and related social welfare benefits. Finally, distances to the nearest healthcare facility are strongly linked to SRH outcomes. Those who residing further from medical centers tend to have poorer SRH, as increased travel times may result in delayed treatment and inadequate healthcare utilization.

In terms of migration characteristics, elderly migrants who relocate inter-city within a province or inter-province have a higher probability of reporting positive SRH compared to those moving inter-county within a city. This can be explained by selective migration, where individuals with superior heath status are more likely to undertake long-distance moves, relocating to developed regions with concentrated healthcare resources.

The impact of migration duration follows an inverted U-shaped pattern, where SRH initially improves before declining over longer durations. Compared to those who have migrated within the last 5 years, elderly migrants with a migration duration of 5–10 years report a significantly better SRH. However, for those residing in their destination city for more than 10 years, the impact turns negative. While the initial years of migration may facilitate environmental adaptation and improved well-being, these benefits appear to be eventually offset by age-related health deterioration.

The impacts of regional differences are also evident. Migrants in the eastern region report a better SRH, while those in central show a relatively poorer SRH. The eastern region is more economically developed, offering better medical resources and services, which directly contribute to improved health outcomes for elderly migrants. Conversely, the central region has limited healthcare resources and lower-quality medical services, restricting access to necessary care.

In the case of chronic diseases, gender differences play a significant role (see Table 3). Male have approximately a 3.5% lower probability of developing chronic diseases compared to females, likely due to differences in lifestyle and lower cumulative exposure to certain risk factors. Aging significantly increases chronic diseases prevalence, as declining immune function and physiological resilience elevate health risks. Notably, unlike its impact on SRH, education level does not significantly affect chronic diseases. This is due to migrant often face unstable living conditions, inadequate social security, and restricted healthcare access, which limit the protective effects typically associated with higher education [25].

Hukou status also influences chronic disease prevalence, albeit in an unexpected direction; older migrants with rural household registration show a lower prevalence of chronic diseases compared to those with urban *hukou*. This may be partially explained by the lower levels of air, water, and noise pollution in rural environment compared to urban settings [55]. Additionally, CPC members have a higher chronic disease prevalence. Employment status is significantly linked to a lower risk of chronic disease, as regular work patterns facilitate sustained physical activity [45]. Finally, greater walking distance to healthcare services is linked to lower SRH, as physical barriers to access limit timely medical intervention [56].

Table 4 presents the effects of the five dimensions of social integration on the SRH and chronic diseases prevalence among elderly migrants. To ensure the robustness of the findings, LPM, Probit, and Logit models were applied; the results remained consistent across all models. For SRH, all five dimensions of social integration have significantly positive effects among elderly migrants. Economic integration demonstrated the strongest positive effect, followed by behavioral adaptation and institutional

Table 4 Regression results for different dimensions of social integration

Variables	SRH	Chronic Diseases
Psychological integration	0.063** (0.022)	0.008 (0.019)
Behavioral adaptation	0.041*** (0.012)	−0.003 (0.012)
Cultural acceptance	0.019* (0.014)	−0.014 (0.015)
Economic integration	0.100*** (0.011)	−0.006 (0.012)
Institutional integration	0.042*** (0.012)	−0.013 (0.012)
Individual Characteristics	Yes	Yes
Socioeconomic Characteristics	Yes	Yes
Healthcare Access	Yes	Yes
Migration Attributes	Yes	Yes
Regional characteristics	Yes	Yes
Pseudo R^2	0.446	0.433
N	6478	6478

The estimation results of the LPM and logit models are consistent with the Probit estimates

integration, while psychological integration has a slightly weaker effect, with cultural acceptance has the smallest influence.

As migrants age, they experience declining physical function and greater vulnerabilities. Economic integration is critical, as it facilitates access to timely and high-quality medical treatment [21]. Without financial capacity, elderly migrants may struggle to afford healthcare spendings, increasing their risk of unmet medical needs. Additionally, since physiological aging is an irreversible process, the capacity for independent health management is often diminished, making institutional support and social assistance essential. Institutional support ensures equitable access to healthcare resources [31], while social engagement fosters a sense of belonging and enhances well-being. These factors explain why economic, institutional, and behavioral dimensions have the most significant impact on migrants' health outcomes.

In contrast, when examining the prevalence of chronic diseases, none of the five dimensions of social integration reached statistical significance. This suggests that chronic conditions such as hypertension and diabetes are largely predominantly influenced by genetic predispositions and long-term lifestyle rather than immediate social integration levels [9].

Endogenous problems

IV estimation results

To address potential endogeneity issues arising from omitted variables and reverse causality between social integration and health outcomes of elderly migrants, this study employs IV estimation. Following previous research of Zou et al. [59], the mean level of social integration within groups, excluding the individual, is used as an IV. This grouping approach satisfies the exclusion restriction, as the aggregate group level is correlated with individual social integration but uncorrelated with personal error terms, validating its suitability. The detailed grouping criteria and IV construction process are provided in Supplementary 1.

Table 5 IV estimation results

Variables	SRH		Chronic Diseases	
	(1)	(2)	(3)	(4)
	The first stage	The second stage	The first stage	The second stage
Social integration of the elderly migrants within groups (exclude themselves)	0.695*** (0.075)		0.695*** (0.075)	
Social integration		1.063*** (0.410)		−0.023 (0.210)
Individual characteristics	Yes	Yes	Yes	Yes
Socioeconomic characteristics	Yes	Yes	Yes	Yes
Medical services	Yes	Yes	Yes	Yes
Mobility characteristics	Yes	Yes	Yes	Yes
Regional characteristics	Yes	Yes	Yes	Yes
Adj R^2	0.432		0.406	
First-stage F value	60.431		60.431	
Wald Test	3.991** (0.047)		0.092 (0.901)	
N	6478	6478	6478	6478

Table 5 presents the 2SLS estimation results. For SRH, Column (1) reports the first-stage regression result, the F-value is 60.431, indicating no weak instrumental problem [41], the coefficient of social integration is positive and significant at the 1% level. Column (2) presents the second-stage regression result. The coefficient for social integration remains positive and significant at the 1% level, confirming its positive effect on SRH even after accounting for endogeneity.

For chronic diseases prevalence, the first-stage regression results remain consistent using the same IV, and F-value indicates that there is no weak instrument issue. However, the Wald test for endogeneity in Column (3) is not significant, indicating that endogeneity does not substantially bias the baseline results for chronic disease. These IV regression results are consistent with baseline results, where social integration is negatively associated with chronic disease, but the effect is not statistically significant.

PSM results

To complement the IV estimation and further mitigate potential selection bias, we further employ Propensity Score Matching (PSM). Prior to the matching process, a balance test was conducted to verify the comparability of the treatment and control groups. Table B in Supplementary 2 reports the results of the balance test using nearest-neighbor matching, confirming that PSM effectively

eliminates initial imbalances. Table C in Supplementary 2 presents the average treatment effect on the treated (ATT), assessing the impact of social integration on SRH using three matching algorithms: kernel matching, radius matching, and nearest-neighbor matching. The findings across all methods are highly consistent and robust across all specifications, confirming that higher social integration significantly enhances SRH among elderly migrants. These findings provide additional empirical support for the positive relationship identified in the baseline and IV regressions.

Robustness check

To further assess the robustness of the findings, this study modifies the measurement of social integration and applies alternative the regression models. First, the numeric social integration index is replaced with a binary variable, where elderly migrants with social integration index above the median are assigned 1, and those below the median are assigned 0. As shown in Columns (1) to (3) of Table 6, after adjusting the measurement of social integration, the coefficient remains positive and statistically significant at the 1% level. These results indicate that elderly migrants with high social integration are more likely to report positive SRH compared to those with lower social integration. However, for chronic diseases, the coefficients remain statistically insignificant.

Additionally, recognizing that existing research often measures social integration using economic integration, behavioral adaptation, cultural acceptance and psychological integration [54], this study excludes institutional integration and reconstructs the social integration index accordingly. The results obtained using this alternative index are consistent with the baseline regression results, confirming the robustness of the original analysis. This consistency also validates the reliability of the social integration index used in this study.

Table 7 presents the robustness test conducted by employing alternative regression methods and redefining the key primary dependent variable, SRH. In this specification, SRH is redefined as an ordinal variable, with the responses "unable to live independently", "unhealthy but able to live independently", "basically healthy", and "healthy" assigned values from 1 to 4, respectively. In this ordering, higher values indicate better health.

Given the ordinal nature of the redefined variable, an ordered probit model was employed. Column (1) in Table 7 reports the results, showing that social integration remains positive and statistically significant at the 1% level. Columns (2)-(5) present the marginal effects, which quantify the changes in the probabilities of each health state resulting from changes in social integration. Specifically, a one-unit increase in social integration is associated with a 9.1% increase in the probability

Table 6 Robustness test results: modified measurement of social integration

Variables	SRH			Chronic Diseases			SRH			Chronic Diseases		
	(1) LPM	(2) Logit	(3) Probit	(4) LPM	(5) Logit	(6) Probit	(7) LPM	(8) Logit	(9) Probit	(10) LPM	(11) Logit	(12) Probit
Social Integration (Binary variable)	0.026*** (0.011)	0.023*** (0.010)	0.024*** (0.009)	−0.013 (0.011)	−0.014 (0.010)	−0.015 (0.012)						
Social Integration (Classical measurement)							0.059*** (0.012)	0.057*** (0.011)	0.058*** (0.011)	−0.016 (0.010)	−0.013 (0.009)	−0.014 (0.009)
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Healthcare Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Migration Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.432	0.443	0.445	0.401	0.403	0.389	0.434	0.447	0.446	0.413	0.421	0.415

Table 7 Robustness test: Modified regression model

Variables	(1)	(2)	(3)	(4)	(5)
	Ordered probit	Marginal effects			
		Healthy	Basically healthy	Unhealthy but able to live independently	Unable to live independently
Social Integration	0.266*** (0.031)	0.091*** (0.011)	−0.029*** (0.002)	−0.056*** (0.008)	−0.008*** (0.002)
Individual Characteristics	Yes	Yes	Yes	Yes	Yes
Socioeconomic Characteristics	Yes	Yes	Yes	Yes	Yes
Healthcare Access	Yes	Yes	Yes	Yes	Yes
Migration Attributes	Yes	Yes	Yes	Yes	Yes
Regional Characteristics	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.431	0.402	0.391	0.387	0.376

of reporting "healthy" status. Conversely, the probabilities of reporting "basically healthy", "unhealthy but able to live independently", and "unable to live independently" decrease by 2.9%, 5.6%, and 0.7%, respectively. These results suggest that higher social integration increases the likelihood of better health outcomes while reducing the probability of health impairment, further confirming the robustness of the baseline regression results.

Heterogeneity analysis

Elderly migrants display significant individual heterogeneity, which may lead to variations in the impact of social integration on health outcomes. To gain a deeper understanding of these dynamics, the analytical samples are categorized based on age, education level, and migration duration.

Age

Table 8 presents the regression results for age-based heterogeneity. Social integration positively affects SRH across all age groups. Specifically, the coefficient rise from 0.045 for migrants aged 60–64 to 0.081 for those aged 65–69, before stabilizing at 0.078 for migrants aged 70 and above. This trend suggests that as elderly migrants age, social integration becomes increasingly crucial for maintaining health. A possible explanation is that younger migrants often maintain higher levels of physical resilience and independence, reducing their reliance on social networks. However, as physiological function declines and mobility is restricted, social integration becomes a vital determinant of health [3]. For chronic diseases, the coefficients of social integration are statistically significant across all age groups, indicating a consistent relationship between social integration and chronic health conditions.

Education level

Table 8 presents the results for education-based heterogeneity. Social integration significantly contributes to improved SRH across all education groups, following an inverted U-shaped pattern. Specifically, the coefficients peak at 0.064 for migrants with primary education and decline slightly for those with higher education achievements. Initially, increased education facilitates greater social engagement and better access to resources, which contributes to improved health outcomes. However, at higher levels of education, individuals may experience new social pressures or challenges, weakening the positive impact of social integration on health. For chronic diseases, the coefficients of social integration remain negative but statistically insignificant across all education groups.

Duration of migration

Regarding migration duration, results presented in Table 8 indicate that social integration significantly enhances SRH across all migration periods, following an inverted U-shaped trend. The estimated coefficient demonstrates an initial upward trend, rising from 0.066 for migrants with less than 5 years migration duration to a peak of 0.071 for those with 5–10 years migration duration. However, this effect subsequently drops to 0.054 for those who have migrated for more than 10 years. This pattern suggests that while the establishment of social networks, environmental adaptation, and institutional benefit provide substantial health dividends during the first decades of relocation, these benefits are eventually diminished by biological realities of aging. Thus, age-related physiological deterioration becomes a more dominant determinant of health status than social factors [29]. In contrast, the coefficients for chronic diseases prevalence remain consistently negative across all cohorts but fail to reach statistical significance, suggesting that the chronic conditions is less sensitive to the temporal dynamics of social integration.

Mechanism analysis

The earlier analyses demonstrate that social integration significantly contributes to SRH among elderly migrants. To explore the underlying mechanisms, we

Table 8 Heterogeneity analysis

Variables	Age (SRH)			Age (Chronic Diseases)			Education Level (SRH)			
	60–64	65–69	70 and above	60–64	65–69	70 and above	No Schooling	Primary	Junior High	Senior High and above
Social Integration	0.045*** (0.013)	0.081*** (0.021)	0.078*** (0.028)	−0.014 (0.017)	−0.043 (0.021)	−0.032 (0.029)	0.061** (0.021)	0.064** (0.019)	0.063** (0.018)	0.054** (0.015)
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Healthcare Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Migration Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.452	0.448	0.493	0.461	0.457	0.449	1040	2051	1956	1431
N	3261	1797	1420	3261	1797	1420	0.456	0.451	0.448	0.427
Coefficient Difference	0.000			0.121			0.010			
Variables	Duration of Migration (SRH)			Duration of Migration (Chronic Diseases)			Education Level (Chronic Diseases)			
	Less than 5 years	5–10 years	Exceeding 10 years	Less than 5 years	5–10 years	Exceeding 10 years	No Schooling	Primary	Junior High	Senior High and above
Social Integration	0.066*** (0.015)	0.071*** (0.017)	0.054*** (0.018)	−0.018 (0.019)	−0.039 (0.025)	−0.009 (0.023)	−0.012 (0.034)	−0.023 (0.024)	−0.033 (0.022)	−0.021 (0.023)
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Healthcare Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Migration Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	2753	1669	2056	2753	1669	2056	1040	2051	1956	1431
N	0.453	0.449	0.450	0.418	0.426	0.402	0.431	0.433	0.431	0.429
Coefficient Difference	0.000			0.112			0.122			

The coefficient differences in *p*-values are derived from the Chow test. Same on the rest tables

utilize a mediation framework to examine three potential mechanisms: social support, social acceptance and social discrimination.

Enhance social support

Social support, measured through the breadth and diversity of social networks, serve as a critical bridge providing emotional and instrumental assistance [32]. Columns (1) to (3) in Table 9 present the mechanism analysis results. The findings indicate that social integration significantly increases social support, which in turn delivers a positive influence on SRH. As results indicated in Column (3), when both variables are included into the model, they both remain statistically significant, confirming that social support partially mediates the impact of social integration on SRH. This pathway suggests that as elderly migrants adapt culturally and behaviorally, they build stronger social networks, these networks facilitate improved access to emotional and practical support, ultimately enhancing subjective health status.

Strengthen social acceptance

Social acceptance contributes to health by fostering a sense of belonging and mitigating the psychological stressors associated with exclusion or discrimination [44]. Columns (4) to (6) in Table 9 present the results for the social acceptance mechanism. Column (4) shows that higher levels of social integration significantly increases social acceptance, while Column (5) reveals that greater social acceptance is associated with a significantly higher probability of reporting positive health. Upon including both variables in the final specifical, as show in Column (6), both remain positive and statistically significant at the 1% level. These results validate social acceptance as a significant mediator, suggesting that deeper integration helps older migrants overcome environmental exclusion, thereby improving their overall health outcomes.

Reducing social discrimination

Similarly, Columns (7) to (9) in Table 9 present the results for the social discrimination mechanism. The findings reveal that social integration significantly reduces perceived discrimination, with higher levels of

Table 9 Mechanism analysis

Variables	(1) Social Support	(2) SRH	(3) SRH	(4) Social Acceptance	(5) SRH	(6) SRH	(7) Social Discrimination	(8) SRH	(9) SRH
Social Integration	0.487*** (0.022)		0.044*** (0.012)	0.856*** (0.014)		0.084*** (0.012)	−0.660*** (0.027)		0.072*** (0.012)
Social Support		0.063*** (0.011)	0.051*** (0.008)						
Social Acceptance					0.016*** (0.007)	0.023*** (0.011)			
Social Discrimination								−0.019*** (0.010)	−0.014*** (0.007)
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Features	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Healthcare Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Migration Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6478	6478	6478	6478	6478	6478	6478	6478	6478
Pseudo R^2	0.435	0.427	0.437	0.433	0.440	0.405	0.432	0.406	0.421

discrimination negatively affecting SRH. When both social integration and social discrimination are included in the model, as presented in Column (9), the coefficients remain statistically significant, confirming that a reduction in perceived discrimination mediates the positive relationship between social integration and SRH.

At the initial stage of migration, elderly migrants often experience limited social integration, a weak sense of belonging, and potential discrimination [44]. However, as their social integration deepens, perceived discrimination tends to decline, while feelings of social acceptance increase. This process is bidirectional: local residents gradually begin to recognize elderly migrants as part of the community, while migrants themselves develop a stronger sense of identification with their new environment.

Discussion and conclusion

With accelerated population aging and rapid urbanization, the number of elderly migrants continues to rise, this group faces increasingly complex health challenges. This study examines the relationship between social integration and elderly migrants' health outcomes using Probit estimation as the baseline model, while employing IV estimation and PSM to address endogeneity concerns. A five-dimensional framework is developed to measure social integration, incorporating economic integration, institutional integration, behavioral adaptation, cultural acceptance, and psychological integration. By accounting for the role of institutional integration in shaping access to healthcare and social welfare, this study expands the theoretical landscape of migration research, moving beyond traditional four-dimensional assessments.

The empirical results show that social integration significantly contributes to SRH among elderly migrants but does not obtain a statistically significant effect on chronic disease prevalence. Among the five dimensions, economic integration demonstrated has the strongest positive effect, followed by behavioral adaptation and institutional integration, and psychological integration. Cultural acceptance was found to have the least pronounced impact. These findings diverge from previous research on general migrant populations, such as Xiao et al. [50], who identified cultural adaptation and identity recognition play a more dominant role in mental health outcomes. This disparity likely arises from two factors: first, SRH and mental health represent distinct concepts that are not directly comparable; second, older migrants possess unique priorities compared to younger cohorts. In particular, elderly migrants are more likely to prioritize economic stability and access to institutional support, while psychological adaptation and cultural acceptance may play a less immediate role in their health perception and behaviors.

Further analysis reveals that the positive impact of social integration on SRH is strongest among migrants aged 65–69, those with primary or high school education, those who have migration duration between

5–10 years. In addition, the mechanism analysis shows that social integration enhances SRH by increasing social support, enhancing social acceptance, and reducing social discrimination. These findings provide new theoretical insights into the pathways through which social integration influences health outcomes among elderly migrants.

Based on these findings, we propose policy recommendations aimed at improving the SRH of elderly migrants by strengthening social integration. First, it is imperative that policymakers recognize the documented health benefit of social integration and prioritize the development of a comprehensive integration framework. Efforts should specifically focus on expanding social support, increasing social acceptance, and eliminating social discrimination. This may be achieved by organizing age-friendly communities, establishing community-based service institutions and mutual support networks, and promoting cultural exchange programs that encourage interaction between elderly migrants and local residents. Public awareness campaigns are necessary to eliminate discriminatory barriers and create a more inclusive and equitable social environment.

Second, targeted interventions should be implemented to address the need of specific groups. For elderly migrants in the 65–69 age cohort, improving healthcare accessibility and social support services can help sustain their well-being. Those with middle or high school education levels may benefit from tailored training programs that facilitate social and economic adaptation. Finally, for those with longer migration durations, the implementation of long-term health management programs and stable social support networks is essential to mitigate the health declines associated with prolonged relocation and aging.

While this study offers valuable insights into the impact of social integration on the health outcomes of elderly migrants, several limitations should be acknowledged. First, although PSM and IV methods were employed to address endogeneity, causal inferences should still be interpreted with caution given the inherent constraints of cross-sectional data. Future research would benefit from the incorporation of longitudinal data to more precisely track the temporal dynamics of these effects. Second, existing measurements for social support mainly capture the structural aspects of social networks. To overcome this limitation, future research should utilize more diverse data sources to evaluate both the functional and qualitative dimensions of social support.

Third, it is important to note that the measurement of chronic diseases in 2017 CMDS was based on self-reported medical diagnoses. Consequently, the dataset excludes undiagnosed cases, which likely leads to an underestimation of the actual prevalence of chronic diseases within other migrant population. This limitation undermines the need for future studies to incorporate clinical health assessments or objective biomarkers to supplement self-reported data.

Abbreviation

SRH Self-rated health

Supplementary Information

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Supplementary Material 1. Supplementary 1: Construction of the Instrumental Variable. Supplementary 2: Propensity Score Matching Results.

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Authors' contributions

Qiang Wang: Data curation, Methodology, Writing—original draft, Funding acquisition; Jing Wen: Writing—original draft; Liming Yao: Writing—review & editing; Xueying Mu: Writing—review & editing; Jing Zou: Conceptualization, Funding acquisition, Supervision, Writing—review & editing.

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Data availability

The datasets generated and/or analyzed during the current study are available in the CMDS repository at https://www.ncmi.cn/phda/dataDetails.do?id=CSTR:17970.11.A000T.202306.185.V1.0-V1.0. Accessing the data requires registration on the webpage; users can register an account to download the data through public channels. Alternatively, you may directly contact the author, Jing Zou (glss2008@126.com), and we would be happy to provide the original data for academic exchange purposes.

Declarations

Ethics approval and consent to participate

Data from the "China Migrants Dynamic Survey" is available to researchers authorized by the Migrant Population Service Center. Written informed consent was previously obtained from all participants. The analysis of this public access data was exempted from review by the Research Ethics Committee of Zhejiang University of Finance & Economics; as the study involved analyzing existing, de-identified data, formal ethical approval was not required. All methods were carried out in accordance with relevant guidelines and regulations. This study was conducted in accordance with the guidelines of Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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62. Please change Brandt et al. (2026) to Brandt et al. (2022).

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