International Journal of
Mental Health Promotion

Tech Science Press

http://doi.org/10.32604/ijmhp.2026.076161

ARTICLE

Ethnic Inequalities in Aging: Multilevel Social Capital and Mental Health Outcomes among Han Chinese and Minority Older Adults

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Received: 15 November 2025; Accepted: 06 March 2026; Published: 28 April 2026

ABSTRACT: Objectives: Structural and cognitive social capital are increasingly recognized as key factors influencing mental well-being. In China, older adults from minority groups often experience different levels of network support, trust, and social connection compared with their Han counterparts. These differences may contribute to the mental health gap observed between the two groups. This study aims to examine how structural and cognitive social capital are associated with mental health outcomes among Han and minority older adults in China, and to assess the extent to which these dimensions of social capital explain mental health disparities between the two groups. **Methods**: This study uses pooled cross-sectional data from the 2012, 2017, and 2023 Chinese General Social Survey (N = 5175 adults aged ≥60). Structural social capital is operationalized into extensivity, upper reachability, mean prestige, and range using the position generator method. Cognitive social capital is measured as the subjective, intangible aspects of social relationships, including shared norms, trust, and reciprocity within social networks. Multilevel regression models were employed to estimate associations between social capital indicators and mental health outcomes, followed by decomposition analysis to assess the relative contribution of structural and cognitive social capital dimensions. **Results**: The main findings suggest that minority older adults have less access to structural social capital than Han older adults, with minorities facing disadvantages in terms of network extensivity and mean prestige. No significant differences were observed in cognitive social capital. County-level structural social capital has a stronger positive impact on the mental health of elderly minorities compared to Han (β = 0.135), suggesting that minorities may rely more on community-based networks for health benefits. Furthermore, results from the Oaxaca-Blinder decomposition analyses show that ethnic mental health disparity is primarily due to the lower occupational mean prestige within minority's network (β = 194.312%), rather than a deficit in the return on social capital. **Conclusion**: Minority older adults face disadvantages in accessing structural social capital, which in turn affects their mental well-being. Policies that strengthen community-based structural networks and shared resources could help narrow the mental health gap between Han and minority aging populations by improving access to health-related support and services.

KEYWORDS: Ethnicity; mental health; older adults; structural social capital; cognitive social capital; China; multilevel analysis

1 Introduction

China is an ethnically diverse country, officially recognizing 56 ethnic groups. The Han Chinese constitute the majority, while the remaining 55 groups are classified as ethnic minorities. According to the most recent national census [1], Han Chinese comprise 91.51% of the total population, with ethnic minorities accounting for 8.49%. While this proportion may appear small, it represents approximately 113 million people. Geographically, ethnic minority populations are concentrated in five autonomous regions—Xinjiang,

Xizang, Guangxi, Inner Mongolia, and Ningxia—which together cover 64% of China's total land area. The Han Chinese predominantly reside in the eastern and central regions, where fertile plains and the presence of the Yellow and Yangtze Rivers have historically supported agriculture and economic development. In contrast, ethnic minorities are primarily concentrated in western China, often in high-altitude areas with harsher environmental conditions and limited agricultural potential, contributing to economic and health disadvantages [2].

The spatial distribution of ethnic majority-minority groups in China has important implications for ethnic disparities in mental health among older adults [3]. National survey evidence indicates that ethnic minority groups experience poorer mental health outcomes than Han populations, with higher prevalence of moderate-to-major depressive symptoms (25.5% versus 19.0%), moderate-to-severe anxiety symptoms (17.4% versus 12.3%), and suicidal ideation (29.4% versus 20.9%) [4]. Ethnic minorities such as Tibetans, Uighurs, and Yi, who are more likely to reside in remote and underdeveloped regions, often face systemic barriers to mental health care. These include a shortage of trained professionals, inadequate psychological support infrastructure, and limited access to age-appropriate mental health services [5].

For older adults in these communities, such structural disadvantages heighten vulnerability to mental health conditions, including late-life depression, anxiety, and trauma-related disorders, which are frequently intensified by sociocultural marginalization, language barriers, and experiences of discrimination or political tension [6]. Focusing on older adults is particularly important in the Chinese context, where rapid population ageing and persistently low fertility rates have led to an unprecedented expansion of the elderly population and a shrinking base of familial caregivers. This demographic transformation increases reliance on limited formal welfare and healthcare systems, while simultaneously weakening traditional family-based support in later life, thereby amplifying the risk of psychological distress among older adults [7]. By contrast, older Han Chinese, who predominantly live in eastern China with more robust healthcare systems, generally benefit from greater access to mental health resources, heightened public awareness of psychological well-being, and more readily available geriatric care. Additionally, the stronger economic conditions in Han-majority regions are often associated with reduced financial stress, higher household incomes, and broader health insurance coverage for older adults—factors that collectively serve to protect mental health in later life [8].

Beyond geographical and infrastructural factors, socio-economic disparities further exacerbate ethnic mental health inequalities. Chinese ethnic minorities, on average, face lower levels of education, reduced income, and limited employment opportunities, all of which are closely associated with poorer mental health outcomes in later life [9]. Older adults in these groups often experience heightened psychological distress due to financial insecurity, social isolation, and limited access to mental health care. Cultural and linguistic barriers can also hinder effective communication with healthcare providers, making it difficult for elderly minority patients to seek, understand, or receive appropriate psychological support [10]. While government policies such as the expansion of public health insurance, targeted poverty alleviation programs, and rural healthcare investments have attempted to narrow these disparities, their impact on mental health provision remains limited. National schemes like the New Rural Cooperative Medical Scheme and the Rural Resident Basic Medical Insurance have extended coverage to disadvantaged populations, yet often fall short in addressing the unique psychological needs of aging minority populations. Therefore, persistent gaps in service availability, quality of care, and mental health literacy continue to undermine the well-being of older adults in these communities, highlighting the need for more culturally sensitive and age-appropriate interventions to reduce the mental health divide between Han and ethnic minority groups.

While geographical disadvantage, socio-economic inequality and institutional constraints contribute substantially to ethnic disparities in mental health, these factors do not fully capture the social mechanisms through which older adults experience and cope with psychological distress. In later life, formal support systems often weaken due to retirement, reduced mobility, and shrinking family networks, rendering informal social resources increasingly salient. Social capital, understood as the resources embedded in social networks and characterized by trust, reciprocity and community engagement, therefore plays a particularly important role in shaping mental health among older adults. For ethnic minority populations residing in resource-limited areas, structural social ties within personal networks, together with cognitive trust and reciprocity, can provide instrumental and emotional support that partially compensates for deficiencies in formal mental health services. Examining social capital thus offers a valuable perspective for understanding how social relationships mediate the impact of structural disadvantage on psychological well-being and for identifying potential pathways to mitigate ethnic inequalities in later-life mental health.

2 Theoretical Framework

Social capital assumes particular significance in later life, as population ageing and rising life expectancy have extended the duration of older age while simultaneously intensifying risks of health decline, social withdrawal, and the erosion of interpersonal networks. Older adults are more likely to experience the loss of spouses, peers, and close social ties, increasing their dependence on alternative social resources embedded within families, communities, and wider society. Importantly, access to and mobilization of such social resources are not evenly distributed across social groups but are shaped by broader structural factors, including ethnicity [11–13]. In multi-ethnic contexts, ethnic position may condition the availability, quality, and effectiveness of social ties, thereby influencing older individuals' capacity to remain socially integrated and to sustain psychological well-being.

Despite this relevance, research on ethnic health inequality in China has largely focused on human capital factors such as education and literacy [14], with comparatively limited attention to the role of social capital—particularly in shaping the mental health of aging populations. This omission is notable given that older adults' mental well-being is closely tied to their capacity to maintain social integration and to mobilize supportive relationships in the face of declining health, social loss, and reduced institutional support. Social capital is commonly defined as the networks and relationships that facilitate cooperation and access to resources [15]. However, its relevance for ethnic health inequality lies not only in its overall availability, but also in the ways access to, and returns from, social capital may be structured along ethnic lines. Ethnic position can shape the density and composition of social networks, the degree of trust embedded within them, and the extent to which social ties can be converted into meaningful support, recognition, and health-related resources in later life.

Theoretical scholarship has conceptualized social capital through two primary approaches: structural and cognitive. The structural perspective emphasizes how individuals access and mobilize resources embedded within their social networks to achieve specific goals [16]. Structural social capital is mostly associated with participation in social networks, though this refers to social capital at the individual level. At the macro level, it often refers to the opportunities for individuals to engage in social activities, for example, via civic or neighbourhood associations. Bourdieu [17] conceptualizes social capital at the individual level as 'the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition.' From this perspective, social capital is not merely a neutral resource but one that is accumulated, maintained, and activated under structurally conditioned circumstances. Scholars adopting this approach often focus on how individuals

invest in and strategically utilize their social ties to gain advantages—including psychological benefits such as reduced loneliness, improved coping mechanisms, and better access to health-related information and services [18–21].

In contrast, the cognitive approach understands social capital as a collective resource that fosters trust, shared norms, and social cohesion within a community. Putnam [22] describes social capital as 'connections among individuals—social networks and the norms of reciprocity and trustworthiness that arise from them', highlighting its normative and relational foundations. Trust constitutes a key dimension of cognitive social capital and is commonly distinguished into generalized trust—confidence in unknown others and in the broader social environment—and particularized trust, which arises from trust in known individuals through established interpersonal relations. While this perspective acknowledges the role of individual interactions in generating social capital, it primarily focuses on the mechanisms underlying the formation and sustainability of collective trust and communal values [23,24]. Importantly, the distribution and effects of cognitive social capital are not socially neutral. In ethnically stratified contexts, levels of trust and social cohesion may vary across groups due to historical marginalization, differential access to public institutions, and experiences of exclusion or discrimination. For aging ethnic minority populations, the presence or absence of such communal bonds may significantly influence mental health outcomes. Empirical studies have shown that high levels of cognitive social capital can help mitigate feelings of isolation, anxiety, and depression among older adults [25–30].

The mechanisms by which structural and cognitive social capital influence individuals' health are analytically distinct. Structural social capital, embedded in formalized networks, institutional affiliations, and hierarchical social positions, impacts health by shaping access to healthcare systems, employment opportunities, and material resources [31]. Individuals endowed with stronger structural social capital are better equipped to navigate complex healthcare bureaucracies, secure employment with health-related benefits, and utilize institutional channels for health advocacy. Consistent with this perspective, empirical research indicates that structurally embedded social standing itself carries independent health advantages; for example, evidence from the United States shows that higher occupational prestige is associated with lower odds of poor self-rated health, even after accounting for income, education, and job characteristics [32]. Conversely, cognitive social capital contributes to health by promoting emotional support, enabling the exchange of health knowledge, and encouraging collective responses to health challenges. Individuals embedded in communities with high levels of cognitive social capital are more likely to receive informal health assistance, experience social cohesion, and benefit from mutual aid, all of which can alleviate psychological distress and improve mental well-being [33]. It is also worth noting that social capital does not invariably promote health. Prior research has shown that closed networks may generate exclusionary pressures, misinformation, or excessive social obligations, while dense ties in disadvantaged settings can reinforce downward-leveling norms and restrict access to external resources [34]. Moreover, high levels of contextual cohesion or cross-group networking may disadvantage low-trust, minority, or low-status individuals when embedded in unequal power relations, indicating that social capital's health effects are conditional rather than uniformly beneficial.

The interplay between structural and cognitive social capital highlights the complex ways in which social networks shape mental health disparities in China, particularly within ethnic ageing settings. In multi-ethnic societies such as China, ethnic minority older adults often encounter structural barriers that constrain their ability to access and mobilize social capital embedded in mainstream institutions and networks. Language differences, for instance, may limit fluent communication in Chinese Mandarin, thereby restricting the formation of new social ties with Han individuals who occupy dominant positions

in China's social hierarchies [35]. Such constraints reduce minorities' access to high-prestige networks and formal support systems, weakening the potential health returns of structural social capital. At the same time, experiences of ethnic discrimination and social exclusion may erode cognitive social capital by undermining trust in broader community institutions [36,37]. Lower levels of generalized trust may attenuate perceptions of social cohesion and diminish individuals' propensity to engage with formalized support infrastructures, thereby exacerbating vulnerability in later life. Moreover, some minority groups may rely more heavily on indigenous medical knowledge and traditional healing practices, such as Tibetan or Miao medicine, which may reduce engagement with mainstream healthcare systems and limit exposure to widely available medical resources [38]. While these practices may provide culturally meaningful forms of care, they may also limit engagement with mainstream healthcare systems and reduce exposure to widely available medical resources. Together, these factors suggest that the pathways linking social capital to mental health are shaped by ethnic-specific cultural practices and structural inequalities, rendering the effects of social capital on mental health in ethnic ageing contexts different from those observed in majority Han populations.

Taken together, existing scholarship indicates that social capital is an unevenly distributed resource shaping mental health in later life, with structural and cognitive dimensions operating through distinct mechanisms and conditioned by broader social contexts. In China's multi-ethnic setting, ethnic minority older adults may experience differentiated access to and returns from social capital due to linguistic barriers, cultural practices, and unequal incorporation into mainstream networks. Yet, existing studies have either focused exclusively on cognitive social capital [39], overlooking the role of structural dimensions, or adopted an individual-level analytical lens that fails to account for macro-level contextual effects [35]. As a consequence, there remains a significant gap in multilevel analyses that simultaneously capture individual access to social capital and the structural attributes of the communities in which individuals are embedded. To address this gap, the present study adopts a multilevel modelling framework and employs the position generator to measure structural social capital. It examines how individual- and county-level structural and cognitive social capital jointly contribute to the mental health gap between Han and minority older adults in the context of ageing.

3 Materials and Methods

3.1 Data

The data for this study were drawn from the 2012, 2017 and 2023 waves of the Chinese General Social Survey (CGSS). Launched in 2003, CGSS is the first nationally representative continuous survey project in Mainland China. It employs a stratified multi-stage probability proportional to size (PPS) sampling technique and covers twenty-eight provinces and four municipalities in Mainland China. Samples were taken from households across all 32 provincial units in Mainland China. In each selected county, four county-level units (neighborhood or village committees) were randomly chosen, and within these units, twenty-five households were selected using the PPS method. Each round of the survey included approximately 12,000 respondents from 400 community-level units.

Data from the 2012, 2017 and 2023 CGSS waves were pooled to increase sample size and improve statistical power. Survey year fixed effects were included to account for potential period-specific influences and temporal variations in mental health outcomes. The analytic sample was restricted to respondents aged 60 years or above, representing older adults from the general population rather than clinical or patient-based samples. Participants were eligible for inclusion if they provided complete information on mental health outcomes, structural and cognitive social capital indicators, and key sociodemographic characteristics.

Respondents were excluded if they had missing data on any of these variables or lacked valid sampling identifiers or survey weights required for weighted analysis. Cases with incomplete sampling identifiers or survey weights were also removed. After applying these exclusion criteria, the final sample comprised 5175 Chinese older adults, including 4140 Han Chinese and 1035 ethnic minority respondents.

Owing to its stratified multistage probability sampling design and the provision of sampling weights, the CGSS yields nationally representative data covering both urban and rural populations and substantial regional and ethnic diversity. The dataset therefore provides a representative picture of older adults in contemporary China, allowing population-level inferences regarding ethnic disparities in mental health. Also, this study relied exclusively on publicly available and fully anonymized secondary data from the Chinese General Social Survey. As no identifiable personal information was involved, the study was exempt from institutional ethical review and did not require formal ethical approval.

3.2 Dependent Variable

The primary dependent variable in this study is mental health status, reflecting the subjective assessment of psychological well-being and social connectedness. It is measured using six questionnaire items drawn from the CGSS, each coded on a five-point scale ranging from 1 (always) to 5 (never), with higher scores indicating better mental health. The items include: (1) 'How would you rate your current physical health status?'; (2) 'In the past four weeks, how often has your health interfered with your work or other daily activities?'; (3) 'In the past four weeks, how frequently have you felt depressed or down?'; and (4) 'In the past four weeks, how often have you experienced the following feelings: a. lacking companionship, b. loneliness, and c. socially ostracized?' These indicators capture both the affective and social dimensions of mental health and have been widely employed in health studies on the Chinese population [7]. Results from the Kaiser-Meyer-Olkin (KMO) test indicated that the data were suitable for factor analysis (KMO = 0.82), and Bartlett's test confirmed that the correlation matrix was appropriate for factor extraction ($p < 0.001$). A single factor with an eigenvalue greater than 1, explaining 65% of the variance. The factor loadings for all items were sufficiently high (ranging from 0.70 to 0.85), suggesting that the six items are appropriate indicators of a single underlying construct. A composite mental health score was then generated from the factor scores using Exploratory Factor Analysis (EFA), with higher values representing better overall mental health.

3.3 Independent Variable

The main independent variables are structural and cognitive social capital. For the construction of structural social capital, the position generator is used. Developed by Lin and Dumin [40], this method presents respondents with a list of occupations ranging from lower-status jobs, such as cleaners, to higher-status ones, like university professors. Participants indicate which occupations are held by people in their social networks. The underlying assumption is that structural social capital, shaped by the occupational status of one's network members, influences access to valuable resources, including health-related knowledge, medical support, and economic opportunities that can improve well-being. By assigning prestige scores to occupations, researchers can assess both the breadth and quality of an individual's social capital and its potential impact on health.

In the CGSS, participants are asked, 'Within your social network, do you know anyone who works in the following occupations?' The listed occupations include university lecturer, lawyer, junior high school teacher, HR manager, policeman, nurse, programmer, hairstylist, receptionist, and farmer. Each occupation is assigned a prestige score based on the Chinese Socioeconomic Index of Occupational Status [41], ranging

from 46.52 for farmers and 53.42 for cleaners to 81.31 for lawyers and 90 for university lecturers. Although the specific occupations used to construct the prestige scale vary slightly across survey waves (see Table 1), each wave consistently includes both high- and low-prestige occupations and exhibits a comparable prestige range. This indicates that the scale captures a continuous hierarchy of occupational status across all waves rather than truncating particular segments of the prestige distribution. To capture the multidimensional nature of network resources, a component score is calculated (see Table 2) using the weighted sum of four key indices, which comprehensively reflect the breadth and quality of occupational ties within an individual's social network:

(1) Volume of network resources (extensivity)—The extensiveness of an individual's social network, measured by the number of different occupations they have access to.
(2) Highest occupational prestige score (upper reachability)—The prestige score of the highest-status occupation within the respondent's network, reflecting access to influential or high-status individuals.
(3) Average occupational prestige score (mean prestige)—The mean prestige score of all accessed occupations, providing an overall measure of the socioeconomic status of one's network.
(4) Range of occupational prestige (range)—The difference between the highest and lowest occupational prestige scores in the respondent's network, capturing the diversity of social capital across status levels.

Table 1: Structural social capital dimensions and occupation accessed.

CGSS 2012/2023 (Range or Prestige Score)	Mean or Percentage (Std. Dev)		CGSS 2017 (Range or Prestige Score)	Mean or Percentage (Std. Dev)
	CGSS 2012	CGSS 2023		
Extensivity (0–10)	2.21 (1.77)	2.36 (1.92)	Extensivity (0–10)	2.62 (2.63)
Upper reachability (0–90)	62.72 (23.64)	63.38 (24.70)	Upper reachability (0–81.31)	55.44 (33.80)
Mean prestige (0–70.98)	14.32 (13.23)	15.43 (14.17)	Mean prestige (0–69.84)	17.99 (18.23)
Range (0–90)	62.63 (23.62)	63.14 (24.67)	Range (0–81.31)	55.16 (33.80)
University lecturer (90)	21.60%	22.35%	Lawyer (81.31)	22.53%
Lawyer (81.31)	13.95%	15.12%	Business executives (78.72)	28.64%
Junior high school teacher (78.61)	46.57%	44.53%	Junior high school teacher (78.61)	51.88%
HR manager (78.31)	19.59%	16.89%	HR manager (78.31)	26.78%
Policeman (76.96)	28.41%	24.63%	Policeman (76.96)	34.35%
Nurse (73.35)	35.61%	38.55%	Nurse (73.35)	43.64%
Programmer (71.58)	17.61%	18.28%	Bus/truck driver (63.5)	45.98%
Hairstylist (59.11)	27.62%	29.93%	Hairstylist (59.11)	41.97%

Table 1: *Cont.*

CGSS 2012/2023 (Range or Prestige Score)	Mean or Percentage (Std. Dev)		CGSS 2017 (Range or Prestige Score)	Mean or Percentage (Std. Dev)
	CGSS 2012	CGSS 2023		
Receptionist (54.26)	14.51%	16.42%	Car repairer (55.09)	39.91%
Farmer (46.52)	83.77%	84.81%	Cleaner (53.42)	36.15%
Number of observations	1508	2332	Number of observations	1335

Note: CGSS: Chinese General Social Survey; Std. Dev: Standard Deviation; HR: Human Resource.

Table 2: Factor structures of structural social capital from principle component analysis.

	CGSS 2012	CGSS 2017	CGSS 2023
Factor Eigenvalues			
I	3.28	3.25	3.29
II	0.69	0.74	0.68
III	0.02	0.01	0.02
IIII	0.00	0.00	0.00
Factor Scoring on Factor I			
Extensivity	0.50	0.50	0.50
Upper reachability	0.51	0.50	0.51
Mean prestige	0.50	0.50	0.50
Range	0.48	0.49	0.48
KMO	0.66	0.64	0.70

Note: CGSS: Chinese General Social Survey; KMO: Kaiser–Meyer–Olkin test.

Cognitive social capital is measured using the trust and reciprocity variables. Respondents in the CGSS were asked to evaluate the following statements: (1) 'Overall, do you agree or disagree that the vast majority of people in this society can be trusted?', (2) 'How often do you party or eat out with friends?', (3) 'How often do you gather with relatives who don't live together with you?', and (4) 'How often do you contact your closest friend?'. Responses were recorded on a five-point Likert scale, ranging from 1 (strongly disagree/never) to 5 (strongly agree/every day). To construct a composite measure of cognitive social capital, Principal Component Analysis (PCA) was applied to extract a single factor score representing the overall level of cognitive social capital for each respondent. The internal consistency of the composite measure was acceptable (alpha = 0.74), with the first component yielding an eigenvalue of 1.948 and explaining 58 percent of the variance. This approach provides a more accurate and robust measure by capturing the under-lying dimensions of trust and social engagement across these variables.

3.4 Control Variable

The following control variables are included in the analysis.

Years of education: CGSS respondents were asked about the highest degree obtained. It is then re-categorized in the analysis into a continuous variable range from 0 (no formal education received) to 19 years of education (doctorate).

Language fluency: respondents were asked to indicate how well they can speak and understand Chinese Mandarin.

Union membership: Respondents were asked whether they belong to a trade union. Union membership has been used as a proxy of social capital in the literature since it helps regulate and extend the naturally occurring social networks that tie members together in workplaces.

Party membership: Respondents were asked whether they belong to the China Communist Party (CCP).

Hukou: Hukou is a system of household registration used in China since the 1950s. The Hukou system decisively shaped China's collectivist socialism by creating a spatial hierarchy of urban places and prioritizing the city over the countryside and is recognized by scholars as the major institutional pillar underlying the deep rural-urban chasm in China. This system has profound implications for health inequality, as it restricts access to essential public services, including healthcare, based on an individual's registered residency status. Other socio-demographic variables—marital status, age, gender—are also included in the analysis.

Seven regional-level variables are included in the analysis: (1) county-level structural social capital, (2) county-level cognitive social capital, (3) county-level average years of education, (4) ethnic minority concentration rate (percentage of ethnic minority in the county), (5) county-level GDP per capita, (6) county-level percentage of older adults over 60 years old, and (7) county-level healthcare expenditure per capita. The question 'which county do you live in?' is used as the basis of generating county-level variables. To generate the first three county-level means, individual level measures were weighted according to previously assigned survey weights provided by CGSS. The last four variables were obtained from the China Statistical Yearbook.

At the aggregate level, county-level structural social capital reflects the community assets that shape individuals' access to social and institutional resources related to health and well-being. Since the measurement technique assesses whether survey respondents can access individuals in a range of occupations, the position-generated county-level social capital highlights the role of local occupational structures in facilitating or constraining access to healthcare resources, information, and support net-works. In this regard, social capital is believed to exert a contextual effect on health inequality, as individuals with limited social connections are more likely to reside in communities with lower levels of social capital. Such communities often provide fewer opportunities for individuals to engage with diverse and influential networks that could enhance health literacy, improve healthcare access, and promote collective health-supporting behaviors.

Similarly, at the aggregate level, county-level cognitive social capital reflects the collective trust, norms, and social cohesion within a community, which can significantly influence health outcomes. Communities with high cognitive social capital tend to exhibit stronger social networks, greater willingness to cooperate, and more robust in-formal support systems, all of which can enhance individuals' ability to access health information, receive emotional support, and navigate the healthcare system. These communities are more likely to foster a culture of mutual aid and collective responsibility for health, where individuals are more inclined to help one another in times of illness or health crisis.

Moreover, variations in aggregated average years of education across different counties serve to disclose the forces of structural human capital that extend beyond individuals' capacities, influencing health outcomes on a community level. Higher levels of education within a county are often associated with better health literacy, greater awareness of preventive health measures, and improved access to healthcare resources. The proportion of ethnic minorities in a county reflects the socio-cultural environment in which individuals are situated. Higher concentrations of minority populations may foster stronger social cohesion, cultural affirmation, and peer support, while lower concentrations may expose minorities to heightened social isolation and discrimination (The minority population proportion for each province is presented in

Appendix A Table A1). County-level GDP per capita captures broader economic conditions that influence public service provision, employment opportunities, and overall quality of life. Wealthier counties are typically better positioned to support older adults' mental health through stronger infrastructure and more responsive welfare systems. The percentage of older adults in a county indicates demographic pressures and the ageing profile of local populations. Regions with a high share of elderly residents may offer more age-friendly services and informal peer networks, though they may also face greater demands on care-giving systems and healthcare capacity. Finally, healthcare expenditure per capita serves as a proxy for institutional investment in health services. Counties with higher spending levels are more likely to provide accessible and higher-quality healthcare, including mental health support, while underfunded regions may lack the necessary re-sources to address psychological distress.

3.5 Analytical Strategy

The distribution of social capital varies across geographical regions [40] and social groups [41]. Given the hierarchical structure of the CGSS data, multilevel models were employed to investigate the influence of social capital on mental health disparity between minorities and Han older adults. Traditional ordinary least squares regression assumes independence among variables and errors, yet the CGSS datasets exhibit a hierarchical structure with within-group similarities. Multilevel statistical models are well-suited for estimating the potential contextual effects of county-level social capital by accounting for the spatial clustering of individuals within counties. To assess the extent to which disparities in access to individual and county-level social capital contribute to ethnic health inequality, two-level models were specified: an individual-level model and a county-level model.

Level-1 model:

$$\text{Health } Y_{ij} = \alpha_{0j} + \text{minority} * x_{ij} + \sum \alpha_{ij} * x_{ij} + e_{ij} \quad (1)$$

Level-2 model:

$$\alpha_{0j} = \beta_{00} + \gamma_{0j} + \sum \delta_j * X_j \quad (2)$$

where Y_{ij} is the self-assessed health status for individual i in county α_{0j} denotes the intercept parameter of the model. $\sum \alpha_{ij}$ are the coefficients of all explanatory variables (including both structural and cognitive social capital and all controls), x_{ij} represents the individual i in county e_{ij} denoted the normally distributed random error term. β_{00} is the intercept of all individuals. γ_{0j} is the residual random effect of county j. And $\sum \delta_j * X_j$ represents the fixed county-level variables.

3.6 Statistical Analysis

Statistical analyses proceeded in four stages. First, descriptive statistics were computed for all key variables, and mean differences in mental health outcomes and social capital indicators between Han and ethnic minority older adults were examined using *t*-tests. Second, multilevel linear regression models with individuals nested within counties were estimated to assess the associations between individual- and county-level social capital and mental health outcomes, accounting for the hierarchical structure of the CGSS data. Third, cross-level interaction terms between ethnicity and county-level variables were introduced to examine whether contextual factors moderated ethnic differences in mental health. Finally, the Oaxaca–Blinder decomposition method was applied to quantify the extent to which differences in

structural and cognitive social capital contributed to the observed mental health gap between Han and minority older adults.

4 Results

4.1 Descriptive Statistics

Table 3 presents the summary statistics for the full sample, as well as for the Han Chinese and ethnic minority subsamples. Notable differences between Han and minority older adults are observed in terms of socioeconomic characteristics. On average, ethnic minority older adults are less healthy, possess lower levels of structural social capital, have lower education levels, are less fluent in Mandarin, are less likely to be union members, are more likely to hold a rural hukou, and earn lower annual incomes compared to Han Chinese. Regarding structural social capital dimensions, elderly minorities have access to fewer occupational opportunities than elderly Han, and the average occupational prestige within their networks is lower than that within Han Chinese networks. No significant difference is observed in terms of cognitive social capital between Han and minority older adults.

Table 3: Descriptive statistics.

Variables	All	Han Chinese	Ethnic Minorities	Ethnic Significance
Individual-level variables (Range)	Mean (Std. Dev)	Mean (Std. Dev)	Mean (Std. Dev)	*t* test result
Mental Health (−3.831, 1.140)	−0.016 (0.908)	−0.014 (0.971)	−0.035 (0.972)	0.005
Ethnic minorities (0, 1)	0.069 (0.254)	-	-	-
Structural Social capital (−3.340, 2.912)	−0.483 (1.371)	−0.467 (1.376)	−0.694 (1.293)	0.022
Extensivity (0, 10)	2.408 (2.228)	2.437 (2.225)	2.025 (1.780)	0.012
Upper reachability (0, 90)	59.330 (29.064)	59.411 (29.105)	58.258 (28.554)	0.590
Mean prestige (0, 70.98)	16.058 (19.154)	16.272 (19.226)	13.211 (17.372)	0.009
Range (0, 65.56)	59.149 (28.803)	59.216 (28.559)	58.257 (29.411)	0.655
Cognitive Social Capital (−3.207, 3.198)	−0.435 (1.518)	−0.435 (1.513)	−0.438 (1.594)	0.558
Years of education (0, 19)	6.271 (4.857)	6.319 (4.910)	5.631 (4.828)	0.000
Mandarin fluency (0, 10)	5.933 (2.131)	5.963 (2.109)	5.530 (2.372)	0.005
Union membership (0, 1)	0.306 (0.461)	0.316 (0.464)	0.184 (0.388)	0.000
CCP membership (0, 1)	0.167 (0.373)	0.169 (0.375)	0.141 (0.349)	0.301
Urban hukou (0, 1)	0.402 (0.490)	0.412 (0.492)	0.284 (0.452)	0.000

Table 3: *Cont.*

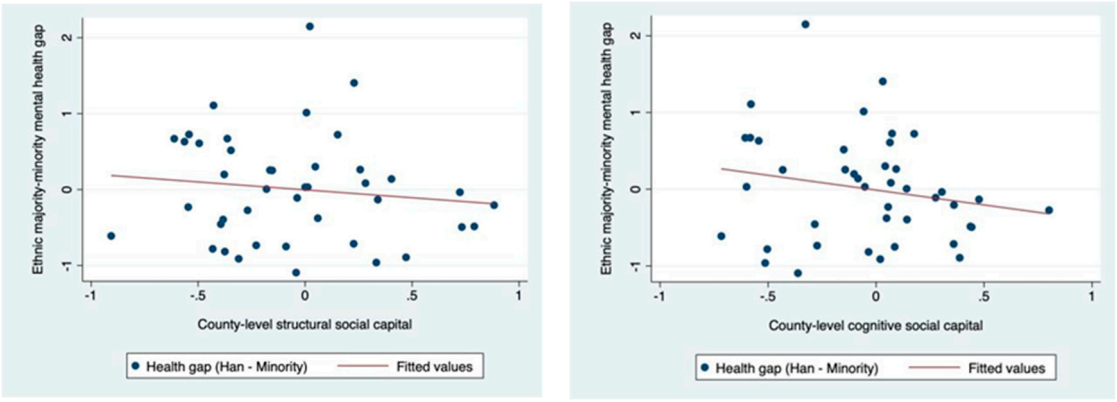
Variables	All	Han Chinese	Ethnic Minorities	Ethnic Significance
Married (0, 1)	0.700 (0.458)	0.702 (0.458)	0.671 (0.470)	0.377
Age (60, 102)	69.182 (7.04)	69.126 (7.060)	69.919 (6.739)	0.127
Male (0, 1)	0.507 (0.500)	0.507 (0.500)	0.500 (0.501)	0.732
Logged annual income (4.38, 16.11)	9.173 (1.378)	9.203 (1.364)	8.746 (1.488)	0.000
N (number)	5175	4756	419	
County-level variables		**Mean (Std Dev.)**	**Range**	
County-level structural social capital		0.00 (0.34)	(−0.58–0.78)	-
County-level cognitive social capital		3.47 (0.13)	(2.73–3.89)	-
County-level years of education		9.04 (1.89)	(5.86–12.41)	-
Ethnic minority concentration rate		0.08 (1.53)	(0–0.94)	-
County-level GDP per capita (in 10 thousand yuan)		6.17 (3.30)	(0.92–18.40)	-
County-level percentage of older adults over 60 years old		28.408 (6.205)	(10.975–38.636)	-
County-level healthcare expenditure per capita (in yuan)		1404.24 (221.31)	(971.70–3949.20)	-

Note: Ethnic significance denotes the statistical significance of mean differences between Han and ethnic minority respondents, assessed using two-sample *t*-tests. Std Dev: Standard Deviation; CCP: Chinese Communist Party; GDP: Gross Domestic Product.

Furthermore, Fig. 1 illustrate county-level disparities in mental health between Han and minority older adults, plotted against regional levels of structural and cognitive social capital, respectively. Each point represents the mental health gap in a specific county, with positive values indicating an advantage for the Han majority and negative values indicating an advantage for ethnic minorities. In both figures, the fitted trend lines slope downward, suggesting that higher levels of regional social capital are associated with a narrowing of the mental health gap in favour of minority populations. Notably, the slope for cognitive social capital is steeper than that for structural social capital, implying a stronger association between cognitive social capital and the reduction of ethnic disparities in mental health.

4.2 Structural and Cognitive Social Capital and Ethnic Mental Health Disparity

Table 4 presents the results from the multilevel regression analysis. Mental health status is used as the dependent variable, and a rich set of variables discussed above is controlled for. The regression coefficients can be understood as the percentage change in income with changes in the covariates.



(**a**) (**b**)

Figure 1: Plots showing county gaps in ethnic mental health by levels of county-level social capital. (**a**) Han-minority mental health gap by county-level structural social capital. (**b**) Han-minority mental health gap by county-level cognitive social capital.

Table 4: Multilevel regressions.

	Model 1	**Model 2**	**Model 3**	**Model 4**
Fixed parameters				
Constant, (β)	−2.093	−2.083	−1.824	−1.784
Individual-level variables				
Ethnic minorities, β (SE)	−0.083** (0.05)	−0.051* (0.04)	−0.048 (0.04)	−0.048 (0.04)
Structural social capital, β (SE)	0.172** (0.01)	0.104** (0.01)	0.066** (0.01)	0.066** (0.01)
Cognitive social capital, β (SE)	0.104*** (0.01)	0.092*** (0.01)	0.092*** (0.01)	0.092*** (0.01)
Years of education, β (SE)	-	0.007 (0.00)	0.007 (0.00)	0.007 (0.00)
Mandarin fluency, β (SE)	-	0.063*** (0.01)	0.063*** (0.01)	0.063*** (0.01)
Age, β (SE)	-	−0.010 (0.01)	−0.010 (0.01)	−0.010 (0.01)
Urban hukou, β (SE)	-	−0.013 (0.04)	−0.010 (0.03)	−0.009 (0.03)
Union membership, β (SE)	-	0.022 (0.03)	0.223 (0.03)	0.232 (0.03)
CCP membership, β (SE)	-	0.123* (0.04)	0.124* (0.04)	0.124* (0.04)
Married, β (SE)	-	0.191 (0.04)	0.190 (0.04)	0.190 (0.04)
Male, β (SE)	-	0.133*** (0.03)	0.132*** (0.03)	0.132*** (0.03)
Logged annual income, β (SE)	-	0.235*** (0.02)	0.235*** (0.02)	0.235*** (0.02)

Table 4: *Cont.*

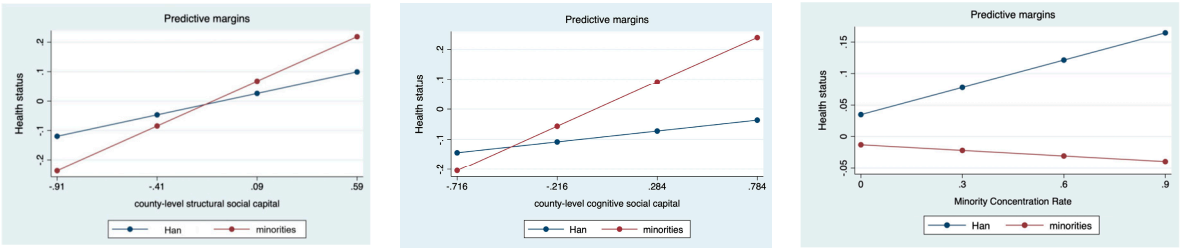
	Model 1	Model 2	Model 3	Model 4
Year	-	Controlled	Controlled	Controlled
County-level variables				
County-level structural social capital, β (SE)	-	-	0.136** (0.06)	0.135* (0.06)
County-level cognitive social capital, β (SE)	-	-	0.177* (0.11)	0.176 (0.17)
County-level years of education, β (SE)	-	-	0.014 (0.03)	0.014 (0.03)
Minorities concentration rate, β (SE)	-	-	−0.117* (0.21)	−0.116 (0.26)
County-level GDP per capita, β (SE)	-	-	0.199 (0.13)	0.198 (0.13)
County-level percentage of older adults over 60 years old, β (SE)	-	-	0.007 (0.01)	0.007 (0.01)
County-level healthcare expenditure per capita, β (SE)	-	-	0.012 (0.01)	0.012 (0.01)
Cross-level interaction				
Minority × County-level structural social capital, β (SE)	-	-	-	0.016* (0.12)
Minority × County-level cognitive social capital, β (SE)	-	-	-	0.014 (0.17)
Minority × County-level years of education, β (SE)	-	-	-	0.074 (0.03)
Minority × Minority concentration rate, β (SE)	-	-	-	0.028 (0.13)
Random parameters				
Level 2, between counties (county-level variance)	0.095	0.040	0.038	0.036
BIC	34,637.4	26,222.8	26,257.0	26,285.4

Notes: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Standard error in parentheses. All models were based on 5175 individuals at level 1 nested within 29 counties in level 2. Stata module "*meglm*" was used to conduct the analysis. CCP: Chinese Communist Party; GDP: Gross Domestic Product; BIC: Bayesian information criterion.

In Table 4, Model 1 includes only ethnicity and social capital variables, Model 2 incorporates individual-level explanatory variables, Model 3 adds county-level variables, and Model 4 introduces cross-level interaction terms. The estimation results from Model 1 indicate that both ethnic minority status and two social capital variables significantly predict older adults' mental health. When social capital is accounted for, the Han-minority mental health gap remains significant ($\beta = -0.083$, $p < 0.01$). In Model 2, which includes human capital and socioeconomic variables, factors such as social capital, Mandarin fluency, gender, CCP membership, and personal income all have significant effects on older adults' mental well-being. These findings align with the existing literature. However, even after controlling for social and human capital as well as other socioeconomic characteristics, a substantial portion of the health gap remains attributable to ethnicity ($\beta = -0.051$, $p < 0.05$).

Model 3 incorporates county-level variables. The results indicate that, holding other factors constant, older adults from counties with higher structural social capital are mentally healthier than those from counties with lower structural social capital. This finding suggests a contextual positive effect of structural social capital, as communities with stronger structural networks may provide enhanced access to resources, social support, and health-related information. Moreover, ethnic minority concentration rate is found to be negatively associated with individual mental health. This suggests that older adults living in areas with a higher concentration of ethnic minorities tend to report poorer mental health outcomes. One possible explanation is that ethnic minority-concentrated communities may have limited access to healthcare resources, lower socioeconomic conditions, or weaker social support networks, which could negatively impact their mental well-being. Additionally, structural inequalities and barriers, such as language difficulties and ethnic discrimination, may further contribute to the disparities in health status. Although county-level cognitive social capital follows the expected trend, its impact on older adults' mental health is not statistically significant. County-level years of education is also insignificant in predicting mental health status. The robustness of these findings has been confirmed through sensitivity tests excluding provinces with minority population proportion lower than the national average 8%, with results remaining consistent (see Appendix A Table A2).

Interesting patterns emerge when cross-level interactions are introduced into the model. In Model 4, which includes interactions between ethnicity and county-level variables, the interaction between minority status and structural social capital has a significant positive effect on older adults' mental well-being ($\beta = 0.016$, $p < 0.05$). As is shown in Fig. 2, as county-level structural social capital increases, its positive effect on older adults' mental health strengthens for ethnic minorities but diminishes for Han Chinese. In other words, ethnic status moderates the relationship between county-level structural social capital and individual mental well-being, suggesting that ethnic minorities may tend to rely more on community-based networks and shared resources for social and economic support, making structural social capital more beneficial to their mental health. By contrast, Han individuals, who have greater access to alternative forms of social or economic capital, are less dependent on county-level structural social capital, explaining the smaller effect observed. These findings provide important policy implications for addressing ethnic mental health disparities by highlighting the role of structural social capital in promoting health equity. Policies aimed at strengthening community-based structural networks and shared re-sources, particularly in areas with significant ethnic minority populations, could enhance their access to health-related support and services.



(**a**) (**b**) (**c**)

Figure 2: Cross-level interaction predictive margins plot. (**a**) Cross-level interaction between county-level structural social capital and ethnic status; (**b**) Cross-level interaction between county-level cognitive social capital and ethnic status; (**c**) Cross-level interaction between minority concentration rate and ethnic status.

The heterogeneity analysis shown in Table 5 highlights the role of social capital on ethnicity-based mental health disparity in China. The results suggest that while structural and cognitive social capital benefits both Han and minority older adults, the mechanisms through which it translates into better mental health differ significantly by ethnicity. A key finding is that, for structural social capital, mean prestige—a measure of the average socioeconomic status of one's accessible network—predicts health for Han ($\beta = 0.042$, $p < 0.01$) but not for minorities. This suggests that the quality of social ties, rather than just having structural social capital, plays a crucial role in determining mental health outcomes. Since descriptive statistics in Table 3 shows that minorities have significantly lower mean prestige in their structural social capital compared to Han, their networks may not provide the same level of advantage. This disparity may be due to differences in network composition and access to high-status connections. Han individuals, on average, may have greater opportunities to form ties with individuals of higher socioeconomic status, which can facilitate better access to healthcare resources, information, and economic opportunities that contribute to improved health. By contrast, minority networks, while providing strong emotional and communal support, may be more inward-looking and less connected to individuals who can offer access to healthcare or upward economic mobility. These findings underscore that both the presence and the quality of social capital are critical in shaping mental health outcomes among older adults.

Table 5: The role of structural and cognitive social capital for older adults' mental health by ethnicity.

	Model 1		Model 2	
Variables	**Han**	**Minorities**	**Han**	**Minorities**
Structural Social Capital, β (SE)	0.075*** (0.01)	0.053*** (0.01)	-	-
Extensivity, β (SE)	-	-	0.008 (0.06)	0.242 (0.03)
Upper reachability, β (SE)	-	-	−0.002 (0.00)	−0.04 (0.00)
Mean prestige, β (SE)	-	-	0.042** (0.01)	0.040 (0.01)
Range, β (SE)	-	-	−0.003 (0.00)	0.006 (0.01)
Cognitive Social Capital, β (SE)	0.09*** (0.03)	0.11* (0.05)	-	-

Notes: Other individual-level and county-level covariates, the same as those in Table 4, are not shown in this table. Significance at: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. N (number) = 4756 for the Han sample, and 419 for the minority sample.

Finally, the Oaxaca-Blinder decomposition analysis [42,43] is employed to assess the extent to which structural and cognitive social capital, and other socioeconomic variables contribute to the health disparity between Han and minority older adults. This method decomposes the observed disparity into two components: the portion explained by measurable factors such as social capital and socioeconomics, and the portion attributed to unobserved factors, which may include discrimination or structural inequalities. This approach provides a clearer understanding of the key drivers of ethnicity-based health disparities and the extent to which policy interventions could address them. Let h and m represent the health status of Han and minorities, respectively, while Xh and Xm denote the vectors of mean values of explanatory variables for Han and minorities. The health outcome equations for the two groups can be expressed as follows:

$$h = X_H \beta_H + \epsilon_H$$

$$m = X_M \beta_M + \epsilon_M$$

where β_h and β_m are the vectors of estimated coefficients representing the returns to the explanatory variables, and ϵ_M and ϵ_W are the error terms capturing unobserved factors. The standard Oaxaca-Blinder decomposition is applied to decompose the health gap into explained and unexplained components:

$$h - m = (X_H - X_M)\beta * + X_M(\beta_H - \beta_M)$$

where $(X_H - X_M)\beta *$ represents the explained portion of the health gap, which accounts for differences in observed characteristics such as structural and cognitive social capital; $X_M(\beta_H - \beta_M)$ capture the unexplained portion, which reflects differential returns to these characteristics and may indicate discrimination or structural inequalities; and β^* is a reference coefficient vector, often chosen as a weighted average of β_H and β_M or obtained from a pooled regression.

Table 6 shows the explained and unexplained portions of the health disparity between Han and minority older adults. Overall, there is 0.182 difference in health status between Han and minority older adults. In Model 1 where the composite structural social capital and cognitive variables are included, differences in structural social capital explain 12.334 percent of the health disparity between Han and minorities ($p < 0.01$). Difference in cognitive social capital explains 19.319 percent of the health gap ($p < 0.05$). While 84.1 percent of the health gap is explained by all explanatory variables, 15 percent remains unexplained.

Table 6: Oaxaca-Blinder decomposition of difference in mental health between Han and minority older adults.

		Mean		**% of the Total Gap**
Group 1 (Han)		−0.518		-
Group 2 (Minorities)		−0.700*		-
Difference		0.182*		-
Difference due to endowment		0.144*		79.121%
Difference due to coefficient		0.038		20.866%
Difference due to interaction		0.001		1.300%
	Model 1	**Model 2**	**Model 3**	**Model 4**
Variables	Endowments Contribution (%)	Endowments Contribution (%)	Coefficient Contribution (%)	Coefficient Contribution (%)
Structural social capital	12.334%**	-	−1.450%	-
Extensivity	-	−10.328%*	-	22.214%
Upper reachability	-	78.524%	-	−76.723%
Mean prestige	-	194.312%**	-	122.125%
Range	-	−2.978%	-	23.125%
Cognitive social capital	19.319%*	−88.428%	−12.888%	−22.221%
Other variables	52.447%	−87.002%	29.338%	−53.52%

Note: Significance at: *$p < 0.05$; **$p < 0.01$.

In Model 2, where structural social capital is decomposed into its four position-generated dimensions, the combined effect of these dimensions accounts for 259.53 percent of the ethnic-based health gap. This indicates that differences in structural network resources alone would produce a larger mental health disparity than that actually observed, but their effects are partially canceled out by other variables contributing in the opposite direction. Among these, extensivity and mean prestige independently contribute to explaining the mental health disparity with statistical significance. Mean prestige contributed to widen the gap while extensivity contributed to diminish the gap. Notably, the difference in mean prestige between Han and minorities exhibits the strongest explanatory effect, accounting for 194.312 percent of the explained

part of the mental health gap. Its contribution exceeding 100 per cent signifies that prestige-based network disparities would on their own generate a larger gap than observed, but this effect is offset by countervailing contributions from other dimensions. Differences in cognitive social capital explain 88.428 percent of the health gap, but its effect is insignificant. However, even after controlling for all individual- and county-level variables, 15 percent of the Han-minority mental health gap remains unexplained, highlighting the presence of unobserved factors that contribute to ethnic mental health disparities. These factors may include cultural differences in health behaviors, access to informal support networks, discrimination in healthcare settings, or historical and structural inequalities that are not fully captured by the available variables.

Overall, the overall decomposition results indicate that both differences in structural social capital—particularly mean prestige—and cognitive social capital significantly contribute to the ethnic mental health gap between Han and minority older adults. While minorities experience mental health disadvantage in China, the effect of social capital on individual mental health is primarily driven by their limited access to structural social capital, especially the average occupational prestige of their network, rather than a lower return on social capital, i.e., discrimination.

5 Discussion

Social capital and social networks are widely recognized as key mechanisms through which social inequalities in health are produced and maintained, particularly across ethnic groups [23,25,32,33,37]. Against this backdrop, this study investigates the extent to which structural and cognitive social capital contribute to ethnicity-based mental health disparities among older adults in China. Drawing from three waves of the Chinese General Social Survey, the analysis employs multilevel regression and decomposition techniques to examine differences in access to social capital and their contribution to mental health inequalities in later life. Descriptive statistics reveal that structural social capital is unevenly distributed along ethnic lines in China, with ethnic minority older adults occupying a disadvantaged position relative to Han counterparts. This finding is in line with the existing studies [19,44]. *t*-tests indicate that older minorities face significant disadvantages in terms of both the extensivity and the average prestige of their social networks. Specifically, the number of occupations they can access through their networks is smaller, and the mean occupational prestige of these connections is lower than that of older Han individuals. In contrast, no statistically significant ethnic difference was found in cognitive social capital among older adults (*t*-test, $p > 0.05$), suggesting that trust and reciprocity-based social ties may be more evenly distributed across ethnic groups in later life.

Multilevel regression analysis reveals that ethnic health disparity is persistent in China even after controlling for individual- and county-level structural and cognitive social capital, human capital and socioeconomics variables, a finding that is consistent with existing research documenting enduring ethnic inequalities in health outcomes among older adults in China [3–11,45]. Cross-level interaction analysis shows that as county-level structural social capital increases, its positive effect on mental health strengthens among ethnic minority older adults but weakens among their Han counterparts. This implies that ethnicity moderates the relationship between county-level structural social capital and individual mental health. In other words, variations in county-level structural conditions generate unequal health returns across ethnic groups, highlighting the critical role of local social infrastructure in shaping well-being trajectories in later life. Older ethnic minorities may rely more heavily on community-based networks and shared local resources for social and economic support, rendering structural social capital particularly beneficial to their well-being [46]. Thus, improvements in county-level network structures and associational density are especially important for mitigating mental health risks among minority elders. In contrast,

older Han individuals, who may have greater access to alternative forms of social or economic capital, appear less dependent on local structural social capital, resulting in diminishing marginal returns. This divergence underscores that county-level conditions do not affect all residents uniformly but operate as a key macro-level mechanism through which ethnic health disparities are reproduced.

Further heterogeneity analysis indicates that the differential health returns of structural social capital between Han and minority older adults primarily stem from disparities in the average prestige of their accessed networks. While both groups benefit from structural and cognitive social capital, only the mean occupational prestige of networks significantly predicts Han individuals' mental health when structural social capital is disaggregated into its four sub-dimensions. None of these dimensions are significantly associated with minority older adults' health outcomes. This pattern is consistent with prior research emphasizing that mean network prestige constitutes a key component of position-generated social capital, as it reflects differential access to resource-rich and influential social ties that are more readily convertible into health-related advantages [30]. Finally, the Oaxaca-Blinder decomposition analysis confirms the persistence of ethnic health disparities in China, with approximately 15% of the mental health gap remaining unexplained after accounting for observed characteristics. The contribution of structural social capital to this disparity is driven primarily by endowment differences, particularly gaps in average occupational prestige within social networks, rather than by differences in the returns to social capital between Han and minority older adults.

These findings highlight the pivotal role of network prestige in shaping ethnic health inequalities [30]. Although high-prestige contacts are not necessarily linked to the medical profession, a higher average prestige within one's network often signals greater access to information, institutional resources, and problem-solving capacity. Such networks are more likely to provide guidance on navigating healthcare systems, securing better-quality services, or mobilizing support during health crises. In addition, high-prestige ties can enhance individuals' perceived social standing and sense of control, which are themselves protective factors for psychological well-being in later life. Conversely, minority older adults' relative lack of access to prestigious networks limits these indirect yet consequential pathways to mental health protection, thereby reinforcing ethnic disparities. This mechanism suggests that the health relevance of social capital lies not merely in network size or frequency of contact, but in the stratified quality of social connections embedded within broader structures of social inequality. Taken together, these findings underscore that disparities in network prestige are central to understanding how structural social capital contributes to ethnic mental health inequality.

The findings of this study should be interpreted in light of several limitations. First, the use of pooled cross-sectional rather than panel data constrains causal inference and raises the possibility of endogeneity and reverse causality between social capital and mental health. Future research should employ longitudinal or panel data to better assess causal pathways between social capital and mental health among older adults. Second, due to data limitations, other dimensions of social capital, such as strong versus weak ties and bonding versus bridging social capital, could not be examined. Third, although ethnic minority respondents constitute approximately 8 per cent of the total sample, reflecting China's demographic reality, substantial heterogeneity exists across minority groups. For example, the mental health experiences of Korean minorities in north-eastern China may differ from those of Tibetan or Yi populations in western regions. These variations could not be fully explored in the present analysis. Further studies are needed to examine heterogeneity across specific ethnic minority groups and regions.

6 Conclusion and Policy Implications

In conclusion, the present study contributes to the literature in three key ways. First, it broadens research on ethnicity-based health disparities in China by proposing that the mental health disadvantages experienced by ethnic minorities are partly attributable to their limited access to and returns on social capital, particularly in regions with lower county-level structural social capital. This finding suggests that social capital does not uniformly benefit all individuals within the same society, and its impact on mental well-being varies across social groups. Second, it extends the theoretical debate on conceptualizing social capital as an individual- or community-level asset by empirically testing it in the Chinese context. By leveraging multilevel modelling, which allows for the simultaneous inclusion of variables at different levels of analysis, this study reveals that the effects of individual-level social capital on mental well-being differ significantly between ethnic groups and are conditioned by the broader structural environment of county-level social capital. Third, this study contributes timely empirical evidence from China on how social networks shape ethnic inequalities in mental health in the context of rapid population ageing. As the country with the world's largest ageing population, China represents a critical case for understanding the social foundations of mental well-being in later life, particularly given long-standing concerns about elder care following decades of the one-child policy and the continued reliance on family-based care arrangements. These structural conditions heighten older adults' dependence on informal social networks and community-level resources for emotional support and health-related assistance.

These contributions are of broader relevance to a global readership because China's aging and care regime shares important similarities with many countries in the Global South, where elder care is predominantly organized through family ties, kinship networks, and community-based collectivist relations rather than individualized or fully institutionalized systems of care [47]. In such contexts, social obligations and interdependence within families and communities play a central role in shaping older adults' access to support and resources. In contrast, many Global North societies are characterized by more individualized welfare regimes, where institutionalized care systems and formal service infrastructures more readily facilitate the formation of social connections beyond the family. In family-centered care regimes, by comparison, older adults rely more heavily on embedded social networks to secure everyday assistance, emotional support, and mental well-being [48,49]. Moreover, as in many Global South settings, cultural norms of filial piety continue to exert a strong influence, such that reliance on institutional care may carry moral stigma and be interpreted as a failure of family responsibility, further reinforcing dependence on informal social relations [50]. These dynamics are especially salient in ethnically diverse societies, where access to social networks and the composition of social capital often vary substantially across ethnic groups due to differences in settlement patterns, historical marginalization, linguistic boundaries, and institutional inclusion. In such settings, minority older adults may face structural constraints in converting social ties into health-protective resources, even within ostensibly collectivist care regimes. From this perspective, the social capital framework adopted in this study offers analytical insights that are transferable to other multiethnic aging societies characterized by limited formal care provision, strong collectivist norms, and uneven distributions of social capital across ethnic lines.

The findings from the current study suggest several policy implications. First, policies should prioritize improving ethnic minority older adults' access to structural social capital, particularly by expanding community-based organizations and social participation platforms in minority regions. Strengthening neighbourhood associations, elder activity centers and mutual-aid groups may help increase network size and facilitate connections to higher-prestige occupational networks, thereby enhancing access to health-related information and support. Second, targeted public investment in community infrastructure

and outreach services in underdeveloped minority areas is needed to reinforce shared resources and link older residents to formal health and welfare systems. Third, given that county-level structural social capital has a stronger protective effect on minority older adults' mental health, local governments should incorporate community network-building initiatives into ageing and mental health policies as a means of narrowing ethnic disparities in later-life psychological well-being.

Acknowledgement: We would like to thank Renmin University of China for granting access to the Chinese General Social Survey (CGSS) data used in this study.

Funding Statement: This research was funded by The National Social Science Fund of China (25CSH046).

Author Contributions: Conceptualization, Zizhen Wang; methodology, Shitian Su; software, Shitian Su; validation, Shitian Su; formal analysis, Shitian Su; investigation, Shitian Su; resources, Zizhen Wang; data curation, Shitian Su; writing—original draft preparation, Shitian Su; writing—review and editing, Zizhen Wang; visualization, Shitian Su; supervision, Zizhen Wang; project administration, Zizhen Wang; funding acquisition, Zizhen Wang. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials: The data that support the findings of this study are openly available in: http://cgss.ruc.edu.cn.

Ethics Approval: This study utilized data from the Chinese General Social Survey, which is publicly available and anonymized. As such, ethical approval was not required in accordance with institutional guidelines.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

CCP	Chinese Communist Party
CGSS	Chinese General Social Survey
EFA	Exploratory Factor Analysis
GDP	Gross Domestic Product
PCA	Principal Component Analysis

Appendix A

Table A1: Minority population proportion by province.

Province	Minority Population Proportion (percentage)
Xinjiang Uyghur Autonomous Region	0.9411
Ningxia Hui Autonomous Region	0.8902
Guangxi Zhuang Autonomous Region	0.5043
Yunnan	0.4884
Hunan	0.1265
Hubei	0.1057
Liaoning	0.1009
Guizhou	0.0992
Inner Mongolia Autonomous Region	0.0909
Heilongjiang	0.0716
Jilin	0.0662
Shandong	0.0588
Beijing	0.0550
Qinghai	0.0435

Table A1: *Cont.*

Province	Minority Population Proportion (percentage)
Tianjin	0.0225
Henan	0.0212
Hebei	0.0203
Zhejiang	0.0191
Gansu	0.0118
Anhui	0.0110
Jiangsu	0.0096
Guangdong	0.0089
Shanghai	0.0088
Shaanxi	0.0060
Chongqing	0.0041
Shanxi	0.0044
Jiangxi	0.0025
Sichuan	0.0000
Fujian	0.0000

To assess the robustness of our main findings, we conducted a sensitivity test by excluding provinces with minority population proportions below 8% (the national average), including Jiangsu, Shaanxi, Chongqing, Shanxi, Jiangxi, Sichuan, and Fujian. Provinces with very low minority representation may have limited sample sizes and characteristics that differ systematically from provinces with higher minority populations, potentially influencing the overall results. The results remained largely consistent, indicating that the reported patterns are not driven by provinces with low minority representation and are robust across the broader set of provinces.

Table A2: Sensitivity tests.

	Model 1
Fixed parameters	
Constant (β)	−1.29
Individual-level variables	
Ethnic minorities, β (SE)	−0.052* (0.04)
Structural social capital, β (SE)	0.068* (0.01)
Cognitive social capital, β (SE)	0.133*** (0.01)
Years of education, β (SE)	0.092* (0.00)
Mandarin fluency, β (SE)	0.061** (0.01)
Age, β (SE)	−0.010 (0.01)
Urban hukou, β (SE)	−0.012 (0.03)
Union membership, β (SE)	0.244 (0.04)

Table A2: *Cont.*

	Model 1
CCP membership, β (SE)	0.126* (0.04)
Married, β (SE)	0.180 (0.04)
Male, β (SE)	0.144*** (0.03)
Logged annual income, β (SE)	0.245*** (0.02)
Year	Controlled
County-level variables	
County-level structural social capital, β (SE)	0.144** (0.06)
County-level cognitive social capital, β (SE)	0.189* (0.11)
County-level years of education, β (SE)	0.013 (0.03)
Minorities concentration rate, β (SE)	−0.124** (0.22)
County-level GDP per capita, β (SE)	0.197 (0.13)
County-level percentage of older adults over 60 years old, β (SE)	0.064 (0.01)
County-level healthcare expenditure per capita, β (SE)	0.011 (0.01)
Random parameters	
Level 2, between counties (county-level variance)	0.044
BIC	34,421.4

Notes: Significance level: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Standard error in parentheses. All models were based on 4861 individuals at level 1 nested within 22 counties in level 2. Stata module "*meglm*" was used to conduct the analysis. CCP: Chinese Communist Party; GDP: Gross Domestic Product; BIC: Bayesian Information Criterion.

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