Inequalities in Cognitive Impairment Among Older Adults in China and the Associated Social Determinants: A Decomposition Approach

Qingwen Deng
Fujian Medical University

Wenbin Liu (✉ wenbinliu126@126.com)
Fujian Medical University  https://orcid.org/0000-0001-9369-9858

Research

Keywords: Income-related inequalities, Cognitive impairment, Older adults, Concentration index, Decomposition analysis, China

DOI: https://doi.org/10.21203/rs.3.rs-102596/v1

License: ☇ ① This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

Background

Despite there is growing evidence focusing on health inequalities in China, socioeconomic inequalities in cognitive impairment among older adults have received little attention. This study aims to measure socioeconomic inequalities in cognitive impairment among Chinese older adults, and determine the contributing social factors to the inequalities.

Methods

A cross-sectional analysis was performed using data from the 2018 Chinese Longitudinal Healthy Longevity Survey (CLHLS), a total of 10556 older adults aged 65 and over were included in the study. The prevalence of cognitive impairment was measured by using the Chinese version of the Mini-Mental State Examination. The socioeconomic inequalities in cognitive impairment were illustrated and quantified by the concentration curve and normalized concentration index. Multivariate logistic regression was conducted to identify the associated factors of cognitive impairment. And decomposition analysis was further applied to decompose the contribution of each determinant to the observed inequalities in cognitive impairment.

Results

The study indicated that the prevalence of cognitive impairment among Chinese older adults was 18.95%. The overall concentration index for cognitive impairment was −0.046, which suggested a higher concentration of cognitive impairment among socioeconomically disadvantaged older adults. The results showed the prevalence of cognitive impairment was associated with sex, age, marital status, education level, occupation, economic status, emotional support, financial support, living arrangement, and participation in informal activities. Decomposition results further revealed the contributions of the determinants to the inequalities in cognitive impairment. Specifically, age (131.61%), marital status (85.68%), emotional support (84.85%), education level (39.73%), occupation (21.24%), sex (17.25%), financial support (−4.19%), economic status (1.02%), living arrangement (0.88%), and informal activities (0.30%) have varying degrees of contributions to the inequality in cognitive impairment.

Conclusion

This study sheds light on the pro-rich inequality in cognitive impairment among older adults in China. It suggests that policymakers should pay more attention to older adults who are female, old-old, widowed, illiterate, economically disadvantaged, have no social support, and are less socially involved. Also, more targeted interventions should be undertaken to improve the socioeconomic conditions of these vulnerable individuals and their ability to cope with the risk of cognitive impairment.

Background

Cognitive impairment is characterized by declines in attention, memory, reasoning, intelligence and other mental functions [1]. Older adults with severe cognitive impairment can lead to dementia, which is still incurable [2], and thus lose the ability to accomplish daily life and independent living [3], posing a heavy burden on families and health care systems, and a profound adverse impact on health and successful aging [4]. In recent years, the prevalence of cognitive impairment has been expected to dramatically increase with rapid aging, which is increasingly become a great public health concern on a global scale. Taking China for example, China has the largest number of older adults in the world, as well as the largest population of patients with dementia, with nearly 25% of the world’s dementia cases and an annual increase of more than 0.36 million [5]. Thus, there is an urgent need to concentrates efforts to improve cognitive function and prevent the progression of cognitive impairment to dementia among older adults at high risks.

As the increasing demand for care of older adults with dementia, the problems related to cognitive impairment have aroused great attention, but little is known about the inequality in cognitive impairment. Existing few studies have mainly
The current status of inequalities in cognitive impairment [6,7], or the relationship between related factors and inequalities in cognitive impairment [8,9]. For instance, a study has indicated that women and rural populations have unfavorable inequalities in cognitive impairment compared with men and urban populations [7], and studies have suggested that the inequalities in cognitive impairment were related to individual characteristics and socioeconomic context [8-10]. Although researchers have found that cognitive impairment is unequally distributed among socioeconomic groups, namely, people of disadvantaged socioeconomic status are at greater risk for cognitive impairment, these studies did not assess the degree of health inequalities or determine how much of it was explained by proposed factors.

Regarding the influencing factors of inequalities in cognitive impairment, several studies have investigated the impact of socioeconomic factors on cognitive ability, and it is generally highlighted that better cognitive performance was associated with higher socioeconomic status [8,11]. Specifically, educational inequality can widen racial/ethnic/nativity disparities in dementia for older adults [12], and offspring education has a profoundly positive influence on later-life cognitive health from a family perspective [13].

In addition to socioeconomic factors, social support and social participation also have been documented in the literature on social determinants for inequalities in cognitive impairment. Social support is defined as “the support accessible to an individual through social ties to other individuals, groups, and the larger community” [14]. It generally includes emotional support and instrumental support [15]. Emotional support often refers to contact and care from family members, friends, and people who regularly associate. Instrumental support refers to tangible support such as financial or material assistance [16,17]. With the deepening of the research on the relationship between social support and health of older adults, there are increasing studies believe that living arrangement should be incorporated into the scope of social support [18,19]. Older people living alone, in care facilities, or with family members are considered to have a significant impact on their health [20,21]. Social participation is defined as a person engage in social or community activities that provide interaction with others [22], which involves activities that may be formal (such as participation in organized activities) or informal (such as participation in group leisure activities) [23]. Different from individual or family activities, social participation activities place more emphasis on interaction with the community [24]. In sum, a growing body of evidence illustrates the protective influence of higher socioeconomic status [11], social support [25], and social participation [26] on cognitive impairment in older adults.

Increasing the understanding of the inequalities in cognitive impairment among different socio-economic groups is of great value to researchers and policymakers in developing meaningful targeted interventions to promote equity. To the best of our knowledge, prior research on the social factors of cognitive impairment in older adults is relatively scattered. Additionally, few studies have paid attention to the measurement and quantification of inequalities in cognitive impairment. These research gaps lead to a dearth of evidence on the impact of multidimensional social factors on inequalities in cognitive impairment. Therefore, this study aims to determine the degree of inequalities and integrate its social determinants of cognitive impairment among older adults in China. The findings are promising for bridging the gap in the literature about the inequality in cognitive impairment. It will help to tailor strategies to reduce the inequalities of cognitive health, especially echoes the increasing highlight on health equity in health systems of China and many other countries.

**Methods**

**Data Source**

The data used in this study are from the Chinese Longitudinal Health Longevity Survey (CLHLS), which is a large population-based study conducted by the Centre for Healthy Aging and Family Studies at Peking University and the Chinese Center for Disease Control and Prevention. The CLHLS sampled older adults aged 65 and over from 22 out of the 31 provinces of mainland China, the population in these provinces constitutes approximately 85% of the total population [27]. The CLHLS has established the sampling frame with all centenarians from the sampled counties/cities. Based on the prepared code, one octogenarian and one nonagenarian were randomly selected that matched each sampled centenarian. And for every three
sampled centenarians, four older adults aged 65–79 were randomly selected from a nearby geographical unit. All
respondents in the CLHLS were surveyed by face-to-face interviews using internationally compatible questionnaires. Proxy
respondents (a spouse or other family member) were instead interviewed when the participants were unable to answer
questions, while questions about cognitive function were answered by the participants themselves. Data of the study were
obtained from the CLHLS in 2018, which surveyed 15874 older adults. To ensure the analysis effectively, the samples with
missing values or answers of “don’t know” in any variables of interest would be excluded. Finally, a total of 10665
respondents were included in this study.

The CLHLS study was approved by the Ethics Committee of Peking University (IRB00001052-13074), and all respondents or
their proxies provided written informed consent.

Measures

Explained variable: Cognitive impairment

Cognitive impairment of the respondents was assessed by the Chinese version of the Mini-Mental State Examination
(MMSE) adapted from the scale developed by Folstein and colleagues [28], which has been proven to be reliable and valid for
elderly Chinese [29,30]. MMSE tests 24 items from the five aspects of cognitive function: orientation, reaction, attention &
calculation, recall, and language. The total score ranged from 0 to 30, and the higher score indicated better cognitive ability.

Education-based MMSE cutoff points are widely used to screen for cognitive impairment in the elderly population with low
education [31]. As quite a number of respondents (48.29%) in this study had no formal education, we used education-based
MMSE cutoff points to define those who with cognitive impairment: < 18, respondents with no formal schooling; < 21,
respondents with 1 to 6 years of schooling; and < 25, respondents with more than 6 years of schooling [32,33].

Explanatory variables

Explanatory variables of the study consisted of socioeconomic factors, social support, and social participation.

Socioeconomic factors included education level, occupation, and economic status. Respondents were asked “How many
years did you attend school?”, according to the answers of 0 years, 1~6 years, and 7 years or more, education level was
classified into three categories: illiterate (1), primary school (2), and middle school or more (3). The categories of occupation
in the questionnaire included professional and technical personnel, governmental, institutional or managerial personnel,
commercial, service or industrial worker, self-employed, agriculture, forestry, animal husbandry or fishery worker, house
worker, and others. In this study, the occupation was recoded into non-white-collar (1) and white-collar (2). Economic status
was assessed by asking “the per capita of household income in the last year?” and then divided into quintiles with quintile 1
(1) indicating the poorest and quintile 5 (5) indicating the richest.

Social support was measured by three elements: emotional support, financial support, and living arrangement. Emotional
support was obtained by the question “The first person to whom you usually talk frequently in daily life (including spouse,
son/daughter, son-/daughter-in-law, grandchildren and their spouse, other relatives, friends/neighbors, social
workers/housekeeper, network friends, and nobody).” The answers were grouped into four categories: nobody (1),
relatives/friends/neighbors and others (2), children (3), and spouse (4). Financial support was calculated by the answers to
three questions: “How much did you receive from your son(s) or daughter(s)-in-law, last year?”, “How much did you receive
from your daughter(s) or son(s)-in-law last year?”, and “How much did you receive from your grandchild(ren) last year?”. If
the answers to the three questions add up to 0, we assumed the respondent had no financial support (1), otherwise, he/she
had financial support (2). Living arrangement was categorized into lived alone (1), lived in an institution (2), and lived with
household members (3).

Social participation included two aspects of organized activities and informal activities. The questions for organized
activities and informal activities were “Do you take part in some social activities (organized) at present?”, “Do you take part in
the following activities (e.g. square dance, series, interact with friends, play cards/mah-jongg) at present?”, respectively. And the options of two questions both included “almost every day”, “not daily, but once for a week”, “not weekly, but at least once for a month, “not monthly, but sometimes”, and “never”. If the respondents select “never”, we assumed the respondent had not participated in organized activities or informal activities (1), otherwise, he/she had participated in organized activities or informal activities (2).

**Covariates**

Covariates included demographic factors such as sex, age, marital status, and residential area. Sex was defined as male (1) and female (2). Age was obtained by self-reported and then divided into three groups: aged 65~74 years old (1), aged 75~84 years old (2), and aged 85 years or above (3). Marital status was categorized into two groups: separated/divorced/widowed/never married (1), married and living with spouse (2). The residential area was defined as urban/town (1) and rural (2).

**Statistical analysis**

The Stata 15.1 software was used for data analysis. Difference analysis was performed with the Chi-square test. As the dependent variable is dichotomous, binary logistic regression was used to estimate the effects of demographic factors, social support, and social participation on cognitive impairment among older adults. In addition, the concentration curve and concentration index (C) were used to reflect the income-related inequality in cognitive impairment. In this study, the distribution of cognitive impairment was examined by economic status quintiles. The C is defined as twice the area between the concentration curve and the line of equality, and the concentration curve is obtained by plotting the cumulative percentage of cognitive impairment (Y-axis) against the cumulative percentage of the population ranked by economic status (X-axis). The C can be calculated using the following formula [34]:

$$C = \frac{2}{\mu \times cov(h, r)}$$

where $h$ is the health outcome (cognitive impairment in this study), $\mu$ is the mean of $h$, and $r$ denotes the fractional rank of individuals in the distribution used (economic status quintiles). The C ranges between $-1$ and $+1$, a value of zero represents absolute fairness and there exists no income-related inequality. When C is positive, suggesting that cognitive impairment is more concentrated among rich people (pro-poor). Conversely, if the C takes a negative value, indicating cognitive impairment is more concentrated among poor people (pro-rich). As the outcome variable in the study is binary, the bounds of C do not vary between $-1$ and $+1$. To correct this issue, we followed Wagstaff’s suggestion [35], normalizing the C by dividing estimated C by $1$ minus the mean $(1-\mu)$.

Decomposition analysis was further performed to determine the contribution of each factor to the inequality, in which the contribution of each factor is the product of the sensitivity or elasticity of cognitive impairment with respect to that factor and its degree of inequality.

**Results**

Table 1 outlines the demographic characteristics of the included respondents, as well as the prevalence of cognitive impairment by independent variables. A total of 10556 adults aged 65 and over with an average age of 84.74 (standard deviation [SD]=11.55) years were included in this study, of which 5833 (55.26%) were females, 5187 (49.14%) were 85 years or older. The majority of respondents were separated/divorced/widowed/never married (57.76%), resided in urban/town area (55.83%). The illiterate elderly nearly accounted for half of the respondents (48.29%). Most of the respondents had engaged in non-white-collar occupation (88.50%). The proportion of reporting lack of emotional support, financial support, and lived
alone was 2.16%, 28.17%, and 15.42%, respectively. In addition, 14.08% and 62.45% of the respondents, respectively, had participated in organized activities and informal activities.

The overall prevalence of cognitive impairment among the study population was 18.95%, significantly lower than those who were females (23.32%), aged 85 years or older (34.88%), Separated/divorced/widowed/never married (28.06%), lived in an institution (31.27%) or lived with household member (19.59%), and received no education (27.90%). Cognitive impairment showed a general income gradient, with the lower prevalence found among people with a higher economic status. More specifically, the richest (quintile 5) had the lowest prevalence of cognitive impairment (15.77%). The prevalence of cognitive impairment was higher among respondents who had no emotional support (46.49%), had financial support (21.99%), and not participated in informal activities (20.61%). However, there was no significant difference in the prevalence of cognitive impairment between residential areas, and participation in organized activities ($P > 0.05$).

The logistic regression results for cognitive impairment and its determinants are presented in Table 2. Except for residential area and whether participated in organized activities ($P > 0.05$), all other factors were predicted to have significant influences on cognitive impairment. Among demographic factors, being female ($OR = 1.257$, 95%CI = 1.101 to 1.434) was significantly associated with higher odds of cognitive impairment. Compared to the young-old (aged 65~74 years), the old-old (aged 75 years or above) were estimated with the higher odds of cognitive impairment. Special strikingly, those who aged 85 years or above (OR = 20.486, 95%CI = 14.505 to 28.935) were at an alarmingly high risk of cognitive impairment. Older adults who were married and living with spouse (OR = 0.690, 95%CI = 0.521 to 0.913) were less likely to suffer from cognitive impairment compared to the separated/divorced/widowed/never married older adults. As for the education level, compared to the respondents who were illiterate, the respondents who had a primary school (OR = 0.678, 95%CI = 0.585 to 0.787) can significantly lower the odds of cognitive impairment. Compared with non-white-collar jobs, white-collar jobs (OR = 0.738, 95%CI = 0.580 to 0.937) had a lower risk of cognitive impairment. In economic status, we found that higher income was related to the lower risks of cognitive impairment. For example, the richest (OR = 0.577, 95%CI = 0.475 to 0.701) had the lowest odds of cognitive impairment. Furthermore, of social support, having different sources of emotional support (from relatives/friends/neighbors and others $OR = 0.219$, 95%CI = 0.154 to 0.311; from children $OR = 0.400$, 95%CI = 0.293 to 0.546); from spouse $OR = 0.242$, 95%CI = 0.160 to 0.366) and having financial support (OR = 0.712, 95%CI = 0.630 to 0.804) were correlated with the lower risks of cognitive impairment. However, it’s surprising that in living arrangement, the highest odds of cognitive impairment were found in the respondents who were lived in an institution (OR = 3.374, 95%CI = 2.425 to 4.695), followed by living with household members (OR = 2.227, 95%CI = 1.855 to 2.658), while rather than lived alone. Of social participation, respondents who participated in informal activities (OR = 0.872, 95%CI = 0.776 to 0.980) were less likely to suffer from cognitive impairment than those who did not participate in informal activities.

The concentration curve of cognitive impairment among older adults is shown in Figure 1. The curve lay above the equality line, with the negative value of the concentration index of − 0.046. This indicated that income-related health inequalities exist in the distribution of cognitive impairment. Furthermore, the inequality disadvantageous to the poor, namely cognitive impairment was more concentrated among older people with lower economic status.

The results of the decomposition analysis of inequalities in cognitive impairment are illustrated in Table 3. Demographic factors such as age (133.61%), marital status (85.68%) and sex (17.25%), had the largest contribution to the pro-rich inequalities in cognitive impairment. Social support variables came next in the importance of the contribution, 84.85%, − 4.19%, and 0.88% of inequalities in cognitive impairment can be explained by emotional support, financial support, and living arrangement, respectively. In third place were socioeconomic factors, with education level, occupation, and economic status accounting for − 39.73%, 21.24%, and − 1.02% of inequalities in cognitive impairment. Social participation factors were fourth in importance, with informal activities (0.3%) making small contributions to the inequalities that disfavor the poor. While residential area (− 0.07%) and organized activities (0.18%) showed their insubstantial contributions to the inequalities. Furthermore, as indicated by the C, women, the old-old, separated/divorced/widowed/never married, resided in rural, with less education, had no emotional support, had financial support, lived in an institution, and not participated in informal activities were more concentrated among the poor, and they had higher probabilities of reporting the problem of cognitive impairment.
Discussion

To our knowledge, several studies have been conducted on the prevalence and risk factors affecting cognitive impairment among older adults, but there was a dearth of studies on the inequalities in cognitive impairment and its associated social determinants. In this study, we quantified and decomposed income-related inequalities in cognitive impairment among older adults based on the national representative data from CLHLS. This approach can help us to determine the income-related inequalities in cognitive impairment among older adults and the main causes, which will be of vital importance for tailoring effective interventions to prevent or delay cognitive impairment among older adults.

The results revealed that cognitive impairment among older adults in China is unequally distributed and mainly concentrated among those with lower socioeconomic status (uneducated, non-white-collar occupation, and economically disadvantaged). Education is the most commonly considered socioeconomic factor in studies on cognitive impairment, and its protective effect on cognition has been repeatedly demonstrated [16,36]. Socioeconomic conditions other than good education are also important for the cognitive health of older adults, including white-collar occupations and better economic status [14,37]. Studies in both developed and developing countries [15,17] have depicted the way that an individual's socioeconomic status affects their cognitive function by the resources available and the environment they are exposed to. Better socioeconomic status generally suggests higher quality of life, wider social information, and greater access to health care, which leads to more cognitive stimulation and cognitive reserve to prevent or delay the onset of cognitive impairment [15]. Surprisingly, among the three levels of education in this study, we did not detect a significant protective effect of the highest level of education against cognitive impairment. The reason for the insignificance may lie in the confounding caused by the criterion of outcome variable related to education level. Since the sensitivity of MMSE scores to mild cognitive impairment is relatively low [33,38], there may be some overlap between groups with different MMSE scores [11]. As indicated in previous research, MMSE in the CLHLS may weaken the impact of education [4].

The decomposition results suggested that all proposed variables (except residential area and organized activities) have positive contributions to income-related inequality in cognitive impairment. Demographic factors such as sex, age and marital status showed a profound impact on the cognitive impairment of older adults. Older women generally have poorer cognitive health and a higher prevalence of cognitive impairment than the older man, which was in lined with the findings of previous studies [12,39]. It is important to realize that, women being exposed to gender discrimination since their childhood due to the long-term influence of traditional concepts and cultural norms, they have less access to education and fewer financial resources in comparison with men [40]. Increasing age is a well-known major risk factor of the onset of cognitive impairment and dementia [41]. Studies have shown that with the increase of age, the effectiveness of dopamine neurotransmission decreases [42] and different degrees of microvascular dysfunction occur, thus affecting the decline of cognitive function [43]. Moreover, the possibility of cognitive impairment in the old-old is much higher than that in the young-old. Being married and living with a spouse was a significant protective factor against cognitive impairment among older adults, which supports the findings of prior research [44,45]. A stable marital relationship can ensure daily care and emotional sustenance for older adults, while those who are separated, divorced, widowed, or never married may suffer from loneliness, insecurity and passive attitude due to a lack of marital support, making them more vulnerable to cognitive impairment [46]. Residence contributed little to the inequality in cognitive impairment among older adults, and there was no significant difference in the prevalence of cognitive impairment between urban/town and rural elderly in this study. On the one hand, it is possible that China has promoted equality and industrialization in rural areas in recent decades, which leads to the improvement of infrastructure, Internet construction, and health care systems in rural areas [14]. Rural residents have more access to receive cognitive stimulation than before, and the conditions for prevention and treatment of cognitive decline are more favorable. On the other hand, although urban/town areas can provide a more cognition-stimulating environment than rural areas [47], urban/town areas also furnished an adverse environment (such as fragmentation of family structure and support, reduced social interaction) that drives chronic stress and cognitive abnormalities in disadvantaged individuals [48].
Previous research has shown that social support plays a vital part in later life [22] and is associated with overall cognitive performance in older adults [29]. As a psychosocial factor, social support can shape the positive attitudes of older adults and provide a “transition zone” to buffer the negative effects associated with stressful events [49]. In the multivariate analysis, different sources of emotional support play a protective role in cognitive impairment. Studies of elderly Chinese have shown that children are irreplaceable spiritual pillar [22], and the emotional support from their children is one of the important factors affecting their mental health [50], which is related to a reduced risk of cognitive impairment. The emotional support from the spouse again emphasized the importance of marriage for the healthy life of older adults [22]. Besides, connections with friends, neighbors, and others (meaning richer sources of information) also indicated the significant role of support from outside the family for older adults’ cognitive health [51]. In addition, in terms of the resources available to older adults in China, it is common for older adults to receive financial support from family members [23], especially for those in rural areas, because they are less likely to be covered by pensions and health insurance [52]. Access to financial support can help them prevent the insufficient cognitive condition and underutilization of health services resulting from financial dependence.

Regarding living arrangement, results showed that older adults living in an institution or with household member(s) have a higher risk of cognitive impairment than older adults who living alone. This is similar to previous studies that have shown that older adults who live alone are in better health than those who live in a nursing home or with family member(s) [23] [53]. The higher concentration of cognitive impairment among older adults living in an institution or with family member(s) also confirmed that older adults with impairment are more likely to use informal or formal care. The more severe the illness or disability, the formal institutional care is more required [54].

The relationship between social participation and cognitive impairment varies with the type of social participation. Informal activities such as group dancing and singing, playing cards/mahjong are the major forms of activities for Chinese older adults to participate in society [30], and these activities may be of use to delay cognitive decline. Previous studies have suggested that participation in group leisure activities can help older adults relieve negative emotions and gain self-efficacy while remaining physically [55] or cognitively active [56] for direct health benefits. In China, especially for older adults, participation in organized activities is relatively limited due to barriers such as age discrimination, lack of access to information, and a greater emphasis on contact with the family rather than the outside world [30]. In our study, only 14.08% of respondents said they had participated in organized activities. This may provide an explanation for the insignificant effect of participation in organized activities on the prevalence of cognitive impairment.

This study was also strengthened by some features. A key strength was that this study is the first study using the decomposition methodology to quantify the inequality in cognitive impairment and its influencing factors, it helps to better estimate and explain the degree of inequalities in cognitive impairment and the contributions of determinants. The second strength was that this study provides a comprehensive insight into the social determinants of inequalities in cognitive impairment through combining the previous piecemeal evidence. Another strength was that the measurement of inequality in cognitive impairment was based on a large national sample among Chinese older adults, which makes the results more convincing and representative. Nevertheless, this study has some limitations. First, research based on cross-sectional data may not be able to claim the causality, which may need to be investigated by establishing panel data in the future. Second, some responses may be influenced by social desirability biases due to the use of self-reported data. Third, there may be other potential social variables that have not been considered and need more comprehensive research in the future.

**Conclusion**

This study provides evidence of socioeconomic-related inequalities in cognitive impairment among Chinese older adults disfavoring the poor population. The vulnerable whose socioeconomic status is at a disadvantage requires more attention in policies, such as elderly women, the older elderly, widowed elderly, illiterate elderly, elderly in poor economic conditions, individuals without social support, or individuals who are less involved in social. Social strategies focusing on socioeconomic factors will beneficial to reduce the inequality in cognitive impairment among older adults.
Abbreviations

CLHLS: Chinese Longitudinal Health Longevity Survey

MMSE: Mini-Mental State Examination

C: Concentration index

Declarations

Ethics approval and consent to participate

This study is a secondary analysis of the data from the CLHLS. The CLHLS study was approved by the Ethics Committee of Peking University (IRB00001052-13074). The participants provided their written informed consent to participate in this study.

Consent for publication

Not applicable.

Availability of data and materials

Publicly available datasets were analyzed in this study. Please contact CLHLS for data requests: http://162.105.138.117/dataset.xhtml?persistentId=doi:10.18170/DVN/WBO7LK.

Competing interests

The authors declare no competing interests.

Funding

The study was supported by Distinguished Young Scientific Research Talents Plan in Universities of Fujian Province (2018B030). The funders had no involvement in study design, data collection, statistical analysis and manuscript writing.

Authors’ contributions

WL and QD contributed to the conception and design of the study. QD conducted the data reduction, analyses and wrote the manuscript. WL guided the whole process and reviewed the manuscript. All authors read and approved the manuscript before submission.

Acknowledgements

We acknowledge all the interviewees for their voluntary participation in the CLHLS study.

Authors’ information

Affiliations

Department of Health Management, School of Public Health, Fujian Medical University, Fuzhou, Fujian, China

Qingwen Deng, Wenbin Liu

Corresponding author

Correspondence to Wenbin Liu.
References

1. Gao M, Kuang W, Qiu P, Wang H, Lv X, Yang M. The time trends of cognitive impairment incidence among older Chinese people in the community: based on the CLHLS cohorts from 1998 to 2014. Age Ageing. 2017;46(5):787-793.

2. Duan J, Lv YB, Gao X, Zhou JH, Kraus VB, Zeng Y, et al. Association of cognitive impairment and elderly mortality: differences between two cohorts ascertained 6-years apart in China. BMC Geriatr. 2020;20(1):29.

3. Mavrodaris A, Powell J, Thorogood M. Prevalences of dementia and cognitive impairment among older people in sub-Saharan Africa: a systematic review. Bull World Health Organ. 2013;91(10):773-783.

4. Yu R, Chau PH, McGhee SM, Cheung WL, Chan KC, Cheung SH, et al. Trends in prevalence and mortality of dementia in elderly Hong Kong population: projections, disease burden, and implications for long-term care. Int J Alzheimers Dis. 2012;2012:406852.

5. Jiang Y, Cui M, Tian W, Zhu S, Chen J, Suo C, et al. Lifestyle, multi-omics features, and preclinical dementia among Chinese: The Taizhou Imaging Study. Alzheimers Dement. 2020.

6. Lv X, Li W, Ma Y, Chen H, Zeng Y, Yu X, et al. Cognitive decline and mortality among community-dwelling Chinese older people. BMC Med. 2019;17(1):63.

7. Hou C, Lin Y, Ren M, Liu M, Ma Y, Li H, et al. Cognitive functioning transitions, health expectancies, and inequalities among elderly people in China: A nationwide longitudinal study. Int J Geriatr Psychiatry. 2018;33(12):1635-1644.

8. Yang F, Cao J, Qian D, Ma A. Stronger Increases in Cognitive Functions among Socio-Economically Disadvantaged Older Adults in China: A Longitudinal Analysis with Multiple Birth Cohorts. Int J Environ Res Public Health. 2020;17(7):2418.

9. Fernández-Blázquez MA, Noriega-Ruiz B, Ávila-Villanueva M, et al. Impact of individual and neighborhood dimensions of socioeconomic status on the prevalence of mild cognitive impairment over seven-year follow-up. Aging Ment Health. 2020;1-10.

10. Letellier N, Carrière I, Cadot E, et al. Individual and neighbourhood socioeconomic inequalities in cognitive impairment: cross-sectional findings from the French CONSTANCES cohort. BMJ Open. 2020;10(3):e033751.

11. Yang L, Martikainen P, Silventoinen K, Konttinen H. Association of socioeconomic status and cognitive functioning change among elderly Chinese people. Age Ageing. 2016;45(5):674-680.

12. Garcia MA, Saenz J, Downer B, Wong R. The role of education in the association between race/ethnicity/nativity, cognitive impairment, and dementia among older adults in the United States. Demogr Res. 2018;38:155-168.

13. Yahirun JJ, Vasireddy S, Hayward MD. The Education of Multiple Family Members and the Life-Course Pathways to Cognitive Impairment. J Gerontol B Psychol Sci Soc Sci. 2020;75(7):e113-e128.

14. Lin N, Simeone RS, Ensel WM, Kuo W. Social support, stressful life events, and illness: a model and an empirical test. J Health Soc Behav. 1979;20(2):108-119.

15. Berkman LF, Glass T, Brissette I, Seeman TE. From social integration to health: Durkheim in the new millennium. Soc Sci Med. 2000;51(6):843-857.

16. Krause N. Social support, stress, and well-being among older adults. J Gerontol. 1986;41(4):512-519.

17. Langford CP, Bowsher J, Maloney JP, Lillis PP. Social support: a conceptual analysis. J Adv Nurs. 1997;25(1):95-100.

18. Yin S, Yang Q, Xiong J, Li T, Zhu X. Social Support and the Incidence of Cognitive Impairment Among Older Adults in China: Findings From the Chinese Longitudinal Healthy Longevity Survey Study. Front Psychiatry. 2020;11:254.

19. Feng Z, Jones K, Wang WW. An exploratory discrete-time multilevel analysis of the effect of social support on the survival of elderly people in China. Soc Sci Med. 2015;130:181-189.

20. Koskinen S, Joutseniemi K, Martel T, Martikainen P. Mortality differences according to living arrangements. Int J Epidemiol. 2007;36(6):1255-1264.

21. Herm A, Poulain M, Anson J. International Union for the Scientific Study of Population. Busan: 2013. Living arrangement, health status and mortality risk.
http://www.iussp.org/sites/default/files/event_call_for_papers/2013%20HERM%20POULAIN%20ANSON.pdf. Accessed 9 Aug 2020.

22. Levasseur M, Duff H, Kelly S, McHugh Power JE, Brennan S, et al. The impact of social activities, social networks, social support and social relationships on the cognitive functioning of healthy older adults: a systematic review. Syst Rev. 2017;6(1):259.

23. Gao M, Sa Z, Li Y, Zhang W, Tian D, Zhang S, et al. Does social participation reduce the risk of functional disability among older adults in China? A survival analysis using the 2005-2011 waves of the CLHLS data. BMC Geriatr. 2018;18(1):224.

24. Zeng Y, Feng Q, Xu RF, et al. Cognitive impairment using education-based cutoff points for CMMSE scores in elderly Chinese people of agricultural and rural Shanghai China. Acta Neurol Scand. 2011;124(6):361-367.

25. Zeng Y, Feng Q, Heseth T, Christensen K, Vaupel JW. Survival, disabilities in activities of daily living, and physical and cognitive functioning among the oldest-old in China: a cohort study. Lancet. 2017;389(10079):1619-1629.

26. Zhang MY, Katzman R, Salmon D, et al. The prevalence of dementia and Alzheimer’s disease in Shanghai, China: impact of age, gender, and education. Ann Neurol. 1990;27(4):428-437. doi:10.1002/ana.410270412

27. Zhu X, Qiu C, Zeng Y, Li J. Leisure activities, education, and cognitive impairment in Chinese older adults: a population-based longitudinal study. Int Psychogeriatr. 2017;29(5):727-739.

28. O’Donnell O, Van Doorslaer E, Wagstaff A, Lindelow M. Analyzing health equity using household survey data: World Bank Publications. https://openknowledge.worldbank.org/bitstream/handle/10986/6896/424800ISBN978011OFFICIAL0USE0ONLY10.pdf?sequence=1&isAllowed=y. (2008). Accessed 9 Aug 2020.

29. Jagger C, Matthews FE, Wohland P, Fouweather T, Stephan BC, Robinson L, et al. A comparison of health expectancies over two decades in England: results of the Cognitive Function and Ageing Study I and II. Lancet. 2016;387(10020):779-786.

30. Lei X, Hu Y, Mc Ardle JJ, Smith JP, Zhao Y. Gender Differences in Cognition among Older Adults in China. J Hum Resour. 2012;47(4):951-971. doi:10.3368/jhr.47.4.951
41. Ballard C, Gauthier S, Corbett A, Brayne C, Aarsland D, Jones E. Alzheimer's disease. Lancet. 2011;377(9770):1019-1031.
42. Volkow ND, Gur RC, Wang GJ, Fowler JS, Moberg PJ, Ding YS, et al. Association between decline in brain dopamine activity with age and cognitive and motor impairment in healthy individuals. Am J Psychiatry. 1998;155(3):344-9.
43. Rensma SP, van Sloten TT, Houben AJHM, Köhler S, van Boxtel MPJ, Berendschot TTJM, et al. Microvascular Dysfunction Is Associated With Worse Cognitive Performance: The Maastricht Study. Hypertension. 2020;75(1):237-245.
44. Håkansson K, Rovio S, Helkala EL, Vilsla AR, Winblad B, Soininen H, et al. Association between mid-life marital status and cognitive function in later life: population based cohort study. BMJ. 2009;339:b2462.
45. Shin SH, Kim G, Park S. Widowhood Status as a Risk Factor for Cognitive Decline among Older Adults. Am J Geriatr Psychiatry. 2018;26(7):778-787.
46. Gerritsen L, Wang HX, Reynolds CA, Fratiglioni L, Gatz M, Pedersen NL. Influence of Negative Life Events and Widowhood on Risk for Dementia. Am J Geriatr Psychiatry. 2017;25(7):766-778.
47. Cassarino M, Setti A. Environment as 'Brain Training': A review of geographical and physical environmental influences on cognitive ageing. Ageing Res Rev. 2015;23(Pt B):167-182.
48. Tost H, Champagne FA, Meyer-Lindenberg A. Environmental influence in the brain, human welfare and mental health. Nat Neurosci. 2015;18(10):1421-1431.
49. Zhou M, Qian Z. Social Support and Self-Reported Quality of Life China's Oldest Old. In: Yi Z, Poston DL, Vlosky DA, Gu D, editors. Healthy Longevity in China. Demographic Methods and Population Analysis. Dordrecht: Springer; 2008.
50. Lu M, Guo C. Present situation of the empty nest elderly's mental health and research commentary. Adv Psychol Sci (2013) 21(2):263–71.
51. Zunzunegui MV, Alvarado BE, Del Ser T, Otero A. Social networks, social integration, and social engagement determine cognitive decline in community-dwelling Spanish older adults. J Gerontol B Psychol Sci Soc Sci. 2003;58(2):S93-S100.
52. Wu L. Inequality of pension arrangements among different segments of the labor force in China. J Aging Soc Policy. 2013;25(2):181-196.
53. Sereny M. Living Arrangements of Older Adults in China: The Interplay Among Preferences, Realities, and Health. Res Aging. 2011;33(2):172–204.
54. Wang Z, Yang X, Chen M. Inequality and Associated Factors in Utilization of Long-Term Care Among Chinese Older People: Evidence from the Chinese Longitudinal Healthy Longevity Survey. Soc Indic Res. 2020.
55. Choi LH. Factors affecting volunteerism among older adults. J Appl Gerontol. 2003;22(2):179–196.
56. Sakamoto A, Ukawa S, Okada E, Sasaki S, Zhao W, Kishi T, Kondo K, Tamakoshi A. The association between social participation and cognitive function in community-dwelling older populations: Japan Gerontological Evaluation Study at Taisetsu community Hokkaido. Int J Geriatr Psychiatry. 2017;32(10):1131-1140.

Tables

Table 1. Descriptive statistics of the study population and proportions of cognitive impairment
| Variable                              | Variable frequencies | Prevalence of cognitive impairment | $\chi^2$ |
|--------------------------------------|----------------------|-----------------------------------|---------|
|                                      | $n$ | % | $n$ | % |         |
| **Demographic factors**              |     |   |     |   |         |
| Sex                                  |     |   |     |   |         |
| Male                                 | 4723 | 44.74 | 640 | 13.55 | 162.049*** |
| Female                               | 5833 | 55.26 | 1360 | 23.32 |         |
| Age (years old)                      |     |   |     |   |         |
| 65~74                                | 2428 | 23.00 | 38 | 1.57 |         |
| 75~84                                | 2941 | 27.86 | 153 | 5.20 |         |
| ≥85                                  | 5187 | 49.14 | 1809 | 34.88 |         |
| Marital status                       |     |   |     |   |         |
| Separated/divorced/widowed/never married | 6097 | 57.76 | 1711 | 28.06 | 781.131*** |
| Currently married and living with spouse | 4459 | 42.24 | 289 | 6.48 |         |
| Residential area                     |     |   |     |   |         |
| Urban/Town                           | 5893 | 55.83 | 1094 | 18.56 |         |
| Rural                                | 4663 | 44.17 | 906 | 19.43 |         |
| Socioeconomic status                 |     |   |     |   |         |
| Education level                      |     |   |     |   |         |
| Illiterate                           | 5097 | 48.29 | 1422 | 27.90 | 514.650*** |
| Primary school                       | 3479 | 32.96 | 376 | 10.81 |         |
| Middle school or more                | 1980 | 18.76 | 202 | 10.20 |         |
| Occupation                            |     |   |     |   |         |
| non-white-collar                     | 9342 | 88.50 | 1856 | 92.80 | 44.838*** |
| white-collar                         | 1214 | 11.50 | 144 | 7.20 |         |
| Economic status (quintile)           |     |   |     |   |         |
| 1 (poorest)                          | 2111 | 20.00 | 415 | 19.66 | 18.861** |
| 2                                    | 2111 | 20.00 | 428 | 20.27 |         |
| 3                                    | 2112 | 20.01 | 425 | 20.12 |         |
| 4                                    | 2111 | 20.00 | 399 | 18.90 |         |
| 5 (richest)                          | 2111 | 20.00 | 333 | 15.77 |         |
| Social support                       |     |   |     |   |         |
| Emotional support                    |     |   |     |   |         |
| Nobody                               | 228 | 2.16 | 106 | 5.30 | 933.919*** |

| $\chi^2$ |
|-----------|
| 162.049*** |
| 1696.464*** |
| 781.131*** |
| 1.269 |
| 514.650*** |
| 44.838*** |
| 18.861** |
| 933.919*** |
| Variable                              | Variable frequencies | Prevalence of cognitive impairment | $\chi^2$ |
|--------------------------------------|----------------------|-----------------------------------|---------|
| Relatives/friends/neighbors and others | 1325 12.55           | 161 8.05                          |         |
| Children                             | 5176 49.03           | 1510 75.50                        |         |
| Spouse                               | 3827 36.25           | 223 11.15                         |         |
| **Financial support**                |                      |                                   | 24.983***|
| No                                   | 2974 28.17           | 654 21.99                         |         |
| Yes                                  | 7582 71.83           | 1346 17.75                        |         |
| **Living arrangement**              |                      |                                   | 61.264***|
| Alone                                | 1632 15.46           | 220 13.48                         |         |
| In an institution                    | 275 2.61             | 86 31.27                         |         |
| With household member(s)            | 8649 81.93           | 1694 19.59                        |         |
| **Social participation**            |                      |                                   |         |
| Organized activities                 |                      |                                   | 1.066   |
| No                                   | 9070 85.92           | 1704 18.79                        |         |
| Yes                                  | 1486 14.08           | 296 19.92                         |         |
| Informal activities                 |                      |                                   | 11.444**|
| No                                   | 3964 27.55           | 817 20.61                         |         |
| Yes                                  | 6592 62.45           | 1193 17.95                        |         |
| **Cognitive Impairment**            |                      |                                   |         |
| Yes                                  | 2000 18.95           | – –                               |         |
| No                                   | 8556 81.05           | – –                               |         |

Table 2. Multivariable logistic regression analysis results for cognitive impairment
| Variable                             | OR  | S.E. | z    | p value | 95% CI |
|-------------------------------------|-----|------|------|---------|--------|
| Low                                |     |      |      |         |        |
| High                               |     |      |      |         |        |
| **Demographic factors**            |     |      |      |         |        |
| **Sex**                            |     |      |      |         |        |
| Male                               |     |      |      |         |        |
| Female                             | 1.257 | 0.085 | 3.39  | 0.001   | 1.101  | 1.434  |
| **Age (years)**                    |     |      |      |         |        |
| 65~74                               |     |      |      |         |        |
| 75~84                               | 2.986 | 0.557 | 5.87  | 0.000   | 2.072  | 4.303  |
| ≥85                                 | 20.486 | 3.609 | 17.14 | 0.000   | 14.505 | 28.935 |
| **Marital status**                 |     |      |      |         |        |
| Separated/divorced/widowed/never married |     |      |      |         |        |
| Currently married and living with spouse | 0.690 | 0.099 | −2.59 | 0.009   | 0.521  | 0.913  |
| **Residential area**               |     |      |      |         |        |
| Urban/Town                          |     |      |      |         |        |
| Rural                              | 0.996 | 0.059 | −0.07 | 0.946   | 0.887  | 1.119  |
| **Socioeconomic status**           |     |      |      |         |        |
| **Education level**                |     |      |      |         |        |
| Illiterate                          |     |      |      |         |        |
| Primary school                     | 0.678 | 0.051 | −5.13 | 0.000   | 0.585  | 0.787  |
| Middle school or more              | 1.223 | 0.142 | 1.74  | 0.082   | 0.975  | 1.535  |
| **Occupation**                     |     |      |      |         |        |
| non-white-collar                   |     |      |      |         |        |
| white-collar                       | 0.738 | 0.090 | −2.49 | 0.013   | 0.580  | 0.937  |
| **Economic status (quintile)**     |     |      |      |         |        |
| 1 (poorest)                        |     |      |      |         |        |
| 2                                  | 0.861 | 0.078 | −1.65 | 0.099   | 0.722  | 1.028  |
| 3                                  | 0.812 | 0.075 | −2.27 | 0.023   | 0.678  | 0.972  |
| 4                                  | 0.771 | 0.073 | −2.74 | 0.006   | 0.640  | 0.929  |
| 5 (richest)                        | 0.577 | 0.057 | −5.55 | 0.000   | 0.475  | 0.701  |
| **Social support**                 |     |      |      |         |        |
| **Emotional support**              |     |      |      |         |        |
| Nobody                             |     |      |      |         |        |
| Relatives/friends/neighbors and others | 0.219 | 0.039 | −8.48 | 0.000   | 0.154  | 0.311  |
| Variable                              | OR  | S.E. | z    | p value | 95% CI  |
|--------------------------------------|-----|------|------|---------|---------|
| Children                             | 0.400 | 0.063 | -5.78 | 0.000   | 0.293   | 0.546   |
| Spouse                               | 0.242 | 0.051 | -6.71 | 0.000   | 0.160   | 0.366   |
| **Financial support**                |     |      |      |         |         |         |
| No                                   | –    | –    | –    | –       | –       | –       |
| Yes                                  | 0.712 | 0.044 | -5.45 | 0.000   | 0.630   | 0.804   |
| **Living arrangement**              |     |      |      |         |         |         |
| Alone                                | –    | –    | –    | –       | –       | –       |
| In an institution                    | 3.374 | 0.569 | 7.22  | 0.000   | 2.425   | 4.695   |
| With household member(s)            | 2.227 | 0.201 | 8.87  | 0.000   | 1.866   | 2.658   |
| **Social participation**            |     |      |      |         |         |         |
| **Organized activities**            |     |      |      |         |         |         |
| No                                   | –    | –    | –    | –       | –       | –       |
| Yes                                  | 1.065 | 0.089 | 0.76  | 0.449   | 0.905   | 1.253   |
| **Informal activities**             |     |      |      |         |         |         |
| No                                   | –    | –    | –    | –       | –       | –       |
| Yes                                  | 0.872 | 0.050 | -2.30 | 0.021   | 0.776   | 0.980   |

Table 3. Decomposition analysis of socioeconomic inequalities in cognitive impairment among Chinese older adults
| Variable                        | Elasticity | C     | Contribution to the C |
|--------------------------------|------------|-------|-----------------------|
| Contribution                   |            |       |                       |
| **Demographic factors**        |            |       |                       |
| **Sex**                        |            |       |                       |
| Female (ref.)                  |            |       |                       |
| Male                           | -0.0918    | 0.0855| -0.0078 17.25         |
| **Age (years)**                |            |       |                       |
| ≥85 (ref.)                     |            |       |                       |
| 75~84                          | -0.4813    | 0.1100| -0.0529 116.36        |
| 65~74                          | -0.6230    | 0.0126| -0.0078 17.25         |
| **Marital status**             |            |       |                       |
| Currently married and living with spouse (ref.) | | | |
| Separated/divorced/widowed/never married | 0.1922 | -0.2028 | -0.0390 85.68         |
| **Residential area**           |            |       |                       |
| Rural (ref.)                   |            |       |                       |
| Urban/Town                     | 0.0020     | 0.0163| 0.0000 -0.07          |
| **Socioeconomic status**       |            |       |                       |
| **Education level**            |            |       |                       |
| Middle school or more (ref.)   |            |       |                       |
| Primary school                 | -0.1744    | -0.0691| 0.0120 -26.48         |
| Illiterate                     | -0.0872    | -0.0691| 0.0060 -13.25         |
| **Occupation**                 |            |       |                       |
| white-collar (ref.)            |            |       |                       |
| non-white-collar               | 0.2416     | -0.0400| -0.0097 21.24         |
| **Economic status (quintile)** |            |       |                       |
| 5 (richest) (ref.)             |            |       |                       |
| 4                              | 0.0521     | 0.0078| 0.0004 -0.89          |
| 3                              | 0.0613     | 0.0017| 0.0001 -0.23          |
| 2                              | 0.0719     | -0.0002| 0.0000 0.03          |
| 1 (poorest)                    | 0.0987     | -0.0003| 0.0000 0.07          |
| **Social support**             |            |       |                       |
| **Emotional support**          |            |       |                       |
| Spouse (ref.)                  |            |       |                       |
| Children                       | 0.2219     | -0.1735| -0.0385 84.60         |
| Variable                                      | Elasticity | C       | Contribution to the C |
|----------------------------------------------|------------|---------|-----------------------|
| Relatives/friends/neighbors and others       | -0.0110    | 0.0093  | -0.0001               | 0.23      |
| Nobody                                       | 0.0275     | -0.0005 | 0.0000               | 0.03      |
| **Financial support**                        |            |         |                       | -4.19     |
| Yes (ref.)                                   |            |         |                       |           |
| No                                           | 0.0859     | 0.0222  | 0.0019               | -4.19     |
| **Living arrangement**                       |            |         |                       | 0.88      |
| With household member(s) (ref.)              |            |         |                       |           |
| In an institution                            | 0.0097     | -0.0539 | -0.0005             | 1.15      |
| Alone                                        | -0.1110    | -0.0011 | 0.0001             | -0.27     |
| **Social participation**                     |            |         |                       | 0.18      |
| Organized activities                         |            |         |                       |           |
| Yes (ref.)                                   |            |         |                       |           |
| No                                           | -0.0486    | 0.0017  | -0.0001             | 0.18      |
| **Informal activities**                      |            |         |                       | 0.30      |
| Yes (ref.)                                   |            |         |                       |           |
| No                                           | 0.0462     | -0.0030 | -0.0001             | 0.30      |

**Figures**

![Concentration curve and Equality line](image)

Figure 1
Concentration curve of cognitive impairment

**Supplementary Files**

This is a list of supplementary files associated with this preprint. Click to download.

- STROBExchecklistcrosssectional.doc