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The influencing factors of cognitive impairment in elderly individuals in Chengdu city: a cross-sectional study based on AD8

Xi Ruan[1], Hongyi Li[1], Ziqi Wang[1], Yu Wang[1], Yamei Nie[2], Yan Li[1], Yuanjing Li[1], Qin Fan[1], Baiwei Ni[1], Yinxue Huang[1], Xuan Hong[1], Ting Sun[1], Yuan Luo[1] and Shoukang Zou[1*]

Abstract

Background With the aging of society, cognitive impairment in elderly people is becoming increasingly common and has caused major public health problems. The screening of cognitive impairment in elderly people and its related influencing factors can aid in the development of relevant intervention and improvement strategies.

Methods In this study, stratified random cluster sampling was used to conduct a cross-sectional survey of elderly individuals aged 65 years in Chengdu, Sichuan Province, through an electronic questionnaire from November 2022 to November 2023. Descriptive analysis and logistic regression analysis were used to investigate cognitive impairment and its relevant influencing factors.

Results Among the 16,609 elderly people, 7524 (45.3%) were males and 9085 (54.7%) were females, with an average age of 73.6 ± 6.5 years (age range 65–101 years). The average years of education was 5.9 ± 6.2 years, and the proportion of individuals with cognitive impairment was 13.1%. With increasing age, the risk of cognitive impairment increased significantly. The risk factors for cognitive impairment in elderly individuals included advanced age, hypertension, heart disease, diabetes, cerebrovascular disease, depressive symptoms, and anxiety symptoms, while the protective factors included higher education level, married status, and greater life satisfaction.

Conclusion Cognitive impairment in elderly individuals in Chengdu is serious. We can intervene in and improve cognitive impairment in elderly people by controlling blood pressure and blood sugar, treating depressive and anxiety symptoms and developing community colleges for elderly people and increasing satisfaction with life.

Keywords Elderly people, Cognitive impairment, Influencing factors, Chengdu city

*Correspondence:
Shoukang Zou
464934211@qq.com
[1]Unit 4—Department of Geriatric Medicine, the Fourth People's Hospital of Chengdu, Chengdu City, China
[2]Department of Public Health, the Fourth People's Hospital of Chengdu, Chengdu City, China

Introduction

Cognitive impairment is a common mental health problem in elderly individuals with a high prevalence and may lead to severe disability and death [1–3]. A survey conducted in 12 provinces in China revealed that the prevalence of dementia and mild cognitive impairment among elderly individuals over 60 years old is 6% and 15.5%, respectively [1]. A longitudinal study from the city of Porto in Portugal revealed that the prevalence of cognitive impairment was 15.5% among residents aged 65–85 [4]. Hale JM reported that the prevalence of cognitive impairment in women increased from 18.7 to 21.2%, the percentage of males increased from 17.6 to 21.0% (from 1996 to 2014) [5]. A 6-year follow-up cohort from Germany revealed that cognitive impairment without dementia was an independent risk factor for later death, especially in older men [6].

The risk factors for cognitive impairment in elderly individuals include mental and psychological factors, sociodemographic factors, and physical disease factors [7, 8]. Among the mental and psychological factors, anxiety and depression are considered to be important influencing factors. A cohort study from Europe followed for more than 8 years revealed that depressive symptoms in elderly people were significantly correlated with mild cognitive impairment later, and the more severe the depressive symptoms were, the greater the risk of mild cognitive impairment later, especially in elderly women over 70 years old [9]. A cross-sectional study from six low-income and middle-income countries, including China and Russia, revealed that anxiety symptoms were significantly associated with MCI in people over 50 years of age, with sleep problems explaining 41% of the correlation [10]. A study from Capuano AW in Brazil revealed that negative life events in elderly people were significantly correlated with the occurrence of dementia [11].

Scholars worldwide have performed much research on the sociological demographic and physical disease factors related to cognitive impairment in elderly people. With increasing age, the risk of cognitive impairment significantly increases, and a low education level, living alone, a widowed spouse, unhealthy lifestyle, lack of physical exercise, and the apolipoprotein Eε4 allele (APOEε4) are also considered risk factors for cognitive impairment [1, 12, 13]. Yaffe K pooled four prospective cohort studies and found that cardiovascular risk factors (body mass index, fasting blood glucose, systolic blood pressure, and blood lipids) at different periods of life were associated with cognitive decline later in life, and cardiovascular risk factors in early adulthood were most significantly associated with cognitive decline later in life [14]. A cohort study of older adults from Germany revealed that type 2 diabetes was associated with worse cognitive function, especially in the area of working memory [15]. A cohort study conducted by Imahori Y in Sweden revealed that ischemic heart disease was an independent risk factor for dementia and cognitive decline in older adults and that coexisting atrial fibrillation or heart failure did not further increase the risk of dementia and cognitive decline [16]. A 3-year follow-up longitudinal study from Japan revealed that stroke history and advanced age were risk factors for cognitive decline in elderly people, while a higher education level were protective factors [17]. An analysis from the China Longitudinal Study on Health and Retirement showed that the risk factors of cognitive impairment in elderly individuals over 60 years old included being unmarried, having depressive symptoms, drinking, etc [18].

This study further analyzed the prevalence of cognitive impairment and its influencing factors in elderly individuals over 65 years of age in Chengdu through survey data from the National Elderly Psychological Care Action Project and analyzed additional influencing factors, including mental, psychological and physical diseases, through a larger sample size to provide more information and support for the prevention and intervention of cognitive impairment in elderly individuals.

Methods

Research design

This research was based on the National "14th Five-Year" Plan for Healthy Aging-National Elderly Psychological Care Action Project (2022–2025), the Project had researched in 31 provinces in the mainland China, which was leaded by Department of Ageing Health, National Health Commission, executed by Chronic Disease Center, Chinese Center for Disease Control and Prevention (China CDC). The study investigated the mental health status and needs of the elderly over 65 years old in 31 provinces across the country, aimed to improve the level of mental health services of grass-roots staff and enhance the mental health awareness of the elderly, and improve their mental health status. We only analyzed the prevalence and influencing factors of cognitive impairment in the elderly in Chengdu city in this article.

Characteristics of the reference population

By the end of 2022, Chengdu has a registered population of 15,715,700. Among them, the elderly population (60 years old and above) is 3,242,400, accounting for 20.63% of the total registered population. The registered elderly population aged 70 and above is 1,734,800, accounting for 53.50% of the registered elderly population. In addition, the proportion of the elderly in Chengdu is higher than the average level of the whole Sichuan province, and even higher than the whole country (20.63%VS 20.04%VS19.80%) [19]. The degree of aging in Chengdu is very serious, the dementia-related problems brought by

aging will bring huge economic and public health burden to society, so we pay attention to the cognitive function impairment of this group and related influencing factors specially, in order to provide a basis for early prevention and intervention.

Data collection

The survey used a unified electronic questionnaire, which was developed by the National Action Office, with unified filling instructions, and unified training, practice and assessment for the investigators. Only whom had passed the assessment could participate in the field investigation, and the questions on the questionnaire were asked and filled in face-to-face by the investigators. The subjects received two forms of electronic questionnaire survey, the first one was a centralized survey for the elderly who had the ability to move, and the elderly who did not have the ability to move conducted a household survey by the staff. The results of the survey are entered into a specialized data platform by the staff for later analysis and processing.

This study adopts a stratified random cluster sampling method to stratify 20 districts, cities and counties under the jurisdiction of Chengdu from November 2022 to November 2023. Then, a subdistrict office or township (town) in each district, city and county was randomly selected, a corresponding number of communities or villages was selected for investigation, and electronic questionnaires were issued to elderly people who were more than 65 years old at each point position. All senior citizens aged 65 years in the region participated in the survey. If the survey is not completed, the staff member should record the specific reasons, such as inability to speak, inability to understand the questions, or refusal to conduct the survey.

Sample size calculation: The prevalence of cognitive impairment in elderly individuals was 20% to calculate the sample size [1, 18], tolerance error = 0.02, type I error = 0.05, and substitution of the sampling survey formula of PASS software (version 11.0, PASS11. NCSS LLC, Kaysville, UT, USA) to calculate the sample size ($n = 1585$). An estimated 20% may be missing or uncooperative. The sample size was determined to be 1982. The actual sample 16,609 is larger than the theoretical sample, so the whole sample has a certain representativeness.

Survey tools

The unified electronic questionnaire was developed by the National Action Office, including psychological scale and demographic information. The self-rated Ascertain Dementia 8-item Questionnaire (AD8) has 8 items . To determine whether the content of each item has changed, a score of one point is given for each item with changes, and a score of 0 points indicates no changes or that the participants do not know whether there are changes. A reliability and validity study conducted by Huali Wang in China showed that the threshold score for cognitive impairment was ≥ 2, with a sensitivity of 93.9% and a specificity of 76.0% [20, 21]. The Patient Health Questionnaire-9 (PHQ-9) consists of 9 items and is a self-rating scale. The participants were required to complete a 4-point scale (0–3 points) according to the frequency of symptoms and to focus on evaluating depressive emotions or moods within two weeks. The higher the score was, the greater the degree of depression, and the threshold value of depressive symptoms was ≥ 5. A study by Chao Wang revealed that the PHQ-9 and GDS-15 are both effective tools for depression assessment in middle-aged and elderly people, but the PHQ-9 is shorter and has better internal consistency [22, 23]. The generalized anxiety disorder 7-item scale (GAD-7), which consists of 7 items, is a self-rating scale, assessed according to the number of days in which target symptoms appear in the last 2 weeks, with a total of 4 levels (0–3 points). We divided the threshold value of anxiety symptoms into ≥ 5 [24, 25]. Self-designed questionnaires were used to assess the participants' age, sex(male/female), years of education, marital status (unmarried, married, divorced, married but separated, widowed), satisfaction with life (not satisfied, middle, satisfied), self-reported medical history (have you ever been diagnosed with any of the following diseases by the hospital (hypertension, heart disease, diabetes, cerebrovascular disease, etc.)). (Detail in Appendix)

Informed consent and ethical materials for research

Informed consent

Respondents were informed of the significance, confidentiality and safety of the study through electronic informed consent and signed electronic informed consent forms. After adhering to the principles of equality, voluntariness and cooperation, only those who agreed and signed informed consent were investigated. This study was approved by the Ethical Review Committee of Chronic Disease Center, China CDC and was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Statistical analysis

All the data were analyzed using the SPSS 23.0 software package (IBM, Armonk, NY, USA). In addition, descriptive analysis was used to analyze sex, age, marital status, satisfaction with one's current life, hypertension, heart disease, diabetes and other basic diseases in the survey samples. The chi-square test (or t test) was used to preliminarily screen for variables related to cognitive impairment in elderly people. Then, the potential influencing factors of cognitive impairment in elderly people were

Table 1 Demographic data (number of persons, %/X ± S)

Item	Distribution
Gender	
Male	7524(45.3%)
Female	9085(54.7%)
Age	73.6 ± 6.5 years old
Years of education	5.9 ± 6.2 years
Marital status	
Unmarried	148(0.9%)
Married	12,881(77.5%)
Divorced	119(0.7%)
Married but separated	108(0.7%)
Widowed	3353(20.2%)
Hypertension	6050(36.4%)
Heart disease	917(5.5%)
Diabetes	2348(14.1%)
Cerebrovascular disease	332(2.0%)
Whether satisfied with current life	
Not satisfied	317(1.9%)
Middle	2540(15.3%)
Satisfied	13,752(82.8%)

Table 2 Mental health status of the elderly subjects (X ± S)

Scale	Score
PHQ-9	0.81 ± 1.81
GAD-7	0.31 ± 1.20
AD8	0.57 ± 1.31

Abbreviations: PHQ-9, the Patient Health Questionnaire-9; GAD-7, the generalized anxiety disorder 7-item scale; AD8, the self-rated Ascertain Dementia 8-item Questionnaire

further analyzed via binary logistic regression. Quantitative data were expressed as the mean ± standard deviation (x ± s), and qualitative data were expressed as percentages. Two-sided tests were performed, and the significance level was set at 0.05.

Results

Demographic data

In this research, 20,105 questionnaires were distributed, and 16,609 valid questionnaires were collected, data from 3,496 older adults were excluded because they could not cooperate with the survey, refused to participate in the survey, had incomplete data, or had clearly incorrect data, for an effective recovery rate of 82.6%. There were 7524 males (45.3%) and 9085 females (54.7%), with an average age of 73.6 ± 6.5 years (age range 65–101 years). The average duration of education was 5.9 ± 6.2 years. The distribution of marital status, the number and proportion of people suffering from hypertension, heart disease, diabetes and cerebrovascular disease, and the number and proportion of people satisfied with their current life are shown in Table 1.

Table 3 Status of cognitive impairment among different age groups

Age group	Number of persons	Numbers of Cognitive impairment	Proportion(95%CI)
65–74	10,211	951	9.3% (8.8-9.9%)
75–84	5230	895	17.1% (16.1-18.2%)
85 and older	1168	335	28.7% (26.1-31.4%)

Mental health status of the elderly

The average score of the surveyed elderly individuals was 0.81 ± 1.81 points on the PHQ-9, the proportion of depressive symptoms was 4.0%, the average score on the GAD-7 was 0.31 ± 1.20 points, the proportion of anxiety symptoms was 1.9%, the average score on the AD8 was 0.57 ± 1.31 points, and the proportion of individuals with cognitive impairment was 13.1%. (See Table 2)

We divided the surveyed elderly individuals into groups of 65–74 years old/75–85 years old/over 85 years old by age, and there was a significant difference in the proportion of individuals with cognitive impairment among the three groups (9.3% vs. 17.1% vs. 28.7%). (See Table 3 for details.)

Related influencing factors of cognitive impairment in elderly people

First, through the chi-square test (or t test), we initially screened the correlations between sex, age, years of education, marital status, whether people suffer from somatic diseases such as hypertension and heart disease, whether they are satisfied with their current life, the PHQ-9 score, the GAD-7 score and whether there is cognitive impairment ($p < 0.05$ indicates that there is a correlation). We found that the above independent variables were correlated with cognitive impairment, so they were all included in the final binary logistic regression analysis (whether there was cognitive impairment as the dependent variable), and the logistic model obtained was statistically significant, x2 = 2019.142, $p < 0.001$. The model can correctly classify 87.7% of the subjects. The sensitivity and specificity of the model were 15.1% and 98.7%, respectively. In this study, older age was found to be a risk factor for cognitive impairment in elderly individuals, and the risk of cognitive impairment increased by 5.6% for each additional year of age (OR = 1.056, $p < 0.001$, 95% CI 1.048–1.064). Having more years of education was a protective factor against cognitive impairment in elderly people, and the risk of cognitive impairment decreased by 8.5% for each additional year of education (OR = 0.915, $p < 0.001$, 95% CI 0.903–0.928). Married and separated marital status was a protective factor against cognitive impairment in elderly individuals compared with unmarried individuals (OR = 0.555, $p = 0.010$, 95% CI 0.355–0.869; OR = 0.440, $p = 0.044$, 95% CI 0.198–0.977).

Table 4 Binary logistic regression analysis of factors related to cognitive impairment in elderly people

variable	B	SE	Wald	Exp (B) (95% CI)	*P*
Age	0.054	0.004	202.287	1.056(1.048–1.064)	< 0.001
Gender	0.071	0.053	1.790	1.074(0.968–1.191)	0.181
Years of education	-0.088	0.007	159.841	0.915(0.903–0.928)	< 0.001
Marital status					
Married/unmarried	-0.589	0.229	6.623	0.555(0.355–0.869)	0.010
Divorced/unmarried	-0.607	0.409	2.207	0.545(0.245–1.214)	0.137
separated/unmarried	-0.822	0.407	4.070	0.440(0.198–0.977)	0.044
Widowed/unmarried	-0.304	0.233	1.695	0.738(0.467–1.166)	0.193
Hypertension	0.186	0.053	12.387	1.205(1.086–1.336)	< 0.001
Heart disease	0.257	0.098	6.887	1.293(1.067–1.567)	0.009
Diabetes	0.232	0.068	11.524	1.261(1.103–1.442)	0.001
Cerebrovascular disease	0.793	0.139	32.748	2.209(1.684–2.898)	< 0.001
Whether satisfied with current life					
Middle/not satisfied	-0.374	0.163	5.277	0.688(0.500-0.947)	0.022
Satisfied/not satisfied	-0.582	0.155	14.091	0.559(0.412–0.757)	< 0.001
PHQ-9 score	0.298	0.015	388.814	1.346(1.307–1.387)	< 0.001
GAD-7 score	0.162	0.023	50.628	1.176(1.124–1.229)	< 0.001
Constant	-5.076	0.393	167.223	0.006	< 0.001

Abbreviations: CI, confidence interval; PHQ-9, the Patient Health Questionnaire-9; GAD-7, the generalized anxiety disorder 7-item scale

Compared with not being satisfied with one's current life, being middle-handed or satisfied with one's current life was a protective factor against cognitive impairment in elderly people (OR = 0.688, $p = 0.022$, 95% CI = 0.500-0.947; OR = 0.559, $p < 0.001$, 95% CI = 0.412–0.757). Among the somatic diseases, hypertension, heart disease, diabetes and cerebrovascular disease were all risk factors for cognitive impairment in elderly individuals (OR = 1.205, $p < 0.001$, 95% CI 1.086–1.336; OR = 1.293, $p = 0.009$, 95% CI 1.067–1.567; OR = 1.261, $p = 0.001$, 95% CI 1.103–1.442; OR = 2.209, $p < 0.001$, 95% CI 1.684–2.898). Among mental and psychological factors, depressive symptoms were risk factors for cognitive impairment in elderly people, and the risk of cognitive impairment increased by 34.6% for every 1-point increase in the total depression score (OR = 1.346, $p < 0.001$, 95% CI 1.307–1.387). Anxiety symptoms were a risk factor for cognitive impairment in elderly people, and the risk of cognitive impairment increased by 17.6% for every 1-point increase in the total anxiety score (OR = 1.176, $p < 0.001$, 95% CI 1.124–1.229). (See Table 4 for details.)

Discussion

This study revealed that the prevalence of cognitive impairment in elderly individuals over 65 years old in Chengdu was 13.1%. The risk factors for cognitive impairment included older age, hypertension, heart disease, diabetes, cerebrovascular disease, depressive symptoms and anxiety symptoms, while the protective factors included higher education level, being married, and being satisfied with their current life. The prevalence of cognitive impairment in elderly people was greater than that in Taiwan [26] and lower than that reported by Wei Bai and Huashuang Chen [27, 28]. Most previous studies suggested that elderly women were more prone to cognitive impairment [4, 29], but no such difference was found in this study. In cerebrovascular disease factor, the risk factor with the largest OR value in our binary logistic regression, the proportion of males was higher than that of females (2.1% vs. 1.9%), and the average age of males was mild older than females (73.74 ± 6.49 VS 73.54 ± 6.46 years old), which might have influenced the effect of gender on cognitive impairment.

Consistent with previous studies, the risk of cognitive impairment increases significantly with age [1]. Previous studies have shown that a lower education level is not only a risk factor for cognitive impairment but also a risk factor for death in Alzheimer's patients [30, 31]. Similar to the results of this study, a cohort study of elderly people in the United States revealed that divorce and widowhood were risk factors for cognitive impairment and dementia [32], and another study from South Korea also revealed that unmarried and divorced elderly people were more prone to cognitive impairment than married elderly people [33]. Consistent with the results of a large longitudinal study from Korea, better life satisfaction is a protective factor against cognitive impairment in older adults [34].

In terms of mental and psychological factors, consistent with most previous studies, we found that depressive symptoms and anxiety symptoms were both risk factors for cognitive impairment in elderly people [9, 35, 36]. However, a study conducted by Lee ATC in Hong Kong revealed that only subjects with depressive symptoms in

both adulthood and old age had a greater risk of dementia, while those with depressive symptoms only in adulthood or old age had no significant correlation with the risk of dementia [37]. Through a 10-year follow-up study, Mirza SS and his colleagues found that different trajectories of depressive symptoms had different correlations with the risk of dementia in elderly people, and only part of the trajectory of depressive symptoms was later associated with an increased risk of dementia [38]. Therefore, well-designed cohort studies are needed in the future to further confirm the correlation between mental and psychological factors such as depressive symptoms and cognitive impairment in elderly people.

In terms of somatic diseases, hypertension, heart disease, diabetes, and cerebrovascular disease were all risk factors for cognitive impairment in elderly individuals. Although many articles have shown a significant correlation between hypertension and cognitive impairment in elderly people [39, 40], a meta-analysis conducted by Hughes D showed that the risk of cognitive impairment and dementia in elderly people could be reduced by controlling blood pressure [41], but there were also different results. A cross-sectional survey conducted by Lazo-Porras M in Peru did not find a significant association between hypertension and cognitive impairment in elderly people [42]. Souza-Lima J's investigation in Chile revealed that a greater risk of cardiovascular disease was associated with a greater risk of cognitive impairment in older adults [43], and a 12-year follow-up cohort study from Sweden revealed that diabetes characterized by poor glycemic control or cardiovascular complications was associated with a greater risk of cognitive impairment in older adults [44]. Consistent with previous research results, we also found that cerebrovascular dysfunction is a risk factor for cognitive impairment in elderly individuals [17, 45].

This study also has certain limitations. First, this was a cross-sectional study, and causality cannot be inferred. Second, the participants in this study were elderly individuals over 65 years old in Chengdu, Sichuan Province, and most of them were Han; therefore, the conclusions cannot be extended to other regions and populations. Third, the cognitive impairment in this study is based on the results of the self-rated AD8 scale of the respondents, which is mainly used for preliminary screening of cognitive impairment, therefore the reliability of the results is limited and can lead to decreased sensitivity meanwhile, and the results are also affected by the cultural level and cognitive function of the respondents. In subsequent studies, more reliable screening tools or clinical diagnosis depended on psychiatrists are needed to retest our results. Fourth, the questionnaire recovery rate in this study was slightly low (82.6%), which may have affected the accuracy of the results.

Despite many limitations, this study also investigated the prevalence of cognitive impairment and related influencing factors in over-65-year-old elderly individuals in Chengdu, Sichuan Province, through a cross-sectional study with a large sample and scientific sampling method and revealed that the risk factors for cognitive impairment in elderly people include older age, hypertension, heart disease, diabetes, cerebrovascular disease, and depressive and anxiety symptoms. Protective factors included higher levels of education, being married, and being satisfied with one's current life. In the future, we can intervene and improve cognitive impairment in elderly people by controlling blood pressure and blood sugar, intervening in cardiovascular and cerebrovascular diseases, and carrying out community colleges for elderly people and increasing their satisfaction with life.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-024-05661-3.

Supplementary Material 1

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Author contributions
Shoukang Zou conceived and designed the experiments. Yan Li, Yuanjing Li, Qin Fan, Baiwei Ni, Yinxue Huang, Xuan Hong, Ting Sun, Yuan Luo collected the data. Xi Ruan, Yu Wang, Yamei Nie analyzed the data and wrote the manuscript. Xi Ruan and Soukang Zou revised the first manuscript. Hongyi Li and Ziqi Wang gave guidance and help to the peer-reviewed revision. All authors have read and approved the manuscript.

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Data availability
The datasets generated and/or analysed during the current study are not publicly available due patient's privacy protection but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethical Review Committee of Chronic Disease Center, China CDC, which was affiliated with the Chronic Disease Center of China CDC and was conducted in accordance with the principles outlined in the Declaration of Helsinki. All participants provided informed consent statement for this study.

Consent for publication
The results/data/figures in this manuscript have not been published elsewhere, nor are they under consideration (from you or one of your Contributing Authors) by another publisher. All authors agreed to publish this article in BMC Geriatrics.

Competing interests
The authors declare no competing interests.

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