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Disparities in anxiety and related factors among Chinese older adults across different aged-care models: a comparison of two cross-sectional studies

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Abstract

Background Anxiety disorders in older adults have become a prominent public health problem due to their concomitant chronic conditions, reduced quality of life and even death. However, fewer studies have been conducted on differences in anxiety among older individuals in different aged-care models, and the interactive relationship between the influencing factors on anxiety remains unclear. The study aimed to examine the disparities in the prevalence of anxiety between community-dwelling and institutionalized older adults and related influencing factors.

Methods Data were collected from the Anhui Healthy Longevity Survey (AHLS) and the Anhui Elderly Caring Social Organizations Survey (AECSOS). Data on demographic variables, lifestyle factors and health-related variables in 6968 older adults were used for analysis. Anxiety symptoms were evaluated using the Generalized Anxiety Disorder Assessment Scale (GAD-7). Binary logistic regression models and a Classification and Regression Tree model (CART) were utilized to examine the relationship between variables.

Results The prevalence of anxiety were 24.3% and 16.7% among community-dwelling older adults and institutionalized older adults, respectively. Several factors including age, gender, residence, education, income level, live alone, and number of chronic diseases showed a linkage with anxiety among community-dwelling older adults. For the institutionalized older adults, gender, residence, source of income, and number of chronic diseases exhibited a significant association with anxiety. We noted the interactive effect, suggesting that community-dwelling female older adults with an income level of less than 6500 RMB per year and reported chronic disease comorbidities had the highest likelihood of anxiety, and institutionalized female older adults with income sources such as pension, subsidy, family providing, and resident in rural areas have the greatest risk of experiencing anxiety.

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Conclusions This study has brought to light the higher risk of anxiety among community-dwelling older adults compared to institutionalized older adults. Targeted interventions are, therefore emphasized to address the negative impact of anxiety for populations at higher risk.

Keywords Anxiety, Older adults, Aged-care models, Influencing factors, China

Introduction

Old age is a significant life stage during which individuals encounter numerous transitions as they navigate their new role in society. On the one hand, as older people transition into retirement, they may disengage from their former work and social settings. The establishment of a new rhythm of life and the change and reduction of existing social relationships can easily lead to different degrees of disconnection between older adults and society [1, 2]. On the other hand, advancing age is often accompanied by declining physical health and an elevated susceptibility to chronic illnesses, which will not be able to escape the fact that the overall quality of life for older adults is declining [3].

These alterations result in a heightened or persistent state of stress in older people, which predisposes them to a number of psychological disorders that cannot be ignored (e.g., depression, anxiety, etc.). Of particular concern is anxiety, characterized by fidgeting, panic attacks, chest tightness, and breathlessness, which significantly impacts the well-being of older individuals [4]. The World Health Organization (WHO) reported in 2019 that the number of people suffering from anxiety symptoms had reached 301 million, highlighting anxiety as a significant mental health concern with implications for global health [5]. In China, prior regional surveys have indicated that the prevalence of anxiety among older adults varies between 11.7% and 22.3% [6–8]. Over the past decade, a growing body of evidence has underscored the necessity for screening and diagnosing anxiety disorders in this demographic. Numerous large-scale studies have highlighted that anxiety, whether as a disorder or a symptom, constitutes a significant risk factor for a broad spectrum of age-related diseases, including cardiovascular, autoimmune, and neurodegenerative conditions. A recent meta-analysis incorporating prospective cohorts ($N = 29{,}608$) concluded that anxiety is significantly correlated with an elevated risk of all-cause dementia [9]. Among older adults, those with severe anxiety disorders exhibited accelerated brain aging, with each additional point on an 80-point worry severity scale corresponding to a reduction in brain age by three months. Moreover, a randomized controlled trial conducted at four European sites (Cologne, London, Barcelona, Lyon) indicated that elevated levels of anxiety may be associated with subjective cognitive decline in older adults, potentially increasing the risk of dementia and diminishing overall healthy life expectancy [10]. Consequently, the investigation of anxiety disorders in older populations has emerged as a crucial direction in the field of mental health.

According to estimation by the WHO, the global population aged 60 years and older is anticipated to reach 2 billion by the year 2050, with 80% of this demographic residing in developing nations [11]. By 2035, China is expected to have an aging population of 418 million, representing 39% of the world's elderly population [12]. The simultaneous growth of the population presents persistent challenges in the realms of elderly care, healthcare, and overall well-being, particularly within the context of China. In recent years, elderly caring social organizations, commonly known as nursing homes or care homes, have emerged as significant entities in the delivery of services for older adults, distinguished by variations in scale and service offerings [6, 13, 14]. At the same time, institutionalized older adults, herein referred to as recipients of services from elderly caring social organizations, have garnered attention as subjects of study and have been a focal point for numerous public health and mental health research [15–17]. Research findings indicate that 2.14 million older individuals in China opt for elderly caring social organizations as their preferred method of aging [15]. In contrast to their counterparts residing in the community, institutionalized older adults display risk factors such as older age and functional limitations [16]. Nevertheless, the provision of daily care and prompt medical attention affords institutionalized older adults the benefit of a living environment that may mitigate the likelihood of developing significant psychological conditions, such as anxiety [18]. Moreover, a significant portion of older adults reside in their communities (community-dwelling older adults), surrounded by familiar environments and receiving care from family members. It follows that the differences in the aged-care models deserve to be an important entry point for exploring the psychological well-being of older people.

Prior research has examined the mental health outcomes of older individuals across different aged-care models, producing varying findings. For instance, a study conducted in Spain revealed that anxiety was prevalent in 41.08% of participants, with the percentage increasing to 69.59% among community-dwelling older women exhibiting frailty [19]. A network analysis found that among community-dwelling older adults, the prevalence of anxiety was 13% with a GAD-7 score of 2.10 ± 3.07, and "nervousness" identified as the central symptom in respondents' anxiety symptoms due to its

highest intensity [20]. Interestingly, the findings of a systematic review and meta-analysis showed that there was a substantial disparity in anxiety prevalence rates among community-dwelling older persons in low- and middle-income countries, ranging from 0.6% in China to 16.0% in India [21]. Previous studies on anxiety symptoms in institutionalized older adults have likewise yielded some notable results. In a research study carried out in 25 Chinese nursing homes, it was found that 11.8% of older adults reported symptoms of anxiety, and the presence of anxiety was identified as a significant mediator in the association between loneliness and cognitive functioning [22]. Emine and colleagues employed the Death Anxiety Scale to assess the psychological well-being of elderly Turkish individuals residing in nursing homes, and revealed a moderate level of death anxiety among the participants, as indicated by a mean score of 6.10 ± 3.50 [23]. Similar findings were also reported in a cross-sectional study conducted in the United States, where it was found that 37.2% of the 239,615 elderly residents in Medicare/Medicaid certified nursing homes diagnosed with Chronic Obstructive Pulmonary Disease (COPD) reported experiencing symptoms of anxiety [24].

Focusing on factors influencing anxiety symptoms among community-dwelling older adults and institutionalized older adults, research suggests that there are several common individual-level factors, including age, gender, educational attainment, functional capacity, and self-perceived health status, that may impact the mental well-being of older adults [25–28]. Peng et al. discovered a significant correlation between sleep duration, risk of dementia, and severity of anxiety symptoms, and a high level of comorbidity between anxiety and depressive symptoms in older adults residing in communities [29]. Similar findings were also observed in a study conducted in Australia [30]. In addition, a prior study identified a statistically significant association between death anxiety in institutionalized older adults and their gender, marital status, and chronic disease status, but there existed a notable positive correlation between anxiety and loneliness [23].

Based on these surveys from different countries, it can be inferred that there are common and distinct factors influence the mental health of older people across different aged-care models. Discrepancies in prior results can be attributed to different measurement tools for anxiety symptoms as well as different survey areas. To the best of our knowledge, there is a paucity of research examining anxiety among older adults across different aged-care models within the same region. The presence of a synergistic or antagonistic effect between influencing factors on anxiety remains unclear. Therefore, it is imperative to undertake a comparative analysis of the risk of anxiety disorders among older individuals within different aged-care models. Furthermore, utilizing anxiety in older people as a focal point for examining the effects of diverse aging models on the mental well-being of older individuals will aid in the formulation of targeted interventions for safeguarding older adults from anxiety symptoms.

Given the mentioned reviews, the present study is aimed at assessing the prevalence of anxiety symptoms and analyzing the associated factors, with emphasis on whether there is an interactive relationship between the influencing factors (e.g., demographic factors, lifestyle behaviors, chronic disease status) among community-dwelling older adults and institutionalized older adults in Anhui Province, China.

Materials and methods

Study design and data collection

The present study was based on data collected from the Anhui Healthy Longevity Survey (AHLS) and the Anhui Elderly Caring Social Organizations Survey (AECSOS). These two large scale provincial surveys were conducted from July to August and November to December 2019, the details of which has been reported somewhere else [6, 13, 14, 31]. Briefly, a multistage sampling strategy was employed to recruit subjects to have a representative sample. In the first stage, purposive sampling was used to select eight cities located in the northern (Suzhou, Fuyang), central (Lu'an, Huainan and Chuzhou) and southern (Anqing, Chizhou and Xuancheng) areas in the administrative region of Anhui Province, based on population distribution and geographic location. In the second stage, for the AHLS, 3–5 urban communities (streets) and 3–5 rural communities (villages) were randomly chosen in each selected city, resulting in a total of 101 communities for the survey. For the AECSOS, a total of 219 elderly caring social organizations were selected for the survey, with 30–45 elderly caring social organizations sampled from each city. In the third stage, the AHLS recruited participants aged ≥ 60 years from the enrolled urban and rural communities accounting for equal shares. Besides, the AECSOS collected household level and individual level information among adults aged ≥ 60 years staying in the selected elderly caring social organizations. Graduate students with professional training from Anhui Medical University conducted face-to-face interviews with each participant using a structured questionnaire. The interviewers employed patient and specialized questioning techniques, while the interviewees engaged in self-reporting, which collectively minimized bias associated with factors such as some participants' lower educational levels. In total, the current study included 7445 older adults recruited from eight selected cities.

Among the initial 7445 participants, 477 participants were excluded due to lack of basic characteristic information ($n = 460$), and lost anxiety data ($n = 17$). Figure 1

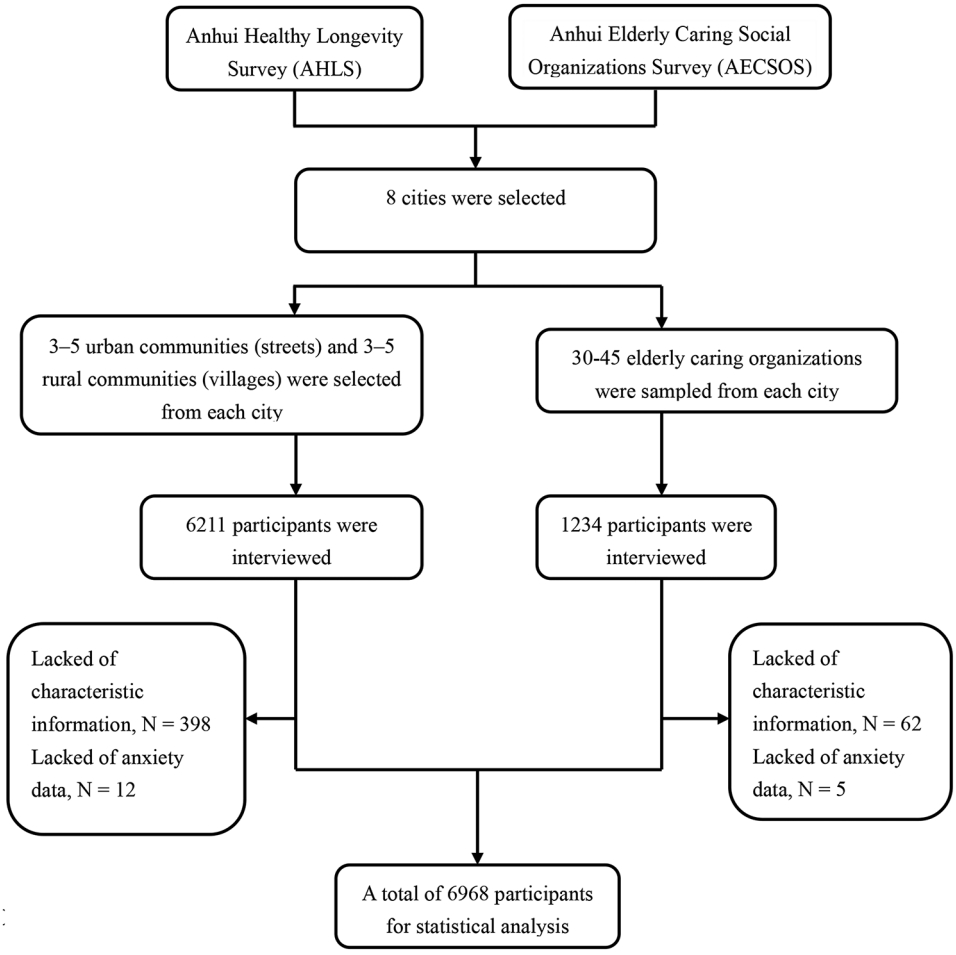

Fig. 1 The sampling and screening process of this study

shows the sampling and screening process. Finally, 6968 participants were included in the study.

Ethical procedure

The study adhered to the Declaration of Helsinki code. Throughout the procedure, all ethical standards of the Biomedical Ethics Committee of Anhui Medical University (No.2020H011, No.20180181) were followed. Data collection was conducted with written informed consent of the participants.

Measurement of anxiety disorders

Both cross-sectional surveys utilized the 7-Item Generalized Anxiety Disorder Scale (GAD-7) to measure the anxiety symptoms of the respondents [32]. The GAD-7 consists of 7 questions that assess the individual's self-reported experiences and feelings over the past 2 weeks. These include feeling nervous, anxious or on edge, not being able to stop or control worrying, worrying about too many things, trouble relaxing, being so restless that it is hard to sit still, becoming easily annoyed or irritable and feeling afraid as if something awful might happen. Additionally, options consisting of four levels of time become the response for each question: never (0 point), several days (1 point), more than half of the days (2 point), almost every day (3 point). The scale's total score ranged from 0 to 21, with scores falling between 0 and 4 being classified as indicative of no anxiety (the "absent" group), while scores ≥ 5 were indicative of an anxiety disorder (the "present" group). The ranges of 5–9, 10–14, and 15 and above denoted mild, moderate, and severe anxiety symptoms, respectively. The scale demonstrated strong internal and test-retest reliability, as evidenced by Cronbach's alpha coefficients of 0.86 and 0.87, respectively.

Measurement of other variables

The demographic variables collected in this study included age (60–69, 70–79, and ≥ 80 years), gender (male, female), residence (urban, rural), education (primary school and below, junior school, high school and above), marital status (married and widowed, others). Regarding the participants' sources of income, this study categorized them as pension, subsidy, family providing, and others (e.g., labor income, property income, etc.).

At the same time, the annual income of the participants was collected according to the national income level in the year (2019) of the survey (<6500 RMB, 6500–15000 RMB, 15000–24000 RMB, >24000 RMB). In relation to the participants' lifestyles, we acquired data on medical insurance enrollment, encompassing both basic and commercial medical insurance options. Cohabitation status indicated whether or not the participants were living alone. In addition, the health status of older adults was assessed by the number of diagnosed chronic diseases, specifically, we collected data on eight chronic diseases: type 1 or type 2 diabetes, hypertension, hyperlipidemia, chronic hepatitis, heart diseases, cancer, chronic lung disease, and mental disease.

Statistical analysis

First, the chi-square test was employed to assess disparities in demographic, lifestyle, and health-related factors across different aged-care models when the variables were categorical. The normality of the distribution of continuous variables was verified through the Kolmogorov-Smirnov test. Subsequently, the independent t-test was employed to assess disparities between two groups for variables that exhibited normal distribution, whereas the Mann-Whitney test was utilized for variables that did not display normal distribution.

Second, the study utilized binary logistic regression to examine the factors influencing anxiety symptoms in two subject populations, with anxiety symptoms as the dependent variable coded as 0 for the "absent" group and 1 for the "present" group. Univariate and multivariate logistic regression analyses were conducted to investigate the relationship between anxiety symptoms and various independent variables. Demographic, lifestyle, and health-related variables were included as covariates in the univariate logistic regression model. The independent variables deemed statistically significant in the univariate logistic regression analysis were included in the multivariate regression model. Crude and adjusted odds ratios (OR), along with their corresponding 95% confidence intervals (CI), were computed to evaluate the impact of these variables on anxiety symptoms among older adults.

Third, in order to explore the homogenous subgroups and the interactive relationship among relevant factors linked to anxiety symptoms, a classification and regression tree model (CART) was employed. This nonparametric model has demonstrated efficacy in numerous mental health investigations for confirming diverse interactions among variables [33]. Specifically, anxiety symptoms were segmented into subgroups based on the most informative independent variables. Subgroups with varying explanatory capabilities encompassing demographic, lifestyle, and health-related variables could subsequently be identified. All variables incorporated in this model exhibited significance in the univariate regression analysis. Furthermore, the CHAID method was employed as a growing method to ensure the dependability of the regression tree outcomes.

A significance level of 0.05 was employed to assess statistical significance in the study, with all statistical analyses conducted using SPSS statistical software (version 23.0; SPSS Inc., Chicago, IL, USA).

Results

Results of descriptive analysis

The current analysis included a total of 5801 community-dwelling older adults and 1167 institutionalized older adults, with most of the demographic, lifestyle, and health-related variables demonstrating statistically significant variations among the participants. In detail, almost half of the community-dwelling older adults and institutionalized older adults were concentrated in the age groups 60–69 and ≥80, respectively. 54.2% of community-dwelling older adults and 41.6% of institutionalized older adults were female. More than half of the participants were from rural areas (50.1% among community-dwelling older adults and 70.4% among institutionalized older adults). A greater number of institutionalized older adults were identified as widowed in comparison to their community-dwelling counterparts. The majority of the respondents had received primary school education and below (76.4% and 80.1%), had an income level of less than 6500 RMB per year (59.5% and 62.4%), enrolled in basic medical insurance (95.9% and 96.8%), not possessing commercial medical insurance (95.3% and 99.1%), and living with others (79.2% and 69.2%). Nearly a third of older people had pension (27.8% and 25.3%), Besides, the prevalence of reported having chronic disease comorbidities was higher in community-dwelling older adults (32.0%) than in institutionalized older adults (16.5%). The average GAD-7 scores were 2.78 ± 3.77 and 1.89 ± 3.16 among community-dwelling older adults and institutionalized older adults, respectively (Table 1).

Figure 2 illustrates the characteristics of anxiety symptoms among participants in the study. Participants were classified according to the presence or absence of anxiety symptoms, with those in the "present" group further categorized as having "mild," "moderate," or "severe" symptoms based on scores of 5–9, 10–14, or 15 and above, respectively. The findings indicated that 24.3% of community-dwelling older adults reported experiencing anxiety, while 16.7% of institutionalized older adults reported experiencing anxiety.

Results of logistic analysis

The results from the binary logistic regression examining the association between anxiety and relevant covariates among community-dwelling older adults and

Table 1 Basic characteristics of the enrolled participants, by aged-care models

Variables	Community-dwelling older adults (*n* = 5801)	Institutionalized older adults (*n* = 1167)	Statistics	*P*-Value
Age (years)			949.623	<0.001
60–69	2754 (47.5%)	137 (11.7%)		
70–79	2266 (39.0%)	451 (38.7%)		
≥ 80	781 (13.5%)	579 (49.6%)		
Gender			62.349	<0.001
Male	2656 (45.8%)	682 (58.4%)		
Female	3145 (54.2%)	485 (41.6%)		
Residence			161.606	<0.001
Urban	2895 (49.9%)	345 (29.6%)		
Rural	2906 (50.1%)	822 (70.4%)		
Education			8.954	0.011
Primary school and below	4433 (76.4%)	935 (80.1%)		
Junior school	850 (14.7%)	134 (11.5%)		
High school and above	518 (8.9%)	98 (8.4%)		
Marital status			1648.101	<0.001
Married	4222 (72.8%)	213 (18.2%)		
Widowed	1404 (24.2%)	604 (51.8%)		
Other	175 (3.0%)	350 (30.0%)		
Source of income			481.545	<0.001
Pension	1611 (27.8%)	295 (25.3%)		
Subsidy	600 (10.3%)	356 (30.5%)		
Family providing	1622 (28.0%)	395 (33.8%)		
Others	1968 (33.9%)	121 (10.4%)		
Income level (RMB/year)			12.952	0.005
<6500	3453 (59.5%)	728 (62.4%)		
6500–15,000	878 (15.1%)	138 (11.8%)		
15,000–24,000	469 (8.1%)	78 (6.7%)		
>24,000	1001 (17.3%)	223 (19.1%)		
Medical insurance			2.153	0.142
No	237 (4.1%)	37 (3.2%)		
Yes	5564 (95.9%)	1130 (96.8%)		
Commercial insurance			34.994	<0.001
No	5529 (95.3%)	1156 (99.1%)		
Yes	272 (4.7%)	11 (0.9%)		
Live alone			55.765	<0.001
No	4592 (79.2%)	807 (69.2%)		
Yes	1209 (20.8%)	360 (30.8%)		
Number of chronic diseases			179.302	<0.001
0	1570 (27.1%)	520 (44.6%)		
1	2373 (40.9%)	454 (38.9%)		
≥ 2	1858 (32.0%)	193 (16.5%)		
GAD-7 score	2.78 ± 3.77	1.89 ± 3.16	-9.953[a]	<0.001

[a] Mann-Whitney test

institutionalized older adults are displayed in Tables 2 and 3, respectively.

In the univariate model, several factors influencing anxiety symptoms were found in community-dwelling older adults, as outlined in Table 2. These included age, gender, residence, education, income level, live alone, number of chronic diseases. Upon adjusting for all covariates, in comparison with reference groups, those who were females (OR = 1.670; 95% CI: 1.460–1.910), resided in rural areas (OR = 1.232; 95% CI: 1.066–1.424), had a chronic disease (OR = 1.281; 95% CI: 1.093–1.502) and comorbidity (OR = 1.685; 95% CI: 1.431–1.985) were more likely to suffer from anxiety symptoms. Individuals aged 80 years and older (OR = 0.733; 95% CI: 0.595–0.904), with a junior school (OR = 0.698; 95% CI: 0.568–0.895), high school and above (OR = 0.727; 95% CI:

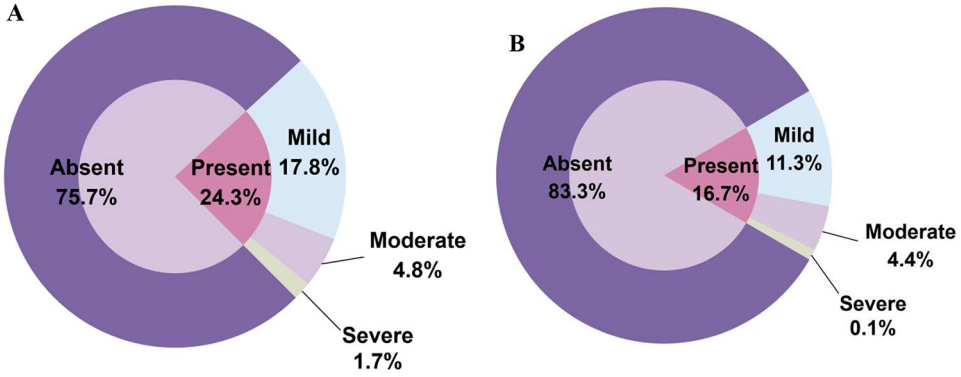

Fig. 2 Rates of different severity levels of anxiety (*N* = 6968). Absent, GAD scores of 0–4; present, GAD scores of 5 and above; mild, GAD scores of 5–9; moderate, GAD scores of 10–14; severe, GAD scores of 15 and above. **A**. The rate of different severities of anxiety in the studied community-dwelling older adults (N=5801). **B**. The rate of different severities of anxiety in the studied institutionalized older adults (N=1167).

0.558–0.948), an income level of 6500–15,000 RMB per year (OR = 0.844; 95% CI: 0.699–1.019), an income level of 15,000–24,000 RMB per year (OR = 0.686; 95% CI: 0.515–0.912), and those living alone (OR = 0.819; 95% CI: 0.681–0.984) exhibited a reduced likelihood of suffering from anxiety symptoms.

A binary logistic regression model was developed to examine the relationship between anxiety symptoms and various covariates for institutionalized older adults (Table 3). The analysis revealed that age, residence, source of income, and number of chronic conditions were identified as significant influencing factors. Controlling for all covariates, it was found that institutionalized older adults who were female (OR = 1.937; 95% CI: 1.296–2.893) and had chronic disease comorbidities (OR = 1.836; 95% CI: 1.200–2.810) were more likely to exhibit symptoms of anxiety. However, only participants with other sources of income (OR = 0.160; 95% CI: 0.051–0.506) were less likely to suffer from anxiety as compared to those with pension.

Results of classification and regression tree Model

The findings of the CART model reveal that the development of anxiety symptoms among community-dwelling older adults is significantly linked to various demographic and health-related factors, including gender, income level, number of chronic diseases, live alone, education, and residence (Fig. 3). Gender emerged as the most influential factor in determining anxiety levels. Subsequent analyses led to the stratification of the sample into subsets. Specifically, community-dwelling female older adults (Node 1), with an income level of less than 6500 RMB per year (Node 3), and reported chronic disease comorbidities (Node 10), were the most susceptible to experiencing anxiety. Meanwhile, community-dwelling older adults with income level of 15,000–24,000 RMB per year (Node 5) and not living alone (Node 14) were more likely to suffer from anxiety compared to those who lived alone (Node 13). However, male participants (Node 2), who reported a chronic disease (Node 6) and possessed higher educational attainment (junior school and above) (Node 16) were least probable to experience anxiety. Within node 2, subjects reported chronic disease comorbidities (Node 8) and lived in rural areas (Node 18), inclined to suffer from anxiety than those who lived in urban areas (Node 17).

Figure 4 illustrates the interplay among various factors that impact anxiety symptoms in institutionalized older adults. Our findings pointed to an interaction between source of income, gender, and residence in influencing the development of anxiety in institutionalized older adults. Briefly, institutionalized older adults who rely on pension, subsidy or family providing as a source of income (Node 1), were female (Node 4) and resided in rural areas (Node 6) had the highest chance of experiencing anxiety symptoms.

Discussion

This study investigated the prevalence and influencing factors of anxiety symptoms among older adults in different aged-care models: community-dwelling older adults and institutionalized older adults, based on two representative databases in Anhui Province, China. Our findings revealed disparities not only in the prevalence of anxiety symptoms but also in the influencing factors of anxiety symptoms between community-dwelling older adults and institutionalized older adults. Furthermore, in our study, the interactive effect of demographic, lifestyle, and health-related factors on anxiety symptoms was explored. This study highlighted concerns about psychological health risk factors for older adults across different aged-care models.

Table 2 Logistic analysis examining factors associated with anxiety among community-dwelling older adults ($n = 5801$)

Variables	Model 1		Model 2	
	Crude OR(95%CI)	*P*-Value	Adjusted OR(95%CI)	*P*-Value
Age (years)				
60–69	Reference		Reference	
70–79	0.928 (0.816–1.056)	0.258	0.899 (0.785–1.029)	0.123
≥ 80	0.764 (0.630–0.926)	0.006	0.733 (0.595–0.904)	0.004
Gender				
Male	Reference		Reference	
Female	1.761 (1.556–1.994)	<0.001	1.670 (1.460–1.910)	<0.001
Residence				
Urban	Reference		Reference	
Rural	1.396 (1.237–1.575)	<0.001	1.232 (1.066–1.424)	0.005
Education				
Primary school and below	Reference		Reference	
Junior school	0.565 (0.467–0.684)	<0.001	0.698 (0.568–0.895)	0.001
High school and above	0.598 (0.473–0.757)	<0.001	0.727 (0.558–0.948)	0.019
Marital status				
Married	Reference		Reference	
Widowed	0.993 (0.863–1.143)	0.921	0.989 (0.830–1.179)	0.904
Others	0.799 (0.550–1.160)	0.237	0.931 (0.624–1.390)	0.728
Source of income				
Pension	Reference		Reference	
Subsidy	1.422 (1.141–1.772)	0.002	1.198 (0.912–1.574)	0.195
Family providing	1.501 (1.273–1.769)	<0.001	1.105 (0.880–1.386)	0.390
Others	1.405 (1.199–1.648)	<0.001	1.184 (0.957–1.464)	0.119
Income level (RMB/year)				
<6500	Reference		Reference	
6500–15,000	0.758 (0.635–0.904)	0.002	0.844 (0.699–1.019)	0.047
15,000–24,000	0.536 (0.416–0.692)	<0.001	0.686 (0.515–0.912)	0.009
>24,000	0.693 (0.584–0.822)	<0.001	1.128 (0.877–1.451)	0.350
Medical insurance				
No	Reference		Reference	
Yes	0.947 (0.702–1.277)	0.721	1.000 (0.737–1.357)	1
Commercial insurance				
No	Reference		Reference	
Yes	0.996 (0.750–1.323)	0.976	0.992 (0.741–1.328)	0.992
Live alone				
No	Reference		Reference	
Yes	0.838 (0.720–0.976)	0.023	0.819 (0.681–0.984)	0.033
Number of chronic diseases				
0	Reference		Reference	
1	1.293 (1.106–1.513)	0.001	1.281 (1.093–1.502)	0.002
≥ 2	1.713 (1.459–2.010)	<0.001	1.685 (1.431–1.985)	<0.001

Comparison of the prevalence of anxiety in community-dwelling older adults and institutionalized older adults

The present study revealed that the prevalence of anxiety in community-dwelling older adults was 24.3%, while in institutionalized older adults it was 16.7%. These findings align with prior studies, such as a study in Shandong province, China which found a prevalence of depressive symptoms of 28.3% among rural community-dwelling older adults [34]. Residents aged 60 years and older in 27 nursing homes exhibited a similar prevalence of anxiety (15%) [35]. Selim et al. conducted a study to assess the mental health of older adults residing in both community settings and nursing homes in Turkey during the COVID-19 pandemic [36]. Their findings revealed a notable variance in the prevalence of anxiety between the two populations, with rates of 43.6% and 39.7%, respectively. Although these results demonstrate a higher prevalence of anxiety compared to those observed in our study, this further underscores the variability in the incidence of anxiety symptoms among older adults across

Table 3 Logistic analysis examining factors associated with anxiety among institutionalized older adults (*N* = 1167)

Variables	Model 1		Model 2	
	Crude OR(95%CI)	*P*-Value	Adjusted OR(95%CI)	*P*-Value
Age (years)				
60–69	Reference		Reference	
70–79	1.031 (0.624–1.703)	0.906	0.913 (0.541–1.540)	0.732
≥ 80	0.867 (0.528–1.421)	0.570	0.788 (0.462–1.342)	0.381
Gender				
Male	Reference		Reference	
Female	1.566 (1.150–2.132)	0.004	1.937 (1.296–2.893)	0.001
Residence				
Urban	Reference		Reference	
Rural	1.387 (0.840–1.677)	0.032	1.350 (0.779–2.340)	0.285
Education				
Primary school and below	Reference		Reference	
Junior school	0.831 (0.502–1.376)	0.472	0.928 (0.534–1.615)	0.793
High school and above	0.661 (0.353–1.237)	0.196	0.730 (0.353–1.508)	0.395
Marital status				
Married	Reference		Reference	
Widowed	0.827 (0.551–1.243)	0.361	0.664 (0.428–1.031)	0.068
Others	0.859 (0.551–1.340)	0.503	1.163 (0.633–2.136)	0.626
Source of income				
Pension	Reference		Reference	
Subsidy	1.179 (0.781–1.779)	0.434	0.685 (0.277–1.694)	0.413
Family providing	1.278 (0.857–1.904)	0.229	0.858 (0.383–1.924)	0.711
Others	0.275 (0.114–0.662)	0.004	0.160 (0.051–0.506)	0.002
Income level (RMB/year)				
<6500	Reference		Reference	
6500–15,000	1.016 (0.628–1.642)	0.950	1.175 (0.697–1.982)	0.545
15,000–24,000	0.877 (0.460–1.671)	0.690	0.830 (0.355–1.942)	0.667
>24,000	0.868 (0.574–1.311)	0.501	0.854 (0.367–1.987)	0.714
Medical insurance				
No	Reference		Reference	
Yes	2.320 (0.705–7.630)	0.166	2.660 (0.789–8.963)	0.114
Commercial insurance				
No	Reference		Reference	
Yes	0.985 (0.650–2.463)	0.835	0.994 (0.352–2.648)	0.997
Live alone				
No	Reference		Reference	
Yes	1.116 (0.803–1.550)	0.514	1.275 (0.885–1.837)	0.192
Number of chronic diseases				
0	Reference		Reference	
1	1.018 (1.106–1.513)	0.922	1.012 (0.708–1.448)	0.946
≥ 2	1.747 (1.161–2.629)	0.007	1.836 (1.200–2.810)	0.005

different aged-care models. Notably, Anxiety prevalence was higher in community-dwelling adults than in institutionalized adults, according to our study. Along with the development of the aging health service industry, the elderly caring social organizations have received attention from many scholars by virtue of their standardized and process-oriented services. In elderly caring social organizations, older individuals have the opportunity to undergo mental health screenings, including assessments for anxiety and depression, to facilitate prompt intervention for anxiety disorders [17]. Participation in age-appropriate physical and recreational activities, such as dancing and mahjong [13], enables older people to engage in meaningful social interactions within these organizations, thereby alleviating stress and potentially reducing the risk of developing anxiety symptoms. Multiple studies conducted in the United Kingdom and Japan have indicated that the quality of care provided in nursing facilities may serve as a protective factor in mitigating the risk of anxiety symptoms among residents when

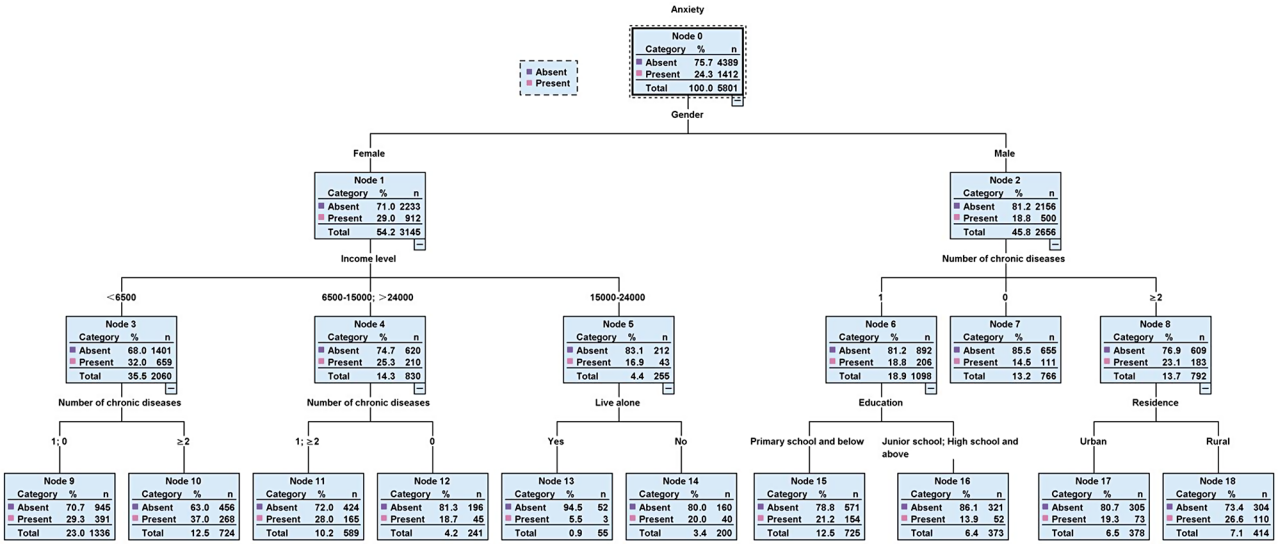

Fig. 3 Classification and regression tree model ($n = 5801$)

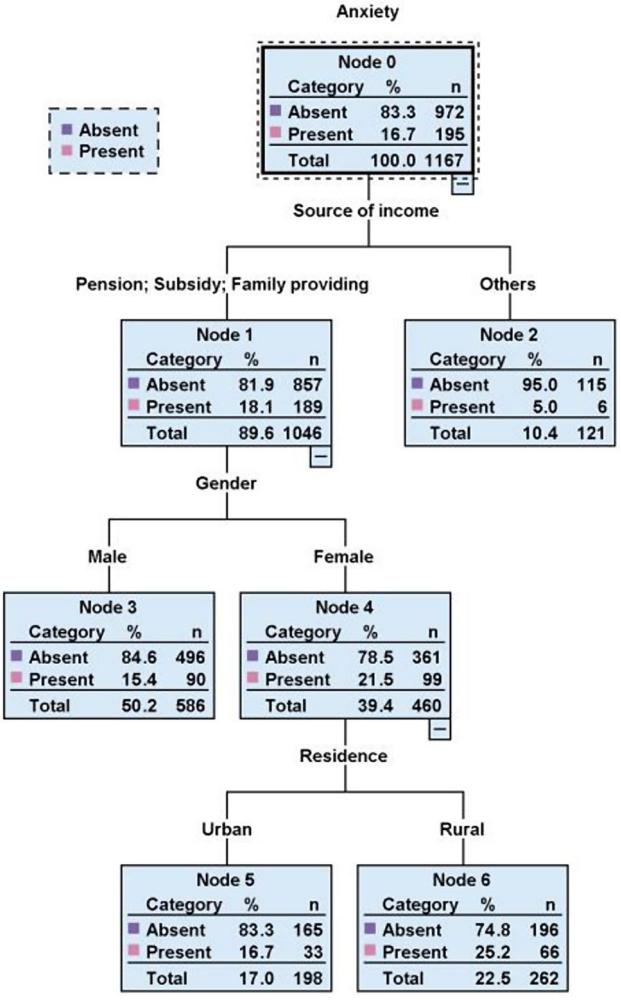

Fig. 4 Classification and regression tree model ($n = 1167$)

compared to older adults residing in the community [37–39]. Hence, these findings suggest that differences in aged-care models may contribute to variations in the prevalence of anxiety between community-dwelling older adults and institutionalized older adults.

Common factors affecting anxiety in community-dwelling older adults and institutionalized older adults

Gender and number of chronic diseases were identified as influential factors for anxiety among community-dwelling older adults and institutionalized older adults. Specifically, female older adults are more likely to suffer from anxiety compared to male older adults, which can be attributed to factors such as genetics (e.g., EPHA5 gene, MAOA polymorphism, etc.) and life roles [40, 41]. This result was consistent with prior findings. Jelena et al. in a cross-sectional study ($n = 2608$) reported that women have a higher likelihood of experiencing anxiety (OR: 2.44, 95% CI: 1.75–3.33) [42]. The female gender is also recognized in literature as a significant factor contributing to anxiety among Portuguese older adults [43]. In traditional Chinese society, particularly within rural communities, older women often experience a lower familial status, leading to heightened tendency of low self-esteem, heightened sensitivity, and anxiety. Additionally, as mothers within the traditional Chinese family structure, older women bear the responsibility of providing for their children, exacerbating feelings of overthinking and stress in their daily lives [44, 45]. The feeling of stress is further exacerbated among older women living in nursing homes as they have limited contact with their children [46]. In this context, female older adults tend to be more prone to anxiety than male older individuals.

The presence of multiple chronic diseases is a significant contributing factor to the increased risk of anxiety among community-dwelling older adults and institutionalized older adults. Our study found that community-dwelling older adults exhibited a higher propensity for two or more chronic diseases (i.e., with comorbidities) compared to their institutionalized counterparts. This finding underscores the potential benefits of institutional settings, which offer specialized resources and services that can be leveraged to enhance the health status of older adults. More importantly, our findings indicated that older adults with chronic disease comorbidities are more likely to develop anxiety symptoms compared to their counterparts without chronic illnesses. Community-dwelling participants with chronic disease comorbidities had a higher likelihood of having anxiety compared to those with one chronic disease. The enduring presence of chronic disease comorbidities in older adults not only results in physical challenges that impact their daily functioning but also contributes to psychological distress. In a study conducted by Rong et al. among elderly patients diagnosed with esophageal cancer and COPD, it was found that 20.7% of the participants exhibited notable symptoms of anxiety [47]. A systematic review of the literature involving anxiety symptoms or anxiety disorders in patients with medical conditions in the general population across 70 countries and territories revealed that moderate to severe anxious symptoms were prevalent among individuals with cardiovascular, respiratory, central nervous system, gastrointestinal, genitourinary, endocrine, musculoskeletal, dermatological diseases, as well as cancer [48]. It is evident that older individuals with multiple chronic conditions, whether community-dwelling older adults or institutionalized older adults, constitute a significant population that warrants attention. Older people with chronic disease comorbidities usually redirect their physical aches and pains into emotional upset and fear, which are the very symptoms of anxiety [49]. Therefore, our research provides further evidence supporting the correlation between chronic illnesses and anxiety symptoms in the elderly population.

Factors affecting anxiety in community-dwelling older adults

Further analysis of the sampled data from the community-dwelling older adults showed several intriguing results. Substantial research suggests a marked decline in anxiety symptoms with advancing age among older individuals [29, 50]. Our results offer further corroboration of this proposition. Moreover, our study found that rural community-dwelling older adults exhibited a greater likelihood of experiencing anxiety symptoms in comparison to their urban counterparts, a phenomenon that can be attributed to several factors. In China, A considerable number of older individuals in rural areas remain actively involved in agricultural activities even after retirement, leading to physical exhaustion that may worsen chronic health conditions and contribute to periodic feelings of anxiety [51]. Education emerged as another significant factor affecting anxiety among community-dwelling older adults. In our study, community-dwelling older adults with higher levels of education were less prone to anxiety. Limited access to educational resources during youth may contribute to lower educational attainment in this population. Prior research has demonstrated that educational interventions, such as the dissemination of knowledge of emotional regulation, can effectively reduce anxiety in older adults [52–54]. Meanwhile, it was found that elevated annual income levels are associated with a decrease in anxiety symptoms among community-dwelling older adults, which is consistent with prior studies [55, 56]. Interestingly, Alex et al. and Hyun et al. have confirmed through large-scale cross-sectional surveys that living alone in old age is associated with increased anxiety regarding illness and financial burdens [57, 58]. The results of the Chinese Longitudinal Healthy Longevity Survey (CLHLS) have indicated that older people who live alone exhibit pronounced anxiety, thereby exacerbating their susceptibility to depression [59]. In contrast to previous findings, our study proposed that living alone may have a protective effect against the development of anxiety in community-dwelling older adults. This discrepancy could potentially be explained by variations in family structures and cultural norms across different regions.

In our study, the CART model was employed to investigate the complex interplay between anxiety and various influencing factors. Our findings indicated that community-dwelling female older adults, had an annual income below 6500 RMB, and reported chronic disease comorbidities were at the greatest risk of experiencing anxiety. Conversely, male participants residing in the community, reporting a chronic illness, and possessing higher levels of education were found to be less susceptible to anxiety. The comprehensive findings could prove valuable in aiding community workers in identifying the demographic groups of older adults most susceptible to developing anxiety symptoms, thus facilitating the development of targeted interventions to mitigate the prevalence of anxiety among community-dwelling older adults.

Factors affecting anxiety in institutionalized older adults

The binary logistic regression model developed in this study revealed distinct results regarding the factors influencing anxiety among institutionalized older adults. A smaller number of factors were identified as significant factors of anxiety in this population compared to community-dwelling older adults. In addition to common

influences such as gender and the number of chronic diseases, source of income was found for the first time as a significant influence on anxiety among institutionalized older adults in our study. Specifically, compared to institutionalized older adults with pension, institutionalized older adults with other sources of income (e.g., labor income, property income, etc.) were less likely to suffer from anxiety symptoms. The findings of a landscape analysis indicated that various sources of income may contribute to income disparity among older people residing in nursing homes, which is associated with the development of psychological disorders, such as anxiety [60]. Additionally, a separate study posited that inadequate pension funds heighten financial strain among elderly residents in care homes, subsequently worsening anxiety levels [58]. Generally, older persons wishing to move into and receive services from nursing homes need to pass through different cost thresholds which correspond to the quality of services offered by the facility. Given the limited availability of pensions for older adults in China, obtaining other incomes can support the income level of older people, thus helping them to obtain higher-quality services [61, 62]. On the other hand, having multiple sources of income can enhance the self-identity of older people residing in nursing homes, thereby mitigating the onset of negative emotions [60]. Besides, the results of the CART analysis showed a clear pathway of factors influencing the development of anxiety in institutionalized older adults. That is, participants who had sources of income as pension, subsidy, or family providing, were female and living in rural areas, had the highest probability for suffering from anxiety. It is noteworthy that the findings of the binary logistic regression model were subsequently refined by the results of the CRAT model, revealing residence as a significant influencing factor. The interactive effect of these models enabled the accurate identification of specific subgroups at heightened risk for anxiety among institutionalized older adults.

The advantages and limitations of this study

Our research presents several significant strengths. Firstly, we utilized data from AHLS and AECSOS, two extensive surveys carried out in Anhui province, China. The credibility and validity of these databases have been validated by numerous prior studies on mental health and risk factors in the elderly population. Secondly, our study focuses on the variations in anxiety symptoms among community-dwelling older adults and institutionalized older adults in the same region. The findings of this study have the potential to enhance the ongoing discourse surrounding the advantages and disadvantages of aged-care models, as well as to investigate the impact of different aged-care models on the mental well-being of older adults. Finally, a systematic approach was utilized in employing the CART model, enables the examination of interrelationships among multiple variables and the creation of a clear and easily interpretable decision tree, facilitating the decision-making process.

Some limitations about our study can be summarized. First, due to the cross-sectional design of this study, we cannot establish a causal relationship between anxiety symptoms and aged-care models. Second, the results on anxiety were derived from self-report questionnaires, involving the presence of reporting bias, and it is important to note that our results are not intended for clinical diagnostic purposes in the realm of mental health. Last but not least, certain variables pertaining to mental health, including smoking status, drinking status, sleep duration, and social support, were not assessed in the present study and should be taken into account in subsequent research endeavors.

Conclusions

The study was conducted to investigate the disparities and influencing factors in anxiety among community-dwelling older adults and institutionalized older adults. The results indicated a significantly higher prevalence of anxiety symptoms among community-dwelling older adults compared to those in elderly caring social organizations. Factors such as age, gender, residence, education, income level, living alone, and number of chronic diseases were identified as influencing anxiety among community-dwelling older adults. However, for institutionalized older persons, gender and residence, source of income and number of chronic diseases were identified as influencing factors. With the help of the CART model, we illustrate the interaction between the factors influencing anxiety in older adults.

It is therefore necessary to pay attention to the mental health of older persons in different aged-care models, to determine which groups are most vulnerable to anxiety and to recognize the complexity of the phenomenon. For community-dwelling older adults, both community workers and families should take responsibility for the care of older adults, taking full advantage of the community environment and adopting regular mental health screening for older adults to help vulnerable groups. For institutionalized older people, standardized care processes need to be strictly enforced, and adequate social support should be provided to promote the mental health of older people.

Abbreviations

AHLS	Anhui Healthy Longevity Survey
AECSOS	Anhui Elderly Caring Social Organizations Survey
GAD	Generalized Anxiety Disorder
CART	Classification And Regression Tree
CI	Confidence intervals
OR	Odds ratios

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Author contributions
Xin Zheng and Ziwen Xu contributed equally to this work.Xin Zheng: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing-original draft. Ziwen Xu: Data curation, Methodology, Formal analysis, Writing - review & editing. Jiajie Zhao and Sanyuan Hao: Data curation, Investigation, Methodology, Writing - review & editing., Fuqin Xu, Shuo Ding and Guoqing Liu: Investigation, Validation. Benjamin Otsen and Wen Zhu: Data curation, Methodology. Shufan Yang, Zhongliang Bai and Jie Yang: Funding acquisition, Project administration. Ren Chen: Funding acquisition, Project administration, Writing - review & editing.

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Data availability
The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
All participants provided written informed consent, after fully comprehending the provided information. Furthermore, all participants possessed the necessary medical and ethical capacity to grant their consent. The procedure received approval and ethical clearance was obtained from the Biomedical Ethics Committee at Anhui Medical University (No.2020H011, No.20180181).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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