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# Decomposition and comparative analysis of differences in anxiety between urban and rural Chinese adults: a national cross-sectional study

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## Abstract

**Background** Anxiety is a severe global health problem. The long-established urban-rural dichotomy in China has led to unequal development in rural and urban areas, which may result in significant differences in the anxiety of rural and urban China. However, a comprehensive nationwide study exploring such disparities among Chinese adults remains lacking.

**Methods** The study extracted 27875 Chinese adults from the Psychology and Behaviour Investigation of Chinese Residents in 2022. The study utilized generalized linear regression analysis to explore the factors associated with Chinese adults' anxiety in urban and rural areas. Further, we used the Blinder-Oaxaca decomposition to analyze the role of explanatory factors in urban-rural disparities in anxiety among Chinese adults.

**Results** The median anxiety score among rural adults was 5.00 ( $P_{25}$ : 1.00,  $P_{75}$ : 7.00), surpassing that among urban adults, which was 4.00 ( $P_{25}$ : 0.00,  $P_{75}$ : 7.00) ( $P < 0.001$ ). The generalized linear model showed that the differences in anxiety between rural and urban Chinese adults were reflected in intermittent fasting and marital status, career status, family per capita monthly income, age, and gender. The Blinder-Oaxaca decomposition revealed that 83.49% of the urban-rural disparities in anxiety among Chinese adults could be explained, and interpersonal network level was the most significant explanatory factor.

**Conclusion** The prevalence of anxiety was higher in rural than in urban Chinese adults. The government should identify urban-rural disparities' explanatory factors to target precise intervention strategies, thereby narrowing the mental health differences between rural and urban.

**Keywords** Anxiety, Urban-rural disparities, Blinder-Oaxaca decomposition, China

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## Introduction

Anxiety is one of the most common mental health problems around the world [1]. The World Health Organization estimates that approximately 3.6% of the worldwide population experiences anxiety [2], while the anxiety's lifetime prevalence rate is 7.6% in China [3]. Anxiety is characterized by the feelings of terror and worry that is keep intensifying and out of proportion to the actual threat, accompanied by decreased daily functionality [4, 5]. Prolonged Anxiety can contribute to decline to the quality of life [6], compromising immune function [7], and leading to a range of diseases [8–10], ultimately imposing social and economic burdens [11]. Given the substantial individual and societal ramifications of anxiety, it is necessary to discover the associated risk factors of anxiety.

Considering previous research perspectives on anxiety-related factors were relatively scattered, we used the socioecological model (SEM) as a conceptual framework for this study to identify it comprehensively. This model included individual characteristics, individual behaviors, interpersonal networks, community, and policy, 5 levels [12]. These levels collectively contribute to providing a comprehensive framework for understanding health-related occurrences and assessing contributing variables from many angles [13, 14]. Previous studies have found that anxiety is associated with numerous factors based on SEM. First, at the individual characteristics level, a study established a prospective association between age and anxiety, which found that participants who were older more often experienced anxiety and were at increased risk of anxiety during the follow-up period [15]. Another study reported the inter-relationships between suboptimal health status and anxiety in China [16]. Second, different individual behavior levels may also determine the onset of anxiety. Among these, a meta-analysis focusing on the anxiety pointed out that better sleep quality significantly alleviate anxiety, and a dose-response relationship between the two was also found [17]. On the other hand, a positive association has been found between unhealthy plant-based dietary patterns with anxiety [18], which is similar to another study that found an interplay between obesity-related eating behavior and the severity of anxiety [19]. Third, at the interpersonal network level, lack of social support was a strong determinant of anxiety [20], whether among women in the perinatal period [21], lung cancer patients [22], and post-injury college-student athletes [23]. Finally, anxiety was also found to be associated with several community level variables, such as long-term unemployment [24] and economic hardships [25]. However, most of the existing studies focusing on a single or a few factors associated with anxiety, and there is a shortage of comprehensive research on the associations of multiple factors with anxiety.

A recent study of Polish cardiovascular disease patients observed that anxiety in rural patients was associated with factors such as age, degree of fulfillment of needs, and quality of life in the physical, social, and environmental domains, while anxiety in urban patients was linked to quality of life in both the physical and psychological domains [26]. This urban-rural disparity also applies to China. A prior study of anxiety in Chinese older adults found that being female, living in the central region, and facing challenges in accessing medical care were found to be independent risk factors for anxiety in rural older adults while living in the Chinese western region and non-smoking were independent risk factors for anxiety in urban older adults [27]. This may be attributed to the entrenched urban-rural dichotomy in China, which has led to unequal economic and social welfare, medical services, employment, and infrastructure development in rural and urban areas, thereby enlarging the difference in anxiety in rural and urban China. However, the studies mentioned above were conducted among some special population groups, and there is still a lack of data on the entire Chinese adults population.

The Blinder-Oaxaca decomposition method has been widely applied to health research [28, 29] and subsequently further investigated into mental health problems [30]. Among these, a study using this approach revealed socioeconomic inequality in mental disorders rates in Iran's adult population [31]. Another South Korean study investigated the gender gap in depression and anxiety and found that women showed lower levels of mental health than men [32]. Additionally, a study of Chinese older adults using the Blinder-Oaxaca decomposition method showed that older adults living in different main residential locations have been proven to have significant differences in depression, and the most important explanatory factors are education and income [30]. However, the difference and its explanatory factors in anxiety are not yet known.

Therefore, this study focuses on urban-rural differences in anxiety among Chinese adults to analyze and quantify the extent to which the individual characteristics level, individual behavior levels, interpersonal network level, community level, and policy level explain these differences. The Blinder-Oaxaca decomposition method provides us with an effective tool to be able to decompose urban-rural differences in anxiety into two parts: on the one hand, it is explained by the differences in characteristics observed between urban and rural areas (explained component), and on the other hand that can be attributed to unmeasured or unobserved factors (unexplained component) [33, 34]. Indeed, although rural and urban areas may share similar individual characteristics, differences between them may still be influenced by unknown factors. Therefore, this study is designed to identify and

then facilitate adjustment for urban-rural differences caused by known factors, thereby revealing how unmeasured or unobserved factors continue to influence urban-rural differences in anxiety when these known factors are excluded. This study will provide policymakers with valuable insights in the field of public health, especially in promoting equitable development of mental health between urban and rural Chinese adults.

## Methods

### Sampling and participants

Data in this study originated from the Psychology and Behaviour Investigation of Chinese Residents (PBICR), carried out between June 20 and August 31, 2022. The survey sample was selected by a multistage random sampling procedure, covering 148 cities, 202 districts (and counties), 390 townships/towns/streets, and 780 communities/villages from 23 provinces, 5 autonomous regions, and 4 municipalities directly under the central government [35]. The population of these provincial administrative regions accounts for almost 94% of the country's total population.

Questionnaires were distributed by a trained surveyor face-to-face utilizing the online Utilizing Questionnaire Star platform (<https://www.wjx.cn/>). This survey included Chinese permanent residents who were at least 12 years old, competent to understand each question in

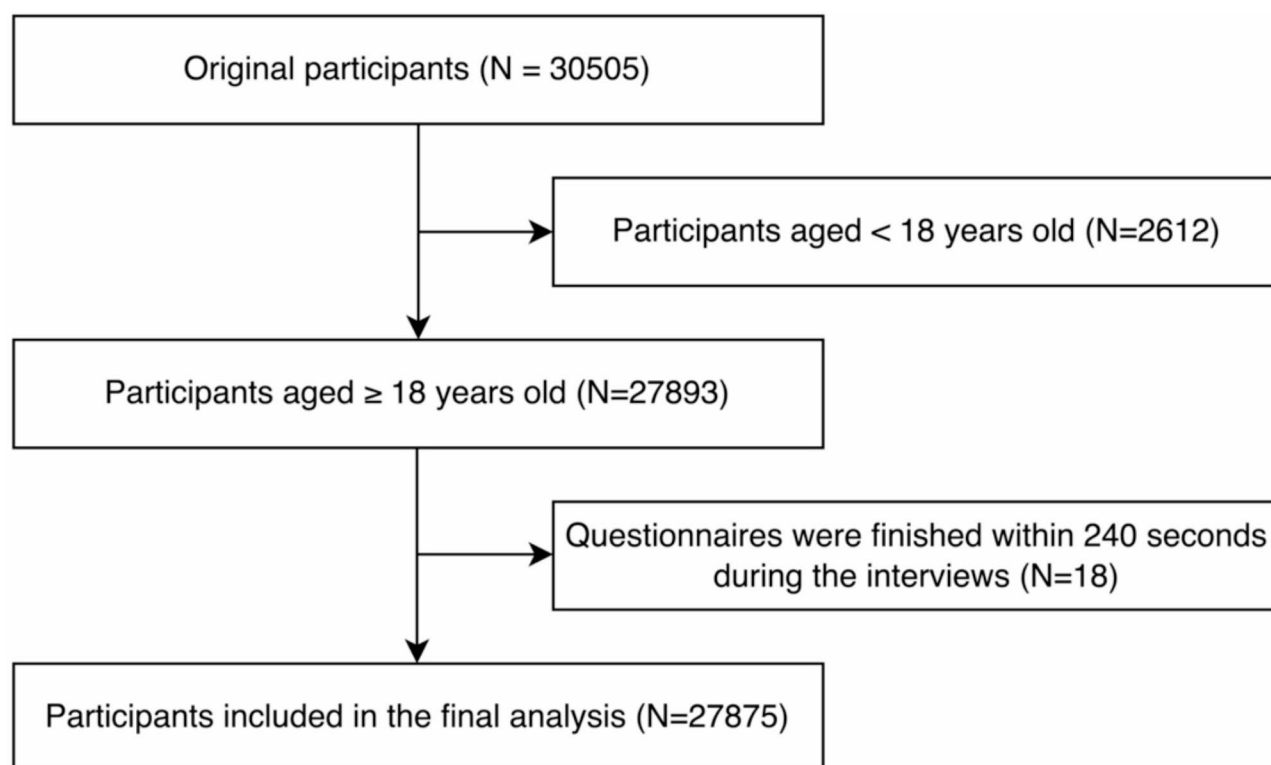
the questionnaire, and capable of filling it out independently or with the assistance of an investigator without interference with the responses. Excluded from the survey were as follows: individuals who were unwilling to participate, those with mental health issues or cognitive impairment, and those who currently participated in other similar clinical studies. The detailed information about this survey has been reported elsewhere [13, 36].

Based on the above criteria, 30505 participants were enrolled. A total of 2612 participants younger than 18 years were excluded from the study. Then, we excluded questionnaires finished within 240 s during the interviews. Finally, this study included a total of 27875 participants (Fig. 1).

This study followed the tenets of the Declaration of Helsinki and received approval from the Ethics Research Committee of the Health Culture Research Center of Shaanxi (No. JKWH-2022-02). All the participants voluntarily participated in the study and signed an informed consent form.

### Outcome variable

Anxiety was measured by utilizing the Generalized Anxiety Disorder-7 (GAD-7), consisting of 7 items [37]. Responses are rated on a 4-point Likert scale, ranging from 0 (never) to 3 (almost every day). The total score ranges from 0 to 21, with higher scores denoting severer



**Fig. 1** Flowchart of the study participant

anxiety symptoms. The Cronbach's  $\alpha$  of this scale in this study was 0.943.

### Group variable

According to the time of the survey reporting the household location in the survey, participants were categorized as rural or urban.

### Explanatory variables

The questionnaires included the routine covariates and the classic scales to explore the possible factors associated with urban-rural disparities in anxiety.

### Routine covariates

Based on the SEM, the study considered routine covariates in the following aspects: individual characteristics level, individual behavior levels, interpersonal network level, community level, and policy level. The individual characteristics level included age (years), gender (female, male), ethnicity (Han, others), whether having diagnosed chronic disease (yes, no), and education level (primary school and below, junior high school, high/vocational school, junior college and above). The individual behaviors level included smoking status (yes, no), drinking alcohol (yes, no), moderate-intensity exercise (yes, no), intermittent fasting (yes, no), and sleep quality (very bad, relatively bad, relatively good, very good). The interpersonal network level included marital status (have a spouse, have no spouse). The community level is broadly defined as the socioeconomic context of the community in which an individual lives, including career status (student, have no job, have a job), family per capita monthly income (Chinese yuan) ( $\leq 3000$ ,  $3001-6000$ ,  $\geq 6001$ ), and family debt situation. The question referred to the debt that is held by members of a family, including housing debt, education debt, automobile debt, business debt, financial debt, and other debt. If a participant had any of these debts, it is regarded as "being in debt", indicated by the word "yes". On the contrary, called "no". The policy level included public insurance coverage (not covered, covered).

### Standardized questionnaires

**Health-related quality of life** The European Quality of Life 5-Dimensions 5-Levels (EQ-5D-5 L) was used to measure health-related quality of life, the most widely used instrument for assessing health-related quality of life of general populations across the world [38]. This scale is composed of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Responses are rated on a 5-point Likert scale, ranging from 1 (no problems) to 5 (unable to/extreme problems). Next, a single EQ-5D index value was calculated through the EQ-5D-5 L Crosstalk Index Value Calculator

to produce the EQ-5D value, which ranges from  $-0.391$  to  $1.000$ , with  $1.000$  representing the best possible health and  $0$  representing death, while values less than  $0$  represent health states regarded as worse than a state that is as terrible as death [39]. The Cronbach's  $\alpha$  of the EQ-5D-5 L in this study was  $0.817$ . The European Quality of Life Group's visual analog scale (EQ VAS) was used to measure self-rated health status [40]. Responses are rated participants' perceived health status on a vertical scale of  $0$  to  $100$ , ranging from "the worst health" to "the best health." Generally, both a higher EQ-5D utility index and a higher EQ VAS score indicate better health status.

**Problematic internet use** The Problematic Internet Use Questionnaire Short-Form-6 (PIUQ-SF-6) was used to measure problematic Internet use, consisting of 6 items in this study [41]. Responses are rated on a 5-point Likert scale, ranging from 1 (never) to 5 (always). The total score ranges from 6 to 30, with higher scores denoting increased problematic use. The Cronbach's  $\alpha$  of the PIUQ-SF-6 in this study was  $0.932$ .

**Loneliness** The Three-Item Loneliness Scale (T-ILS) was used to measure loneliness, consisting of 3 items in this study [42]. Responses are rated on a 3-point Likert scale, ranging from 1 (never) to 3 (often). The total score ranges from 3 to 9, with higher scores denoting higher levels of loneliness. The Cronbach's  $\alpha$  of the T-ILS in this study was  $0.861$ .

**Family health** The Family Health Scale-Short Form (FHS-SF) was used to measure family health, consisting of ten items in this study [43]. Responses are rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 10 to 50, with higher scores denoting greater levels of family health. The Cronbach's  $\alpha$  of the FHS-SF in this study was  $0.828$ .

**Family communication** The Family Communication Scale-10 (FCS-10) was used to measure family communication, consisting of ten items in this study [44]. Responses are rated on a 5-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree". The total score ranges from 10 to 50, with higher scores denoting higher levels of communication among family members. The Cronbach's  $\alpha$  of the FCS-10 in this study was  $0.968$ .

### Statistical analyses

First, the Kolmogorov-Smirnov test was employed to evaluate the normality of continuous variables. All continuous variables had a nonnormal distribution and were shown as the median ( $P_{25}$ ,  $P_{75}$ ). Categorical variables were reported as numbers (percentages). Statistical differences

were tested using Mann-Whitney U tests for the continuous variables and chi-square tests for the categorical variables. Second, the generalized linear model was used to explore the main factors of anxiety in rural and urban Chinese adults. Finally, we used the Blinder-Oaxaca decomposition approach to investigate the importance of factors explaining anxiety between rural and urban Chinese adults. Statistical analysis was performed using SPSS 27.0 and STATA 16.0. A two-tailed significance test was conducted, with a  $P < 0.05$  as statistically significant.

## Results

### Demographic characteristics

Table 1 shows the results of descriptive statistical analyses for Chinese adults in rural and urban. A total of 51.30% of Chinese adults belonged to the urban group. The median age was 32.00 ( $P_{25}$ : 20.00,  $P_{75}$ : 50.00), of whom 15891 (57.01%) participants were female. Overall, the median score for anxiety among Chinese adults in the study was 4.00 ( $P_{25}$ : 1.00,  $P_{75}$ : 7.00). The median anxiety score among rural adults was 5.00 ( $P_{25}$ : 1.00,  $P_{75}$ : 7.00), surpassing that among urban adults, which was 4.00 ( $P_{25}$ : 0.00,  $P_{75}$ : 7.00) ( $P < 0.001$ ).

### Determinants of anxiety between rural and urban

Table 2 shows the results of the generalized linear model for anxiety in rural and urban Chinese people. Both in rural and urban areas, having diagnosed chronic disease, problematic internet use, physical activity, loneliness, and having debt were risk factors for anxiety; health-related quality of life, self-rated health status, sleep quality, and family health were protective factors.

The differences in anxiety between rural and urban Chinese adults were reflected in the following three main areas. First, intermittent fasting (yes, estimate = 0.071) and marital status (have a spouse, estimate = 0.075) were risk factors only in rural areas. Second, career status (have no job, estimate = 0.093) and family per capita monthly income ( $\geq 6001$ , estimate = 0.074) were risk factors only in urban areas. Third, age (higher, estimate = -0.002) and gender (male, estimate = -0.086) were protective factors only in urban areas.

### Decomposition of the anxiety between rural and urban

Table 3 shows the decomposition model results for the differences in anxiety between rural and urban Chinese adults. The results suggested that 83.49% of the anxiety differences were explained by observed factors, with the remaining 16.51% unexplained. Loneliness (52.75%), family health (45.87%), self-rated health status (21.56%), education level (20.18%), public insurance coverage (2.29%), health-related quality of life (14.68%), Age (-2.75%), intermittent fasting (-3.67%), problematic Internet use (-11.01%), family communication (-15.14%), career

status (-15.14%), and family per capita monthly income (-26.15%) were significant ( $p < 0.05$ ) in explaining differences in anxiety (Table 4). Figure 2 depicts the individual characteristics level, individual behaviors level, interpersonal network level, and community level contribution to explaining the disparity in anxiety between rural and urban Chinese adults. Our findings showed that the interpersonal network level (82.57%) explained most of the gap between rural and urban. It is then followed by the individual behavior levels, individual characteristics level, policy level, and community level, accounting for 22.02%, 14.22%, 2.29%, and -40.83%, respectively.

## Discussion

To the best of our knowledge, this is the first study to analyze urban-rural disparity in anxiety among the entire Chinese adults using the Blinder-Oaxaca decomposition. This study explored the association between anxiety and factors (such as individual characteristics level, individual behaviors level, interpersonal network level, community level, and policy level). Our study has shown a difference in anxiety between rural and urban Chinese adults, and interpersonal network level was the most significant explanatory factor.

In the whole of Chinese adults, the differences in anxiety between rural and urban were confirmed in this study. These differences can also be found in populations such as Australian gay-identified men aged 18–39 years [45], Kentucky cancer survivors [46], and Iran elderly menopause [47]. Our study found that the anxiety scores of the rural residents were higher than those of urban residents, similar to the findings of other studies on anxiety among Chinese older adults [48]. One possible explanation is that rural Chinese adults often face greater stressors than their urban counterparts, including greater distances to psychological services providers, lower income levels, and disparities in education and employment opportunities [49–51]. These structural factors may contribute to heightened stress levels and increased susceptibility to anxiety among rural residents, but it is often difficult for them to receive timely and effective early psychological services [52]. Moreover, the mental illness stigma has been proven to have significant differences between rural and urban [53, 54]. Due to rural residents' concerns about the confidentiality of receiving psychological services and stigma, the acceptability of services may be further reduced [55]. Therefore, our findings suggest that focused interventions centered on mental health promotion should give priority to rural populations. It is recommended that communication with them is context-specific, fostering a friendly environment that is appropriate for rural communities and supportive of mental health, thereby easing any anxiety they may have.



**Table 1** Distribution of the variables in rural and urban respondents

Characteristics	Total (N = 27875)	Rural (N = 13575)	Urban (N = 14300)	P
<b>Individual characteristics level</b>				
Age, median (P <sub>25</sub> , P <sub>75</sub> )	32.00 (20.00, 50.00)	31.00 (20.00, 52.00)	33.00 (20.00, 48.00)	0.167
Gender, n (%)				0.167
Female	15891 (57.01)	7796 (57.43)	8095 (56.61)	
Male	11984 (42.99)	5779 (42.57)	6205 (43.39)	
Ethnicity, n (%)				< 0.001
Han	25243 (90.56)	11956 (88.07)	13287 (92.92)	
Others	2632 (9.44)	1619 (11.93)	1013 (7.08)	
Whether having diagnosed chronic disease, n (%)				0.049
Yes	6614 (23.73)	3151 (23.21)	3463 (24.22)	
No	21261 (76.27)	10424 (76.79)	10837 (75.78)	
Education level, n (%)				< 0.001
Primary school and below	3315 (11.89)	2521 (18.57)	794 (5.55)	
Junior high school	2994 (10.74)	2063 (15.20)	931 (6.51)	
High/vocational school	6183 (22.18)	2859 (21.06)	3324 (23.24)	
Junior college and above	15383 (55.19)	6132 (45.17)	9251 (64.69)	
<b>Individual behaviors level</b>				
Anxiety, median (P <sub>25</sub> , P <sub>75</sub> )	4.00 (1.00, 7.00)	5.00 (1.00, 7.00)	4.00 (0.00, 7.00)	< 0.001
Health-related quality of life, median (P <sub>25</sub> , P <sub>75</sub> )	1.00 (0.94, 1.00)	1.00 (0.94, 1.00)	1.00 (0.94, 1.00)	0.550
Self-rated health status, median (P <sub>25</sub> , P <sub>75</sub> )	79.00 (61.00, 89.00)	77.00 (60.00, 88.00)	80.00 (62.50, 90.00)	< 0.001
Problematic internet use, median (P <sub>25</sub> , P <sub>75</sub> )	12.00 (6.00, 17.00)	12.00 (6.00, 17.00)	12.00 (6.00, 17.00)	0.003
Smoking status, n (%)				0.002
Yes	3719 (13.34)	1899 (13.99)	1820 (12.73)	
No	24156 (86.66)	11676 (86.01)	12480 (87.27)	
Drinking alcohol, n (%)				< 0.001
Yes	6089 (21.84)	2791 (20.56)	3298 (23.06)	
No	21786 (78.16)	10784 (79.44)	11002 (76.94)	
Moderate-intensity exercise, n (%)				0.063
Yes	15479 (55.53)	7461 (54.96)	8018 (56.07)	
No	12396 (44.47)	6114 (45.04)	6282 (43.93)	
Intermittent fasting, n (%)				< 0.001
Yes	2767 (9.93)	1162 (8.56)	1605 (11.22)	
No	25108 (90.07)	12413 (91.44)	12695 (88.78)	
Sleep quality, n (%)				0.044
Very bad	874 (3.14)	452 (3.33)	422 (2.95)	
Relatively bad	4009 (14.38)	1895 (13.96)	2114 (14.78)	
Relatively good	15510 (55.64)	7617 (56.11)	7893 (55.20)	
Very good	7482 (26.84)	3611 (26.60)	3871 (27.07)	
<b>Interpersonal network level</b>				
Loneliness, median (P <sub>25</sub> , P <sub>75</sub> )	4.00 (3.00, 6.00)	5.00 (3.00, 6.00)	4.00 (3.00, 6.00)	< 0.001
Family health, median (P <sub>25</sub> , P <sub>75</sub> )	38.00 (34.00, 44.00)	38.00 (33.00, 43.00)	40.00 (34.00, 45.00)	< 0.001
Family communication, median (P <sub>25</sub> , P <sub>75</sub> )	39.00 (31.00, 41.00)	38.00 (30.00, 40.00)	40.00 (32.00, 43.00)	< 0.001
Marital status, n (%)				< 0.001
Have a spouse	14115 (50.64)	6715 (49.47)	7400 (51.75)	
Have no spouse	13760 (49.36)	6860 (50.53)	6900 (48.25)	
<b>Community level</b>				
Career status, n (%)				< 0.001
Student	9792 (35.13)	4892 (36.04)	4900 (34.27)	
Have no job	8653 (31.04)	5255 (38.71)	3398 (23.76)	
Have a job	9430 (33.83)	3428 (25.25)	6002 (41.97)	
Family per capita monthly income (Chinese yuan), n (%)				< 0.001
≤ 3000	9421 (33.80)	6263 (46.14)	3158 (22.08)	

**Table 1** (continued)

Characteristics	Total (N=27875)	Rural (N=13575)	Urban (N=14300)	P
3001–6000	11234 (40.30)	5128 (37.78)	6106 (42.70)	0.122
≥ 6001	7220 (25.90)	2184 (16.09)	5036 (35.22)	
Whether having debt, n (%)				
Yes	11037 (39.59)	5438 (40.06)	5599 (39.15)	
No	16838 (60.41)	8137 (59.94)	8701 (60.85)	
Policy level				
Public insurance coverage, n (%)				< 0.001
Covered	25702 (92.20)	12439 (91.63)	13263 (92.75)	
Not covered	2173 (7.80)	1136 (8.37)	1037 (7.25)	

**Table 2** Associations between study variables and anxiety among Chinese rural and urban adults

Characteristics	Rural			Urban		
	Estimate	95% CI	P	Estimate	95% CI	P
<b>Individual characteristics level</b>						
Age	-0.001	(-0.003, 0.000)	0.138	-0.002	(-0.004, 0.000)	0.027
Gender (ref. female)	-0.024	(-0.063, 0.015)	0.231	-0.086	(-0.124, -0.048)	< 0.001
Ethnicity (ref. others)	0.043	(-0.012, 0.098)	0.123	0.041	(-0.027, 0.109)	0.235
Whether having diagnosed chronic disease (ref. no)	0.085	(0.038, 0.131)	< 0.001	0.097	(0.054, 0.140)	< 0.001
Education level (ref. Primary school and below)						
Junior high school	-0.038	(-0.104, 0.029)	0.268	-0.034	(-0.139, 0.070)	0.518
High/vocational school	-0.018	(-0.088, 0.052)	0.612	-0.030	(-0.121, 0.061)	0.515
Junior college and above	-0.008	(-0.079, 0.063)	0.819	-0.040	(-0.130, 0.050)	0.386
<b>Individual behaviors level</b>						
Health-related quality of life	-0.304	(-0.411, -0.198)	< 0.001	-0.234	(-0.353, -0.115)	< 0.001
Self-rated health status	-0.003	(-0.004, -0.002)	< 0.001	-0.005	(-0.006, -0.004)	< 0.001
Problematic internet use	0.035	(0.031, 0.038)	< 0.001	0.033	(0.029, 0.036)	< 0.001
Smoking status (ref. no)	0.023	(-0.033, 0.078)	0.424	0.035	(-0.021, 0.091)	0.223
Drinking alcohol (ref. no)	0.023	(-0.023, 0.068)	0.324	0.036	(-0.007, 0.079)	0.103
Moderate-intensity exercise (ref. no)	0.041	(0.004, 0.078)	0.029	0.056	(0.019, 0.092)	0.003
Intermittent fasting (ref. no)	0.071	(0.013, 0.130)	0.017	0.029	(-0.024, 0.081)	0.283
Sleep quality (ref. very bad)						
Relatively bad	0.038	(-0.053, 0.130)	0.413	0.005	(-0.088, 0.099)	0.911
Relatively good	-0.113	(-0.199, -0.027)	0.010	-0.137	(-0.226, -0.048)	0.003
Very good	-0.270	(-0.361, -0.179)	< 0.001	-0.344	(-0.438, -0.250)	< 0.001
<b>Interpersonal network level</b>						
Loneliness	0.254	(0.242, 0.266)	< 0.001	0.254	(0.243, 0.266)	< 0.001
Family health	-0.015	(-0.018, -0.011)	< 0.001	-0.012	(-0.016, -0.009)	< 0.001
Family communication	0.001	(-0.002, 0.003)	0.640	0.000	(-0.003, 0.002)	0.714
Marital status (ref. have no spouse)	0.075	(0.020, 0.129)	0.007	0.012	(-0.043, 0.067)	0.660
<b>Community level</b>						
Career status (ref. student)						
Have no job	0.049	(-0.022, 0.121)	0.177	0.093	(0.017, 0.170)	0.017
Have a job	0.057	(-0.001, 0.116)	0.055	0.056	(-0.003, 0.115)	0.064
Family per capita monthly income (Chinese yuan) (ref. ≤ 3000)						
3001–6000	0.013	(-0.027, 0.052)	0.526	0.011	(-0.035, 0.057)	0.637
≥ 6001	0.012	(-0.040, 0.064)	0.655	0.074	(0.025, 0.122)	0.003
Whether having debt (ref. no)	0.040	(0.004, 0.077)	0.031	0.042	(0.005, 0.078)	0.025
<b>Policy level</b>						
Public insurance coverage (ref. not covered)	-0.015	(-0.076, 0.047)	0.646	-0.053	(-0.118, 0.012)	0.112

Abbreviations: CI, confidence interval; ref, reference

**Table 3** Overall Blinder-Oaxaca decomposition of the urban-rural disparities in anxiety among Chinese adults

Component	Estimate	95% CI	P	Contribution (%)
Explained difference	0.182	(0.091, 0.273)	< 0.001	83.49
Unexplained difference	0.036	(-0.057, 0.129)	0.475	16.51
Total difference	0.218	(0.107, 0.329)	< 0.001	

Abbreviations: CI, confidence interval

The study found some important factors associated with urban-rural disparities in anxiety among Chinese adults. First, intermittent fasting and having a spouse were risk factors for anxiety only in rural areas. Intermittent fasting exhibited a propensity for weight management in their dietary behavior [56]. However, people in rural areas usually engage in physical labor, such as farm work and livestock rearing, and these activities have a higher demand for a steady energy supply. Therefore, intermittent fasting may affect the physical strength and labor performance of rural residents, thereby increasing their anxiety.

Further, the analysis revealed that Chinese adults who identified as “having a spouse” had higher anxiety in rural areas, which is consistent with other studies [57]. One possible explanation is that having a spouse in rural areas often tends to get more social recognition, but this can also lead to additional familial duties, and more worry exists about their spouse [58]. Meanwhile, these dynamics are compounded by the various role expectations inherent in marital relationships. In comparison, individuals in urban areas could place more importance on their personal growth. Another possible explanation is living in a more densely populated area, such as an urban area, may get more opportunities for social interaction, which boosts social support from other sources, thereby making them more likely to ignore the negative mental health impact derived from spouses [52].

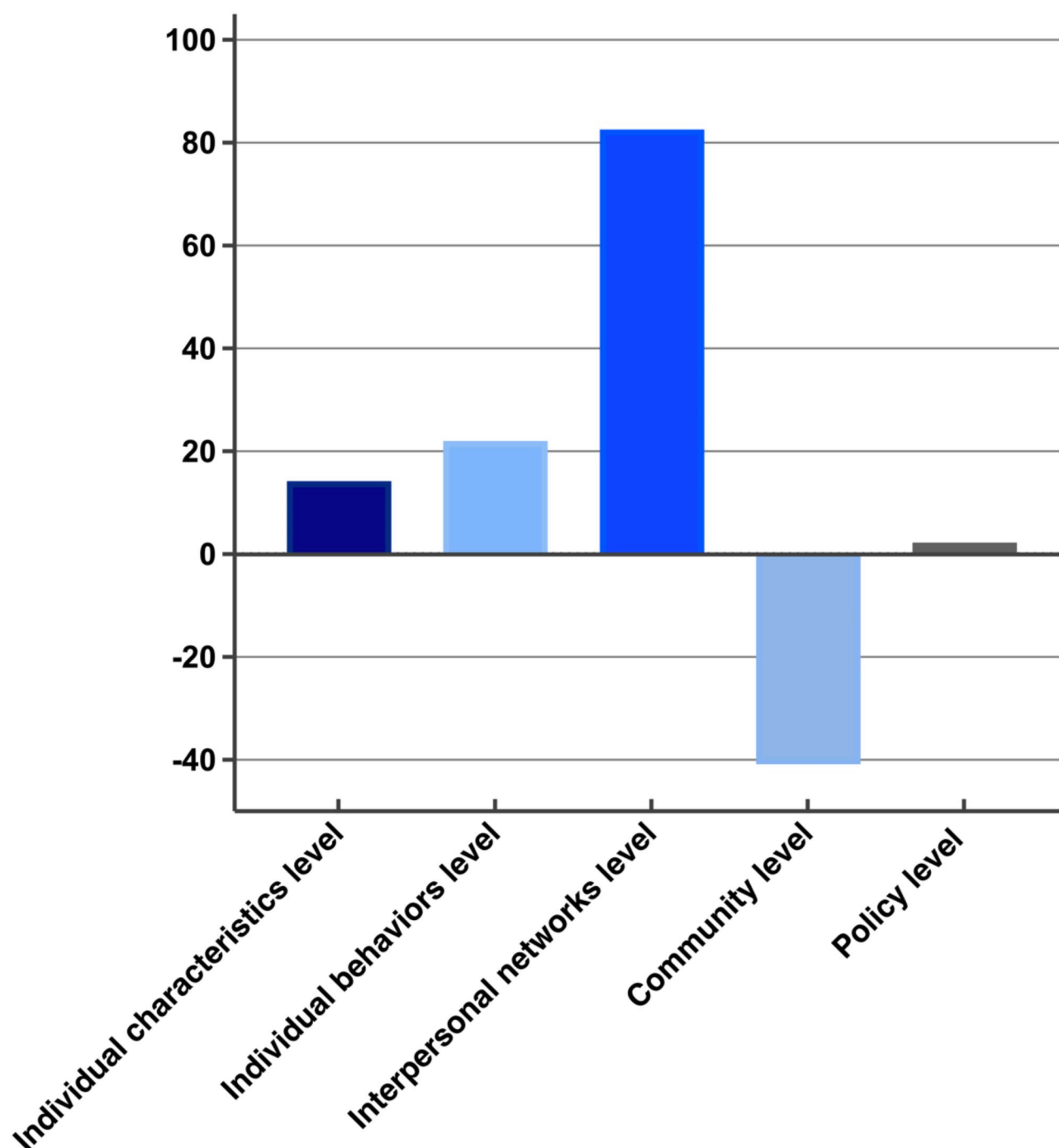
In addition, our study showed that only in urban areas, individuals who have no job or have high incomes have worse anxiety. Although there are usually more job options in urban regions, living costs are higher, and competition is fiercer. Individuals who have no job in urban areas may experience financial strain, job-related anxiety, and social marginalization, thereby increasing

**Table 4** Detailed decomposition of urban-rural disparities in anxiety among Chinese adults

Characteristics	Explained component			Unexplained component		
	Estimate	95% CI	Contribution (%)	Estimate	95% CI	Contribution (%)
<b>Individual characteristics level</b>						
Age	-0.006**	(-0.012, -0.000)	-2.75	-0.009	(-0.294, 0.275)	-4.13
Gender	0.002	(-0.001, 0.004)	0.92	0.068*	(-0.007, 0.144)	31.19
Ethnicity	-0.005	(-0.016, 0.005)	-2.29	0.008	(-0.241, 0.257)	3.67
Education level	0.044**	(0.002, 0.087)	20.18	0.121	(-0.193, 0.435)	55.50
Whether having diagnosed chronic disease	-0.004*	(-0.007, 0.000)	-1.83	-0.014	(-0.063, 0.035)	-6.42
<b>Individual behaviors level</b>						
Health-related quality of life	0.032***	(0.020, 0.045)	14.68	0.272	(-0.288, 0.831)	124.77
Self-rated health status	0.047***	(0.034, 0.059)	21.56	0.398***	(0.107, 0.688)	182.57
Problematic internet use	-0.024**	(-0.045, -0.003)	-11.01	0.298***	(0.089, 0.508)	136.70
Smoking status	0.002*	(-0.000, 0.005)	0.92	0.003	(-0.033, 0.040)	1.38
Drinking alcohol	-0.002	(-0.006, 0.001)	-0.92	0.007	(-0.036, 0.050)	3.21
Moderate-intensity exercise	-0.002	(-0.005, 0.000)	-0.92	-0.017	(-0.110, 0.076)	-7.80
Intermittent fasting	-0.008***	(-0.014, -0.003)	-3.67	0.027**	(0.003, 0.051)	12.39
Sleep quality	0.003	(-0.009, 0.014)	1.38	0.226*	(-0.014, 0.465)	103.67
<b>Interpersonal network level</b>						
Loneliness	0.115***	(0.065, 0.165)	52.75	-0.040	(-0.310, 0.231)	-18.35
Family health	0.100***	(0.080, 0.120)	45.87	-0.185	(-0.768, 0.398)	-84.86
Family communication	-0.033***	(-0.044, -0.021)	-15.14	0.278	(-0.167, 0.724)	127.52
Marital status	-0.002	(-0.006, 0.003)	-0.92	0.181***	(0.058, 0.304)	83.03
<b>Community level</b>						
Career status	-0.033***	(-0.043, -0.010)	-15.14	0.033	(-0.209, 0.276)	15.14
Family per capita monthly income (Chinese yuan)	-0.057***	(-0.091, -0.024)	-26.15	-0.203**	(-0.395, -0.011)	-93.12
Whether having debt	0.001	(-0.001, 0.002)	0.46	0.001	(-0.068, 0.070)	0.46
<b>Policy level</b>						
Public insurance coverage	0.005***	(0.001, 0.009)	2.29	0.135	(-0.143, 0.414)	61.93

Abbreviations: CI, confidence interval. \* P-value &lt; 0.1, \*\* P-value &lt; 0.05, and \*\*\* P-value &lt; 0.01





**Fig. 2** Main contributor factors (%) to the urban-rural disparities in anxiety among Chinese adults

the risk of anxiety [59, 60]. Another possible reason is that the fast-paced metropolitan environment may make individuals with no job exacerbate feelings of being even more alone and powerless [61, 62]. Similarly, compared to the simple consumption channels and scope of life faced in rural areas, high-income individuals living in urban areas often typically have higher standards of living and more material demands, thereby leading to increased

work pressure and social and familial expectations, all of which can increase the likelihood of anxiety symptoms [63–65].

Moreover, this study also revealed an association between being older and having less anxiety in urban areas, similar to previous studies [66, 67]. This can be explained by the phenomenon named the paradox of aging [68]. The multitude of obligations and stressors

associated with the urban lifestyle may prompt individuals to refine their emotional regulation strategies. As people age, they may become better at coping with uncertainty [69]. Meanwhile, they can tend to ignore irrelevant negative stimuli and respond less negatively to unfavourable events, thereby feeling less anxious [70].

Finally, males tend to exhibit less anxiety than females in urban areas, while gender differences have not been found in rural areas. More traditional gender roles and expectations may exist in rural areas, with males and females playing indispensably different roles in the family and community. In contrast, being male may confer certain advantages in urban environments characterized by heightened social disparities and pressures. It is well-known that females are often experiencing social weaknesses and are more likely to sign informal employment contracts than males [71]. In addition, because this study's data was collected during the COVID-19 pandemic, this finding also may be partly attributable to the far-reaching COVID-19 pandemic-related measures, such as school and daycare closures, which have forced females to engage in childcare and household chores at greater levels than before the pandemic [72–74]. However, males may not have taken on the same household responsibilities and may have felt more relaxed at home because they were getting rid of work pressures. This phenomenon is consistent with unequal divisions of housework in previous studies, and females bear the majority of home responsibilities [75, 76]. This all contributes to higher stress levels for females than males, thus suffering more frequently from anxiety and depression [77]. However, in rural areas, greater reliance on traditional agricultural livelihoods means little change in work styles and habits, potentially mitigating pandemic-related disruptions and, thus, the impact of gender-specific pressures.

The results of the Blinder Oaxaca decomposition analysis indicated the urban-rural differences in anxiety were associated with interpersonal network level (loneliness, family health, family communication), individual behaviors level (including health-related quality of life, self-rated health status), individual characteristics level (including age and education level), policy level (public insurance coverage), and community level (career status and family per capita monthly income). The difference in anxiety between rural and urban Chinese adults could be reduced by about 80% after improving the risk factors.

The interpersonal network level variables contributed most to explaining urban-rural disparities in anxiety among Chinese adults. First, loneliness was the most significant explanatory factor of anxiety differences within the interpersonal network level. Rural residents reported higher levels of loneliness in our study. Rural residents are experiencing reduced emotional support among

family members because of China's rapid urbanization and industrialization call for rural-to-urban migration of labor, thus may lead to a greater sense of isolation [78]. However, there is insufficient awareness of and intervention in mental health issues in rural residents, and they may lack effective ways of coping with loneliness, such as fewer opportunities to participate in community activities or to seek professional psychological services, thus making the effect of loneliness on anxiety more pronounced in the rural context and further increasing the difference in anxiety between urban and rural areas [79]. Second, family health also played a key role in the anxiety difference. Unlike urban families, rural families face multiple pressures, such as insufficient household income and limited ability to cope with family members' health problems [80, 81]. It is well-known that urban residents have access to more mental health resources than rural residents, and these resources are further expanded with government and family support. However, in the investment of health resources in mental health problems in rural areas, governmental support is insignificant, and rural residents' family members face the same dilemma [82]. Third, family communication also plays an important role in reducing the urban-rural anxiety difference. Urban residents reported significantly higher levels of family communication compared to rural residents, which may be attributed to urban families benefiting from greater social resources (e.g., widespread use of digital communication tools) that enable more frequent and effective interactions [83, 84]. Another possible reason is that the rapid expansion of Chinese cities and the high density of living environments have led to the fact that urban residents tend to live in more centralized areas and thus have more opportunities for interaction, which to some extent facilitates communication among family members. In contrast, with the migration of many rural young laborers, the distribution of members of many families has become more dispersed [85]. Contacts among rural family members are often limited by space and time, which weakens the frequency of interaction and communication in rural families. However, in rural families, the impact of improved communication levels on anxiety may be more pronounced and focused, as enhanced communication directly compensates for the lack of internal support in resource-limited environments, thereby narrowing the difference in resource utilization between rural and urban residents. Thus, the value of family communication is its role as a socially functional mechanism that effectively moderates urban-rural mental health inequalities in the context of imbalanced resource distribution.

In terms of individual behaviors level, self-rated health status was the largest positively explanatory factor of anxiety differences. There are obvious differences between

Chinese urban and rural residents' health concepts and health behaviors. Compared to rural residents, who have poorer resources for medical protection and health promotion, urban residents usually pay more attention to health management, tend to have regular medical check-ups, and adopt positive health behaviors, and thus, they have a more optimistic assessment of their own health [86]. Rural residents may be more concerned about health-related economic pressures and life burdens, resulting in more anxiety [87]. In addition, differences in psychological coping mechanisms between urban and rural residents are a possible explanation. Rural residents may develop stronger anxiety when facing health problems due to a lack of adequate resources for psychological adjustment [88]. Thus, differences in self-rated health may amplify urban-rural differences in anxiety. In contrast, problematic Internet use was the largest explanatory factor for narrowing the anxiety difference between urban and rural areas at the individual behaviors level. The early and frequent Internet exposure of urban residents exposes them to longer periods of Internet-related anxiety, such as information overload, social media anxiety, and virtual social pressure [89, 90]. With the popularization of the Internet, more rural residents were getting in touch with it. However, rural residents are at a more elementary stage of Internet use, lack effective Internet use experience and coping strategies, and are more likely to fall into negative behaviors in Internet use. As a result, the anxiety level of rural residents regarding problematic Internet use is gradually approaching the urban level, leading to a narrowing of the urban-rural anxiety difference.

The individual characteristics level also contributed to the urban-rural difference in anxiety among Chinese adults. First, the differences in age distribution between urban and rural areas help reduce the overall anxiety disparity. This may reflect the balancing effect of higher proportions of older adults in rural areas, who may experience heightened anxiety due to limited resources, against the potential higher anxiety among younger urban populations driven by workplace stress and economic pressures [91]. In contrast, the unexplained component of age was not statistically significant, indicating that age-related disparities are primarily driven by observable factors (e.g., age distribution differences) rather than unmeasured or latent mechanisms, such as social support, cultural norms or policy environments linked to age. Second, urban areas tend to have higher-quality educational resources, such as high-quality schools, complementary learning opportunities, and stronger education-career connections [92]. Higher levels of education are usually associated with better mental health status, as higher levels of education imply higher socio-economic status and, therefore, higher capacity

to utilize social resources (e.g., health care), which can reduce life's uncertainties and anxieties [93]. In contrast, the lack of educational resources in rural areas may result in rural residents with lower levels of education being less competitive in the labor market, which generates economic stress and indirectly exacerbates anxiety [94]. This structural education gap may be an important explanatory factor for the difference in anxiety between urban and rural areas.

Regarding the community level, family per capita monthly income significantly mitigates the differences in anxiety symptoms between rural and urban areas. Social welfare policies, such as pro-poor initiatives in rural areas, could progressively narrow the urban-rural income difference, thereby reducing the urban-rural anxiety difference [95]. Furthermore, the large unexplained component may reflect the interaction of income with other unobserved factors (e.g., neighborhood characteristics, family structure, cultural practices), whose effects on urban-rural differences in anxiety have not been fully revealed. For example, high-income urban residents tend to live in more developed neighborhoods and enjoy more public resources and services, such as better community activities and cultural facilities [96]. Thus, although urban residents with higher incomes are more anxious, these community characteristics may be able to alleviate the anxiety associated with higher incomes, thereby reducing to some extent the difference in anxiety between urban and rural areas.

Public insurance coverage was also a significant explanatory factor of anxiety differences, which is at the policy level. Urban residents usually enjoy more comprehensive public insurance coverage, especially in terms of basic and commercial medical insurance, which can effectively reduce their burden in terms of medical expenses [97]. In contrast, public insurance coverage in rural areas is relatively inadequate, especially in some remote areas. Although the Government has reformed and improved health insurance in rural areas in many respects in recent years, many rural residents are still unable to fully enjoy sound public insurance benefits due to such factors as uneven urban-rural development, weak infrastructure, and limited channels for information dissemination, and thus tend to face additional obstacles when seeking psychotherapy and related mental health services [98]. Differences in public insurance coverage may, therefore, exacerbate the differences in anxiety levels between urban and rural residents.

Several policy recommendations can be made. First, improving interpersonal network levels in rural areas should be prioritized, as this was identified as the most significant factor explaining the urban-rural anxiety disparities. Setting up community-based programs that promote social interaction, strengthen family ties, and build

supportive neighborhood networks may help reduce anxiety levels among rural residents. One study has demonstrated developmental programs in rural communities may help reduce psychological morbidity [99]. Second, targeted mental health interventions should focus on vulnerable groups identified in our study, such as individuals who are unemployed, or individuals who have a spouse. These groups require tailored support, such as career counseling, and accessible mental health services. Finally, it is necessary to implement social welfare policies, including poverty alleviation initiatives in rural regions and social security programs in urban centers, to narrow the urban-rural mental health divide [95]. China's 14th Five-Year Plan points out that the dominance of resources and scenarios should be fully utilized, and the digital economy and the real should be integrated deeply, thereby prompting the transformation and update of the traditional industries [100]. Leveraging digital technologies to enhance interpersonal networks, promote online mental health services, and create digital-driven employment opportunities in rural areas can address critical factors contributing to anxiety disparities. Changes in industry structure over time may play a role in resolving imbalance in the dual structure of urban and rural areas, including industrial transformation and urbanization processes experienced in rural areas [101]. It is imperative to align our development strategies with those outlined by the government to bridge the urban-rural divide and thus contribute fundamentally to the equitable development of mental health in urban and rural areas.

There are several limitations in this study. First, as this study is a cross-sectional study, the identified factors can contribute to anxiety among Chinese adults but cannot provide causal inference. Second, due to the limited data collection of PBICR, we were unable to include all variables associated with anxiety. For example, the variables included in this study at the community level of SEM failed to include information related to social resources, such as community unemployment rate and green space availability, which may have limited the model's ability to explain the urban-rural anxiety difference comprehensively and led to some unexplained contributions. Future research should explore these unobserved factors to better understand the mechanisms that shape urban-rural anxiety differences and provide more empirical evidence for policy development. Third, data for this study were collected from self-reported questionnaires. Despite the measures taken in this study to ensure all respondents' anonymity and to avoid leading questions as much as possible, there is still the possibility of the effects of recall bias or social desirability bias, which could result in either an overestimation or underestimation of respondent's health status as well as other relevant variables, such as individual behavior and family factors.

## Conclusion

This study has shown that the prevalence of anxiety in rural residents was higher than that in urban residents, and intermittent fasting, marital status, career status, family per capita monthly income, age, and gender were associated with the urban-rural differences in anxiety among Chinese adults. The most important reason for the differences is the interpersonal network level. The results provided new evidence of urban-rural differences in anxiety among Chinese adults and will help to facilitate the development or adjustment of mental health prevention and treatment policies for older people in China. The government should increase its support and investment in mental health services in rural areas and identify urban-rural disparities explanatory factors to target precise intervention strategies, thereby narrowing the mental health differences between rural and urban.

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## Author contributions

Xuange Sun and Yibo Wu shared the first authorship on this work. Conceptualization: Xuange Sun, Yibo Wu, Yi Ma, and Shuang Zang; Methodology: Xuange Sun and Yibo Wu; Data collection: Yibo Wu; Data validation and analyses: Xuange Sun and Yibo Wu; Data interpretation: Xuange Sun and Yibo Wu; Writing—original draft preparation: Xuange Sun; Writing—review and editing: Xuange Sun, Yibo Wu, Juanxia Miao, Xue Wang, Yi Ma, and Shuang Zang; Supervision: Yibo Wu, Yi Ma, and Shuang Zang; Final approval of manuscript: Xuange Sun, Yibo Wu, Juanxia Miao, Xue Wang, Yi Ma, and Shuang Zang.

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## Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

This study followed the tenets of the Declaration of Helsinki and received approval from the Ethics Research Committee of the Health Culture Research Center of Shaanxi (No. JKWH-2022-02). All the participants voluntarily participated in the study and signed an informed consent form.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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