



Research article

The awareness rate of knowledge of chronic diseases and influencing factors among 4790 adults in anhui province: An online survey using WeChat

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ABSTRACT

Objective: To investigate public awareness about core information regarding chronic diseases and identify factors influencing that awareness among Anhui Province residents, provide a scientific basis for policy-making, and formulate corresponding intervention measures.

Methods: From March to April 2021, 12 provincial-level representative counties and districts of Anhui province in the China Adult Chronic Disease and Nutrition Surveillance were selected as survey sites, and 4790 residents were recruited for the survey using stratified multi-stage cluster random sampling. Basic details about the study participants were collected and their awareness of core information about major chronic diseases was measured through an online survey using WeChat.

Results: In 2021, the awareness rate of core information about chronic diseases among residents of Anhui Province was 54.93%. Multivariate logistic regression analysis showed that a higher awareness rate was associated with the following factors: non-housework occupations (agriculture, forestry, animal husbandry, and fishery: OR = 1.309, commercial services and production and transportation: OR = 1.450, institutions, and professional and technical personnel: OR = 1.461), a high education level (high school/junior high school/technical school OR = 1.357, college and above OR = 2.133), and residence in the southern and northern Anhui areas (southern Anhui OR = 1.282, northern Anhui OR = 1.431); whereas in rural areas (by district and country) (OR = 0.863), the awareness rate was low (all $P < 0.05$).

Conclusions: The awareness rate of core information about chronic diseases among residents of Anhui, China, is low. It is necessary to strengthen awareness about chronic disease prevention and management by targeting specific groups of people in this region.

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1. Introduction

Non-communicable diseases (NCDs), also known as chronic diseases, are a general term for a group of diseases characterized by insidious onset, prolonged duration, and lack of clear evidence of an infectious cause [1]. A study published by The Lancet showed that NCDs accounted for 73% of global deaths in 2017. Like many other nations, China has been facing serious challenges in controlling NCD incidence [1]. From the 1990s to the present, chronic NCDs have replaced infectious diseases and maternal and infant diseases as the main high-risk factors for mortality [2]. With the impact of industrialization, urbanization, accelerated population aging, and unhealthy lifestyles, the incidence of NCDs has been rapidly increasing, and NCDs such as cardiovascular and cerebrovascular diseases and malignant tumors [3] have become the main causes of death. NCDs account for 80% of the total deaths in China and nearly 70% of the total disease burden [4,5]. Deaths due to NCDs accounted for 88.5% of total deaths in China in 2019 [6], and this figure was 88.78% in Anhui Province (hereafter “Anhui”), where NCDs such as malignancy, diabetes, cardiovascular disease, and major respiratory diseases have become common [7].

At present, China has entered a period of high burden of chronic diseases, which are characterized by “large number of patients, high medical costs, long illness time, and high demand for services.” Chronic diseases have become a major public health problem that affects the improvement of the health level of our residents and hinders economic and social development [8]. Current research has discovered many influencing factors that influence chronic disease awareness, but some influencing factors are still controversial. A questionnaire survey on the core knowledge of cancer prevention and treatment among esophageal cancer/gastric cancer patients in four provinces, Jiangsu, Anhui, Shandong, and Henan, showed that men (49.51%) had a higher disease awareness rate than women (46.82%) [9], but Qian et al. found that gender has no impact on awareness of chronic diseases [10]; Han et al. research shows that older residents are more likely to know the core information on chronic disease prevention and control. It may be that the prevalence of chronic diseases is higher in older people, which in turn affects Chronic disease knowledge is also of great concern [11], but Qi et al. found that the passing rate of the core knowledge of chronic disease prevention and treatment among elderly residents was low [12]. The knowledge-belief-action model theory emphasizes that knowledge is the foundation. Only after a certain understanding of relevant knowledge about chronic disease prevention and control can corresponding behaviors be adopted to ultimately achieve the effect of controlling chronic diseases [13]. In the chronic disease prevention and control strategy, it is crucial to improve residents’ health literacy, correctly master chronic disease prevention and control skills, and cultivate residents’ healthy behaviors. In summary, it is of great significance and urgency to investigate the chronic disease knowledge of residents in Anhui Province as soon as possible.

The increase in NCDs brings a series of problems such as the increased risk of death, excessive consumption of medical resources, and increased economic burden [14–16]. Studies have found that the incidence of NCDs is related to the level of knowledge about NCDs among the population [17,18]. In December 2016, the National Health Commission of the People’s Republic of China incorporated the rate of residents’ awareness of core information about major NCDs into one of the indexes while constructing the National Demonstration Zone for Comprehensive Prevention and Control of NCDs [19]. Both national and Anhui’s medium- and long-term plans for the prevention and control of NCDs (2017–2025) [20] propose to carry out public education on the prevention and control of NCDs aiming for a 60% awareness rate by 2020 and 70% by 2025. In Anhui, no representative survey study on the awareness of core information about NCDs has been conducted in the past. During the mid-term evaluation of the implementation of China’s Medium- and Long-term Plan for Prevention and Control of NCDs (2017–2025) organized by the National Health Commission of the People’s Republic of China, we conducted a provincial survey using the nationally unified questionnaire and the online survey platform developed in 2020 by the Chronic Disease Centre of the Chinese Centre for Disease Control and Prevention. The survey was carried out between March and April 2021 with the aim to analyze the awareness rate of chronic disease prevention and control and the influencing factors, so as to provide a scientific basis for further development of intervention measures and evaluation of chronic disease planning in the province.

2. Materials and methods

2.1. Study design and participants

Twelve counties and districts that are representative of the China Adult Chronic Disease and Nutrition Surveillance at the provincial level were selected as survey sites. Considering feasibility and economic validity, a stratified multi-stage cluster random sampling method [21,22] was used. In the first step, two towns and two subdistricts were selected from each county and district (probability sampling proportional to population size, i.e., PPS method); in the second step, three administrative villages were selected from each township or three residents’ committees from each subdistrict (PPS method); in the third step, one villagers’ group and one resident group with at least 300 households were taken from the selected administrative villages and residents’ committees, respectively (simple random sampling method); in the fourth step, 33 permanent inhabitants aged 18 years and above were selected from each villager/resident group (equal proportional random sampling method), with permanent inhabitants defined as those who have lived in the area for more than 6 months in the past 12 months. Finally, each surveillance point was required to complete approximately 400 questionnaires.

2.2. Online survey and quality control

From March 15 to April 15, 2021, the survey was conducted using a questionnaire developed by the Chronic Disease Center of the Chinese Center for Disease Control and Prevention. All respondents filled in questionnaires online by scanning QR codes on their

mobile phones, and one mobile phone could only complete the questionnaire once. The surveyors guided and assisted the respondents in completing the questionnaire. Affected by the COVID-19 epidemic and in order to comply with the national epidemic prevention policy, before starting the investigation, we verbally informed all participants of the purpose of this study, possible risks and precautions in a one-on-one manner. We assure all participants that their rights and interests will not be affected and personal information will not be disclosed. All participants participated in the survey voluntarily and had the right to withdraw from the survey midway. At the same time, all participants agreed that the survey data would be used for publication. The questionnaire used in this study was compiled by the China Health Education Center commissioned by the Bureau of Disease Control and Prevention of the National Ministry of Health of China, Expert discussions were conducted to ensure that the questionnaire had good content validity; the internal consistency of the questionnaire was tested, and the Cronbach's α coefficient of the questionnaire was calculated to be 0.926. Finally, after expert discussion, the full score of this questionnaire was set to 75 points, with 63 points being the critical value for understanding the core knowledge of chronic diseases. The questionnaire consisted of two parts: basic information about the respondents and core information about major NCDs.

There were 20 core knowledge questions in total including single-choice and multiple-choice questions. There were 8 single-choice questions, with 2 points for the correct answer and 0 points for an incorrect answer for each question. There were 11 multiple-choice questions (except question 7), each with 5 response options, scored as 1 point for each correct option, with a maximum of 5 points per question. In the 7th question among multi-choice questions, the total of options B, C, D, and E was 4 points, and if option A was not selected, the rest of the options could each get 1 point, with a total of 4 points. A and B were mutually exclusive options; if B and A were checked simultaneously, then option B was not scored.

The quality control measures used in this study included uniform training of investigators, adequate explanation to respondents, randomness of the order of questions, and national and provincial levels of reexamination.

2.3. Regional division

There are two different ways to classify urban and rural areas. The first is to divide the 12 survey sites into urban areas (including the districts of Jinghu, Yingzhou, Yongqiao, and Yushan) and rural areas (including Chaohu City, Guzhen County, Mengcheng County, Shitai County, Shou County, Tianchang City, Wangjiang County, and Jing County) by district and county. The second is to divide them into urban areas (all the selected subdistricts in the 12 districts and counties) and rural areas (all the selected subdistricts in the 12 districts and counties) by subdistricts and towns. Bounded by the Huai River and Yangtze River, they are divided into three zones:

Table 1
The socio-demographic characteristics of the study subjects.

	Category and description	Number of participants, n (%)
Gender	Male	2345(48.96)
	Female	2445(51.04)
Age	18~34	1666(34.78)
	35~44	1242(25.93)
	45~59	1442(30.10)
	≥60	440(9.19)
Education	Primary school and below	1184(24.72)
	Junior high school	1893(39.52)
	High school/junior college/technical school	835(17.43)
	College and above	878(18.33)
Occupation	Agriculture, forestry, animal husbandry, and fisheries	1173(24.49)
	Commercial services and production transport	744(15.53)
	Institutional and professional	770(16.08)
	Housekeeping	547(11.42)
	Retirement	221(4.61)
	Other	1335(27.87)
Self-reported chronic diseases	Yes	811(16.93)
	None	3979(83.07)
Urban and rural (by township and subdistrict)	Urban areas	2122(44.30)
	Countryside	2668(55.70)
Area	Southern Anhui	1705(35.59)
	Central Anhui	1513(31.59)
	Northern Anhui	1572(32.82)
Urban and rural (by district and county)	City	2509(52.38)
	Rural areas	2281(47.62)

southern Anhui (including Jinghu District, Yushan District, Shitai County, and Jing County), central Anhui (Chaohu City, Shou County, Tianchang City, and Wangjiang County), and northern Anhui (including Yingzhou District, Yongqiao District, Guzhen County, and Mengcheng County).

2.4. Inclusion and exclusion criteria

Inclusion criteria: ① Participants who used WeChat to scan the QR code; ② Permanent residents aged 18 or above (residing here for 6 months or more in the past 12 months); ③ Be mentally sound and voluntarily cooperate with investigators.

Exclusion criteria: ① Participants who repeated the WeChat scan (only keep data once); ② Participants with incomplete information.

2.5. Statistical analysis

SPSS 23.0 software was used for statistical analysis of data. Count data were expressed as n (%), and the Pearson chi-square test and Fisher's exact test were used to compare awareness rates between different groups. Taking whether the respondent knows about

Table 2

Population and regional differences in awareness rate of core information about chronic diseases.

Variables	Sample size	Unsure	Knowing	χ^2 value	P value
Gender				0.086	0.77
Male	2345	1062 (45.29)	1283 (54.71)		
Female	2445	1097 (44.87)	1348 (55.13)		
Self-reported chronic diseases				1.827	0.176
None	3979	1776 (44.6%)	2203 (55.4%)		
Yes	811	383 (47.2%)	428 (52.8%)		
Age (years)				10.159	0.017
18~34	1666	705 (42.32)	961 (57.68)		
35~44	1242	558 (44.93)	684 (55.07)		
45~59	1442	683 (47.36)	759 (52.64)		
≥60	440	213(48.40)	227(51.59)		
P for trend*	<0.001				
Education				105.947	<0.001
Primary school and below	1184	600 (50.68)	584 (49.32)		
Junior high School	1893	936 (49.45)	957 (50.55)		
High school/junior college/technical school	835	354 (42.40)	481 (57.60)		
College and above	878	269 (30.64)	609 (69.36)		
P for trend*	<0.001				
Occupation				59.613	<0.001
Agriculture, forestry, animal husbandry, and fisheries	1173	555 (47.31)	618 (52.69)		
Commercial services and production transport	744	307 (41.26)	437 (58.74)		
Institutional and professional	770	266 (34.55)	504 (65.45)		
Housekeeping	547	288 (52.65)	259 (47.35)		
Retirement	221	98 (44.34)	123 (55.66)		
Other	1335	645 (48.31)	690 (51.69)		
Urban and rural (by township and subdistrict)				4.541	0.033
Urban	2122	920 (43.36)	1202 (56.64)		
Countryside	2668	1239 (46.44)	1429 (53.56)		
Area				25.315	<0.001
Southern Anhui	1705	699 (41.00)	1006 (59.00)		
Central Anhui	1513	754 (49.83)	759 (50.17)		
Northern Anhui	1572	706 (44.91)	866 (55.09)		
Urban and rural (by district and county)				10.939	0.001
City	2509	1074 (42.81)	1435 (57.19)		
Rural areas	2281	1085 (47.57)	1196 (52.43)		

P for trend* is the p value of trend analysis.

chronic diseases as the dependent variable, and gender, age, education, occupation, self-reported chronic diseases, region, and area as the independent variables, the logistic regression model was used to analyze the influencing factors of core knowledge on chronic disease prevention and treatment, and a two-sided test was used. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Socio-demographic characteristics

A total of 4790 valid questionnaires were obtained. There were 2345 males (48.96%) and 2445 females (51.04%); The proportions of survey respondents in the age groups of 18–44, 45 to 59, and 60 and above are respectively 60.71%, 30.1% and 9.19%, the urban and rural(by district and county) population proportions were 52.38% and 47.62% respectively; the southern, central and northern population proportions were 35.59%, 31.59% and 32.82% respectively; the largest number of people with junior high school education accounted for 39.52 % (Table 1).

Table 3
Multivariate logistic regression analysis of factors influencing the awareness rate of core information about chronic diseases.

Variables	β	Standard Error	Z value	P value	OR	95%CI
Gender						
Male					1.000	
Female	0.076	0.062	1.222	0.222	1.079	0.955 , 1.218
Age (years)						
18~34					1.000	
35~44	0.100	0.080	1.243	0.214	1.105	0.944 , 1.294
45~59	0.084	0.087	0.962	0.336	1.087	0.917 , 1.289
≥60	0.085	0.133	0.640	0.522	1.089	0.839 , 1.412
Education						
Primary school and below					1.000	
Junior High School	0.030	0.082	0.364	0.716	1.030	0.878 , 1.209
High school/junior college/technical school	0.305	0.106	2.870	0.004	1.357	1.102 , 1.671
College and above	0.758	0.124	6.102	<0.001	2.133	1.672 , 2.721
Self-reported chronic diseases						
None					1.000	
Yes	-0.070	0.086	-0.819	0.413	0.932	0.787 , 1.103
Urban and rural (by district and county)						
City					1.000	
Rural areas	-0.147	0.063	-2.351	0.019	0.863	0.763 , 0.976
Urban and rural (by township and subdistrict)						
Urban					1.000	
Countryside	0.116	0.069	1.677	0.093	1.123	0.981 , 1.286
Occupation						
Housekeeping					1.000	
Agriculture, forestry, and fisheries	0.269	0.107	2.511	0.012	1.309	1.061 , 1.615
Commercial services and production transport	0.372	0.123	3.023	0.003	1.450	1.140 , 1.845
Institutional and professional	0.379	0.134	2.833	0.005	1.461	1.124 , 1.898
Retirement	0.246	0.179	1.376	0.169	1.279	0.901 , 1.816
Other	0.083	0.109	0.763	0.446	1.086	0.878 , 1.344
Area						
Central Anhui					1.000	
Southern Anhui	0.248	0.074	3.356	0.001	1.282	1.109 , 1.482
Northern Anhui	0.358	0.073	4.881	<0.001	1.431	1.239 , 1.652

3.2. Awareness rate of core information about chronic diseases

The overall knowledge rate was 54.93% (2631/4790). The minimum score for core information about NCDs was 11, the maximum score was 75, and the median score was 64. The differences in awareness rates among different ages, education, occupations, urban and rural areas (by township and subdistrict), area (divided into southern, central, and northern Anhui), and urban and rural areas (by district and county) were all statistically significant (Table 2).

3.3. Logistic regression analysis of factors influencing the awareness rate of core information about chronic disease prevention and control

A multivariate logistic regression model was developed using awareness of core information on NCDs as the dependent variable and age, gender, education, self-reported chronic diseases, occupation, area (divided into southern, central, and northern Anhui), and urban-rural area (by district and county, by district and county) as the independent variables. Multivariate logistic regression analysis showed that a higher awareness rate was associated with the following factors: non-housework occupations (agriculture, forestry, animal husbandry, and fishery: OR = 1.309, commercial services and production and transportation: OR = 1.450, institutions, and professional and technical personnel: OR = 1.461), a high education level (high school/junior high school/technical school OR = 1.357, college and above OR = 2.133), and residence in the southern and northern Anhui areas (southern Anhui OR = 1.282, northern Anhui OR = 1.431); whereas in rural areas (by district and county) (OR = 0.863), the awareness rate was low (all $P < 0.05$). (Table 3). In addition, we performed regression diagnosis (see Supplementary Tables 1 and 2), and the VIF of all independent variables is less than 10, indicating that there is no multicollinearity between the independent variables. Omnibus Tests of model coefficients showed that the model was generally meaningful.

In addition, the interaction terms of urban-rural residence and geographic area were also conducted, and the results showed that there was an interaction between the two variables, as shown in Table 4.

4. Discussion

4.1. Principal findings

The results of this survey showed that the awareness rate of core information about NCDs among residents of Anhui was 54.93%. Univariate analysis showed that age, education, occupation, and urban/rural area were important factors influencing awareness level, which is consistent with the findings of a study in Henan Province, China [12]. The awareness rate demonstrated a decreasing trend with increasing age, likely because young people have more access to related information and are more receptive to information [23]. Education was positively associated with the awareness rate, which may be due to the relatively higher health literacy of the more educated residents and their ability to acquire health-related knowledge [24,25].

There were also differences in the awareness rates among different occupational groups, which is consistent with the results reported in Handan City and other places [26], suggesting that different forms of health education activities should be adopted according to the occupational characteristics of various groups of people [27,28]. A study on the nutrition and health knowledge of Wuhan residents showed that medical workers and educators tend to know more about nutrition than other professions [29]. The explanation for this result may be that due to their occupational characteristics, this group of people not only have more access to disease and health knowledge during education but also have more opportunities to obtain disease information at work. It inspires researchers to give full play to the role of medical staff, nutritionists, educators, and other professional teams in the future, and provide targeted health knowledge popularization in communities, rural areas, schools, and other places.

In addition, this study also found awareness rates differ in regions, among which the rate of southern and central Anhui is the highest and lowest respectively. Therefore, health education knowledge on chronic disease prevention and control in central Anhui needs to be strengthened.

The awareness rate of rural residents (by district and county) is lower than that of urban residents, indicating that there is still a lack of awareness of chronic disease hazards among rural residents, and the rural economy, the education level of residents, and the condition of health services are relatively weak, which increases the difficulty of rural residents in acquiring knowledge related to NCDs [30]. At present, rural areas should still be considered key targets for health education on chronic disease prevention and control. The results of this study show that health education must be multifaceted and targeted to achieve better results, which suggests that health education in rural areas should be conducted in a more acceptable, multi-channel, sustainable, and appropriate way according to the characteristics of rural residents.

In this study, no significant difference in core knowledge awareness rate by gender, which is consistent with the findings in Henan Province but different from the report from Jingjiang City that males are better informed than females [31], which may be related to the selection of the survey sample.

Table 4

The interaction terms of urban-rural residence and geographic area.

Variables	Estimate	Standard Error	Z value	P value
Urban-rural residence (by township and subdistrict)*Area	0.143	0.0718	1.987	0.047
Urban-rural residence (by district and county)*Area	0.241	0.0715	3.370	<0.001

As there was no uniform standard core knowledge questionnaire for NCDs nationwide in the past, most questionnaires were self-administered in different places, such as 10 questions randomly selected from a pool of 100 core questions for survey respondents in Henan Province [12], and a self-administered 10-item core knowledge questionnaire used for the survey in Jingjiang City [31]. A questionnaire survey based on the National Health Literacy Survey was conducted in Hubei Province, with 9 questions and a total score of 12 points. A cumulative score of 10 points or more was considered as having chronic disease health literacy [32]. Thus, the core knowledge rates were not comparable across regions.

Given the low awareness rate of core knowledge of chronic diseases, the Anhui government has taken measures with the support of the state. In May 2019, it collaborated with Jiangsu and Zhejiang Provinces to build “Internet + Medical Health,” and explored the establishment of Internet hospitals, achieving good results [33]. Online platforms were used to publish chronic disease information through efforts such as the WeChat mini-program [34], which was welcomed by residents. The second measure undertaken by the Anhui government was to vigorously develop community hospitals and family contract doctor services [35] through the development of primary health institutions to spread chronic disease knowledge, and the actions taken include the establishment of health records, health management of chronic disease patients, and the signing of family doctors [36]. In terms of security, the government proposed many specific measures, such as basic medical insurance for urban and rural residents and medical assistance [37], which are expected to narrow the gap between regions in terms of accessibility and affordability of health care and solve the problems of difficult and expensive medical treatment for patients. Moreover, measures are being taken to strengthen patients’ awareness of medical care facilities and increase the awareness rate of NCDs.

The advantages of this study are as follows. First, this study is the first to investigate the public cognition of the core information of NCDs in Anhui province. The questionnaire used was compiled by experts from the Chinese Center for Disease Control and Prevention with high reliability and validity, and the results are relatively reference; Secondly, this study adopted the method of stratified, multi-stage, whole-group random sampling. The survey subjects were from 12 representative disease surveillance sites in Anhui province, with no less than 400 people in each monitoring site, including southern Anhui, northern Anhui, and central Anhui. The sample size was large and representative, and the survey results were more realistic and objective.

4.2. Limitations

The main limitation of this study is that respondents had to use the WeChat mini program to answer the questions, which increases the possibility of poor understanding and inaccurate self-reporting. Older people may have difficulty using WeChat, which may lead some of them to need help from family members to complete the questionnaire. As a result, the percentage of older adults participating in this study was low. Given this problem, the author will pay more attention to the problems that may occur when the elderly use electronic products in future research, and take certain measures to avoid these problems, such as providing paper versions of questionnaires or personal guidance to fill in.

5. Conclusions

In summary, the awareness rate of core information about NCDs in Anhui is low in 2021. The focus should be on strengthening education on chronic disease prevention and treatment for the elderly, people with low education, and rural residents. Meanwhile, efforts should also be made to expand the forms and channels of health education, cultivate grassroots talent, and promote the integration of urban and rural areas.

6. Summary table

What was already known on the topic.

1. The awareness rate of core information about NCDs in Anhui is low. The elderly population, people with low education, and rural residents are key groups that need to strengthen their knowledge of NCDs.
2. The promotion of chronic disease knowledge needs to consider the characteristics of the interviewees and utilize different methods of chronic disease knowledge dissemination according to different ages, geographical environments, and literacy levels to enhance the acceptance and understanding of chronic disease knowledge.

What this study added to our knowledge.

3. This is the first study to investigate the awareness rate of core knowledge of chronic diseases among residents from Anhui province, China, as well as its influencing factors, to provide a scientific basis for policy formulation in this area.
4. The present study selected 12 counties and districts with provincial representativeness for adult chronic disease and nutrition surveillance as survey sites and applied a stratified multi-stage whole-group random sampling method to survey with full consideration of feasibility and economic validity.

Ethics statement

This study was approved by the Biomedical Ethics Committee of Anhui Medical University (ethics number: 20,210,490, ethics

approval date: March 1, 2021). The study was conducted in accordance with the ethical standards stipulated in the Declaration of Helsinki. Affected by the COVID-19 epidemic, the researcher informed all participants of the oral informed consent before the study. All participants understood and voluntarily participated in this study, and they agreed that the data would be used for paper published.

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Data availability statement

Our study involved personally identifiable information about the participants. If the datasets analysed during the current study are publicly available, there would be a risk of revealing personal privacy. Therefore, the data is not publicly available. We declare that our data is not public. If you have a strong demand, please contact the corresponding author (W-GC 469821743@qq.com) to obtain.

CRedit authorship contribution statement

Xiu-Ya Xing: Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Zhen-Zhen Wu:** Writing – review & editing, Software, Funding acquisition, Data curation. **Hua-Dong Wang:** Supervision, Software, Data curation, Conceptualization. **Wei Xu:** Resources, Project administration, Methodology, Investigation. **Dan Cao:** Visualization, Validation, Supervision, Software. **Zhi-Rong Liu:** Funding acquisition, Formal analysis, Data curation, Conceptualization. **Guo-Cui Wu:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Abbreviations

NCDs Non-communicable diseases
PPS probability sampling proportional to population size

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e28366>.

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