

# Regional heterogeneities of health literacy in China: a population-based study

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## Research article

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# Abstract

**Background:** Few studies have described the geographic variation in health literacy in China. This study aimed to investigate the regional heterogeneities in health literacy levels in the Chinese population, in order to formulate targeted health literacy promotion strategies in different economic and cultural contexts.

**Methods:** Multi-stage stratification, clustering, and random sampling methods were used to select 70 study sites from 25 provinces or municipalities in China in 2017. Health literacy was measured using the National Resident Health Literacy Monitoring Questionnaire. MapInfo software was used to map the geographic distribution. Multiple logistic regression was used to adjust for the factors associated with the health literacy level in the total and regional samples.

**Results:** A total of 3,482 participants were included in the study, including 1,792 (51.5%) males and 1,690 (48.5%) females. Notable geographic variation was observed in the health literacy level. The proportion of respondents with adequate health literacy was 22.3% overall, 33.0% in the eastern region, 23.1% in the central region, and 17.6% in the western region. The proportion of adequate health literacy in the different provinces or municipalities ranged from 10.5%(Xinjiang) to 47.0%(Beijing). Being a female (odds ratio [OR]=1.360, 95% confidence interval [CI]: 1.153-1.605), having a higher education level (OR=1.860, 95% CI: 1.671-2.070), having a better economic status (OR=1.353, 95% CI: 1.220-1.502), having a better self-rated health status (OR=1.263, 95% CI: 1.081-1.476), and having more community health education (OR=1.192, 95% CI: 1.034-1.374) were independently associated with adequate health literacy.

**Conclusions:** The health literacy level of Chinese people is still low, and there are heterogeneities among different regions, between urban and rural areas, and among different social groups. The methods used to improve the health literacy levels of people in different regions should be adapted to local conditions. In the central and eastern regions, low-income people are the focus of health literacy improvement efforts. Special emphasis should be placed on the degree of health knowledge publicity and the accessibility of health knowledge and skills in the central and western regions.

## Background

Health literacy refers to the ability of individuals to acquire and understand basic health information and services and to use them to make informed decisions to maintain and promote their health [1]. The definition of health literacy that has been proposed by the WHO is considered to include the promotion and improvement of individual and community health [2]. Many studies with various methodologies have shown that deficiencies in health literacy are related to worse life expectancy and quality of life, poor healthcare utilization and health outcomes (higher mortality rates and worse overall health status), and health disparities [3-6]. The economic implications of low health literacy are substantial, with some estimates accounting for up to 5% of health care costs annually [7]. People with low health literacy do not always understand self-care procedures or the advice given by doctors and cannot effectively use today's

complex healthcare systems, and this is associated with lower life expectancy and increased health care costs [8]. Improvements in health literacy are an effective and easy way to improve health [9]. Governments and national agencies in the USA, China, Australia, and some European countries have developed national strategies and targets to improve health literacy in their populations. China is a vast territory, and the conditions in different regions vary widely. The level and status of regional economic and social development are different. Health disparities persist across China's three geographic regions: eastern, central and western. Health outcomes in the western region are generally poorer than those in the central or eastern regions [10]. Additionally, the level of health literacy is affected by social factors, such as the economy and culture [11]. Few studies have described the geographic variation in health literacy in China. This study aimed to understand the health literacy levels, distribution characteristics and influencing factors of residents in different regions of China, to investigate the regional heterogeneities of health literacy levels in the Chinese population, and to provide a scientific basis for formulating targeted health literacy promotion strategies in different economic and cultural contexts.

## Methods

### *Study design*

The study investigated the health literacy levels, their distribution characteristics and their influencing factors in China. Health literacy was measured using the National Resident Health Literacy Monitoring Questionnaire. MapInfo software was used to map the geographic distribution. Multiple logistic regression was used to adjust for the factors associated with the health literacy level in the total and regional samples. The study subjects were permanent residents aged 15-69 years who had continuously lived in the survey areas for more than 6 months.

The research protocol was reviewed and approved by the Medical Ethics Committee of Central South University. All participants (aged 16 and upwards) who agreed to participate in the study signed an informed consent form at the beginning of the survey. Written informed consent was obtained from a parent or guardian for participants under 16 years old.

### *Sampling methods*

There are 34 provincial administrative regions in China. After comprehensively considering factors such as geography, economic level, population, accessibility of investigation capacity, project funding, etc., 25 provinces were non-randomly selected for investigation. Multi-stage stratification, clustering, and random sampling methods were used to randomly select a total of 70 survey points nationwide among the 25 provinces or municipalities (6 in the eastern region, 8 in the central region, and 11 in the western region) in China, with the selection of 1-2 urban and rural survey points in each province according to regional and population factors, followed by the random, step by step selection of the sample areas (counties), streets (townships) and neighbourhood committees (villages). Furthermore, 50 households were randomly selected from each community according to the community's resident roster, and then one eligible respondent was randomly selected from each selected household. The sample size (N = 2419) was

calculated to ensure a proportion estimation of adequate health literacy with  $\alpha = 0.05$  based on a conservative assumption of a 15% proportion.

### ***Study measures***

#### ***Demographic characteristics***

The social demographic characteristics included gender, age, place of residence, community type, marital status, education level, and economic status. According to the region classification in the China Health Statistics Yearbook, the surveyed residences were divided into the eastern, central, and western regions. Based on 75% and 125% of the median annual household income per capita, economic status was divided into the poor, medium, and good categories.

#### ***Health literacy***

The National Resident Health Literacy Monitoring Questionnaire (NRHLMQ), prepared by the China Health Education Center, was used to measure health literacy. The overall Cronbach's alpha of the NRHLMQ was 0.95, and the Spearman-Brown coefficient was 0.94 [12]. Confirmatory factor analysis showed that the questionnaire measured a unidimensional construct with three highly correlated factors [12]. It included three dimensions: (1) basic knowledge and attitudes (BKA), (2) healthy lifestyles and behaviours (HLB), and (3) health-related skills (HRS). The NRHLMQ covered six domains: scientific views of health (SVH), prevention and treatment of infectious diseases (PTID), prevention and treatment of chronic diseases (PTCD), safety and first aid (SFA), basic medical care (BMC), and health information (HI).

There are three types of questions in the NRHLMQ: true or false (1 point for each correct response), single answer (only one correct answer in a multiple-choice question, 1 point for each correct response), and multiple answer (more than one correct answer in a multiple-choice question, 2 points for each correct response). For the multiple-answer questions, the correct response had to contain all of the correct answers and none of the wrong ones.

The total score of the NRHLMQ is 66 points, with the total scores of the three dimensions being 28 (BKA), 22 (HLB), and 16 (HRS) points. The total scores of the SVH, PTID, PTCD, SFA, BMC, and HI are 11, 7, 12, 14, 14, and 8 points, respectively.

A total score of 53 (80% of 66) points and above was determined to indicate adequate health literacy (adequate HL). A score of 0 to 52 was considered as limited health literacy (limited HL). The health literacy level was defined as the proportion of participants who had adequate health literacy out of the total number of participants. The judging criteria for adequate HL in each dimension or domain were  $\geq 80\%$  of the total score of the dimension or domain [12-13].

#### ***Health status***

The self-evaluation health status was used as the evaluation index, which was divided into the good, fair, and poor levels. In addition, the original question was, "In the past year, what do you think of your health status?"

### ***Community health education***

We used the number of health talks to assess community health education, and the original question was, "What is the number of health talk in your community in the past three years?" The self-reported frequency of participation in community health talks in the past three years was divided into three categories (0 times, 1-9 times, and  $\geq 10$  times).

### ***Survey method***

In the pre-investigation stage, a certain number of respondents were randomly selected from the sample locations for pre-surveys, focusing on whether the questionnaire entries could be understood and whether ambiguity was generated. The results showed that the respondents could understand the contents of the questionnaires. In the formal investigation phase, individual interviews were used to collect information. In the re-testing phase, which was two weeks after the formal investigation, the investigators re-tested 155 respondents who were selected using a random number table according to numbers assigned to the questionnaires. All stages of the investigation were completed by undergraduate students majoring in preventive medicine. Prior to the investigation, all investigators were given uniform training for this survey. The investigation was conducted from January to April 2017.

### ***Statistical analyses***

Statistical analysis was conducted with SPSS version 19.0 (IBM Corp., Armonk, NY, USA) and MapInfo Professional version 7.0 (Pitney Bowes MapInfo Corp., Stamford, USA). The integrity check was done before submitting the questionnaire, and questionnaires with missing values were not included in the analysis (there were 3 questionnaires with missing values). Prior to the analysis, data were screened for outliers and out of range values. No outliers or out of range values were found. The general conditions and health literacy of the sample were statistically described as the mean  $\pm$  standard deviation, composition ratio, median, and frequency distribution table. To evaluate the factors of health literacy, the health literacy score was dichotomized into two categories: adequate and limited. The chi-square ( $\chi^2$ ) test was used to compare the health literacy levels among different characteristic groups. The geographic variations of health literacy levels were described using MapInfo software, and the National Platform for Common Geospatial Information Services of China provided the map. A series of multiple logistic regressions was used to adjust for the relevant factors associated with the health literacy level in the total and regional samples. The logistic regression analyses were performed with gender, age group, marital status, community type, education level, economic status, self-rated health status, and frequency of participation in community health education as the independent variables; adequate health literacy served as the dependent variable in the total and regional samples. An adequate HL equation was

established using a multiple logistic regression model with the stepwise forward (LR) method. The results of all hypothesis tests with  $p$ -values  $< 0.05$  (two sided) were considered statistically significant.

## Results

### *Basic characteristics and health literacy levels*

Among the 3,600 surveyed people, 3,482 valid questionnaires without apparent logical errors or missing items were obtained, yielding an effective response rate of 96.7% (3,482/3,600) for the questionnaire. The respondents included 566 (16.3%) individuals in the eastern region, 1397 (40.1%) in the central region, and 1519 (43.6%) in the western region (Table 1). The male: female ratio was 1.06:1, and the average age was  $34.27 \pm 13.72$  years old. The education level of the respondents was mainly college and above, accounting for 51.3% of the sample. The ethnic group was mainly Han, accounting for 81.5% of the sample. With respect to marital status, the majority of participants (57.7%) were married. The median annual income per capita was 20,000 CNY. A portion (60.6%) of the respondents had not participated in community health education within the past three years. No statistically significant difference was found for the gender composition ( $\chi^2=4.962$ ,  $P=0.084$ ) or age composition ( $\chi^2=7.201$ ,  $P=0.126$ ) of the respondents among the eastern, central, and western regions.

The univariate analysis showed that gender, age, region, community type, education level, self-rated health status, economic status, and the frequency of participation in community health education were the influencing factors associated with the health literacy level (Table 1).

**Table 1. Association between health literacy level and basic characteristics.**

Characteristics	Health literacy		Percentage (%)	Chi-square	P Value
	Adequate HL (%)	Limited HL (%)			
<b>Gender</b>				13.060	<0.001
Male	356 (45.8)	1436 (53.1)	1792 (51.5)		
Female	422 (54.2)	1268 (46.9)	1690 (48.5)		
<b>Age group (years)</b>				28.972	<0.001
15~	392 (50.4)	1192 (44.1)	1584 (45.5)		
30~	325 (41.8)	1104 (40.8)	1429 (41.0)		
50~	61 (7.8)	408 (15.1)	469 (13.5)		
<b>Region</b>				57.142	<0.001
Eastern region	187 (24.0)	379 (14.0)	566 (16.3)		
Central region	323 (41.5)	1074 (39.7)	1397 (40.1)		
Western region	268 (34.4)	1251 (46.3)	1519 (43.6)		
<b>Community type</b>				8.700	0.003
Urban	488 (62.7)	1536 (56.8)	2024 (58.1)		
Rural	290 (37.3)	1168 (43.2)	1458 (41.9)		
<b>Education level</b>				174.930	<0.001
Elementary school and below	12 (1.5)	314 (11.6)	326 (9.4)		
Junior high school	55 (7.1)	487 (18.0)	542 (15.6)		
Senior high school	173 (22.2)	654 (24.2)	827 (23.8)		
College and above	538 (69.2)	1249 (46.2)	1787 (51.3)		
<b>Marital status</b>				3.621	0.058
Single	352 (45.2)	1120 (41.4)	1472 (42.3)		
Married	426 (54.8)	1584 (58.6)	2010 (57.7)		
<b>Self-rated health status</b>				23.071	<0.001
Good	559 (71.9)	1795 (66.4)	2354 (67.6)		
Fair	206 (26.5)	757 (28.0)	963 (27.7)		
Poor	13 (1.7)	152 (5.6)	165 (4.7)		
<b>Economic status</b>				65.537	<0.001
Good	294 (37.8)	704 (26.0)	998 (28.7)		
General	285 (36.6)	913 (33.8)	1198 (34.4)		
Poor	199 (25.6)	1087 (40.2)	1286 (36.9)		
<b>Community health education (frequency)</b>				7.429	0.024
0	442 (56.8)	1667 (61.6)	2109 (60.6)		
1~9	296 (38.0)	937 (34.7)	1233 (35.4)		
10~	40 (5.1)	100 (3.7)	140 (4.0)		

### *Health literacy levels in different regions*

According to the health literacy score, the proportion of respondents with an adequate HL was 22.3% (778/3482) overall, 33.0% (187/566) in the eastern region, 23.1% (323/1,397) in the central region, and

17.6% (268/1,519) in the western region (Table 2). The proportions of knowledge and attitudes, healthy lifestyles and behaviours, and health-related skills were 42.2%, 17.7%, and 28.0%, respectively. From high to low, the proportions of health literacy in different dimensions were safety and first aid literacy (62.7%), scientific views of health (59.7%), health information (32.4%), prevention and treatment of infectious diseases (23.5%), prevention and treatment of chronic diseases (23.4%), and basic medical care (22.9%). Except for the prevention and treatment of infectious diseases, statistically significant differences were found in the health literacy levels among individuals from different regions (Table 2).

Fig. 1 shows the provincial geographical map for the proportion of respondents with adequate health literacy. Notable geographic variation was observed in the health literacy level. The proportion of adequate HL ranged from 10.5%(Xinjiang) to 47.0%(Beijing).

**Table 2. Percentage of participants with adequate HL by dimensions and domains.**

Dimensions/Domains	Eastern region (n = 566) (%)	Central region (n = 1397) (%)	Western region (n = 1519) (%)	Total (n = 3482) (%)
<b>Three dimensions</b>				
BKA	52.8	43.7	37.0	42.2*
HLB	26.3	18.4	13.9	17.7*
HRS	38.2	28.3	24.0	28.0*
<b>Six domains</b>				
SVH	64.1	62.1	55.9	59.7*
PTID	25.4	22.3	23.9	23.5
PTCD	30.4	25.1	19.3	23.4*
SFA	72.8	63.1	58.5	62.7*
BMC	31.8	22.8	19.7	22.9*
HI	40.3	33.4	28.6	32.4*
<b>Health literacy level</b>	33.0	23.1	17.6	22.3*

\*P<0.05

Note: BKA (basic knowledge and attitudes), HLB (healthy lifestyles and behaviours), HRS (health-related skills), SVH (scientific views of health), PTID (prevention and treatment of infectious diseases), PTCD (prevention and treatment of chronic diseases), SFA (safety and first aid), BMC (basic medical care), HI (health information).

### ***The influencing factors of health literacy levels in different regions***

#### *Unconditional logistic regression analysis to predict the factors influencing health literacy levels*

The stepwise forward (LR) method was used in the multivariate logistic regression analysis. In the omnibus tests of model coefficients, the overall models were significant (chi-square=259.497, p<0.001 (total sample); chi-square=67.859, p<0.001 (eastern region sample); chi-square=95.508, p<0.001 (central region sample); and chi-square=98.409, p<0.001 (western region sample)).

The logistic regression modelling, as shown in Table 3, demonstrated that being a female (odds ratio [OR]=1.360, 95% confidence interval [CI]: 1.153-1.605), having a higher education level (OR=1.860, 95% CI:

1.671-2.070), having a better economic status (OR=1.353, 95% CI: 1.220-1.502), having a better self-rated health status (OR=1.263, 95% CI: 1.081-1.476), and having more community health education (OR=1.192, 95% CI: 1.034-1.374) were predictive of increased health literacy levels.

This study showed that the factors affecting health literacy existed in different regions. High education levels, good economic status and good self-rated health status were positively correlated with health literacy levels in the eastern region. Among participants in the central region, health literacy was significantly associated with gender, education level, economic status and community health education. Female gender, high education level, and more community health education in the past three years were positively correlated with the health literacy levels of people in the western region (Tables 3).

**Table 3. Multiple logistic regression analysis of factors influencing adequate HL.**

Regions	Variables	OR	95% CI of OR	
<b>All regions (n=3482)</b>				
	Gender	1.360	1.153	1.605
	Education level	1.860	1.671	2.070
	Economic status	1.353	1.220	1.502
	Health status	1.263	1.081	1.476
	Community health education	1.192	1.034	1.374
<b>Eastern region (n=566)</b>				
	Education level	1.813	1.443	2.279
	Economic status	1.626	1.280	2.065
	Health status	1.790	1.280	2.502
<b>Central region (n=1397)</b>				
	Gender	1.497	1.156	1.939
	Education level	1.742	1.478	2.053
	Economic status	1.300	1.102	1.533
	Community health education	1.425	1.124	1.807
<b>Western region (n=1519)</b>				
	Gender	1.352	1.028	1.777
	Education level	2.134	1.779	2.561
	Community health education	1.312	1.056	1.629

## Discussion

### *Health literacy level and its distribution characteristics in China*

There are some differences in the definition of health literacy across different countries. The measurement tools and research perspectives are different, and the standards are not uniform. Therefore,

it is difficult to directly compare the health literacy levels among individuals in different countries. The National Assessment of Adult Literacy has reported that 36% of the United States adult population has basic or less-than-basic health literacy. Limited health literacy was more common in Hispanic (66%), black (58%), and American Indian and Alaskan Native (48%) populations [3, 14]. Nearly 19% of African American adults had a serious lack of health literacy [15].

Health literacy research began late in China. In 2008, based on the research results and experiences pertaining to health literacy at home and abroad, the former Ministry of Health of China organized medical and health experts to define the 66 basic contents of Chinese health literacy and compiled the Chinese Health Literacy Monitoring Questionnaire. In the same year, the first survey of health literacy was conducted nationwide. The survey results showed that the overall level of health literacy among Chinese people was 6.48% [16]. The Chinese government has monitored health literacy nationwide since 2012 [17]. From 2012 to 2017, the health literacy level of Chinese residents was 8.80%, 9.48%, 9.79%, 10.25%, 11.58% and 14.18% for each consecutive year.

In this study, the health literacy level was 22.3%. These findings indicated that the health literacy level of Chinese people has improved significantly in the past decade. However, less than a quarter of the participants had adequate health literacy. Furthermore, China's health literacy level is still low. Previous studies have shown that the proportions of people with adequate health literacy in the United States, the United Kingdom and Japan were 64%, 88.6% and 72.3%, respectively [14, 18, 19]. In terms of scores on different dimensions, the participants' scores in the dimension of basic knowledge and attitudes were higher than those in the dimension of healthy lifestyles and behaviours. This finding demonstrated that Chinese people exhibited inconsistency between knowledge and practice in health literacy, and health knowledge was not effectively translated into healthy lifestyles and behaviours. According to health education knowledge and belief theory, behaviour change is divided into three consecutive processes: acquiring knowledge, generating beliefs, and forming behaviours. The acquisition of health knowledge is relatively easy. The transformation from knowledge into belief and then into healthy behaviour is a relatively long process that is influenced by many factors (internal and external factors, etc.) [2].

Among the six types of health literacy, basic medical care literacy and chronic disease prevention literacy were relatively low, especially in the western region, which indicates the need to strengthen the understanding of scientific medical treatment, rational drug use and chronic disease prevention. In recent years, the incidence of chronic diseases in China has increased significantly, but the awareness of knowledge about common chronic diseases such as diabetes and high blood pressure is generally low. The phenomenon of "three high and three low" is common in the prevention and treatment of chronic diseases and is characterized by a high incidence and prevalence of chronic diseases, a high rate of disability, low knowledge, low control rate, and low treatment rate. It is therefore necessary to further strengthen health education on chronic disease prevention and treatment [20].

This study showed that there were significant differences in the levels of health literacy among people in different regions, with the highest levels in the eastern region, the second-highest levels in the central

region, and the lowest levels in the western region, which was consistent with the results of previous research [21]. The proportion of adequate HL in different provinces or municipalities ranged from 10.5% to 47.0%. A previous study showed that health literacy was a comprehensive performance of a country's or a region's level of social and economic development [11]. The heterogeneity in health literacy among people in different regions was also a true reflection of the imbalance in the development of economic, cultural, and medical resources in different regions of China.

### ***Factors affecting health literacy and the emphasis on health literacy promotion in different regions***

This study found that health literacy was strongly associated with education. A higher education level was independently associated with a higher health literacy level, which is consistent with the conclusions of previous studies [22-24]. A well-educated person has a stronger ability to understand, analyse, and judge scientific views, making it easier to acquire and understand health literacy-related knowledge. People with a limited education level obtained less health-related information and had less experience interacting with health professionals than the general population did [25]. Therefore, health education interventions should be designed based on a clear understanding of the patterns of resources available among limited groups based on education levels.

The results of the present study revealed a significant correlation between economic status and health literacy in the eastern and central regions. This result is consistent with the findings of previous studies that showed that low socioeconomic status was correlated with low health literacy and a positive relationship between personal income and health literacy [18, 26, 27]. From the perspective of economics, for middle- and high-income individuals, their basic needs for life have been met, so they pay more attention to the improvement of their quality of life. As a result, the demand for health care services is higher, and more attention and energy can be invested in their own health conditions [28]. Health promotion programmes may be less effective for groups with low economic status because of their poor perception of their own health status, their low use of health education resources and their limited access to relevant educational services and social support [29].

This study found a significant association between adequate health literacy and self-rated health status. This finding is consistent with those of previous studies on health literacy among office workers [30]. However, we also found that self-rated health status was not significantly associated with adequate health literacy in the central and western regions. The possible explanation for this was that in the central and western regions, because of non-health factors such as increased economic and life pressures and less access to health education knowledge and health services, some people are seldom concerned about their own health status even if their physical condition is poor. The studies evaluating the relationship between health literacy and gender yielded mixed results. Studies by Cavanaugh and Tang Chi showed that the women's health literacy level was higher than that of men, which was the exact opposite of the findings of Yan et al. [6, 21, 31]. This contrast might be due to differences in the sample population and the region. This study showed that being female was predictive of increased health literacy levels.

Women are more willing than men to obtain health information through various channels and are more active in obtaining health information [32]. After stratification by area was performed, being female was positively correlated with adequate health literacy in the central and western regions, which might be due to the relative lack of health care resources in the central and western regions, and there are fewer ways for people to obtain health-related information. In the eastern region, various forms of health education information were available, and gender differences were not significant predictors of the health literacy level.

Since 2011, Chinese health departments have vigorously promoted "The National Healthy Lifestyle Action", which is based on knowledge presentation, health consultation and physical examination screening. It is a roving health popularization activity that is conducted by urban and rural communities [33]. This study revealed that health literacy was significantly associated with community health education after adjustments were made for other factors. In the central and western regions, people who received more community health education within three years had higher health literacy. Popularizing health knowledge through face-to-face community health education activities is an effective way of improving the health literacy levels of people in the central and western regions. Moreover, there may be some shortcomings in health education and health promotion in the central and western regions, and access to health knowledge is not as extensive as that in the eastern region. Thus, strengthening the publicity of health knowledge through various channels will be more helpful in improving the health literacy levels of people in the central and western regions. Community health education should combine multiple approaches based on a clear understanding of the patterns of resources available among different socio-demographic groups, such as those specifically focused on disadvantaged groups, and develop the capacity of the community as a whole to act using the social resources available [29].

This study has several limitations that can be improved in further research. First, we did not assess the risky health behaviours (tobacco, alcohol and drug use) of the participants in this particular study, but these behaviours will be evaluated in future studies. Second, some items in this study were self-reported. We obtained data through self-reported items, such as self-rated health status. Self-reporting is prone to bias, which will make respondents more likely to provide socially desirable answers. The effect of self-reporting bias cannot be excluded in the present investigation. Despite these limitations, this study covered 25 provinces or municipalities in different regions of China, and examined the level of health literacy and factors in China. A focus was on the differences by region. This study provided a reference for developing strategies and measures to improve health literacy.

## Conclusions

The health literacy level of Chinese people is still low, with evident heterogeneities among different regions, between urban and rural areas, and among different social groups. Health literacy promotion strategies should not only focus on the dissemination of health knowledge but also pay more attention to behavioural changes and to the continuous exploration of methods to develop healthy behaviours and lifestyles. Improvements in the level of public education are a prerequisite for improvements in health

literacy. The methods of improving levels of health literacy in different regions should be adapted to local conditions. In the central and eastern regions, the focus of health literacy improvement should be on low-income people. Special emphasis should be placed on the degree of health knowledge publicity and the accessibility of health knowledge and skills in the central and western regions.

## List Of Abbreviations

NRHLMQ: The National Resident Health Literacy Monitoring Questionnaire; Adequate HL: Adequate health literacy; Limited HL: Limited health literacy.

## Declarations

### *Ethics approval and consent to participate*

The research protocol was reviewed and approved by the Medical Ethics Committee of Central South University. All participants (aged 16 and upwards) who agreed to participate in the study signed an informed consent form at the beginning of the survey. The written informed consent was obtained from a parent or guardian for participants under 16 years old.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

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

### *Competing interests*

The authors declare that they have no competing interests.

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### *Authors' contributions*

ZHL performed the statistical analysis and drafted the manuscript. ZHL, YQT, ZCG and SYX participated in the design of the study and revision of the paper. ZHL and LQ participated in data collection. All of the authors read and approved the final manuscript.

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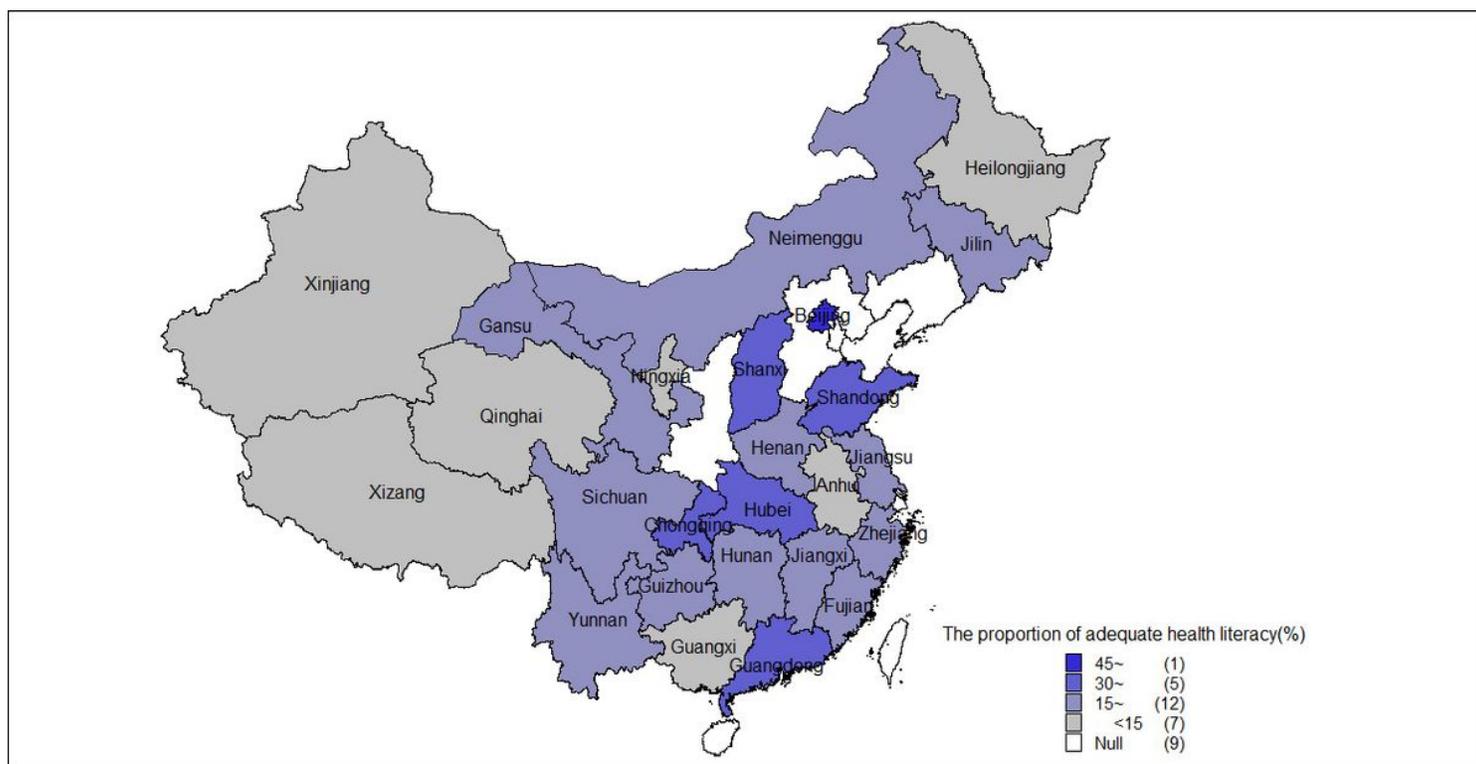
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## Figures



**Figure 1**

The proportion of respondents with adequate HL in different provinces or municipalities of China. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

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