

# Exploring Health Literacy in Wuhan, China: A Cross-Sectional Analysis

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## Research article

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# Abstract

**Background:** In recent years, research on health literacy has become increasingly concerned with the health care system and public health. This cross-sectional study aimed to investigate health literacy and analyse the risk factors that affect health literacy in Wuhan, China.

**Methods:** Multistage stratified random sampling was used to select 5304 urban and rural residents aged 15 to 69 from 204 monitoring points in 15 districts of Wuhan. Using the Chinese citizen Health Literacy Questionnaire (HLQ) (2018 edition), a face-to-face survey was conducted from November to December 2018. Risk factors that may affect health literacy were assessed by Chi-square test and multiple logistic regression models.

**Results:** The knowledge rate of health literacy was relatively low (19.3%). Of the three aspects of health literacy, the knowledge rate of health-related behaviour and lifestyle (BAL, 17.3%) was the lowest, and of the six dimensions of health literacy, the knowledge rate of chronic diseases (CD, 19.0%) was the lowest. Respondents who lived in urban areas, had higher education levels, worked as medical staff, had higher household income and did not suffer from chronic diseases were likely to have higher health literacy.

**Conclusions:** The health literacy levels of citizens in Wuhan are insufficient and need to improve.

## Background

Health literacy [1–3] is often defined as the ability to obtain, process, and understand basic health information and services to make appropriate health decisions. As a variable associated with health outcomes, health literacy is an important component of people's health behaviours, health quality, and access to health information and health care [4]. Many studies have shown that lower health literacy leads to obstacles in communication between health-care professionals and patients, obstruction of citizens' access to health information and inefficiency in self-health management [5–7]. Therefore, health literacy should be an important priority for the government and researchers [8]. Because of the critical role of health literacy in health quality, many countries, such as the United States, Canada and Australia, have treated it as a national health indicator [9–12].

In January 2008, the Chinese Ministry of Health finalized the bulletin “Chinese Resident Health Literacy—Basic Knowledge and Skills (Trial)”, which was the first government document to define citizens' health literacy and played a vital role in the development and promotion of health education in China. According to the bulletin, a Delphi process was conducted among relevant experts to choose indexes for the HLQ to be administered to Chinese residents. After the HLQ was determined to have strong construct validity, reliability, and high acceptability, the national health literacy survey was conducted in 2012 and 2016. The results indicated that the health literacy knowledge rates in 2012 and 2016 were 8.80% and 11.58%, respectively. Surveys of health literacy have been widespread in China, and the results have shown that the overall level of health literacy is low and that there is a large difference in the levels of health literacy of rural and urban residents.

Health literacy is an important determinant of health. It is a comprehensive reflection of economic and social development and is influenced by various factors, such as politics, economics, culture, education and health development level [13]. With the acceleration of urbanization in China, central China around Wuhan will become the most rapidly developing district in the future. Wuhan, the capital of Hubei Province and a core city in central China, is an important industrial base, science and education centre and comprehensive transportation hub, placing it at the "heart" of Chinese economic geography. With the rapid development of the economy, people's living conditions have greatly improved, and there is a growing interest in health. Therefore, investigating health literacy has great practical significance. The objectives of this study are to 1) investigate the health literacy level of citizens in Wuhan, China; 2) analyse the risk factors that may affect health literacy; and 3) provide a basis for improving health literacy and strategies for the next phase of intervention.

## Methods

### Participants

A total of 5304 citizens in Wuhan aged 15 to 69 years were selected, and 5205 were interviewed from November to December 2018 in this cross-sectional survey. Participants were excluded from the survey if they refused to participate or were unable to communicate. The response rate of the questionnaire was 98.1%. A multistage stratified random sampling method [14] was used to recruit participants. The sampling method can be divided into three stages. First, residential committee villages or administrative villages were regarded as primary sampling units (PSUs), and 204 monitoring points (residential committee villages or administrative villages) were selected from the whole city using the probability-proportional-to-size sampling (PPS) method. Then, 26 households were selected at random from each chosen monitoring point. Finally, one eligible resident from each household was selected randomly using a Kish selection table[15]. This study was approved by the Ethics Committee of Wuhan Centers for Disease Prevention and Control, China. Written informed consent was obtained from all participants.

### Questionnaire

Data were obtained in face-to-face interviews with the Chinese citizen HLQ (2018 edition) [16] developed by the Chinese Ministry of Health. The questionnaire consisted of three parts: (1) family support questionnaire, (2) basic personal situation, and (3) health literacy content. The health literacy section (50 questions) was further categorized into three aspects and six dimensions. The three aspects were (1) knowledge and attitudes (KAA, 22 questions); (2) health-related behaviour and lifestyle (BAL, 16 questions); and (3) health-related skills (HRS, 12 questions). The six dimensions were (1) scientific views of health (SVH, eight questions); (2) infectious diseases (ID, six questions); (3) chronic diseases (CD, nine questions); (4) safety and first aid (SAFA, 10 questions); (5) medical care (MC, 11 questions); and (6) health information (HI, six questions). A comprehensive health literacy score was computed as the sum of all three aspects and six dimensions.

### Evaluation Method

There were four types of questions on the scale: true-or-false questions, single-answer questions, multiple-answer questions, and situation questions. For true-or-false questions and single-answer questions, 1 point was assigned to the correct answer. For multiple-answer questions, 2 points were assigned when all of the correct answers and no incorrect answers were chosen. For situation questions, the participants had to answer single- or multiple-answer questions after reading the given material. A score of 0 was given to a wrong answer. The overall health literacy score ranged from 0 to 66. The total points scored in the three aspects, KAA, BAL, and HRS, were 28, 22 and 16, respectively, and the total points scored in the six dimensions, SVH, ID, CD, SAFA, MC, and HI, were 11, 7, 12, 14, 14, and 8, respectively.

## Variables

The participants who received an overall score of 80% or more were categorized as having knowledge of health literacy [4, 17]. The knowledge rate (%) of health literacy was calculated using the following formula: total number of participants with knowledge of health literacy / total number surveyed  $\times$  100%. The knowledge rates of the three aspects and six dimensions of health literacy were calculated similarly. Quality control was applied to the whole investigative process. The possible risk factors considered were area of residence (rural="0"; urban="1"), age (65–69="1"; 55–64="2"; 45–54="3"; 35–44="4"; 25–34="5"; 15–24="6"), education (illiterate="1"; primary school="2"; junior school="3"; high school="4"; college="5"; master's degree or above="6"), occupation (civil servant="1"; teacher="2"; medical staff="3"; other public institution staff="4"; student="5"; farmer="6"; worker="7"; other enterprise staff="8"; other="9"), average annual household income (CNY) (< 30,000="1"; 30,000–50,000="2"; 50,000–100,000="3"; 100,000–300,000="4";  $\geq$ 300,000="5"), suffering from chronic diseases (yes="0"; no="1"), and self-reported health status (excellent="1"; good="2"; average="3"; relatively poor="4"; poor="5").

## Statistical analysis

The data were meticulously sorted, cleaned, and analysed with SPSS Version 21. Descriptive analysis (frequencies, percentages, and means with standard deviations) was performed for participant characteristics. Comparisons of health literacy scores among participants were conducted by one-way analysis of variance. The Chi-square test was used to compare the knowledge rate of health literacy among subgroups. Multiple logistic regression was conducted to assess the associations of multiple potential risk factors with the knowledge rate of health literacy. Multiple logistic regression was used to adjust for the risk factors associated with health literacy. Statistical significance was defined as p-value < 0.05 (two-sided).

## Results

### Sociodemographic characteristics of the participants

As shown in Table 1, of the participants, 2408 (46.3%) were male, and 2797 (53.7%) were female. More than half of the participants (63.7%) lived in urban areas. The average age

was  $49.1 \pm 13.7$  years. A total of 141 participants (2.7%) were illiterate, 550 (10.6%) had a primary education, 1431 (27.5%) had a junior school education, 1524 (29.3%) had a high school education, 1417 (27.2%) had a college education, and 142 (2.7%) had a master's degree or above. Approximately 13.4% of the participants were farmers, and more than 71.0% of the participants had fewer than 3 family members. More than 60% of the participants had an average annual income of no more than 100,000 CNY. Of the participants, 50.1% suffered from chronic diseases, and over 60% reported that they were in excellent or good health.

**Table 1** Sociodemographic characteristics and knowledge rate of health literacy in Wuhan, 2018.

| Characteristics                | N (%) <sup>a</sup> | Mean ± SD <sup>b</sup> | > 80% or score <sup>c</sup> | Knowledge rate (%) | $\chi^2$ | P      |
|--------------------------------|--------------------|------------------------|-----------------------------|--------------------|----------|--------|
| <b>Area of residence</b>       |                    |                        |                             |                    |          |        |
| Urban                          | 3315 (63.7)        | 44.9±11.3              | 773                         | 23.3               | 95.20    | <0.001 |
| Rural                          | 1890 (36.3)        | 39.3±11.7              | 231                         | 12.2               |          |        |
| <b>Gender</b>                  |                    |                        |                             |                    |          |        |
| Male                           | 2408 (46.3)        | 42.7±11.8              | 450                         | 18.7               | 1.04     | 0.308  |
| Female                         | 2797 (53.7)        | 43.0±11.7              | 554                         | 19.8               |          |        |
| <b>Age, years</b>              |                    |                        |                             |                    |          |        |
| 15-24                          | 209 (4.0)          | 45.6±11.6              | 65                          | 31.1               | 210.58   | <0.001 |
| 25-34                          | 759 (14.6)         | 46.0±10.7              | 212                         | 27.9               |          |        |
| 35-44                          | 853 (16.4)         | 46.2±11.4              | 261                         | 30.6               |          |        |
| 45-54                          | 1232 (23.7)        | 41.9±12.0              | 218                         | 17.7               |          |        |
| 55-64                          | 1343 (25.8)        | 40.8±11.6              | 154                         | 11.5               |          |        |
| 65-69                          | 809 (15.5)         | 40.9±11.5              | 94                          | 11.6               |          |        |
| <b>Ethnicity</b>               |                    |                        |                             |                    |          |        |
| Han                            | 5168 (99.3)        | 42.9±11.7              | 993                         | 19.2               | 2.61     | 0.106  |
| Other                          | 37 (0.7)           | 45.7±9.6               | 11                          | 29.7               |          |        |
| <b>Education</b>               |                    |                        |                             |                    |          |        |
| Illiterate                     | 141 (2.7)          | 28.8±12.6              | 7                           | 5.0                | 768.04   | <0.001 |
| Primary school                 | 550 (10.6)         | 36.0±11.9              | 30                          | 5.5                |          |        |
| Junior school                  | 1431 (27.5)        | 39.1±10.9              | 87                          | 6.1                |          |        |
| High school                    | 1524 (29.3)        | 43.6±9.8               | 235                         | 15.4               |          |        |
| College                        | 1417 (27.2)        | 49.0±10.1              | 567                         | 40.0               |          |        |
| Master's degree or above       | 142 (2.7)          | 52.8±10.1              | 78                          | 54.9               |          |        |
| <b>Occupation</b>              |                    |                        |                             |                    |          |        |
| Civil servant                  | 89 (1.7)           | 49.9±9.4               | 39                          | 43.8               | 677.64   | <0.001 |
| Teacher                        | 231 (4.4)          | 53.1±9.3               | 130                         | 56.3               |          |        |
| Medical staff                  | 127 (2.4)          | 53.8±8.6               | 71                          | 55.9               |          |        |
| Other public institution staff | 608 (11.7)         | 48.1±10.7              | 228                         | 37.5               |          |        |
| Student                        | 110 (2.1)          | 47.7±11.1              | 43                          | 39.1               |          |        |
| Farmer                         | 699 (13.4)         | 35.4±11.3              | 41                          | 5.9                |          |        |
| Worker                         | 684 (13.1)         | 39.8±10.9              | 56                          | 8.2                |          |        |

|  |                 |           |      |      |        |        |
|--|-----------------|-----------|------|------|--------|--------|
| Other enterprise staff                       | 815<br>(15.7)   | 43.8±10.3 | 144  | 17.7 |        |        |
| Other  | 1842<br>(35.4)  | 42.2±11.2 | 252  | 13.7 |        |        |
| Number of people in the household            |                 |           |      |      |        |        |
| 1-3  | 3695<br>(71.0)  | 42.7±11.6 | 680  | 18.4 | 6.45   | 0.040  |
| 4-6  | 1447<br>(27.8)  | 43.4±11.9 | 310  | 21.4 |        |        |
| ≥7   | 63 (1.2)        | 41.0±12.5 | 14   | 22.2 |        |        |
| Average annual household income, CNY         |                 |           |      |      |        |        |
| <30,000                                      | 539<br>(10.4)   | 37.5±11.6 | 21   | 3.9  | 268.12 | <0.001 |
| 30,000-50,000                                | 969<br>(18.6)   | 39.6±11.2 | 87   | 9.0  |        |        |
| 50,000-100,000                               | 1826<br>(35.1)  | 43.2±11.7 | 367  | 20.1 |        |        |
| 100,000-300,000                              | 1589<br>(30.5)  | 46.0±11.3 | 478  | 30.1 |        |        |
| ≥300,000                                     | 282 (5.4)       | 44.9±9.8  | 51   | 18.1 |        |        |
| Native population                            |                 |           |      |      |        |        |
| Yes  | 4648<br>(89.3)  | 43.0±11.7 | 894  | 19.2 | 0.09   | 0.771  |
| No   | 557<br>(10.7)   | 42.3±12.1 | 110  | 19.7 |        |        |
| Suffering from chronic diseases <sup>e</sup> |                 |           |      |      |        |        |
| Yes  | 2610<br>(50.1)  | 41.1±11.5 | 370  | 14.2 | 87.91  | <0.001 |
| No   | 2595<br>(49.9)  | 44.7±11.7 | 634  | 24.4 |        |        |
| Self-reported health status                  |                 |           |      |      |        |        |
| Excellent                                    | 1138<br>(21.9)  | 43.2±11.5 | 238  | 20.9 | 9.66   | 0.047  |
| Good   | 2203<br>(42.3)  | 43.6±11.5 | 444  | 20.2 |        |        |
| Average                                      | 1643<br>(31.6)  | 42.1±11.9 | 288  | 17.5 |        |        |
| Relatively poor                              | 186 (3.6)       | 40.9±12.6 | 31   | 16.7 |        |        |
| Poor   | 35 (0.7)        | 36.6±12.3 | 3    | 8.6  |        |        |
| Total  | 5205<br>(100.0) | 42.9±11.7 | 1004 | 19.3 | -      | -      |

<sup>a</sup> percentage of all participants; <sup>b</sup> score of health literacy; <sup>c</sup> number of participants with a total score higher than 80%; <sup>d</sup> number of participants with a total score lower than 80%; <sup>e</sup>

Chronic diseases included hypertension, heart disease, cerebrovascular disease (stroke, cerebral infarction, cerebral thrombosis), diabetes, and malignant cancer.

### **The association between knowledge rate of health literacy level and socio-demographic characteristics**

As shown in Table 1, there are specific groups whose knowledge rate of health literacy is considerably below the average level (19.3%): people living in rural areas, in older age groups, with a lower education level, working as a farmer or worker, with less people in the household, with lower household income, suffered from chronic diseases and with poor self-reported health status.

With regard to socio-economic status, higher proportions of limited health literacy are found among people who were between 45 and 54 years old (17.7%), between 55 and 64 years old (11.5%) or older (11.6%); whose self-reported health status was average (17.5%), relatively poor (16.7%) or poor (8.6%); who suffered from chronic diseases (14.2%); whose annual household income was between 30,000 and 50,000 CNY (9.0%) or less than 30,000 CNY (3.9%); who were workers (8.2%) or farmers (5.6%); and whose education level was junior school (6.1%), primary school (5.5%) or illiterate (5.0%). The differences in the above groups were significant.

### **Average score, knowledge rate of total health literacy and the three aspects and six dimensions of health literacy**

The average scores for each health literacy scale are shown in Table 2. The rate of knowledge in the three aspects, KAA, HRS, and BAL, was 33.9%, 33.2% and 17.3%, respectively. Additionally, for the six dimensions, the knowledge rate in descending order was 57.8%, 52.8%, 41.0%, 27.8%, 26.1%, and 19.0% for SAFA, SVH, HI, MC, ID, and CD, respectively.

**Table 2** Average points and knowledge of each scale in the three aspects and six dimensions.

| Variables <sup>a</sup> | Number of questions | Total points | 80% of total score (%) | Mean±SD   | >80% of score <sup>b</sup> | Knowledge rate (%) |
|------------------------|---------------------|--------------|------------------------|-----------|----------------------------|--------------------|
| <b>Three aspects</b>   |                     |              |                        |           |                            |                    |
| KAA                    | 22                  | 28           | 22.4                   | 19.1±5.0  | 1767                       | 33.9               |
| BAL                    | 16                  | 22           | 17.6                   | 13.3±4.5  | 900                        | 17.3               |
| HRS                    | 12                  | 16           | 12.8                   | 10.5±3.6  | 1728                       | 33.2               |
| <b>Six dimensions</b>  |                     |              |                        |           |                            |                    |
| SVH                    | 8                   | 11           | 8.8                    | 7.4±2.5   | 2749                       | 52.8               |
| ID                     | 6                   | 7            | 5.6                    | 4.6±1.5   | 1356                       | 26.1               |
| CD                     | 9                   | 12           | 9.6                    | 7.0±2.7   | 988                        | 19.0               |
| SAFA                   | 10                  | 14           | 11.2                   | 10.5±3.0  | 3008                       | 57.8               |
| MC                     | 11                  | 14           | 11.2                   | 8.7±2.8   | 1449                       | 27.8               |
| HI                     | 6                   | 8            | 6.4                    | 4.8±2.1   | 2132                       | 41.0               |
| Health literacy        | 50                  | 66           | 52.8                   | 42.9±11.7 | 1004                       | 19.3               |

<sup>a</sup> KAA: Knowledge and attitudes; BAL: Health-related behaviour and lifestyle; HRS: Health-related skills; SVH: Scientific views of health; ID: Infectious diseases; CD: Chronic diseases; SAFA: Safety and first aid; MC: Medical care; HI: Health information.

<sup>b</sup> number of participants with a total score > 80%.

### **Multiple logistic regression analysis on risk factors associated with health literacy knowledge rate**

The variables with statistical significance in the Chi-square test (Table 1) were examined in the multiple logistic regression. As shown in Table 3, participants living in urban areas (OR=1.31, 95% CI: 1.08, 1.60) were significantly likely to have a higher knowledge rate of health literacy than those living in rural areas. Compared to participants who were illiterate, participants with an education level of high school (OR= 2.27, 95% CI: 1.00, 5.13), college (OR=5.36, 95% CI: 2.35, 12.23) and master's degree or above (OR= 6.67, 95% CI: 2.70, 16.46) were likely to have a significantly higher knowledge rate of health literacy. Medical staff (OR=2.42, 95% CI: 1.36, 4.32) were likely to have higher health literacy than residents whose occupation was civil servant. As average household income increased, the participants were more likely to have higher health literacy. Participants suffering from chronic disease were associated with lower health literacy. Of these factors,

living in an urban area, education level (except primary school and junior school), working as medical staff and having a higher annual household income were positively correlated with health literacy, while being a worker or suffering from chronic diseases were negatively correlated with health literacy.

**Table 3** Multiple logistic regression analysis of risk factors associated with health literacy in different socio-demographic characteristics

| Parameters                                   | B     | S.E. | Wald  | df | P     | OR   | OR95%C.I.    |
|--|-------|------|-------|----|-------|------|--------------|
| Area of residence                            |       |      |       |    |       |      |              |
| Rural  | ref   |      |       |    |       |      |              |
| Urban  | 0.27  | 0.10 | 7.26  | 1  | 0.01  | 1.31 | (1.08,1.60)  |
| Age, years                                   |       |      |       |    |       |      |              |
| 65-69  | ref   |      |       |    |       |      |              |
| 55-64  | 0.06  | 0.24 | 0.07  | 1  | 0.79  | 1.07 | (0.67,1.70)  |
| 45-54  | 0.29  | 0.24 | 1.46  | 1  | 0.23  | 1.34 | (0.83,2.14)  |
| 35-44  | 0.01  | 0.24 | 0.00  | 1  | 0.96  | 1.01 | (0.63,1.63)  |
| 25-34  | -0.38 | 0.25 | 2.29  | 1  | 0.13  | 0.69 | (0.42,1.12)  |
| 15-24  | -0.01 | 0.26 | 0.00  | 1  | 0.97  | 0.99 | (0.59,1.66)  |
| Education                                    |       |      |       |    |       |      |              |
| Illiterate                                   | ref   |      |       |    |       |      |              |
| Primary school                               | 0.02  | 0.44 | 0.00  | 1  | 0.96  | 1.02 | (0.43,2.41)  |
| Junior school                                | 0.03  | 0.42 | 0.00  | 1  | 0.95  | 1.03 | (0.45,2.32)  |
| High school                                  | 0.82  | 0.42 | 3.88  | 1  | 0.05  | 2.27 | (1.00,5.13)  |
| College                                      | 1.68  | 0.42 | 15.97 | 1  | <0.01 | 5.36 | (2.35,12.23) |
| Master's degree or above                     | 1.90  | 0.46 | 16.91 | 1  | <0.01 | 6.67 | (2.70,16.46) |
| Occupation                                   |       |      |       |    |       |      |              |
| Civil servant                                | ref   |      |       |    |       |      |              |
| Teacher                                      | 0.60  | 0.27 | 5.19  | 1  | 0.02  | 1.83 | (1.09,3.07)  |
| Medical staff                                | 0.89  | 0.30 | 9.02  | 1  | <0.01 | 2.42 | (1.36,4.32)  |
| Other public institution staff               | 0.12  | 0.24 | 0.24  | 1  | 0.62  | 1.13 | (0.70,1.81)  |
| Student                                      | 0.31  | 0.37 | 0.72  | 1  | 0.40  | 1.37 | (0.67,2.80)  |
| Farmer                                       | -0.29 | 0.31 | 0.86  | 1  | 0.36  | 0.75 | (0.41,1.38)  |
| Worker                                       | -0.79 | 0.28 | 8.10  | 1  | <0.01 | 0.46 | (0.27,0.78)  |
| Other enterprise staff                       | -0.72 | 0.25 | 8.58  | 1  | <0.01 | 0.49 | (0.30,0.79)  |
| Other  | -0.45 | 0.24 | 3.49  | 1  | 0.06  | 0.64 | (0.40,1.02)  |
| Number of people in the household            |       |      |       |    |       |      |              |
| 1-3  | ref   |      |       |    |       |      |              |
| 4-6  | -0.04 | 0.09 | 0.19  | 1  | 0.67  | 0.96 | (0.81,1.15)  |
| ≥7   | 0.37  | 0.35 | 1.11  | 1  | 0.29  | 1.44 | (0.73,2.86)  |
| Average annual household income, CNY         |       |      |       |    |       |      |              |
| <30,000                                      | ref   |      |       |    |       |      |              |
| 30,000~50,000                                | 0.51  | 0.26 | 3.93  | 1  | <0.05 | 1.67 | (1.01,2.76)  |
| 50,000-100,000                               | 1.21  | 0.24 | 25.81 | 1  | <0.01 | 3.36 | (2.11,5.37)  |
| 100,000-300,000                              | 1.41  | 0.24 | 34.73 | 1  | <0.01 | 4.11 | (2.57,6.57)  |
| ≥300,000                                     | 0.65  | 0.29 | 5.06  | 1  | 0.02  | 1.91 | (1.09,3.35)  |
| Suffering from chronic diseases <sup>a</sup> |       |      |       |    |       |      |              |
| Yes  | ref   |      |       |    |       |      |              |
| No   | 0.18  | 0.09 | 4.41  | 1  | 0.04  | 1.20 | (1.01,1.42)  |
| Self-reported health status                  |       |      |       |    |       |      |              |
| Excellent                                    | ref   |      |       |    |       |      |              |
| Good   | 0.05  | 0.10 | 0.26  | 1  | 0.61  | 1.05 | (0.86,1.29)  |
| Average                                      | 0.05  | 0.11 | 0.17  | 1  | 0.68  | 1.05 | (0.84,1.31)  |
| Relatively poor                              | 0.20  | 0.24 | 0.66  | 1  | 0.42  | 1.22 | (0.76,1.96)  |
| Poor   | -0.11 | 0.65 | 0.03  | 1  | 0.87  | 0.90 | (0.25,3.23)  |
| Constant                                     | -3.52 | 0.58 | 36.83 | 1  | <0.01 | 0.03 | -            |

<sup>a</sup> Chronic diseases included hypertension, heart disease, cerebrovascular disease (stroke, cerebral infarction, cerebral thrombosis), diabetes, and malignant cancer.

## Discussion

The analysis of the risk factors may not only help identify key groups and areas where health literacy is limited but also indicate targeted intervention measures. With the development of the economy, we should strengthen quality-oriented education, popularize health-related knowledge and skills, and strive to improve people's health literacy level. In our study conducted in Wuhan, China, the knowledge rate of health literacy was 19.3%, with an average score of  $42.9 \pm 11.7$ , which was higher than the scores of all Chinese residents in 2018 (17.1%)[18] but still constituted a large gap compared with the knowledge rate in developed areas[19] (32.3% in Beijing, China). The high proportions of people with a limited knowledge rate of health literacy indicate that the health literacy deficit is a challenge for researchers, community organizations, health care providers, and policy-makers[19].

In terms of the three aspects, we found that the knowledge rate of health literacy related to BAL (17.3%) was comparatively lower than that of the other two components of comprehensive health literacy: KAA (33.9%) and HRS (33.2%). This finding indicates that Chinese people may lack awareness that a healthy lifestyle can help prevent diseases rather than just cure them. Considering that China is a developing country, this lack of awareness may be associated with socio-cultural and economic limitations. In addition, based on the theory of knowledge, attitude and practice (KAP), changes in health-related behaviour can be divided into three continuous processes: obtaining knowledge, forming faith and producing behaviour. It is comparatively easy to obtain knowledge, but it takes a long time to form faith and then produce health-related behaviour, which indicates that health education and promotion should focus not only on health knowledge but also on health-related behaviour. It is necessary to clarify that risk factors may affect the health-related behaviour of different groups in different ways; thus, individually targeted health education and health promotion activities should be developed.

Of the 6 dimensions, the knowledge rate of CD (19.0%) was the lowest, which is consistent with the reports of Zhang Y et al [20]. Chronic disease is the leading global health threat, and the costs of chronic disease are steep, not only for individuals but also for families and society [21]. The survey showed that 29.08% of the participants suffered from chronic diseases, and the health literacy knowledge rate of CD was at a lower level. Participants who were not suffering from chronic diseases had a higher knowledge rate of health literacy, which is consistent with the results of Zhang D et al [14] and Beauchamp A et al [22]. Restricted interpersonal relations, social resources and scope of activity might be related to the accessibility of health information, which may affect the level of health literacy. Studies have reported that inadequate health literacy poses a major barrier to educating patients with chronic diseases [22]. Meanwhile, citizens with low CD levels may have difficulty improving their lifestyles, managing their diseases, and participating in complex decisions about treatment [8]. Hence, we should strengthen health education and promote health literacy in the future, especially in terms of CD.

In our study, the multiple logistic regression analysis indicated that area of residence, education level, occupation, household income and suffering from chronic diseases may affect health literacy.

This study showed that the knowledge rate of health literacy was higher in participants who lived in urban areas than in those who lived in rural areas, which is consistent with the results of Zahnd WE et al [23]. This finding suggests that higher health literacy are associated with urban residence. The explanation could be that participants living in urban areas have easy access to high-quality health information and medical information services. Therefore, rural areas are key areas for future health education and health promotion.

Education level may be one of the most important positive factors of health literacy [24]. The knowledge rate of health literacy increased as education level increased (except between primary school and junior school), which is consistent with the results of Manafo E et al [25] and Heather M et al [26]. The same result was found for the factor of occupation, as medical staff have a higher level of health literacy, which might be a result of medical professional knowledge and a higher education level [27]. A low level of education is related to poor reading and comprehension ability, which can cause people to make poor or indirect use of health information and media. Therefore, improving the education level of residents is fundamental to better health literacy. For people with a low educational level, we should apply a popular propagation mode and develop health communication materials that are easy to understand.

Many studies have reported that higher health literacy levels were associated with higher household income [17, 28], which is similar to our results. This study showed that the knowledge rate of health literacy was lower in participants whose household income was lower. With increasing household income, the participants likely paid more attention to self-health management and quality of life. A study by Pawlak R [29] showed that a lower income level is an important reason for low health literacy, which leads to worse health and a greater rate of hospitalization. For low-income groups, increasing household income and improving the system of health care are of great significance for improving the health level.

In our study, the health literacy of people with chronic diseases was low, which is consistent with the results of Sørensen K et al [9] and Wu L et al [30]. It should be noted that the risk of chronic diseases in elderly people also rises when they are suffering from chronic diseases. Therefore, interventions to help people suffering from chronic diseases stay healthy and improve the quality of life in their later years is of great significance [14, 31].

In conclusion, the survey extends the evidence base on health literacy by measuring the knowledge rate of health literacy in Wuhan, China. Limited health literacy and a social gradient in health literacy represent important challenges for health policies and practices in Wuhan. This health literacy deficit and inequality should be addressed by Wuhan health planners and policy-makers, and appropriate public health and health promotion strategies should be developed.

This study has some limitations. All the data were analysed by self-report measures. Therefore, the programme may be subject to bias. First, the study was cross-sectional in design; hence, the analysis did

not permit causal inferences. Second, health literacy, by definition emphasizes health skills and applications. However, the survey of health literacy focused on knowledge, which is little involved in skills and application. Finally, we assessed health literacy in three categories: total health literacy, three aspects of health literacy and six dimensions of health literacy. However, when designing the questionnaire, the complexity and quantity of questions in different categories should be balanced.

## Conclusions

The knowledge rate of health literacy of Wuhan residents is relatively low (19.3%). Of the three aspects of health literacy, the knowledge rate of health-related behaviour and lifestyle (BAL, 17.3%) is the lowest, and of the six dimensions of health literacy, the knowledge rate of chronic diseases (CD, 19.0%) is the lowest. The knowledge rate of health literacy was negatively associated with respondents living in rural areas, with a low-level education, with low household income, and suffering from chronic diseases. Thus, health education and promotion interventions should be targeted to high-priority topics (BAL and CD), key areas (rural) and high-risk populations (people who are illiterate, have a low annual income and suffer from chronic diseases) to improve health outcomes.

## Abbreviations

KAA:Knowledge and attitudes; BAL:Health-related behaviour and lifestyle; HRS:Health-related skills; SVH:Scientific views of health; ID:Infectious diseases; CD:Chronic diseases; SAFA:Safety and first aid; MC:Medical care; HI:Health information.

## Declarations

### Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of the Wuhan Centers for Disease Prevention and Control. Written informed consent was obtained from all participants and a parent or guardian for participants under 17 years old.

### Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files.

### Competing interests

The authors declare that they have no competing interests.

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### Authors' contributions

Conceived and designed the study: JL, YH. Study implementation: JL, YH. Drafted the manuscript: GC, XM, QZ. Reviewed the paper: JL, YH, XM, QZ, GC. All authors read and approved the final manuscript.

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