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# Association of health literacy with illness perception of Chinese community patients with chronic disease

Chaowei Guo<sup>1†</sup>, Yibo Wu<sup>2†</sup>, Xinghua Bai<sup>3</sup>, Qiao Qiao<sup>3</sup>, Dianjun Qi<sup>4\*</sup> and Shuang Zang<sup>1\*</sup>

## Abstract

**Background** This study aimed to examine the association between health literacy and illness perception among Chinese patients with chronic disease in the community through a national cross-sectional study.

**Methods** This cross-sectional study was conducted in China from June 20, 2022, to August 31, 2022, and used a multistage sampling approach to select patients with chronic diseases. The study included 5,525 participants from 15 provinces, drawn from the Psychology and Behavior Investigation of Chinese Residents in 2022. We constructed univariate analysis, smooth curve fitting, threshold saturation effect analysis, and forest plot of subgroup analysis to evaluate the association between health literacy and illness perception.

**Results** The analysis revealed an inverted J-shaped association between health literacy and illness perception ( $P < 0.001$ ). Moreover, the identified inflection point was 22.22. When the health literacy score was below 22.22, illness perception exhibited a positive association with health literacy ( $\beta = 0.12$ , 95%CI = 0.03, 0.21,  $P = 0.009$ ). When the health literacy score was higher than 22.22, illness perception decreased with the increasing health literacy ( $\beta = -0.23$ , 95%CI = -0.27, -0.19,  $P < 0.001$ ). The significant association between health literacy and illness perception did not differ significantly across subgroups, except for the Hukou subgroup.

**Conclusions** This study determined a threshold of health literacy that was associated with the illness perception of Chinese chronic disease patients. Additionally, an inverted J-shaped association between health literacy and illness perception was observed, suggesting that targeted health literacy intervention measures should be tailored to specific chronic disease groups rather than a uniform approach.

**Clinical trial number** Not applicable.

**Keywords** Health literacy, Illness perception, Chronic disease, China

<sup>†</sup>Chaowei Guo and Yibo Wu share the first authorship on this work.

\*Correspondence:

Dianjun Qi  
djqi@cmu.edu.cn

Shuang Zang  
zangshuang@cmu.edu.cn

<sup>1</sup>Department of Community Nursing, School of Nursing, China Medical University, No.77 Puhe Road, Shenyang North New Area, Shenyang, Liaoning 110122, China

<sup>2</sup>School of Public Health, Peking University, No.38 Xueyuan Road, Haidian District, Beijing 100191, China

<sup>3</sup>Department of Radiation Oncology, The First Hospital of China Medical University, No. 155 Nanjing North Street, Heping District, Shenyang, Liaoning 110001, China

<sup>4</sup>Department of General Practice, The First Affiliated Hospital of China Medical University, No.155 South Nanjing Street, Heping District, Shenyang, Liaoning 110001, China



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## Introduction

Chronic illnesses are the primary contributors of global morbidity and mortality [1]. According to the Report on the Status of Nutrition and Chronic Diseases of Chinese Residents (2020), 88.5% of all deaths in China are caused by chronic diseases. Previous studies have shown that chronic disease patients respond to their illness both cognitively and emotionally, assigning personal meaning and understanding to it, which may lead to irrational perceptions of illness, thereby affecting health behaviors and clinical outcomes [2, 3]. Misinterpretation of illness may lead chronic disease patients to adopt inappropriate health coping strategies, preventing them from effectively managing the risk factors of their chronic conditions, thereby increasing the risk of mortality and disability [4, 5]. Patients with an accurate perception of illness are often able to actively cope with their condition, make informed treatment choices, and thus improve health outcomes [6]. Illness perception reflects the patient's understanding and interpretation of their condition, which may vary depending on the level of the patient's health literacy [7, 8].

Health literacy refers to a person's ability to access, comprehend, communicate, evaluate and apply health information to make informed decisions about their health [9, 10]. Previous studies have shown that the health literacy levels of individuals with non-communicable diseases in China remain low, and exhibit regional as well as demographic disparities [11]. The health literacy level of community-based chronic disease patients in China is not clearly established. However, given the prolonged disease course and substantial dependence on self-care, it is crucial to understand the health literacy level of chronic disease patients. The common-sense model of self-regulation proposed by Leventhal et al. provides a comprehensive framework that integrates social and environmental factors with individuals' emotional and cognitive factors [12]. According to the common-sense model of self-regulation model, individuals understand health threats by developing their cognition and perceptual abilities. In this context, this study aims to examine whether health literacy, as a key component of cognitive ability, is related to illness perception among community-based chronic disease patients.

There is currently limited data on the association between health literacy and illness perception among patients recruited from hospitals or communities [13, 14]. The findings have been inconsistent, and the association between health literacy and illness perception has yet to be clearly established. A cross-sectional study of Korean patients with diabetes found no statistically significant association between health literacy and illness perception [15]. In Perez's research, health literacy was a significant determinant of the illness perception of

hypertension among Hispanics [16]. Another study of a population in southern Sweden revealed that illness perception varied according to the level of health literacy [17]. All of these previous results were based on samples from other countries and involved participants with various disease types. Therefore, it may not be generalizable to the general chronic illness population and reach cogent conclusions. In addition, previous studies have primarily examined the linear relationship between health literacy and illness perception, overlooking the potential non-linear association between the two. This oversight could result in a skewed interpretation of health literacy and illness perception in patients with chronic diseases.

To address the knowledge gap in this field, the present study specifically focuses on the nonlinear association between health literacy and illness perception among patients with chronic diseases in the community, and how illness perception changes when health literacy reaches a certain level. We aim to elucidate why improving health literacy among patients with chronic diseases does not necessarily promote illness perception, providing a scientific foundation for the development of more precise and targeted illness perception of patients with chronic diseases intervention strategies.

## Materials and methods

### Participants and design

The data used were obtained from the psychology and behavior investigation of Chinese residents, which is a multicenter, large-sample cross-sectional survey in China. The survey was conducted from June 20, 2022 to August 31, 2022 using the multistage sampling approach to select participants for the study.

In the first sampling stage, the study included the four directly municipalities (Beijing, Tianjin, Shanghai, Chongqing). Our study covered all 22 provinces and 5 autonomous regions of China. The number of cities sampled from each province or autonomous region was based on its economy and population size. A total of 148 cities were selected by equal probability sampling method. Using a random number table, between 2 and 12 cities were selected at random, leading to a total of 148 cities. In the second sampling stage, each selected city chose 6 rural communities (villages) and 4 urban communities, totaling 468 rural communities (villages) and 312 urban communities, amounting to 780 communities overall. In the third sampling stage, residents from each community were selected using a quota sampling method based on gender and age. The selection aimed for a 1:1 gender ratio and an age distribution that matched the proportions from the Seventh National Population Census [18]. The thorough sampling approach employed in this study has been described in previous literature, ensuring that our

results are both reliable and consistent with established methodologies [19].

### Data collection

The survey was carried out through the network Wenjuanxing platform (<https://www.wjx.cn/>), by investigator s issuing questionnaires to residents one-on-one. At the outset of the study, participants were informed about its purpose and required to provide informed consent. Prior to data collection, researchers were responsible for explaining important considerations regarding the questionnaire completion process to ensure the accuracy and completeness of the data. The participants signed the informed consent form and answered the questionnaires by clicking on the link, and the investigators input the questionnaire number. After the completion of the questionnaire, the researcher immediately retrieved the questionnaire and checked for missing data.

### Eligibility criteria

The study included surveys for all Chinese participants (aged  $\geq 18$  years) who provided informed consent to voluntarily participate in the study and completed the questionnaire independently or with the assistance of an investigator. The assistance of the investigator will not affect the participants' responses. Surveys were excluded if any of the following applied: (1) participants who were delirious, mentally disordered, or had cognitive disabilities; (2) participants who were participating in other similar studies; or (3) participants who were unwilling to participate in this study.

### Sample size

The G-power software (3.1.9.7) software was used to conduct the sample size calculation. Based on a previous study in which  $R^2$  was reported to be 0.20 [16]. A minimum of 122 subjects were needed after estimating the condition of a type I error 0.05 to a power of 0.95. The initial psychology and behavior investigation of Chinese residents survey involved 21,916 participants. After excluding participants without chronic diseases ( $n = 16,232$ ) and those younger than 18 years of age ( $n = 159$ ), the final data for analysis consisted of 5,525 participants. A total of 5,525 valid questionnaires were collected. The effective questionnaire recovery rate was 100.00%.

### Ethical issue

This study was approved by the Ethics Research Committee of the Health Culture Research Center of Shaanxi (No. JKWH-2022-02).

### Explanatory variables

Based on prior research [16, 20, 21], we incorporated the following socio-demographic characteristics into this study. Data were collected on demographics (sex, age, ethnicity, body mass index (BMI), education, Age-adjusted Charlson Comorbidity Index (ACCI), home address, hukou, spouse, income, medicare, alcohol consumption, cigarette smoking), health literacy, and illness perception for all participants. Hukou refers to the type of household registration of the participants, which is mainly divided into agricultural and non-agricultural categories in China. ACCI scores were computed based on the method outlined by Charlson [22], in which comorbid conditions are weighted and scored, and additional points added based on age (see supplementary file 3 for further detail). The details of the demographics variables and assignments were showed in supplementary file 1 and supplementary file 2.

### Outcome measures

#### Health literacy

The 9-item Short-Form Health Literacy Survey (HLS-SF9) was employed to gauge health literacy [23]. Sun et al. developed the HLS-SF9 based on the short-form health literacy survey questionnaire to assess the health literacy of patients with chronic diseases [23, 24]. The HLS-SF9 demonstrated good reliability and validity, supporting the original structure of the short-form health literacy survey questionnaire. The BIPQ has been used in Chinese people and demonstrated good reliability and validity, with Cronbach's  $\alpha$  for the total scale 0.913 [23]. The scale comprised three dimensions: healthcare literacy, which pertains to the ability to acquire and comprehend medical information in order to make informed decisions and follow medical advice; disease prevention, pertaining to the capacity to access and comprehend information about health risks and make informed decisions to avert disease; health promotion, referring to the capacity to comprehend the health determinants in societal and living contexts regularly, and make informed decisions and participate. Patients were requested to rate the difficulty they perceived for each item on a 4-point Likert scale, from 1 = "very difficult" to 4 = "very easy." This questionnaire contains 9 questions, with a scoring range between 0 and 50, with higher scores representing greater health literacy. The Cronbach's  $\alpha$  of the nine items in the HLS-SF9 was 0.930.

According to formula (1), the overall score was standardized to an index from 0 to 50, where higher scores represent better health literacy:

$$(\text{Index}) = (\text{Mean} - 1) \times \left( \frac{50}{3} \right) \quad (1)$$

We computed the average score of the 9 items in the HLS-SF9. A score of 1 represented the minimal possible value of the mean, resulting in a minimum index value of 0, while 3 was the range of the mean. The score of 50 was the chosen maximum value of health literacy index.

### Illness perception

The Brief Illness Perception Questionnaire (BIPQ) was utilized to evaluate the participants' perception of illness [25]. Broadbent et al. developed the BIPQ based on the illness perception questionnaire-revised to assess the illness perception of patients with chronic diseases [25, 26]. The BIPQ demonstrated good reliability and validity, supporting the original structure of the illness perception questionnaire-revised. The BIPQ has been used in Chinese people and demonstrated good reliability and validity, with Cronbach's  $\alpha$  for the total scale 0.831 [27]. Five of the items evaluated cognitive illness representations, including personal control, consequences, treatment control, timeline, and identity. Two of the items evaluated emotional representations: emotions and concern. One item evaluated illness comprehensibility. All of the items were rated on a scale of 0 to 10, resulting in an overall score (range: 0–80). The total score was generated by summing the scores for the BIPQ items. The score of the forward items was added to the reverse score of the reverse items. A higher overall score signified a more serious perception of illness. The Cronbach's  $\alpha$  of the eight items in the BIPQ was 0.615.

### Statistical analysis

First, the Shapiro-Wilk normality test was used to determine whether the data were normal. The data in this study did not follow a normal distribution. Continuous variables were presented as means (standard deviations) or median (interquartile ranges), while categorical variables were shown as frequency and percentage. Second, we used univariate analysis to evaluate the association between study variables and illness perception. Study variables included sex, BMI, age, ACCI, education, home address, Hukou, ethnicity, spouse, income (Chinese yuan), medicare, alcohol consumption, cigarette smoking, and health literacy.

Third, after adjusting for potential confounders, we applied smooth curve fitting to investigate whether the independent variable was partitioned into intervals. Each interval was fitted using a piecewise regression model that employed a separate line segment. The nonlinearity P value for the smooth curve fitting was calculated using loglikelihood ratio tests contrasting the piecewise regression model with the one-line (non-segmented) model. The maximum model likelihood was reached at the inflection point, which determined the threshold level of health literacy. Fourth, we applied a piecewise linear

regression model to examine threshold effect of health literacy on illness perception. Fifth, subgroup analysis on the illness perception in association with health literacy was performed based on the following variables: sex (male vs. female), education (primary school degree and below vs. secondary school vs. college and above), home address (town vs. country), Hukou (non-agricultural vs. agricultural), ethnicity (Han vs. others), spouse (without a spouse vs. with a spouse), income ( $\leq 3000$  vs. 3000–5000 vs.  $>5000$  Chinese yuan), medicare (without health insurance vs. medical insurance reimbursement), alcohol consumption (yes vs. no), and cigarette smoking (yes vs. no), respectively. Interactions between health literacy and sex, education, home address, Hukou, ethnicity, spouse, income, medicare, alcohol consumption, and cigarette smoking were also explored.

Analyses were conducted using the Prism 8.0 software (GraphPad Software, Inc., San Diego, USA) and EmpowerStats (<http://www.empowerstats.com>, X&Y Solutions, Inc., Boston, Massachusetts, USA). G-Power software (version 3.1.9.7; Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) was used for sample size calculation. A two-sided test was used with statistical significance set at  $P < 0.05$ .

### Results

Of the 5,525 participants, 2,774 (50.21%) were male, and the mean age of the participants was 52.46 years (Table 1). The median baseline health literacy score was 33.33 (IQR: 11.11). The median baseline ACCI score was 3.00 (IQR: 3.00). A total of 37.12% of the participants had a college degree or above. A total of 66.55% of the participants reside in urban areas, and 91.11% of the participants are of Han ethnicity. A total of 52.63% of the participants were non-agricultural household registrants, 75.42% were had a spouse, and 37.52% had an income of 3,000 yuan or less. Additionally, 96.13% of the participants had medical insurance, 77.23% did not consume alcohol, and 79.11% did not smoke.

Univariate analysis was conducted for all variables related to illness perception among chronic patients. Univariate analysis revealed that ethnicity 1.10 (0.10, 2.09), BMI  $-0.14$  ( $-0.21$ ,  $-0.07$ ), education level  $-4.06$  ( $-4.75$ ,  $-3.38$ ) and  $-8.04$  ( $-8.71$ ,  $-7.36$ ), ACCI 2.61 (1.89), home address 3.59 (3.00, 4.18), hukou 4.06 (3.51, 4.62), income  $-1.80$  ( $-2.48$ ,  $-1.12$ ) and  $-3.83$  ( $-4.50$ ,  $-3.16$ ), alcohol consumption  $-3.28$  ( $-3.95$ ,  $-2.61$ ), and health literacy  $-0.28$  ( $-0.31$ ,  $-0.25$ ) were significantly associated with illness perception (Table 1).

We analyzed potential non-linear association between illness perception and health literacy using a smoothing fitting curve. After adjusting for sex, age, ethnicity, BMI, education, ACCI, home address, hukou, spouse, income, medicare, alcohol consumption, and cigarette smoking,

**Table 1** Univariate analysis of illness perception

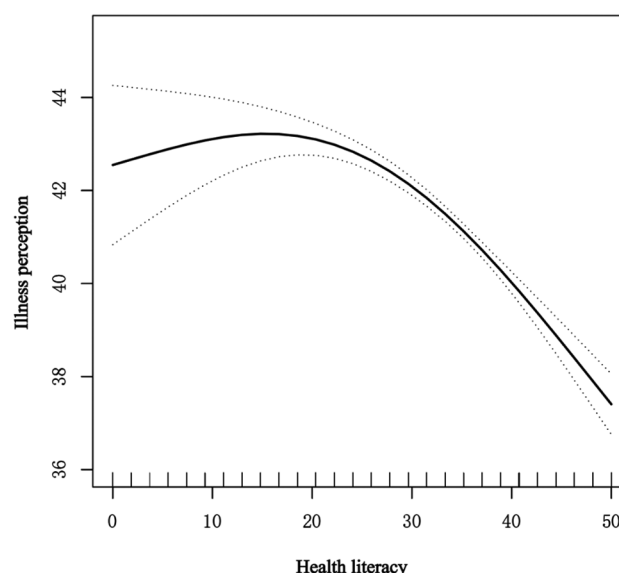
| Variable                           | Value <sup>#</sup>     | Illness perception<br>$\beta$ (95%CI) | P<br>value |
|------------------------------------|------------------------|---------------------------------------|------------|
| Sex                                |                        |                                       |            |
| Male                               | 2774 (50.21%)          | Reference                             |            |
| Female                             | 2751 (49.79%)          | 0.16 (-0.41, 0.72)                    | 0.582      |
| BMI, mean (SD)                     | 22.31 (4.28)           | -0.14 (-0.21, -0.07)                  | < 0.001    |
| Age (year),<br>mean (SD)           | 52.46 (17.49)          | 0.17 (0.16, 0.19)                     | < 0.001    |
| ACCI                               | 3.00 (1.00–4.00)       | 1.45 (1.31, 1.60)                     | < 0.001    |
| Education                          |                        |                                       |            |
| Primary school<br>degree and below | 1549 (28.04%)          | Reference                             |            |
| Secondary school                   | 1925 (34.84%)          | -4.06 (-4.75, -3.38)                  | < 0.001    |
| College and above                  | 2051 (37.12%)          | -8.04 (-8.71, -7.36)                  | < 0.001    |
| Home address                       |                        |                                       |            |
| Town                               | 3677 (66.55%)          | Reference                             |            |
| Country                            | 1848 (33.45%)          | 3.59 (3.00, 4.18)                     | < 0.001    |
| Hukou                              |                        |                                       |            |
| Non-agricultural                   | 2908 (52.63%)          | Reference                             |            |
| Agricultural                       | 2617 (47.37%)          | 4.06 (3.51, 4.62)                     | < 0.001    |
| Ethnicity                          |                        |                                       |            |
| Han                                | 5034 (91.11%)          | Reference                             |            |
| Others                             | 491 (8.89%)            | 1.10 (0.10, 2.09)                     | 0.030      |
| Spouse                             |                        |                                       |            |
| Without a spouse                   | 1358 (24.58%)          | Reference                             |            |
| With a spouse                      | 4167 (75.42%)          | 0.21 (-0.44, 0.87)                    | 0.526      |
| Income<br>(Chinese Yuan)           |                        |                                       |            |
| ≤ 3000                             | 2073 (37.52%)          | Reference                             |            |
| 3001–5000                          | 1650 (29.86%)          | -1.80 (-2.48, -1.12)                  | < 0.001    |
| > 5000                             | 1802 (32.62%)          | -3.83 (-4.50, -3.16)                  | < 0.001    |
| Medicare                           |                        |                                       |            |
| No                                 | 214 (3.87%)            | Reference                             |            |
| Yes                                | 5311 (96.13%)          | -0.67 (-2.13, 0.79)                   | 0.370      |
| Alcohol consumption                |                        |                                       |            |
| No                                 | 4267 (77.23%)          | Reference                             |            |
| Yes                                | 1258 (22.77%)          | -3.28 (-3.95, -2.61)                  | < 0.001    |
| Cigarette smoking                  |                        |                                       |            |
| Yes                                | 1154 (20.89%)          | Reference                             |            |
| No                                 | 4371 (79.11%)          | 0.30 (-0.39, 1.00)                    | 0.392      |
| Health literacy                    | 33.33<br>(25.93–37.04) | -0.28 (-0.31, -0.26)                  | < 0.001    |

<sup>#</sup>Data are n (%) or median (P25–P75). Results in table:  $\beta$  (95%CI) P value

Abbreviation: SD, standard deviation

ACCI: age-adjusted Charlson comorbidity index

we identified an inverted J-shaped association between illness perception and health literacy, as shown in both Fig. 1; Table 2. Correspondingly, a threshold effect analysis (Table 2) showed that P for log likelihood ratio test was < 0.001. The score inflection point for health literacy was identified as 22.22. The percent changes in illness perception were 0.12 (0.03, 0.21) on the left side and -0.23 (-0.27, -0.19) on the right side, respectively.



**Fig. 1** Association between illness perception and the probability of health literacy. Note: Non-linear associations between illness perception and health literacy were found ( $P < 0.05$ ). The estimated values and their corresponding 95%CI are shown by solid and dashed lines, respectively. Adjusted for sex, age, ethnicity, BMI, education, ACCI, home address, hukou, spouse, income, medicare, alcohol consumption, cigarette smoking. ACCI: age-adjusted Charlson comorbidity index, CI: confidence interval

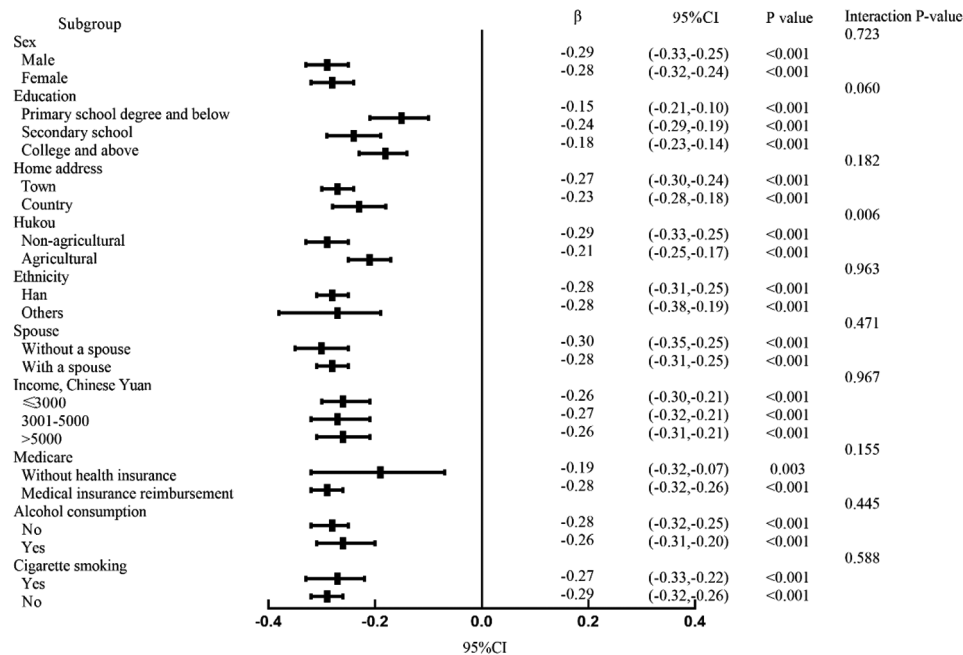
**Table 2** Threshold effect analysis of health literacy on illness perception using piecewise linear regression model

| Models                             | $\beta$ (95%CI)      | P-value |
|------------------------------------|----------------------|---------|
| Model I                            |                      |         |
| Fitting by a standard linear model | -0.16 (-0.19, -0.13) | < 0.001 |
| Model II                           |                      |         |
| Inflection point (K)               | 22.22                |         |
| Health literacy < 22.22            | 0.12 (0.03, 0.21)    | 0.009   |
| Health literacy ≥ 22.22            | -0.23 (-0.27, -0.19) | < 0.001 |
| P for log-likelihood ratio test    |                      | < 0.001 |

Note: Model I, one-line linear regression; Model II, two-segment regression. The 95% CI represented the confidence interval, and  $\beta$  represented the effect size. Adjusted for sex, age, ethnicity, BMI, education, ACCI, home address, hukou, spouse, income, medicare, alcohol consumption, and cigarette smoking. ACCI: age-adjusted Charlson comorbidity index

We conducted subgroup analyses based on 13 pre-defined factors (sex, education, home address, hukou, ethnicity, spouse, income, medicare, alcohol consumption, and cigarette smoking) (Fig. 2). The positive association between health literacy and illness perception was generally persistent across these subgroups. Significant interactions between health literacy and Hukou (non-agricultural vs. agricultural: -0.29 [-0.33, -0.25] vs. -0.21 [-0.25, -0.17]; P for interaction = 0.006) were observed. The associations were more pronounced in non-agricultural individuals than in their agricultural counterparts.





**Fig. 2** Subgroup analyses of the association between health literacy and illness perception in Chinese community patients with chronic diseases. The effect size ( $\beta$ ) and 95% confidence interval (95% CI) of health literacy are shown in forest plots

**Discussion**

This study examined the association between health literacy and illness perception in Chinese patients with chronic diseases in the community. The findings revealed that an inverted J-shaped association between the health literacy in chronic disease patients and their illness perception. Illness perception levels were highest when health literacy was 22.22. When health literacy was less than 22.22, illness perception increased as health literacy increased. When health literacy was 22.22 or greater, illness perception decreased as health literacy increased. After adjusting for potential confounding variables, a significant association between health literacy and illness perception persisted. Subgroup analysis showed that the association between health literacy and illness perception was unaffected by any predefined variables (listed in the Methods) except for the Hukou status.

This study showed that the health literacy of individuals with chronic diseases is significantly associated with their illness perception. This is consistent with a previous study on vascular disease patients in Sweden [17]. This may be related to the significant association between health literacy and the perception of health information [28] and discomfort [29]. Individuals with higher health literacy are generally better able to understand and process health-related information, thereby enhancing their perception of illness [30]. Individuals with a higher level of health literacy are more likely to ask healthcare professionals questions, understand doctors' recommendations and treatment plans, gain a clearer understanding of the

nature of their illness, and reduce anxiety and confusion caused by misunderstandings [31].

Contrary to this finding, existing research showed no correlation between health literacy and the average overall score of illness perception, and revealed that there is a significant correlation between health literacy and the duration of illness perception [32]. The inconsistency in results on this matter may be attributed to variations in the research setting, ethnicity, demographic characteristics, and measurement tools. Moreover, the role of health literacy may be influenced by the course of an individual's illness. As the duration of the disease increases, individuals may continuously acquire health information to adjust their perception of the illness [17]. Socio-economic factors, healthcare accessibility, and patients' ability to comprehend and apply health information may also serve as moderating factors between health literacy and illness perception [33, 34]. The results of this study not only enrich the understanding of the association between health literacy and illness perception across different populations, but also assist researchers and health professionals in recognizing the critical role of health literacy in improving illness perception.

Another important finding from this study was the inflection point in the positive association between health literacy and illness perception. For chronic disease patients with low health literacy, there was a significant positive association between illness perception and health literacy, further validating our hypothesis that health literacy can amplify or reduce the illness

perception. It is possible that these chronic patients with inadequate health literacy may lack the ability to acquire, process, and comprehend health information, and therefore might not know how to use it to recognize their disease condition [35, 36], which may hinder their ability to perceive their own illness. The evidence also indicated that patients with low health literacy become confused when facing complex illness symptoms, and may even misunderstand false illness information, resulting in anxiety, and ultimately hindering their perception of the illness [37]. Studies have shown that patients with lower levels of health literacy often rely on informal sources, such as social media, advice from family and friends, or unverified health information, when accessing and processing health-related information [38, 39]. This reliance may result in biased or even incorrect information, further compromising the accuracy of their illness perception. Individuals with lower health literacy are more likely to experience helpless emotions when facing health issues, which can interfere with their perception of illness [40]. These outcomes imply that healthcare professionals should prioritize addressing health literacy issues among patients with chronic disease who have low health literacy before addressing illness perception among chronically ill patients.

Conversely, after the inflection point, as health literacy increases, the perception of illness decreases among patients with chronic illnesses. One possible explanation is that patients with higher health literacy may be more critical of the medical information they receive, which may distort their perception of the illness [41]. These patients are more likely to comprehend medical terminology and be more aware of the limitations of medical knowledge [42]. As a result, they may perceive their illness diagnosis as less accurate and hold more positive or negative outlooks. Another possible explanation is that patients with higher health literacy may have a better understanding of their chronic condition and its management, thereby feeling more confident about managing their illness [43]. This increased confidence may lead to a decreased perception of illness severity. As health literacy improves, patients may develop a more rational perspective on illness, thereby lessening their perceived illness burden [44, 45]. Additionally, patients who with a negative perception of their illness are more likely to disengage from treatment and care, which can worsen their illness perception [46]. For example, patients who believe their illness is uncontrollable or their symptoms are severe may be less likely to engage in self-care activities or seek medical care when necessary. Individuals with low health literacy are less likely to believe that their illness is chronic and more likely to have negative emotions about their condition, including greater concern about their disease [7]. Individuals with higher health

literacy are more likely to actively and scientifically utilize medical resources, such as undergoing regular check-ups and seeking appropriate medical care [16, 20]. In this context, their uncertainty and fear about the disease may diminish, thereby lessening their perception of the illness. Therefore, it is essential to strengthen health literacy education for chronic disease patients, helping them view their condition more rationally and fostering a more accurate understanding of their illness.

This study found that health literacy across different subgroups was significantly associated with illness perception. There were no significant differences in illness perception between subgroups, except within the hukou subgroup. The results of this study are consistent with those of Tsai et al., who reported differences in illness perception between urban and rural patients [47]. It is possible that individuals from different hukou subgroups possess distinct cultural, social, and economic backgrounds that influence their illness perception [48, 49]. Moreover, some investigators have also pointed out poorer cognitive health function among individuals with an agricultural hukou compared to those with a non-agricultural hukou [50], indicating difficulties in accessing and utilizing health information and an inaccurate perception of illness among these agricultural hukou individuals. Specifically, urban participants often receive more comprehensive health education, have easier access to medical information, and benefit from more abundant medical resources, which may lead to a deeper illness perception. Rural residents may have a limited perception of diseases due to factors such as relatively scarce medical resources, inadequate health education, and financial constraints [51, 52]. This difference also suggests that when promoting the improvement of public health literacy, it is essential to adopt tailored approaches that fully consider the urban-rural disparities. Future health literacy promotion activities should be strengthened to enhance illness perception, particularly among patients with agricultural hukou.

### Limitations

This study has several limitations that should be acknowledged. The cross-sectional design limits the ability to establish a diachronic relationship between health literacy and illness perception. Future research should incorporate longitudinal cohort designs. Additionally, data collection relied solely on self-reported questionnaires, which may introduce recall bias. Moreover, some influential covariates that could confound the association between health literacy and illness perception may not have been considered in this study. This study may have limitations of heterogeneous study sample. In conclusion, further research is needed to gain a more comprehensive

understanding of the association between health literacy and illness perception.

## Conclusions

Health literacy is an important individual psychosocial factor, particularly for individuals with chronic diseases. It must be prioritized before implementing interventions aimed at improving illness perception. Given the variability in health literacy levels, the trend of illness perception in response to changes in health literacy also differs. For chronic disease patients with a high level of health literacy, it is necessary to optimize illness perception through targeted health education. Tailored support should be offered to patients with chronic diseases based on their health literacy levels to enhance their illness perception.

The findings of this study have important implications for the health system. This inverted J-shaped association between health literacy and illness perception in chronic disease patients suggests that while improving health literacy is generally beneficial, excessive health literacy may lead to decreased illness perception. These results emphasize the need for tailored health education programs that optimize health literacy levels without diminishing patients' awareness of their disease.

For the health system, the benefits of this study are twofold. First, it provides evidence to guide the development of more effective health communication strategies, ensuring that information is tailored to different health literacy levels to maximize positive patient illness perception. Second, the findings support policy-making aimed at integrating health literacy enhancement into chronic disease management programs, which can improve healthcare efficiency, reduce unnecessary hospital visits, and optimize resource allocation. By recognizing the nuanced association between health literacy and illness perception, the health system can implement more patient-centered approaches, leading to better overall health outcomes.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-23123-2>.

Supplementary Material 1

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## Author contributions

CG, YW and XB prepared conceptualization; QQ, DQ and SZ prepared methodology; CG, YW, and SZ wrote the original draft; CG, YW, QQ, and SZ reviewed and edited draft; YW, DQ, and XB prepared visualization; All authors have read and agreed to the published version of the manuscript.

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## Data availability

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

## Declarations

### Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki. This study was approved by the Ethics Research Committee of the Health Culture Research Center of Shaanxi (No. JKWH-2022-02). Informed consent was acquired from each participant, and all participants remained anonymous, in accordance with the Declaration of Helsinki.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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