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The prevalence and related factors for low health literacy in Xingtai

A cross-sectional survey in prefecture-level city

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Abstract

This study aimed to evaluate the low health literacy prevalence and its socio-demographic related factors in Xingtai.

This study was a community-based, cross-sectional survey performed in Xingtai, with a sample size of 960. Participants' socio-demographic characteristics were collected, and their health literacy status was evaluated by the questionnaire designed by the 2012 Chinese Resident Health Literacy Survey.

There were 904 (94.2%) participants who provided valid questionnaires and they were included in the analyses. The mean health literacy score was 63.0 ± 16.6; for its subscales, the mean scores of health literacy of basic knowledge and concepts, lifestyle, and health-related skills were 31.6 ± 8.7, 17.1 ± 4.7, and 14.3 ± 3.9, respectively. Low total health literacy prevalence was 83.1%; as for its subscales, the prevalence of low health literacy of basic knowledge and concepts, lifestyle, and health-related skills was 72.5%, 87.8%, and 87.4%, respectively. Meanwhile, age, male and rural location were positively correlated, but education level and annual household income were negatively correlated with low health literacy risk. Further multivariate analysis revealed that lower education level was the only independent related factor for low total health literacy, and the most important independent related factor for low total health literacy of basic knowledge and concepts, lifestyle and health-related skills.

Low health literacy prevalence is 83.1%, and lower education level is the most critical related factor for low health literacy in Xingtai.

Abbreviations: CI = confidence interval, PPS = Probability Proportionate to Size.

Keywords: cross-sectional survey, education level, low health literacy, socio-demographic related factor, Xingtai

1. Introduction

Health literacy, the concept first raised in the 1970 s, refers to an individual's ability to gain, understand and utilize information on health to enhance and sustain his/her health status.[1,2] Several previous studies reveal that health literacy reflects an individual's health quality and closely associates with healthcare utilization.[3–5] For example, it is suggested that low health literacy is connected with an individual's worse self-management and inferior health status.[3,4] Meanwhile, low health literacy is a strong predictor for hospital admission, indicates worse public health education and lower health resource utilization.[5,6] Therefore, low health literacy issues have received broad attention during the past decades.

Currently, only a few studies have focused on the related factors of low health literacy prevalence.[7,8] For example, previous studies show that several factors including higher age, lower education level, rural location, lower level of physical exercise, lower income and limited health information access are associated with low health literacy.[9,10] Another study indicates that adolescents with younger age, male, whose parents have lower education level, and from non-prestigious schools tend to have low health literacy.[11] However, most of these researches are regional-based and their results could not represent other regions.

Xingtai, located in the south part of Hebei Province of China, is an ancient prefecture-level city with a history of over 3500 years. The population of permeant residents in Xingtai city is approximately 7.40 million, among which about 51% permeant residents are urban residents. Xingtai city is one of the most important industrial cities in Hebei Province (and the latter one is also a large industrial province in China).[12,13] Therefore, among Hebei Province, Xingtai city might possess certain representa-

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CW and GG contributed equally to this work.

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tiveness in the aspects of demographic, economic structure and low health literacy prevalence, however, the local prevalence and related factors of low health literacy are unclear. According to previous studies, understanding the local prevalence of low health literacy and its related factors might help the local government to formulate policies and allocate resources.[6–8] Therefore, we performed this cross-sectional survey, aiming to investigate the overall health literacy status, then evaluate the low health literacy prevalence and its socio-demographic related factors among Xingtai residents.

2. Methods

2.1. Study population

This study was conducted between January 2019 and December 2019 in Xingtai. It was reported that the permanent residents of Xingtai were 7.40 million in 2019. A total of 960 residents in Xingtai were invited to participate in this cross-sectional survey. Subjects were eligible to participate in this study if they were permanent residents in Xingtai and had age within 16 to 75 years. The permanent resident was defined as the resident who had lived in the Xingtai for more than 12 months, regardless of whether they had a local household registration or not. While the residents, who collectively resided in military bases, hospitals, prisons, nursing homes, or dormitories, were not included in the study. This study was approved by the Research Ethics Committee of Hebei Provincial Centers for Disease Control and Prevention. All participants signed informed consents.

2.2. Sample size estimation

The study population was selected using a multistage, stratified sampling method. The considered stratification factors included area (urban and rural), age (16~35 years, 36~55 years, 56~75 years) and gender (male and female). In each stratification, the sample size was estimated using the formula[14]: $N = \frac{Z^2_{1-\frac{\alpha}{2}}}{\delta^2} \times p(1-p) \times deff$, where the parameters were set as follows: prevalence $P = .89$ (based on the results of national health literacy survey, available at http://www.nhc.gov.cn/), maximum permissible error $\delta = 0.1p$, significance level $\alpha = 0.05$, $Z_{1-\alpha/2} = 1.96$, the design effect of complex sampling deff = 1.5 (based on a previous study[14]), the required sample size in each stratification was N = 71.22. Considering a refusal rate of 10%, the sample size was increased to 80. Total sample size of this study was calculated as: N = 80 × 2 (area stratifications) × 3 (age stratifications) × 2 (gender stratifications) = 960.

2.3. Sampling procedures

The outline of sampling procedures was shown in Figure 1. Two urban areas and 2 rural areas in Xingtai were randomly selected using Probability Proportionate to Size (PPS) sampling. In each chosen urban area, 2 districts were randomly selected with PPS sampling, then 2 communities were randomly selected with PPS sampling from each chosen district; next, 60 registered households were randomly selected from each chosen community using random number table, and 1 resident was selected from each chosen household with the use of Kish method. In each chosen rural area, 2 towns were randomly selected with PPS sampling, then 2 villages were randomly selected with PPS sampling from each chosen town; next, 60 registered households were randomly selected from each chosen village using random number table, and 1 resident was selected from each chosen household with the use of Kish method. Consequently, 960 residents were sampled. Finally, 56 participants were excluded from analysis, among which 34 (3.5%) participates were unwilling to participate (non-responders) and 22 (2.3%) participates provided invalid questionnaire due to incorrect filling, then 904 participants (94.2%) provided valid questionnaire and were included in the analysis.

2.4. Data collection

A questionnaire designed for the survey was used to collect information, which consisted of 2 parts: part 1 was designed to collect participants' socio-demographic characteristics including age, gender, education level, annual household income and location; part 2 was the 2012 Chinese Resident Health Literacy Scale derived from the manual of "Chinese Resident Health Literacy-Basic Knowledge and Skills (trial edition)" published by the Chinese Ministry of Health in 2008.[15] The questionnaire was completed by the participants themselves. If the participants were unable to fulfill the questionnaire independently due to low cultural level or other reasons, the face-to-face interview was performed to collect information.

2.5. Health literacy evaluation

The 2012 Chinese Resident Health Literacy Scale comprised 80 questions including 38 questions about basic knowledge and concepts, 22 questions about lifestyle, and 20 questions about health-related skills.[16] There were 4 types of questions in the scale: 15 true-or-false questions, 40 single-answer questions, 18 multiple-answer questions and 7 situation questions (including 5 single-answer questions and 2 multiple-answer questions). For true-or-false and single-answer questions, 1 point was assigned for a correct answer, and 0 points were assigned for an incorrect answer. For multiple-answer questions, 2 points were assigned if the response contained all correct answers without the wrong ones, and 0 points were given to wrong or omitted answers. The total basic knowledge and concepts score was 47 points, the total lifestyle score was 28 points, and the total health-related skills score was 25 points. The total health literacy score was the sum of the 3 scores, which was ranging from 0 to 100 points. Low health literacy was defined as the total health literacy score < 80 points (which was 80% of total health literacy score).[14,16] Low health literacy of basic knowledge and concepts was defined as the total basic knowledge and concepts score < 38 points (which was 80% of total basic knowledge and concepts score). Low health literacy of lifestyle was defined as the total lifestyle score < 23 points (which was 80% of total lifestyle score). Low health literacy of health-related skills was defined as the total health-related skills score < 20 points (which was 80% of health-related skills score).

2.6. Statistical analysis

SPSS 24.0 (IBM, Chicago, IL) was used for statistical analysis, and GraphPad Prism 8.01 (GraphPad Software Inc., San Diego, CA, USA) was used for graphics making. Socio-demographic characteristics data and low health literacy prevalence were described as number and percentage. The distribution of health literacy score was displayed by the histogram and determined by Kolmogorov-Smirnov (K-S) test. Since the score was approximately normally distributed, it was described by mean with standard deviation. The

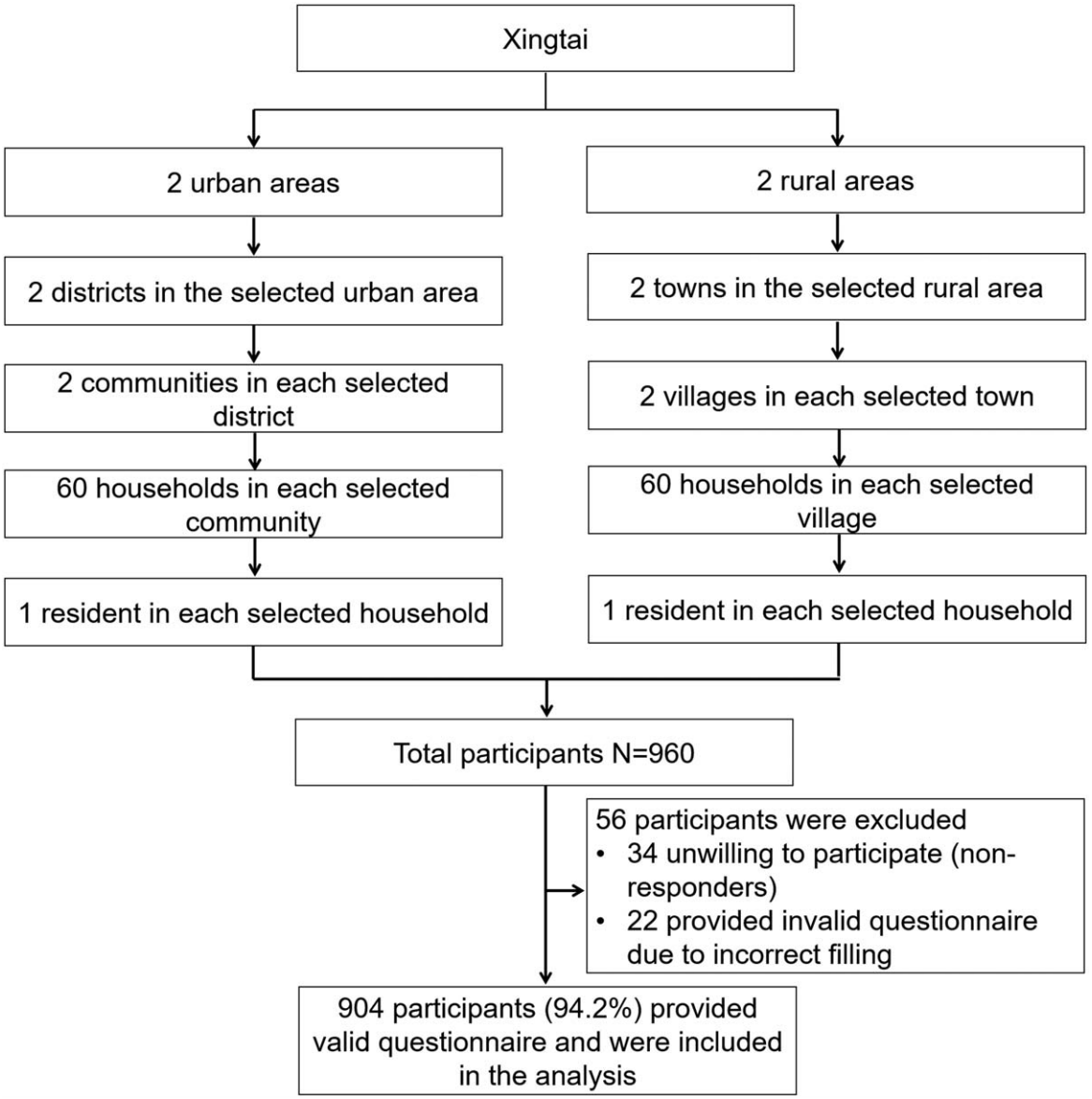

Figure 1. Study procedure.

comparison of health literacy scores among subjects with different characteristics was determined by one-way analysis of variance or Student *t* test. The comparison of low health literacy prevalence among subjects with different characteristics was determined by the Chi-Squared test. Considering the design effect by complex sampling, factors related to low health literacy risk were analyzed by the general linear mixed model (GLMM) analysis (by lme4 package in R software), in which the sampling unit (communities or villages) was considered as random effect and other factors were fixed. *P* value <.05 was considered significant.

3. Results

3.1. Description of participants' characteristics

Among the 904 analyzed participants, 305 (33.7%) of them had age of 16 to 35 years, 290 (32.1%) of them had age of 36 to 55 years, and 309 (34.2%) of them had age of 56 to 75 years; 434 (48.0%) of them were female, and 470 (52.0%) of them were male. As to education level, 230 (25.4%) participants had education level of primary school or below, 352 (38.9%) participants had education level of junior high school, 219 (24.2%) participants had education level of high school, and 103 (11.4%) participants had education level of university or above. Regarding annual household income, 75 (8.3%) participants had income less than ¥10000, 462 (51.1%) participants had income of ¥10000-¥29999, 217 (24.0%) participants had income of ¥30000-¥49999, and 150 (16.6%) participants had income higher than or equal to ¥50000. For resident location, 443 (49.0%) participants were from rural area and 461 (51.0%) participants were from urban area (Table 1).

3.2. Description of participants' health literacy status and low health literacy prevalence

The health literacy score distribution of all analyzed participants was shown in Figure 2A. In detail, 7 (0.8%) participants had

Table 1

Characteristics.

Characteristics	Participants (N = 904)
Age, No. (%)	
16–35 years	305 (33.7)
36–55 years	290 (32.1)
56–75 years	309 (34.2)
Gender, No. (%)	
Female	434 (48.0)
Male	470 (52.0)
Education level, No. (%)	
Primary school or below	230 (25.4)
Junior high school	352 (38.9)
High school	219 (24.2)
University or above	103 (11.4)
Annual household income, No. (%)	
<¥10000	75 (8.3)
¥10000–¥29999	462 (51.1)
¥30000–¥49999	217 (24.0)
≥¥50000	150 (16.6)
Location, No. (%)	
Rural	443 (49.0)
Urban	461 (51.0)

¥, RMB.

health literacy score of 10 to 20, 17 (1.9%) participants had health literacy score of 21 to 30, 66 (7.3%) participants had health literacy score of 31 to 40, 123 (13.6%) participants had health literacy score of 41 to 50, 166 (18.4%) participants had health literacy score of 51 to 60, 196 (21.7%) participants had health literacy score of 61 to 70, 184 (20.4%) participants had health literacy score of 71 to 80, 115 (12.7%) participants had health literacy score of 81 to 90, and 30 (3.3%) participants had health literacy score of 91 to 100 (Fig. 2A). Meanwhile, on average, the participants displayed unsatisfied total health literacy score (mean score: 63.0 ± 16.6), and unsatisfied health literacy of basic knowledge and concepts score (mean score: 31.6 ± 8.7), lifestyle score (mean score: 17.1 ± 4.7) and health-related skills score (mean score: 14.3 ± 3.9) (Fig. 2B). Moreover, 83.1% (95% confidence interval (CI): 80.4%–85.8%) participants had low total health literacy, 72.5% (95% CI: 69.1%–75.9%) participants had low health literacy of basic knowledge and concepts, 87.8% (95% CI: 85.5%–90.1%) participants had low health literacy of lifestyle, and 87.4% (95% CI: 85.1%–89.7%) participants had low health literacy of health-related skills (Fig. 2C). Besides, the basic knowledge and concepts score, lifestyle score and health-related skills score distribution of all analyzed participants was shown in Supplementary Figure 1A–C, http://links.lww.com/MD/F822, respectively.

3.3. Correlation between socio-demographic characteristics and health literacy score and low health literacy prevalence

Regarding health literacy score, age was negatively correlated, while female, education level, annual household income and urban location were positively correlated with health literacy score, as well as its subscales including basic knowledge and concepts score, lifestyle score and health-related skills score (all $P < .001$) (Table 2).

As to low health literacy prevalence, female, education level, annual household income and urban location were negatively associated with low health literacy prevalence, as well as its subscales including low basic knowledge and concepts prevalence, low lifestyle prevalence and low health-related skills prevalence (all $P < .05$). Meanwhile, age was positively associated with low health literacy prevalence, as well as the prevalence of low health literacy of basic knowledge and concepts, and health-related skills (all $P < .05$), but not lifestyle ($P = .081$) (Table 3).

3.4. Related factors for low health literacy risk

Univariate fixed variables in GLMM showed that higher age (36–55 years vs 16–35 years, $P = .136$; 56–75 years vs 16–35 years, $P = .002$), male (male vs female, $P < .001$), lower education level (high school vs university or above, $P = .003$; junior high school vs university or above, $P < .001$; primary school or below university or above, $P < .001$), lower annual household income (¥30000–¥49999 vs ≥¥50000, $P = .021$; ¥10000–¥29999 vs ≥¥50000, $P < .001$; <¥10000 vs ≥¥50000, $P < .001$), and rural location (rural vs urban, $P < .001$) were related factors for low health literacy. Forward stepwise multivariate fixed variables in GLMM revealed that lower education level (high school vs university or above, $P = .003$; junior high school vs university or above, $P < .001$;

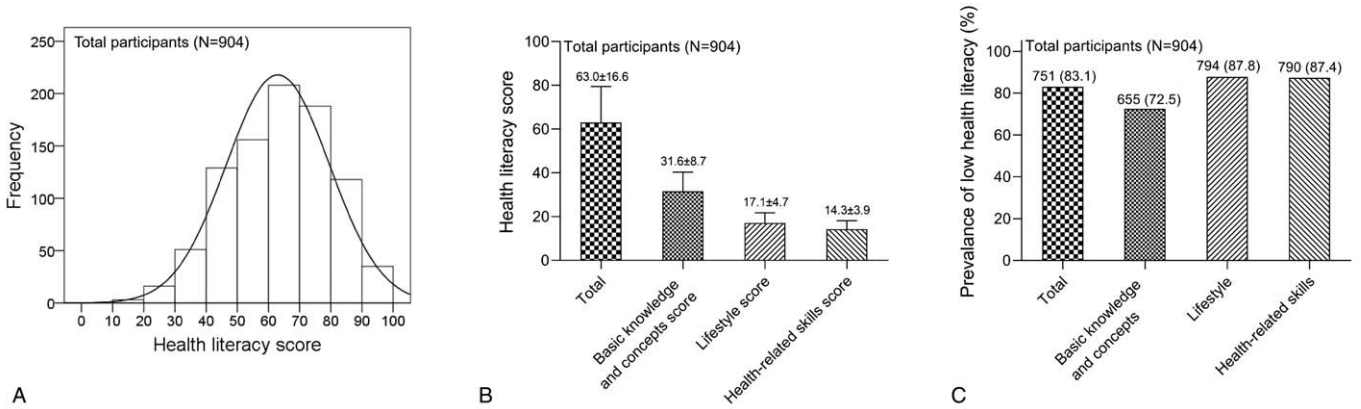

Figure 2. Health literacy status in Xingtai. A: Health literacy score distribution of all analyzed participants; B: Mean total health literacy score, and mean health literacy scores of basic knowledge and concepts, lifestyle, and health-related skills, respectively; C: Prevalence of low health literacy, and prevalence of low health literacy of basic knowledge and concepts, lifestyle, and health-related skills, respectively.

Table 2

Correlation of participants' characteristics with health literacy score.

Characteristics	Total health literacy score		Basic knowledge and concepts score		Lifestyle score		Health-related skills score	
	Mean ± SD	*P* value	Mean ± SD	*P* value	Mean ± SD	*P* value	Mean ± SD	*P* value
Age		<.001		<.001		<.001		<.001
16–35 years	66.6 ± 15.0		33.3 ± 8.0		18.2 ± 4.3		15.1 ± 3.6	
36–55 years	62.9 ± 16.7		31.8 ± 8.8		16.9 ± 4.6		14.2 ± 4.0	
56–75 years	59.2 ± 17.1		29.6 ± 9.0		16.2 ± 4.9		13.5 ± 4.0	
Gender		<.001		<.001		<.001		<.001
Female	66.9 ± 15.3		33.5 ± 8.0		18.2 ± 4.4		15.2 ± 3.7	
Male	59.5 ± 16.9		29.9 ± 9.0		16.1 ± 4.7		13.4 ± 3.9	
Education level		<.001		<.001		<.001		<.001
Primary school or below	54.4 ± 16.1		27.3 ± 8.6		14.8 ± 4.6		12.3 ± 3.6	
Junior high school	61.7 ± 15.5		31.1 ± 8.3		16.7 ± 4.4		13.9 ± 3.6	
High school	68.3 ± 14.6		34.1 ± 7.8		18.6 ± 4.2		15.6 ± 3.6	
University or above	75.4 ± 13.0		37.8 ± 6.8		20.5 ± 3.8		17.2 ± 3.5	
Annual household income		<.001		<.001		<.001		<.001
<¥10000	53.6 ± 15.7		26.9 ± 8.6		14.6 ± 4.5		12.1 ± 3.3	
¥10000-¥29999	59.6 ± 16.0		29.9 ± 8.4		16.2 ± 4.6		13.6 ± 3.8	
¥30000-¥49999	66.2 ± 16.0		33.3 ± 8.5		18.0 ± 4.5		14.9 ± 3.8	
≥¥50000	73.5 ± 13.0		36.9 ± 7.0		20.0 ± 3.7		16.7 ± 3.4	
Location		<.001		<.001		<.001		<.001
Rural	58.3 ± 16.3		29.2 ± 8.5		15.9 ± 4.7		13.3 ± 3.8	
Urban	67.5 ± 15.5		34.0 ± 8.3		18.3 ± 4.3		15.3 ± 3.8	

SD = standard deviation; ¥, RMB.

primary school or below vs university or above, $P < .001$) was the only independent related factor for low health literacy (Table 4).

3.5. Independent related factors of low health literacy in basic knowledge and concepts, lifestyle and health-related skills

Forward stepwise GLMM analysis showed that lower education level and rural location (all $P < .05$) were independent related factors for low basic knowledge and concepts. Meanwhile, lower education level was the only independent related factor for low health literacy of lifestyle and health-related skills (all $P < .05$), respectively (Table 5).

4. Discussion

In the present study, we found that:

1. the mean total health literacy score was 63.0 ± 16.6, and low health literacy prevalence was 83.1% in Xingtai;

Table 3

Correlation of participants' characteristics with low health literacy prevalence.

Characteristics	Low health literacy							
	Total	*P* value	Basic knowledge and concepts	*P* value	Lifestyle	*P* value	Health-related skills	*P* value
Age, No. (%)		.007		.001		.081		.003
16–35 years	242 (78.3)		205 (66.3)		261 (84.5)		255 (82.5)	
36–55 years	254 (83.3)		219 (71.8)		274 (89.8)		269 (88.2)	
56–75 years	255 (87.9)		231 (79.7)		259 (89.3)		266 (91.7)	
Gender, No. (%)		<.001		<.001		0.002		<.001
Female	339 (78.1)		339 (78.1)		366 (84.3)		359 (82.7)	
Male	412 (87.7)		412 (87.7)		428 (91.1)		431 (91.7)	
Education level, No. (%)		<.001		<.001		<.001		<.001
Primary school or below	217 (94.3)		208 (90.4)		221 (96.1)		221 (96.1)	
Junior high school	307 (87.2)		260 (73.9)		319 (90.6)		321 (91.2)	
High school	166 (75.8)		138 (63.0)		182 (83.1)		179 (81.7)	
University or above	61 (59.2)		49 (47.6)		72 (69.9)		69 (67.0)	
Annual household income, No. (%)		<.001		<.001		<.001		<.001
<¥10000	71 (94.7)		66 (88.0)		72 (96.0)		74 (98.7)	
¥10000–¥29999	414 (89.6)		373 (80.7)		425 (92.0)		423 (91.6)	
¥30000–¥49999	167 (77.0)		137 (63.1)		183 (84.3)		183 (84.3)	
≥¥50000	99 (66.0)		79 (52.7)		114 (76.0)		110 (73.3)	
Location, No. (%)		<.001		<.001		<.001		<.001
Rural	399 (90.1)		365 (82.4)		407 (91.9)		409 (92.3)	
Urban	352 (76.4)		290 (62.9)		387 (83.9)		381 (82.6)	

¥, RMB.

Table 4

Factors related to low health literacy risk.

	GLMM analysis			
			95% CI	
Items	***P* value**	**OR**	**Lower**	**Higher**
Univariate fixed variables in GLMM				
Age				
16–35 years	Reference	–	–	–
36–55 years	.136	1.367	0.906	2.071
56–75 years	.002	2.047	1.308	3.252
Gender				
Female	Reference	–	–	–
Male	<.001	2.082	1.450	3.015
Education level				
University or above	Reference	–	–	–
High school	.003	2.157	1.307	3.560
Junior high school	<.001	4.697	2.844	7.784
Primary school or below	<.001	11.493	5.949	23.568
Annual household income				
≥¥50000	Reference	–	–	–
¥30000–¥49999	.021	1.721	1.084	2.737
¥10000–¥29999	<.001	4.443	2.832	6.994
<¥10000	<.001	9.144	3.533	31.245
Location				
Urban	Reference	–	–	–
Rural	<.001	2.808	1.937	4.133
Forward stepwise multivariate fixed variables in GLMM				
Education level				
University or above	Reference	–	–	–
High school	.003	2.157	1.307	3.560
Junior high school	<.001	4.697	2.844	7.784
Primary school or below	<.001	11.493	5.949	23.568

CI = confidence interval, GLMM = general linear mixed model, OR = odds ratio; ¥, RMB.

Table 5

Independent factors related to risk of low health literacy of basic knowledge and concepts, lifestyle and health-related skills.

	Forward stepwise GLMM analysis			
			95% CI	
Items	***P* value**	**OR**	**Lower**	**Higher**
Low health literacy of basic knowledge and concepts				
Education level				
University or above	Reference	–	–	–
High school	.026	1.727	1.069	2.802
Junior high school	<.001	2.592	1.595	4.231
Primary school or below	<.001	7.632	3.992	14.972
Location				
Urban	Reference	–	–	–
Rural	.049	1.444	1.002	2.085
Low health literacy of lifestyle				
Education level				
University or above	Reference	–	–	–
High school	.007	2.118	1.219	3.671
Junior high school	<.001	4.162	2.391	7.251
Primary school or below	<.001	10.573	4.991	24.562
Low health literacy of health-related skills				
Education level				
University or above	Reference	–	–	–
High school	.004	2.205	1.289	3.768
Junior high school	<.001	5.102	2.942	8.902
Primary school or below	<.001	12.100	5.753	27.992

CI = confidence interval, GLMM = general linear mixed model, OR = odds ratio; ¥, RMB.

2. higher age, male, lower education level, lower annual household income and rural location were closely associated with low health literacy risk in Xingtai;
3. lower education was the only independent related factor for low total health literacy, and was an important independent correlation factor for low health literacy in subscales in Xingtai.

This study was the first study to explore the prevalence of low health literacy and its related factors in Xingtai to the best of our knowledge, which might provide potential supportive information for the local government of Xingtai to formulate policies and allocate resources to improve local health literacy status.

Health literacy critically affects one's health status.[17] People with low health literacy tend to have worse self-management and inferior health status.[18] Meanwhile, low health literacy is closely associated with several diseases such as diabetes mellitus, hypertension, coronary artery disease, cancer, etc., which leads to more hospitalization and higher medical cost, thus increasing the burden of public health.[5,19–21] On the other hand, recognizing related factors for low health literacy might provide supportive information for the government to guide public health education, formulate relevant policies and allocate medical resources.[22] Therefore, it is of great importance to understand the prevalence of low health literacy and to explore the related factors for low health literacy.

Several studies have been conducted to evaluate the local prevalence of low health literacy in some areas of China, however, the reported low health literacy prevalence varies greatly partly due to the difference in the standard of low health literacy.[9,14] Meanwhile, no previous study had explored low health literacy prevalence in Xingtai. In order to fill this blank, we performed a cross-sectional questionnaire survey with a multiple-stage randomization design, enrolled 960 participants and analyzed 904 valid data. Moreover, to achieve relative objective evaluation, we adopted the standard of low health literacy published by the Chinese Ministry of Health in 2012.[16] Data showed that the mean total health literacy was 63.0 ± 16.6, and low health literacy prevalence was 83.1% in Xingtai, which was numerically lower than low health literacy prevalence in China mainland in 2012.[16] Possible explanations might be that:

1. the average household income and education level of Chinese residents were increased at present compared to that in 2012,[23] which might result in reduced prevalence of low health literacy;
2. several developed areas are located around Xingtai, such as Beijing, which might result in higher household income and education level of Xingtai residents than that of Chinese residents, thus, the low health literacy prevalence was lower in Xingtai.

In the present study, we also collected participants' socio-demographic characteristics, and analyzed the correlation between participants' socio-demographic characteristics and low health literacy. Data showed that higher age, male, lower education level, lower annual household income and rural location were correlated with reduced total health literacy score and increased prevalence of low health literacy. Further univariate logistic regression analysis displayed that higher age, male, lower education level, lower annual household income and rural location were related factors for low health literacy. Our data could be explained by that:

1. as the age increase, people might have worse eyesight, hearing and suffer from dementia; meanwhile, the elderly in China had few opportunities to get literate due to historical reason, which could hinder their ability in receiving and processing key information on improving health status[24];
2. according to a previous study, the male might face higher occupational pressure compared to female,[25] which might reduce their time in receiving key information on promoting health status;
3. people with lower annual household income might face with higher living pressure, which could also limit their time in absorbing and processing knowledge on promoting and maintaining good health;
4. people living in the rural area might have less access to receiving information to keep them in good health.

Therefore, these socio-demographic factors were closely associated with low health literacy. Notably, multivariate analysis illustrated that lower education level was the only independent related factor for low total health literacy; meanwhile, lower education level was also the most important independent related factor for low health literacy of basic knowledge and concepts, lifestyle and health-related skills. Our data could be explained by that:

1. people with lower education level might have obstacles in understanding and processing information which could keep them in good health status;
2. people with lower education level might have lower annual household income, which further resulted in low health literacy.

Our data indicated that reinforcing the coverage of education might be the main solution to ameliorate the prevalence of low health literacy in Xingtai.

Although we had found lots of interesting results, there were several limitations in this study. Firstly, this was a cross-sectional study, therefore, we could not determine the direct casual inferences and the direction of casualty. Secondly, since this study was based on questionnaires, there might exist bias in participants' self-evaluation of health literacy, and developing and exploiting more objective evaluation methods could ameliorate this situation. Thirdly, some of the continuous variables were transferred into categorized variables in order to achieve better visualization, which might cause information loss. A future large-scaled longitudinal study could be conducted to recognize the risk factors for low health literacy in Xingtai city. Moreover, although the design effect of the complex sampling procedure was addressed as much as possible by the stratification analysis, as well as univariate and multivariate logistic regression analyses, it may not be completely eliminated, which might cause bias.

To be conclusive, low health literacy is quite prevalent in Xingtai; meanwhile, higher age, male, lower education level, lower annual household income and rural location are related factors for low health literacy, among which lower education level is the only independent related factor of low health literacy, indicating the necessity of reinforcing education coverage.

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