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ORIGINAL RESEARCH

Health Literacy Among University Students in Shaanxi Province of China: A Cross-Sectional Study

Shuqiang Wu[1,2,*], Bilin Shao[1,*], Gaimei Wang[2]

[1]School of Management, Xi'an University of Architecture and Technology, Xi'an, 710055, People's Republic of China; [2]College of Mechanical and Electrical Engineering, Shaanxi University of Science & Technology, Xi'an, 710021, People's Republic of China

*These authors contributed equally to this work

Correspondence: Shuqiang Wu, School of Management, Xi'an University of Architecture and Technology, 13 Yanta Road, Beilin District, Xi'an, 710055, People's Republic of China, Tel +86029-86168302, Fax +86029-86168127, Email 4256@sust.edu.cn

Background: An adequate level of health literacy will help university students to better respond to public health emergencies and reduce unintended harm caused by public health events. The objective of this study was to assess the health literacy levels of students from Universities of Shaanxi province of China, in order to provide a basis for the development of health literacy promotion plan for university students.

Methods: An online cross-sectional questionnaire survey was conducted at five universities in Shaanxi Province of China on the Wen-Juan-Xing online platform. A purposive sampling method was used to 1578 students via self-administered questionnaire. Comparisons of means were made using the *t*-test and ANOVA, and comparisons of ratios or composition ratios were made using the χ^2 test.

Results: The mean score for health literacy was (105.33±10.14) out of 135, and the mean scores for the three dimensions of health knowledge, attitudes and practices were (36.093±4.192), (34.178±4.227) and (35.059±4.515) respectively. Of the total sample, 39.2% were classified as sufficient in health literacy. Female students had higher health literacy level than male students (t=4.064, p=0.044), lower grade students scored higher than higher grade (F=3.194, p=0.013), students from urban cities scored higher than those who came from rural areas (t=16.376, p<0.001), and university students with health education experience scored higher than those without (t=24.389, p<0.001).

Conclusion: University students' health literacy is closely related to their gender, grades, family location and health education experience.

Keywords: health literacy, knowledge, attitudes, practices, university students

Introduction

Health Literacy

Despite the growing recognition of the importance of health literacy (HL), there is no consensus on the definition of health literacy or its conceptual dimensions, which limits the possibilities for measurement and comparison.[1–5] The World Health Organization defines health literacy as the cognitive and social skills that determine an individual's motivation and ability to acquire, understand and use information in order to promote and maintain good health mastery of information in order to promote and maintain good health.[6] The US National Library of Medicine defines health literacy as an individual's ability to access, understand, and process basic health information or services and to make sound health-related decisions.[7] Sørensen K has proposed a model of health literacy that combines medical and public health perspectives, which can be used as a basis for the development of interventions to improve health literacy and provide a conceptual basis for the development and validation of measurement tools.[8] Health literacy measurement is an important way to assess health literacy.[9,10] The construction of health literacy measurement which scales from the dimensions of health knowledge, attitude and practice (KAP) can accurately and scientifically express an individual's health literacy.[11,12]

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Health Literacy Levels

Health literacy varies from country to country and the overall performance is unsatisfactory. Data from the European Health Literacy Survey shows that nearly half of Europeans surveyed have inadequate or problematic health literacy.[13] Over a third of the US population is experiencing low health literacy.[14] The results of the recent European Health Literacy Survey indicate that 12% of the population surveyed had inadequate health literacy in general and 35% had problematic health literacy.[15] Health literacy problems are common among national population groups, with less than 2% of the Netherlands and 27% of Bulgaria being less health literate.[16] Health literacy among Koreans appears to be worse than previously expected, and this may be a major obstacle to effective health public education campaigns.[17] In a cross-sectional study of health literacy levels among students in nursing, social work, primary education and special education, only 36.5% were classified as having adequate health literacy.[18]

In China, the health literacy of the population is also not promising.[19] A cross-sectional study of health-related knowledge among Chinese vocational university students showed that only 1.4% of students had a good level of health-related knowledge.[20] Studies have shown that the percentage of low health literacy in Hebei province was 81.0%, with higher age, males, lower education levels, lower annual household income and rural areas being strongly associated with low health literacy risk.[21] In 2008, the Chinese Ministry of Health conducted the first survey on the state of health literacy in China, which examined the health literacy of 79,542 participants and found that only 6.48% of the population had adequate health literacy level.[22]

Research Justification

Harmony and stability are the cornerstones of social development and the guarantee of people's happiness.[23] Improving the public's health literacy and enhancing the ability to respond to public health emergencies will help to better respond to public health emergencies and reduce unintended harm caused by public health events.[24] Universities are an important part of society and play an important role for talent training, scientific research, social services and cultural heritage and innovation. Safety and stability are the basic prerequisites for the development of the university and in return the safety and stability of universities help to ensure social harmony and stability. In China, the scale of higher education continues to expand and the development process continues to accelerate. In 2021, there are 3012 universities, with a total enrollment of 44.3 million students.[25] The high concentration of students in universities can lead to widespread transmission of infectious diseases if an epidemic occurs, which can have a serious impact on the safety and health of students and teachers. In the process of rapid development, university has also shown characteristics such as socialization of logistics, diversification of school subjects and diversification of student groups. If potential problems are not effectively prevented due to low level of health literacy, it will easily lead to various kinds of health emergencies.

Also, increasing the level of health literacy is necessary to reduce health inequalities. To this end, good, reliable and accessible health information tailored to the needs and circumstances of different social groups is needed, especially for university students. A study in Nepal showed that most medical students had only moderate health knowledge. In addition, medical students scored higher than those who only attended training courses.[26]

Rababah emphasized the role of interprofessional education in optimising health outcomes for university students.[27] Morrison described a public health emergency simulation exercise in which senior undergraduate nursing students participated, and 91.5% of the students felt that the importance of providing safe care in a public health emergency was highlighted.[28] University students are both a key group of people for public health protection and a reserve force for the public health system. Conducting health literacy research among university students, understanding their health literacy and providing targeted health and hygiene education can help them identify, manage or eliminate risky factors that threaten health and safety, prevent and control the occurrence and development of public health events and reduce or avoid their harm.[29]

The literature on HL is rapidly increasing, however little research has been done on the health literacy of university students in Shaanxi. Shaanxi Province, as a major province of higher education in China, has more than one million university students. Conducting research on the health literacy of university students in Shaanxi and developing a health promotion plan can effectively improve the health management skills of university students.

The aims of this study were to: 1) design a questionnaire with good validity for Chinese university students' health literacy through a literature review and expert scoring;2) analyze the health literacy status of students in Shaanxi Province from the KAP dimensions, aiming to understand the health literacy of university students and provide a basis for developing a health literacy promotion plan;[12] 3) explore the influencing factors related to the health literacy of university students in Shaanxi Province.Due to the frequency of emergencies in universities, these findings can inform health education promotion programmes to improve the health literacy of university students.

Materials and Methods

Participants

The cross-sectional study involved undergraduate and postgraduate students in Shaanxi Province, China. A total of 1578 university students were surveyed, 756 (47.9%) male and 822 (52.1%) female, 381 (24.1%) freshmen, 367 sophomores (23.3%), 354 (22.4%) juniors, 205 (13.0%) seniors, 271 (17.2%) postgraduates; 303 (19.2%) literature, history, law and philosophy students, 338 (21.4%) engineering, agriculture and medicine students, 328 (20.8%) economic and management students, 313 (19.8%) education students, 296 (18.8%) art students; 684 (43.3%) urban students, 894 (56.7%) rural students. The number of students who participated in health education activities was 889 (56.3%), while 689 (43.7%) did not.

Research Scale Design

Health literacy (HL) scale used in this study was developed from HLS-EU-Q47.[15] Based on relevant literature and expert interviews, we formed a pool of 3 primary indicators, 9 secondary indicators and 38 tertiary indicators on health knowledge, attitude and practice. We consulted 10 experts in the fields of public health, university safety management, emergency education and disease prevention and control, and revised the questionnaire repeatedly to create a health literacy survey for university students.

The Likert 5-point scale was used to rate the importance of each item, and there was a column for "comments for revision". The 38 indicators were compiled into specific entries and two rounds of consultation were conducted with 24 experts using the Delphi method to collect their comments and suggestions on the 38 entries. 100% and 94.4% of the questionnaires were returned in the two rounds of consultation. In the first round, 8 items were revised, 5 were combined (items 6, 7 and 8 were combined into 1 item, items 9 and 11 were combined into 1 item), 2 were added and 6 were deleted; in the second round, 10 items were revised and 4 were deleted.

The questionnaire consists of 27 questions on three dimensions: health knowledge (9 items), health attitude (9 items) and health practice (9 items), covering disease prevention knowledge, policy and regulation knowledge, healthy living knowledge, self-protection awareness, information screening awareness, responsibility awareness, injury and disease detection skills, life safety skills and accident first aid skills. The total Cronbach's alpha value is 0.802 and the KMO value is 0.847 (the experimental data is attached as "407113-results.pdf" in the Supplementary Materials), which indicates good reliability. The validity of all variables and dimensions was measured using AMOS 21.0, and the fit indices of all variables met the criteria. The standardised loadings of all items were further examined, and Table 1 shows that the standardised loadings of all items were above 0.6, which met the criteria. Finally, the CR and AVE values of the variables were tested for compliance with the criteria based on the standardised loadings, and Table 1 shows that the CR values of all variables and dimensions were greater than 0.7 and the AVE values were greater than 0.5. The results of the analysis showed that the data from this study's scale had excellent convergent validity.

Each item was scored on a 5-point scale as follows: the score of positive questions in the questionnaire was "strongly agree" (5 points), "agree" (4 points), "average" (3 points), "disagree" (2 points) and "strongly disagree" (1 point), the opposite is true for reverse questions. A score of 45 was calculated for health knowledge, 45 for health attitude and 45 for health practice, giving a total score of 135. The higher the score, the better the knowledge, attitude and practice in health literacy.

A total score of 80% or more, ie a total score ≥108(135×80%= 108), is considered to be adequate health literacy. The criteria for determining the level of literacy in a particular dimension is that: if the sum of the scores for all questions in

Table 1 Scale Validity

Dimensions	Items	Standardised Loads	CR	AVE
Knowledge	Q1	0.749	0.903	0.511
	Q2	0.768		
	Q3	0.669		
	Q4	0.784		
	Q5	0.785		
	Q6	0.616		
	Q7	0.660		
	Q8	0.651		
	Q9	0.728		
Attitude	Q10	0.894	0.981	0.851
	Q11	0.933		
	Q12	0.946		
	Q13	0.964		
	Q14	0.948		
	Q15	0.928		
	Q16	0.910		
	Q17	0.903		
	Q18	0.874		
Practice	Q19	0.890	0.976	0.822
	Q20	0.920		
	Q21	0.924		
	Q22	0.875		
	Q23	0.880		
	Q24	0.929		
	Q25	0.925		
	Q26	0.908		
	Q27	0.907		

a dimension is≥80% of the full score for that dimension, ie a score ≥36(45×80%=36), the student is considered to have adequate literacy in that dimension.

Data Collection

The questionnaire was distributed through the Wen-Juan-Xing online platform in China (https://www.wjx.cn/app/survey.aspx) and it was completed anonymously by survey respondents and submitted only once per IP address. In October 2022, 1635 students from five universities in Shaanxi Province were selected for the study using convenience sampling method. The questionnaire was set up with compulsory questions and logical correlation discriminations, so that any missing items, omissions and logical errors could not be submitted, ensuring the integrity and validity of the questionnaire.

A total of 1635 questionnaires were actually distributed, and 1578 completed self-administered questionnaires were collected, with a valid questionnaire return rate of 96.51%. After the questionnaires were collected, the data was cleaned and those with problems such as very short filling time, duplicate filling (basic information and survey content are identical) were eliminated.

The research data is attached as "407113-data.xls" in the Supplementary Materials. The research data mainly includes the demographic information of the participants and the scores of the health literacy indicators.

Statistical Analysis

The analysis was conducted using SPSS 20.0 software, with *t*-test and ANOVA for comparison of means and χ^2 test for comparison of rates or composition ratios. Statistical analyses were conducted using a dichotomous logistic regression

with the inclusion criterion of α=0.05 and the exclusion criterion of α=0.10. Statistical differences were considered statistically significant at $p< 0.05$.

Results

Overall Health Literacy

Overall health literacy was calculated using the sum of the scores of the core health literacy measurement items.[30] The mean scores for the three dimensions of health knowledge, attitude and practice were (36.093±4.192), (34.178±4.227) and (35.059±4.515) respectively. The level of female's health knowledge and health attitude is higher than male students, but female's health practice is lower than that of male's. The level of urban student's health knowledge, health attitude and health practice is higher than that of rural students. The health literacy level of students with health education experience was higher than those without. (Table 2).

As shown (Table 2), the mean score of the respondents was (105.33 ± 10.14) out of 135, with a range of 51 to 134 and a median score of 108. Female scored higher (105.82 ± 9.51) than male (104.79±10.75). Sophomores scored the highest (106.02±10.17), while postgraduates the lowest (103.42±10.83). Urban university students scored higher (106.50±10.71) than rural university students (104.43±9.58) and those who had health education experiences (106.43±10.13) scored

Table 2 Overall Health Literacy

Variables	n=1578	Percentage	Total Score	Knowledge	Attitude	Practice
Gender						
Male	756	47.9%	104.794±10.755	35.812±4.419	33.836±4.219	35.146±4.714
Female	822	52.1%	105.822±9.513	36.35±3.957	34.493±4.213	34.979±4.325
t value			4.064	6.514	9.557	0.533
p value			0.044	0.011	0.002	0.465
Discipline						
Literature, History, Law, Philosophy	303	19.2%	105.142±9.085	36.086±4.143	34.069±3.557	34.987±4.29
Engineering, Agriculture, Medicine	338	21.4%	106.692±11.664	36.657±4.616	34.393±3.889	35.642±5.031
Economics and Management	328	20.8%	104.716±9.838	35.918±4.107	34.223±4.454	34.576±4.451
Education	313	19.8%	106.058±9.048	36.102±3.755	34.93±4.282	35.026±4.154
Arts	296	18.8%	103.875±10.5	35.639±4.22	33.199±4.72	35.037±4.511
F value			3.807	2.552	6.820	2.380
p value			0.004	0.037	0.000	0.050
Grades						
Freshman	381	24.1%	105.882±10.414	36.509±4.281	33.84±4.034	35.533±4.717
Sophomore	367	23.3%	106.019±10.165	36.025±4.219	34.706±3.772	35.289±4.54
Junior	354	22.4%	105.26±10.148	36.011±4.053	34.641±4.629	34.607±4.425
Senior	205	13.0%	105.707±8.184	36.063±3.619	35.146±4.162	34.498±4.062
Postgraduate	271	17.2%	103.424±10.834	35.727±4.577	32.601±4.128	35.096±4.566
F value			3.194	1.518	15.787	2.984
p value			0.013	0.194	0.000	0.018
Family location						
Urban area	684	43.3%	106.504±10.711	36.541±4.361	34.232±4.164	35.731±4.777
Rural area	894	56.7%	104.431±9.583	35.749±4.027	34.136±4.276	34.545±4.235
t value			16.376	13.928	0.200	27.196
p value			0.000	0.000	0.655	0.000
Health Education Experience						
Yes	889	56.3%	106.431±10.128	36.394±4.098	34.828±4.508	35.209±4.609
No	689	43.7%	103.909±9.977	35.704±4.281	33.340±3.670	34.865±4.386
t value			24.389	10.574	120.598	2.258
p value			0.000	0.001	0.000	0.133
Mean Score				36.093±4.192	34.178±4.227	35.059±4.515

Notes: Test ANOVA. The descriptive variables (mean and standard deviation) are shown with the degree of perceived difficulty in each situation proposed in the survey.

higher than those who had not (103.91±9.98). Students of Engineering, Agriculture and Medicine scored the highest (106.69±11.66), while Arts students scored the lowest (103.88±10.50). The differences in scores for gender, grade, family location, discipline and health education experience were statistically significant ($p < 0.05$).

Table 3 shows the scores of the participants who answered the questions. Of the 27 items, the three with the lowest correct responses were "earthquake escape" ($\bar{x}$=2.53; 95% CI: 2.46–2.60), "awareness of using communal spoons and chopsticks" ($\bar{x}$=3.14;95% CI:3.08–3.19) and "awareness of psychological adjustment" (x=3.23; 95% CI: 3.17–3.28), while the three with the highest correct responses were "dog bite management" ($\bar{x}$=4.36; 95% CI: 4.32–4.39), "electric shock rescue" ($\bar{x}$==4.36; 95% CI: 4.32–4.39) and "awareness of outbreak reporting" ($\bar{x}$=4.35; 95% CI: 4.32–4.39).

We used Pearson correlation analysis to analyze and verify the relationship between the three dimensions of knowledge, attitude, and practice. The results showed that the correlation coefficient between knowledge and attitude was 0.600, and both were positively significant. The correlation coefficient between knowledge and practice was 0.668, and both were positively significant. The correlation coefficient between attitude and practice was 0.446, and both were positively significant (Table 4). The strong relationship between knowledge and practice in this context suggests that there is a close link between health knowledge and health practice.

Table 3 Health Literacy Items

Indicators and Items	Scores	Average Scores	95% CI
Knowledge	45	36.09	35.89–36.30
Q1. If I am scratched or bitten by a dog or cat, I will immediately rinse the wound and get a human rabies vaccination at the hospital as soon as possible.	5	4.36	4.32–4.39
Q2. I know that HIV, hepatitis B and hepatitis C are transmitted through blood, sexual contact and mother-to-child contact, but not through daily or work contact.	5	3.57	3.51–3.62
Q3. I know that proper hand washing and hand hygiene can help prevent influenza.	5	4.23	4.19–4.27
Q4.I believe that everyone has a duty to report any cases of infectious disease in their neighbourhood to the CDC.	5	4.35	4.32–4.39
Q5. I know that is illegal to hide my personal journey and cause the spread of an epidemic, or to "fail to attend an organised nucleic acid test" for no good reason.	5	4.22	4.18–4.26
Q6. I know that eat a light diet, with less oil, salt and sugar is benefit for health.	5	3.32	3.26–3.37
Q7. I know that exercising 6000 to 10,000 steps a day is good for your health.	5	3.71	3.66–3.75
Q8. I know that using condoms correctly reduces the risk of contracting HIV and STIs and prevents unwanted pregnancies.	5	4.18	4.14–4.22
Q9. I store and process raw and cooked food separately, wash raw vegetables and fruits, and do not eat food that has spoiled or exceeded its shelf life.	5	4.16	4.11–4.20
Attitude	45	34.18	33.97–34.39
Q10. I do not use communal spoons and chopsticks when I eat with friends and family. *(reverse questions)*	5	3.14	3.08–3.19
Q11. I have common medical and first aid supplies at home.	5	3.98	3.94–4.02
Q12. I believe that if I have anxiety, depression, fear, despair or other psychological problems during a major infectious disease epidemic, I should manage them on my own.	5	3.23	3.17–3.28
Q13. I believe that whether or not to seek medical treatment for an infectious disease is a personal matter and that others have no right to interfere.	5	4.11	4.07–4.15
Q14. I will actively cooperate with medical and health personnel in taking emergency measures such as investigation, isolation, disinfection and vaccination.	5	4.045	4.01–4.09
Q15. I will not smoke or spit in public places and will cover my mouth and nose if I cough or sneeze.	5	3.54	3.48–3.59
Q16. I will read packaging, labels and instructions carefully before buying food, medicines and health products.	5	4.22	4.19–4.26
Q17. I understand the outbreak through official media reports and do not listen to other sources of information.	5	3.85	3.79–3.85
Q18. I can recognise common hazard signs such as high pressure, flammable, explosive, highly toxic, radioactive, biosecurity, etc.	5	4.07	4.03–4.11

(*Continued*)

Table 3 (Continued).

Indicators and Items	Scores	Average Scores	95% CI
Practice	45	35.06	34.84–35.28
Q19. To take my temperature, I would shake the thermometer below 35°C, place it under my armpit against my skin and remove it after 5 minutes to take a reading.	5	4.14	4.10–4.19
Q20. When taking blood pressure, I wrap the cuff around my elbow 2–3cm above my heart and place it as tightly as possible to fit one finger in.	5	4.01	3.96–4.05
Q21. In the event of an earthquake when I am working or studying in a building, I will take the lift and evacuate as quickly as possible.	5	2.53	2.46–2.60
Q22. In the event of a flood, I will evacuate in an orderly manner and in accordance with the principles of moving people before things.	5	4.32	4.29–4.36
Q23. If I smell a strong smell of gas when I return home from work, I will turn on the lights as soon as possible to check for gas leaks.	5	3.30	3.24–3.37
Q24. When performing chest compressions on adults, I apply compressions at a depth of 5–6cm and at a rate of 100–120 compressions per minute.	5	3.90	3.86–3.94
Q25. When resuscitating a person who has been electrocuted, I cut off the power supply first and do not touch the person directly.	5	4.36	4.32–4.39
Q26. If someone near me has an epileptic fit, I will put strips of wood or cloth in their mouth to prevent them from biting their tongue. *(reverse questions)*	5	4.15	4.12–4.19
Q27. When escaping from a fire, I will cover my mouth and nose with a wet towel, stay low and call the fire alarm number 119.	5	4.34	4.31–4.38

Notes: Test ANOVA. The descriptive variables (mean and standard deviation) are shown with the degree of perceived difficulty in each situation proposed in the survey ("strongly agree" (5 points), "agree" (4 points), "average" (3 points), "disagree" (2 points) and "strongly disagree" (1 point)).

Table 4 Correlation Analysis

	Knowledge	Attitude	Practice	Mean	Std. Deviation
Knowledge	1			36.093	4.192
Attitude	0.600**	1		34.178	4.227
Practice	0.668**	0.446**	1	35.059	4.515

Notes: Pearson Correlation. **: Correlation is significant at the 0.01 level.

Health Literacy KAP

The mean scores for the three dimensions of health knowledge, attitude and practice were (36.093±4.192), (34.178 ±4.227) and (35.059±4.515) respectively. The level of female's health knowledge and health attitude is higher than male students, but female's health practice is lower than that of male's. The level of urban student's health knowledge, health attitude and health practice is higher than that of rural students. Students with health education experience have higher levels of health knowledge, attitudes and practices than those without (Table 2).

In terms of health knowledge (Table 5), female students scored higher than male students, urban students scored higher than rural students, students with health education experience scored higher than those who lack of such experience, art students scored the highest, and literature, history, law and philosophy students scored the lowest. The differences in health knowledge scores were statistically significant in the categories of gender, discipline and health education experiences ($p<0.05$), but it is not statistically significant in terms of family location and grade.

In terms of health attitudes (Table 6), female students scored higher than male students, undergraduate students scored higher than postgraduate students, urban students scored higher than rural students, students with health education experience scored higher than those without, students in Education scored the highest, and Arts students scored the lowest. The differences in public health attitude scores were statistically significant for gender, grade, discipline and health education experience ($p<0.05$), but not in family location categories.

Table 5 Health Knowledge Score

Variables	n=1578	Percentage	Knowledge of Disease Prevention	Knowledge of Policies and Regulations	Knowledge of Healthy Living	Total Score
Gender						
Male	756	47.9%	12.114±1.906	8.418±1.508	15.28±2.572	35.812±4.419
Female	822	52.1%	12.196±1.781	8.72±1.227	15.434±2.497	36.35±3.957
t value			0.782	19.204	1.453	6.514
p value			0.377	0.000	0.228	0.011
Discipline						
Literature, History, Law, Philosophy	303	19.2%	12.046±1.835	8.538±1.395	15.502±2.474	36.086±4.143
Engineering, Agriculture, Medicine	338	21.4%	12.308±1.817	8.621±1.495	15.728±2.463	36.657±4.616
Economics and Management	328	20.8%	12.22±1.867	8.631±1.249	15.067±2.605	35.918±4.107
Education	313	19.8%	12.275±1.729	8.607±1.299	15.22±2.495	36.102±3.755
Arts	296	18.8%	11.902±1.943	8.466±1.43	15.27±2.591	35.639±4.22
F value			2.682	0.791	3.466	2.552
p value			0.030	0.531	0.008	0.037
Grades						
Freshman	381	24.1%	12.323±1.935	8.69±1.456	15.496±2.547	36.509±4.281
Sophomore	367	23.3%	12.084±1.806	8.526±1.336	15.414±2.531	36.025±4.219
Junior	354	22.4%	12.164±1.796	8.576±1.271	15.271±2.544	36.011±4.053
Senior	205	13.0%	12.215±1.775	8.571±1.217	15.278±2.373	36.063±3.619
Postgraduate	271	17.2%	11.967±1.857	8.483±1.549	15.277±2.628	35.727±4.577
F value			1.691	1.086	0.552	1.518
p value			0.150	0.362	0.698	0.194
Family location						
Urban area	684	43.3%	12.237±1.825	8.637±1.418	15.667±2.617	36.541±4.361
Rural area	894	56.7%	12.095±1.854	8.528±1.342	15.126±2.443	35.749±4.027
t value			2.296	2.453	17.811	13.928
p value			0.130	0.117	0.000	0.000
Health Education Experience						
Yes	889	56.3%	12.27±1.862	8.637±1.274	15.487±2.576	36.394±4.098
No	689	43.7%	12.01±1.807	8.496±1.495	15.197±2.469	35.704±4.281
t value			7.753	4.041	5.088	10.574
p value			0.005	0.045	0.024	0.001

Notes: Test ANOVA. The descriptive variables (mean and standard deviation) are shown with the degree of perceived difficulty in each situation proposed in the survey.

In terms of health practices (Table 7), male students scored higher than female students, urban students scored higher than rural students, students with health education experience scored higher than those who did not have, students in the Engineering, Agriculture, Medicine scored the highest, and students in the Economics and Management scored the lowest. The difference in health practice scores between the categories of grades and family location was statistically significant ($p<0.05$), while the differences in scores as to gender, discipline, health education experiences were not statistically significant.

Distribution of Students with Adequate Health Literacy

As shown (Table 8), 39.2% of the participants (619/1578) had adequate health literacy, with 37.8% (596/1578), 58.0% (915/1578) and 46.4% (732/1578) having adequate health knowledge, attitude and practice respectively. The proportion of female students with adequate health literacy was higher than that of male students, the proportion of urban students with adequate health literacy was significantly higher than that of rural students, and the proportion of university students of adequate health literacy with health education experience was higher than that of those who without it. The difference in total scores among variables was not statistically significant, except for the difference in total scores between family location and health education experience, which was statistically significant.

Table 6 Health Attitudes Score

Variables	n=1578	Percentage	Awareness of Self-Protection	Awareness of Responsibility	Awareness of Information Screening	Scores
Gender						
Male	756	47.9%	10.266±1.906	11.405±1.913	12.165±2.098	33.836±4.219
Female	822	52.1%	10.412±1.831	11.961±1.936	12.119±2.117	34.493±4.213
t value			2.426	32.896	0.188	9.557
p value			0.120	0.000	0.664	0.002
Discipline						
Literature, History, Law, Philosophy	303	19.2%	10.413±1.835	11.422±1.609	12.234±1.955	34.069±3.557
Engineering, Agriculture, Medicine	338	21.4%	10.47±1.833	11.719±1.46	12.204±2.116	34.393±3.889
Economics and Management	328	20.8%	10.14±1.901	11.893±2.31	12.189±2.02	34.223±4.454
Education	313	19.8%	10.498±1.776	12.144±2.128	12.288±2.133	34.93±4.282
Arts	296	18.8%	10.182±1.975	11.25±1.971	11.767±2.281	33.199±4.72
F value			2.563	10.655	2.992	6.820
p value			0.037	0.000	0.018	0.000
Grades						
Freshman	381	24.1%	10.457±1.811	11.197±1.743	12.186±2.212	33.84±4.034
Sophomore	367	23.3%	10.403±1.943	11.956±1.597	12.346±1.874	34.706±3.772
Junior	354	22.4%	10.24±1.903	12.251±2.182	12.15±2.186	34.641±4.629
Senior	205	13.0%	10.463±1.816	12.376±2.079	12.307±1.932	35.146±4.162
Postgraduate	271	17.2%	10.14±1.822	10.797±1.686	11.664±2.218	32.601±4.128
F value			1.732	39.389	4.745	15.787
p value			0.140	0.000	0.001	0.000
Family location						
Urban area	684	43.3%	10.363±1.899	11.621±1.873	12.249±2.071	34.232±4.164
Rural area	894	56.7%	10.327±1.845	11.751±1.996	12.059±2.133	34.136±4.276
t value			0.143	1.713	3.129	0.200
p value			0.705	0.191	0.077	0.655
Health Education Experience						
Yes	889	56.3%	10.372±1.919	12.151±2.175	12.305±2.073	34.828±4.508
No	689	43.7%	10.303±1.799	11.106±1.393	11.930±2.135	33.340±3.670
t value			120.598	12.343	49.602	120.598
p value			0.000	0.000	0.000	0.000

Notes: Test ANOVA. The descriptive variables (mean and standard deviation) are shown with the degree of perceived difficulty in each situation proposed in the survey.

Discussion

Health literacy is the foundation for the health and safety of students and teachers in universities. In this study, a questionnaire survey was conducted about the health knowledge, attitude and practice of university students in Shaanxi Province, China. The results showed that the mean score of health knowledge, attitude and practice of university students was (105.33±10.14) out of 135, and the mean scores for the three dimensions of public health knowledge, attitude and practice were (36.093±4.192), (34.178±4.227) and (35.059±4.515) respectively. Female students had higher health literacy than male students in general (t=4.064, p=0.044), lower grade students scored higher than higher grade scores (F=3.194, p=0.013), urban university students scored higher than rural university students (t=16.376, p<0.001), and university students with health education experience scored higher than those without (t=24.389, p<0.001). We also found that only 39.2% of the participants had adequate health literacy. The majority of students had basic health literacy, while a minority of students had adequate health literacy.

There are gender differences in levels of health literacy. The results of this study show that female students have higher health literacy, and the levels of their health knowledge and attitude are higher than those of males, but the level of health practice is lower than male students. The proportion of females with adequate health literacy was higher than that of males, which is consistent with the findings of some scholars.[21] Conversely, research has found that males have higher

Table 7 Health Practices Score

Variables	n=1578	Percentage	Injury Detection Skills	Life Safety Skills	First Aid Skills	Total Score
Gender						
Male	756	47.9%	8.009±1.454	10.358±2.424	16.778±2.332	35.146±4.714
Female	822	52.1%	8.274±1.359	9.977±2.411	16.729±2.146	34.979±4.325
t value			13.947	9.811	0.189	0.533
p value			0.000	0.002	0.663	0.465
Discipline						
Literature, History, Law, Philosophy	303	19.2%	8.162±1.316	10.191±2.117	16.634±2.196	34.987±4.29
Engineering, Agriculture, Medicine	338	21.4%	8.237±1.499	10.396±2.537	17.009±2.346	35.642±5.031
Economics and Management	328	20.8%	8.049±1.407	9.866±2.568	16.662±2.224	34.576±4.451
Education	313	19.8%	8.073±1.409	10.022±2.436	16.93±2.102	35.026±4.154
Arts	296	18.8%	8.216±1.407	10.328±2.384	16.493±2.271	35.037±4.511
F value			1.138	2.641	2.960	2.380
p value			0.337	0.032	0.019	0.050
Grades						
Freshman	381	24.1%	8.244±1.48	10.236±2.488	17.052±2.207	35.533±4.717
Sophomore	367	23.3%	8.223±1.332	10.289±2.338	16.777±2.23	35.289±4.54
Junior	354	22.4%	8.119±1.364	9.862±2.507	16.627±2.3	34.607±4.425
Senior	205	13.0%	8.141±1.304	9.8±2.356	16.556±2.179	34.498±4.062
Postgraduate	271	17.2%	7.948±1.536	10.539±2.323	16.609±2.218	35.096±4.566
F value			2.106	4.518	2.689	2.984
p value			0.078	0.001	0.030	0.018
Family location						
Urban area	684	43.3%	8.32±1.454	10.433±2.471	16.978±2.297	35.731±4.777
Rural area	894	56.7%	8.015±1.363	9.951±2.368	16.579±2.175	34.545±4.235
t value			18.381	15.457	12.401	27.196
p value			0.000	0.000	0.000	0.000
Health Education Experience						
Yes	889	56.3%	8.28±1.316	10.098±2.621	16.831±2.25	35.209±4.609
No	689	43.7%	7.975±1.509	10.239±2.144	16.65±2.217	34.865±4.386
t value			18.306	1.325	2.546	2.258
p value			0.000	0.250	0.111	0.133

Notes: Test ANOVA. The descriptive variables (mean and standard deviation) are shown with the degree of perceived difficulty in each situation proposed in the survey.

health literacy than females.[31] Other research has also shown that gender is not related to the level of emergency knowledge and practice.[19] Therefore, the role that gender plays on health literacy needs to be further explored.

There are differences in the health literacy of urban and rural university students. The results of this study show that urban university students have higher health literacy. Their health knowledge, attitude and practice are all higher than those of rural university students, and the number of urban university students with adequate health literacy is higher than that of rural students. The reason for this probably is that health awareness in rural areas is not as high as that in urban areas and rural university students' access to public health knowledge is less convenient than those urban students. This is consistent with the findings of other scholars.[19,20]

It is worth highlighting that although 39.2% participants had adequate health literacy, a large number of them are students of Engineering, Agriculture and Medicine. Differences in health literacy levels among students in different disciplines was caused by different learning environments and learning abilities. When conducting health education programmes, cross-curricular and literacy-related training activities can be developed based on disciplinary differences.[27]

There are differences in health literacy among university students of different grades. The results of this study showed that undergraduate students had higher health literacy level than graduate students. The reasons for this may be related to the educational situation and the forgetting law of long-time memory. The health education system at secondary school in China is complete and demanding. Undergraduate students who graduated from high school would remember the relevant points better than master or doctoral students who have left high school for a longer period of time.

Table 8 Distribution of Students with Adequate Health Literacy

Variables	Participants	Knowledge		Attitude		Practice		Total Scores	
		Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Gender									
Male	756	261	34.5%	412	54.5%	359	47.5%	280	37.0%
Female	822	335	40.8%	503	61.2%	373	45.4%	339	41.2%
$\chi 2$ value		6.504		7.245		0.705		2.919	
p value		0.011		0.007		0.401		0.088	
Discipline									
Literature, History, Law, Philosophy	303	103	34.0%	177	58.4%	149	49.2%	116	38.3%
Engineering, Agriculture, Medicine	338	144	42.6%	203	60.1%	166	49.1%	146	43.2%
Economics and Management	328	124	37.8%	189	57.6%	141	43.0%	119	36.3%
Education	313	142	45.4%	186	59.4%	143	45.7%	131	41.9%
Arts	296	83	28.0%	160	54.1%	133	44.9%	107	36.1%
$\chi 2$ value		24.806		2.782		3.794		5.622	
p value		0.000		0.595		0.435		0.229	
Grades									
Freshman	381	129	33.9%	230	60.4%	178	46.7%	156	40.9%
Sophomore	367	162	44.1%	205	55.9%	191	52.0%	148	40.3%
Junior	354	152	42.9%	211	59.6%	157	44.4%	141	39.8%
Senior	205	93	45.4%	126	61.5%	85	41.5%	82	40.0%
Postgraduate	271	60	22.1%	143	52.8%	121	44.6%	92	33.9%
$\chi 2$ value		46.041		5.996		7.656		0.931	
p value		0.000		0.199		0.105		0.415	
Family location									
Urban area	684	268	39.2%	423	61.8%	357	52.2%	296	43.3%
Rural area	894	328	36.7%	492	55.0%	375	41.9%	323	36.1%
$\chi 2$ value		1.024		7.374		16.36		8.299	
p value		0.312		0.007		0.000		0.004	
Health Education Experience									
Yes	889	403	45.3%	543	61.1%	433	48.7%	395	44.4%
No	689	193	28.0%	372	54.0%	299	43.4%	224	32.5%
$\chi 2$ value		49.542		8.006		4.401		23.139	
p value		0.000		0.005		0.036		0.000	

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The study showed that the health literacy level of those who received health education training was significantly higher than that of the group did not not receive it. It shows that health education has a better effect on improving health literacy among university students.[32] Consideration can be given to incorporating health literacy into the general education system, thus students can be a great force to respond to emergencies for their family and the society when necessary.

In summary, health literacy is a comprehensive reflection of individual's level of knowledge, attitude and practice in relation to public health and safety events, and the level of health literacy of university students in Shaanxi province of China still needs to be improved. Improving the health literacy of university students is the basis and prerequisite for effectively responding to public health and safety incidents in universities. At the same time, it is an important measure to enhance the emergency response capability of society.[33] According to the distribution characteristics of the health literacy level of university students, key groups should be identified, targeted intervention strategies and measures should be formulated, and the awareness of crisis and responsibility of university students should be strengthened.[34] When carrying out specific educational programmes, emphasis should be placed on strengthening university students' first aid skills and psychological adjustment awareness by combining online and offline methods, and special attention should be paid to students from rural areas.[35,36]

This study has certain limitations. The questionnaire used in this study is independently designed, which may have shortcomings in terms of authority. But the questionnaire is based on a large number of domestic and international public health literacy publications and revised by experts several times, therefore its scientific validity and reasonableness should stand test. The research questionnaire is mainly completed through online platforms, and the quality of filling out the questionnaire needs to be further improved.The cross-sectional sampling method is adopted in this study. Since part of observation units are randomly selected from the population as survey objects, sampling errors are unavoidable.

Conclusion

In order to objectively assess the health literacy of university students in Shaanxi and promote the development of health education, this study used a cross-sectional study method to conduct a questionnaire survey on students in five universities in Shaanxi Province.The number of university students with adequate health literacy in Shaanxi Province of China is at a low level of 39.2%. There were significant differences in gender, grades, family location and health education experience for health literacy among university students. Female students had higher levels of health literacy than male students, lower grade students scored higher than higher grade students, students from urban areas scored higher than students from rural areas, and university students with experience in health education scored higher than students without experience in health education.

Enhancing health literacy among university students can help improve self-care and management skills. Public health education plays an important role in improving health literacy among university students. Health education should be tailored to the individual and not a one-size-fits-all approach. Universities should strengthen health education for students and develop corresponding health education programmes according to the characteristics of different groups.

Abbreviations

KAP, knowledge, attitudes and practices; HL, health literacy; ANOVA, Analysis of Variance.

Data Sharing Statement

The datasets obtained and analyzed during the current study are available from the corresponding author on reasonable request via email: 4256@sust.edu.cn.

Ethics Approval and Informed Consent

This study was approved by the ethical committee of the School of management from Xi'an University of Architecture and Technology. This study adheres to the Helsinki declaration. Participates in this research voluntarily and conduct

anonymously. Thus, participants who select "Agree" at the interviewee's informed consent were considered as consent to participate in our investigation.

Consent for Publication

The details in present study can be published, and that the persons providing consent have been shown the article contents to be published.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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