

RESEARCH

Open Access



# Nutrition literacy level of medical personnel in tertiary hospitals: evidence from a cross-sectional study

Guangju Mo<sup>1,2†</sup>, Erchang Zhu<sup>1†</sup>, Xuan Guo<sup>1</sup>, Sijin Kong<sup>1</sup> and Jingbo Ma<sup>1\*</sup>

## Abstract

**Background** Nutrition literacy (NL), stemming from health literacy, profoundly influences dietary habits and chronic diseases. Despite their pivotal societal role, scant research exists on NL levels among medical personnel. This study examined NL levels among tertiary hospital medical staff in Bengbu and identified influencing factors.

**Methods** Using cluster sampling, all Bengbu tertiary hospitals were selected, with 4–5 departments randomly chosen. A structured questionnaire assessed demographic characteristics, while the NL short-form scale (NL-SF12) evaluated NL. SPSS 26.0 and AMOS conducted statistical analysis, including confirmatory factor analysis and Cronbach's  $\alpha$  for reliability. Chi-square tests and logistic regression analyzed group differences and influencing factors.

**Results** The NL-SF12 demonstrated robust reliability and validity. Of participants, 34.22% were male and 65.78% female; 41.03% were doctors and 42.16% nurses. Overall, 45.68% exhibited high NL. Females showed higher total NL (OR = 1.47, 95% CI: 1.08–1.98), cognition (OR = 1.66, 95% CI: 1.22–2.24), skills (OR = 1.48, 95% CI: 1.09–2.00), and interactive NL (OR = 2.21, 95% CI: 1.53–3.19) than males. Those with a master's or higher had higher total NL (OR = 2.20, 95% CI: 1.33–3.65) and cognition (OR = 3.23, 95% CI: 1.94–5.37) than those with an associate degree or less. Pharmacists, inspectors, and technicians had higher total NL (OR = 1.55, 95% CI: 1.06–2.26) and functional NL (OR = 1.49, 95% CI: 1.02–2.17). Gender, education level, and career were the influencing factors of nutrition literacy among medical personnel.

**Conclusions** Female medical staff and those with a master's degree or higher showed higher nutrition literacy (NL), particularly in cognition and skills. Pharmacists, inspectors, and other technicians exhibited higher levels of total NL and functional NL. Gender, education level, and career were identified as significant influencing factors of nutrition literacy among medical personnel. Understanding and considering these factors are crucial for developing targeted strategies to enhance nutrition literacy among healthcare professionals. Future efforts to improve nutrition literacy through training and interventions should be tailored to the characteristics of different groups to effectively enhance the capabilities and proficiency of healthcare professionals in nutrition knowledge and practice.

**Keywords** Nutrition literacy, Medical personnel, Healthy diet, Tertiary hospitals

<sup>†</sup>Guangju Mo and Erchang Zhu contributed equally to this work.

\*Correspondence:  
Jingbo Ma  
925728507@qq.com

<sup>1</sup>The First Affiliated Hospital of Bengbu Medical University, Bengbu 233000, China

<sup>2</sup>School of public health, Shandong Second Medical University, Weifang 261053, China



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

---

**Text box 1. Contributions to the literature**

---

- Nutrition literacy is closely related to dietary habits and many chronic NCDs, but few people are concerned about their nutrition literacy levels, and this study will help to evaluate the nutrition literacy levels of healthcare workers, an important group in society.
  - NL-SF12 appears to be a valid and reliable instrument for assessing the nutrition literacy of medical personnel.
  - There is an urgent need for decision-making on nutrition literacy among male health workers.
- 

**Introduction**

In the current healthcare environment, the nutrition literacy (NL) of medical personnel has become a significant topic. Particularly in tertiary hospitals, which are high-level centers of medical service, medical personnel not only bear a heavy workload but also play a crucial role in disseminating public health education. The NL of medical personnel in tertiary hospitals directly impacts their work efficiency and service quality and subsequently affects patient recovery outcomes and the implementation of health promotion activities.

In recent years, with changes in lifestyle and an increase in the incidence of chronic diseases, nutrition issues have gained increasing attention from the public and medical community. Unhealthy diet is one of the major risk factors for Noncommunicable diseases (NCDs), such as diabetes, hypertension, heart disease, cancer, and other conditions linked to obesity, which accounts for 71% of all deaths worldwide [1]. The 2030 Agenda for Sustainable Development regards NCDs as a major challenge for sustainable development [2]. World Health Organization (WHO) recommends that we have a healthy diet like reducing the intake of saturated and trans fats to help preventing a range of diet-related NCDs [3–6]. Nutrition literacy is closely related to healthier dietary habits. Hence, those with high NL levels may make better nutrition-related decisions [7–10].

NL is an important aspect of health literacy, NL is mainly about the understanding, acquisition, and correct application of nutrition knowledge [11]. NL is affected by many factors including internal factors and external factors. Among college students, NL is related to their gender [12], birthplace, and nutrition education [13]. The change in health behavior is often affected by the surrounding environment. To effectively modify behavior, it's crucial to first identify the factors influencing it. This understanding can enhance the application of ecosystem theory within the health sector [14]. Additionally, methods for assessing NL are crucial in public health and clinical practice. Considering the burden of surveys, NF-SF12 offers an efficient and practical solution [15]. This scale includes only 12 items, covering key areas such

as cognition and skills. Although simplified, these scales require rigorous testing to ensure they effectively measure NL.

In recent years, researchers have concentrated studies on NL among college students, pregnant women, and the elderly [16–19]. Medical personnel are the indispensable group in society, especially in the last three years of the COVID-19 pandemic. Good nutritional status is essential not only for individual health but also a key factor in improving the quality and efficiency of medical services [20]. Therefore, enhancing the NL of medical personnel, especially those on the front lines of medical service provision, is particularly important. However, existing research shows that despite their expertise in medical knowledge, medical staff often lack sufficient nutrition literacy, which could affect their professional performance and their nutritional guidance to patients [21].

This study aims to explore the level of NL among medical personnel in tertiary hospitals, analyze its influencing factors, and propose strategies and recommendations to improve their nutrition literacy, thereby enhancing the overall quality and efficiency of medical services. By conducting a comprehensive assessment of the nutritional knowledge, attitudes, and behaviors of medical personnel in tertiary hospitals, this research hopes to provide data support and empirical suggestions for hospital management and policymakers, offering a basis for optimizing the healthcare service system and advancing the formulation and implementation of public health policies.

**Materials and methods****Study design and setting**

This cross-sectional study was implemented from May to July 2022 in Bengbu, China. Firstly, we selected all tertiary hospitals in Bengbu City using whole cluster sampling, and then 4–5 departments were randomly selected from the seven tertiary hospitals.

**Participants and procedure**

All medical personnel in 4–5 randomly selected departments were surveyed. Inclusion criteria for the study population: (1) being active hospital employees; (2) voluntary participation in the survey. This study was approved by the Ethics Committee of Bengbu Science & Technology Bureau (20220139). Informed consent was obtained from all participants.

**Sample size**

Take the sample size calculation method to calculate the minimum sample size required:

$$N = \frac{\mu_{\alpha}^2 P(1-P)}{\delta^2} \times def f$$

$N$  is the sample size, when  $\alpha=0.05$ ,  $\mu=1.96$ ,  $P$  is 30% of the pre-survey NL rate for medical personnel,  $\delta=0.15*P$ , as calculated,  $N=799$ . Considering the presence of incomplete questionnaires, a minimum sample size of 879 individuals is necessary, assuming a 10% non-response rate.

### Nutrition literacy assessment

The 12-item Short-Form Nutrition Literacy Assessment Scale (NL-SF12) [15] was performed to assess the level of NL. The scale was simplified from the Nutrition Literacy Assessment Scale for adults [22] developed by our research group in the previous period, including cognitive domains and skill domains, three dimensions of functional, interactive and critical NL, and six dimensions of knowledge, understanding, obtaining, applying, interactive skill, and critical skill, with each dimension containing two items. Each item was rated on a 5-point Likert-type scale i.e.1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree. For example, item 1: balanced diet and reasonable nutrition are important measures to prevent and control chronic diseases such as diabetes and hypertension; item 2: steaming and boiling are healthier ways of cooking than frying and grilling. A high score on these two items indicates a given level

**Table 1** General demographic characteristics of medical personnel ( $N=1160$ )

Characteristics		N(%)
Gender	Male	397(34.22)
	Female	763(65.78)
Marital status	Married	872(75.17)
	Unmarried	256(22.07)
	Other	32(2.76)
Status of children born	One child	579(49.91)
	Two children	227(19.57)
	Infertile or other	354(30.52)
Education level	Associate degree or below	213(18.36)
	Bachelor's degree	797(68.71)
	Master's degree or above	150(12.93)
Career	Doctor	476(41.03)
	Nurse	489(42.16)
	Other technical personnel	175(15.09)
	Administrative personnel	20(1.72)
Professional and technical title	Primary and below	527(45.43)
	Middle level	472(40.69)
	High level professional title	161(13.88)
Years of working experience (Year)	<5	265(22.85)
	5~	311(26.81)
	10~	232(20.00)
	15~	352(30.34)
Average monthly income (CNY)	<5000	229(19.74)
	5000~	614(52.93)
	8000~	274(23.62)
	1000~	43(3.71)

of nutrition knowledge. The level of total NL was judged by adding up the sum of the scores for each item, high scores indicated a high level of NL, in addition, according to the median of the NL score, the scores will be divided into two groups, i.e., high-level NL group and low-level NL group. The reliability of the scale in this study showed that Cronbach's  $\alpha$  was 0.907.

### Demographic characteristics

General demographic characteristics were also included in the questionnaire, such as gender, marital status (married, unmarried, and others), the status of children born (one child, two children, and infertile or others), education level (associate degree or below, bachelor's degree, and master's degree or above, career (doctor, nurse, other technical personnel such as pharmacists and inspector, and administrative personnel), professional and technical title (primary and below, middle level, and high-level professional title), number of years working (below 5 years, 5–10 years, 10–15 years, and above 15 years), average monthly income (below 5,000 CNY, 5,000–8,000 CNY, 8,000–10,000 CNY, and above 10,000 CNY).

### Statistical analysis

All data was entered into Epidata version 3.1. Measurement data were summarized as mean  $\pm$  standard deviation. Categorical variables were expressed as frequency and percentage. Descriptive statistics were performed to determine the distributions of total nutrition literacy and the two domains and three levels. Confirmatory factor analysis (CFA) was carried out to evaluate the construct validity of NL-SF12. Several fit indexes were calculated, including adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), incremental fit index (IFI), Tucker-Lewis index (TLI), normal fit index (NFI), and goodness-of-fit index (GFI), with their values above 0.9 considering satisfactory [23]. Internal consistency was assessed by 0.70 of Cronbach's  $\alpha$  value for satisfactory reliability [24]. The chi-square test was applied to test for differences in the groups. Logistic regression analysis was conducted to evaluate influencing factors of total NL and two domains and three levels. All statistical analyses were performed by using SPSS (Version 26.0) and AMOS (Version 24.0). A  $P$  value of  $<0.05$  was considered to be statistically significant.

## Results

### Participant characteristics

A total of 1,185 medical personnel completed the survey. Invalid questionnaires provided by 25(2.1%) medical personnel were excluded. As Table 1 showed, a total of 1,160 medical personnel were included in the study, the average age of participants was 36.37 (SD=8.79) years. Of these participants, 34.22% were male and 65.78% were

female, 41.03% were doctors, 42.16% were nurses, 18.36% had received an associate degree or below, 68.71% had received bachelor's degree, 12.93% had received master's degree or above, 19.74% had average monthly income of <5,000 CNY

#### Validation of the NL-SF12 scale for the medical personnel

A CFA was conducted to examine the structural validity of the NL-SF12, Table 2 showed good model-data-fit and the values of AGFI, CFI, IFI, TLI, NFI, and GFI ranged from 0.91 to 0.97. The result of convergent validity was reported in Table 3, the values of average variance extracted (AVE) and composite reliability (CR) were greater than 0.5 and 0.6, indicating that NL-SF12 has good convergence validity. Cronbach's  $\alpha$  was 0.907 for the NL-SF12 among medical personnel, suggesting a good internal consistency reliability.

#### NL level of medical personnel

In our study, 45.68% of medical personnel have a high overall level of NL. In the cognitive domain and skill domain, 47.84% and 43.97% of medical personnel are of a high level. Comparing the three levels, it was found that 46.03% of medical personnel are of a high level at the functional level, and only 24.22% and 17.93% of the medical personnel had high levels at the functional interactive and critical levels.

#### NL levels of medical personnel with different characteristics

Table 4 illustrated the frequency and proportion of medical personnel with different characteristics who are at a high level of NL, as well as their distribution by gender, marital status, status of children born, education level, career, etc. The results of the study presented that females had higher levels of NL than males in the cognitive domain and skill domain, and the difference was statistically significant. Medical personnel with a master's degree or higher had a higher level of NL in the cognitive domain than other participants ( $\chi^2=24.68$ ,  $P<0.001$ ).

#### Factors affecting the NL of medical personnel

Multiple logistic regression analysis was performed with the level of NL as the dependent variable and general demographic characteristics such as gender, marital status, status of children born, career, professional and technical title, years of working experience, and average monthly income as independent variables (Table 5). The results showed that females reported higher levels of total NL ( $OR=1.47$ , 95%  $CI$ : 1.08–1.98), cognition domain ( $OR=1.66$ , 95%  $CI$ : 1.22–2.24), skill domain ( $OR=1.48$ , 95%  $CI$ : 1.09–2.00) and interactive NL ( $OR=2.21$ , 95%  $CI$ : 1.53–3.19) than male. In addition, medical personnel who possessed a master's degree or above reported higher

**Table 2** Construct validity of the NL-SF12 with goodness-of-fit indices

AGFI	CFI	IFI	TLI	NFI	GFI
0.910	0.971	0.971	0.951	0.967	0.955

**Table 3** The results of AVE and CR in NL-SF12

Two domains	Three levels	Six dimensions	AVE	CR
Cognition domain	Functional level	Knowledge	0.833	0.909
		Understanding	0.847	0.917
		Obtaining skills	0.637	0.776
		Applying skills	0.656	0.789
Skill domain	Interactive level	Interactive skills	0.651	0.789
	Critical level	Critical skills	0.815	0.898

levels of total NL ( $OR=2.20$ , 95%  $CI$ : 1.33–3.65) and cognition domain ( $OR=3.23$ , 95%  $CI$ : 1.94–5.37) than associate degree or below. It was worth mentioning that pharmacist and inspector technical personnel reported higher levels of total NL ( $OR=1.55$ , 95%  $CI$ : 1.06–2.26), functional NL ( $OR=1.49$ , 95%  $CI$ : 1.02–2.17), and interactive NL ( $OR=1.54$ , 95%  $CI$ : 1.00–2.36) than doctor. We also found that medical personnel with between 10 and 15 years of working experience had lower levels of total NL ( $OR=0.55$ , 95%  $CI$ : 0.33–0.93) and functional NL ( $OR=0.58$ , 95%  $CI$ : 0.34–0.96) than those with less than 5 years of working experience.

## Discussion

#### Validation of the NL-SF12 scale for the medical personnel

The NL-SF12 scale was administered for the first time to medical personnel, which is one of the innovations of this study. CFA has been recognized as a common method for validating the validity of scale constructs [25–27]. As we have seen, the NL-SF12 scale has good reliability and validity among medical personnel. Specifically speaking, the model fit indices for this scale were all greater than 0.9, indicating the scale is well structured [23]. The values of AVE were greater than 0.5, indicating that NL-SF12 has a good fit [28, 29]. This is also a good basis for rationalizing the use of measurement tools in the research.

#### NL level of medical personnel

This study shows that nearly half of the medical personnel (45.68%) possess a high overall level of NL. This result indicates that most medical personnel have a good grasp of nutritional knowledge, which they can apply in their practical work. High levels of NL are crucial for improving the quality of patient care and promoting health management. This is also consistent with previous studies [30–33]. In the cognitive (47.84%) and skill domains (43.97%), nearly half of the medical personnel exhibited high levels. This may reflect the effectiveness of medical education and continuous training in enhancing the understanding and application skills of nutritional

**Table 4** Nutrition literacy levels of medical personnel with different characteristics

Characteristics	N	Cognition domain	Skill domain	Functional NL	Interactive NL	Critical NL	
Gender	Total	1160	555(47.84)	510(43.97)	534(46.03)	281(24.22)	208(17.93)
	Male	397	166(41.81)	155(39.04)	170(42.82)	67(16.88)	67(16.88)
	Female	763	389(50.98)	355(46.53)	364(47.71)	214(28.05)	141(18.48)
	$\chi^2$		8.80	5.94	2.51	17.75	0.46
	P		0.003	0.015	0.285	0.000	0.796
Marital status	Married	872	416(47.71)	393(45.07)	404(46.33)	216(24.77)	160(18.35)
	Unmarried	256	123(48.05)	104(40.62)	118(46.09)	55(21.48)	42(16.41)
	Other	32	16(50.00)	13(40.63)	12(37.50)	10(31.25)	6(18.75)
	$\chi^2$		0.07	1.74	0.97	2.05	0.52
	P		0.965	0.420	0.616	0.359	0.770
Status of children born	One child	579	273(47.15)	261(45.08)	266(45.94)	143(24.70)	100(17.27)
	Two children	227	119(52.42)	108(47.58)	116(51.10)	63(27.75)	50(22.03)
	Infertile or other	354	163(46.05)	141(39.83)	152(42.94)	75(21.19)	58(16.38)
	$\chi^2$		2.48	3.95	3.71	3.39	3.33
	P		0.290	0.139	0.156	0.184	0.189
Education level	Associate degree or below	213	70(32.86)	83(38.97)	84(39.44)	41(19.25)	27(12.68)
	Bachelor's degree	797	402(50.44)	360(45.17)	381(47.80)	204(25.60)	150(18.82)
	Master's degree or above	150	83(55.33)	67(44.67)	69(46.00)	36(24.00)	31(20.67)
	$\chi^2$		24.68	2.66	4.74	3.69	5.19
	P		0.000	0.265	0.094	0.158	0.075
Career	Doctor	476	225(47.27)	196(41.18)	204(42.86)	101(21.22)	85(17.86)
	Nurse	489	240(49.08)	217(44.38)	233(47.65)	125(25.56)	83(16.97)
	Other technical personnel	175	82(46.86)	86(49.14)	86(49.14)	49(28.00)	33(18.86)
	Administrative personnel	20	8(40.00)	11(55.00)	11(55.00)	6(30.00)	7(35.00)
	$\chi^2$		0.92	4.43	3.78	93.37	4.37
P		0.820	0.219	0.287	0.000	0.224	
Professional and technical title	Primary and below	527	236(44.78)	225(42.69)	233(44.21)	117(22.20)	83(15.75)
	Middle level	472	232(49.15)	209(44.28)	221(46.82)	122(25.85)	87(18.43)
	High level	161	87(54.04)	76(47.20)	80(49.69)	42(26.09)	38(23.60)
	$\chi^2$		2.36	1.05	1.69	2.16	5.30
	P		0.308	0.591	0.430	0.340	0.071
Years of working experience	<5	265	117(44.15)	110(41.51)	120(45.28)	62(23.40)	46(17.36)
	5~	311	153(49.20)	132(42.44)	145(46.62)	65(20.90)	51(16.40)
	10~	232	108(46.55)	95(40.95)	95(40.95)	55(23.71)	35(15.09)
	15~	352	177(50.28)	173(49.15)	174(49.43)	99(28.13)	76(21.59)
	$\chi^2$		2.67	5.64	4.16	4.92	5.04
P		0.445	0.131	0.245	0.178	0.169	
Average monthly income	<5000	229	98(42.79)	100(43.67)	98(42.79)	46(20.09)	36(15.72)
	5000~	614	288(46.91)	260(42.35)	278(45.28)	149(24.27)	102(16.61)
	8000~	274	147(53.65)	131(47.81)	138(49.72)	74(27.01)	59(21.53)
	1000~	43	22(51.16)	19(44.19)	20(46.51)	12(27.91)	11(25.58)
	$\chi^2$		6.45	2.31	3.18	3.61	5.61
P		0.092	0.511	0.364	0.307	0.132	

knowledge among medical personnel. However, the proportion of medical personnel exhibiting high levels in the interactive (24.22%) and critical (17.93%) domains is relatively low. This indicates potential deficiencies among medical personnel in using nutritional knowledge for deeper communication and critical thinking. The interactive domain requires medical personnel to effectively communicate nutritional information with patients or colleagues; the critical domain requires them to evaluate

and integrate complex nutritional information and make scientific judgments [34–36].

#### Evaluation of NL levels of medical personnel with different characteristics

NL is closely related to social factors [37]. Both internal and external factors may affect the acquisition and utilization of nutritional knowledge. Overall, 34.22% of the medical personnel recruited in our study were male



**Table 5** Multivariate analysis for variables associated with total NL and two domains and three levels among medical personnel

Characteristics	Total NL	Cognition domain	Skill domain	Functional NL	Interactive NL	Critical NL
<i>Gender (ref. = male)</i>						
female	1.47(1.08~1.98)*	1.66(1.22~2.24)**	1.48(1.09~2.00)*	1.21(0.90~1.64)	2.21(1.53~3.19)***	1.29(0.87~1.91)
<i>Marital status(ref. = married)</i>						
unmarried	1.39(0.84~2.29)	1.65(0.99~2.73)	1.19(0.72~1.96)	1.62(0.98~2.69)	1.15(0.63~2.11)	1.03(0.54~1.99)
other	0.60(0.28~1.30)	1.14(0.54~2.39)	0.79(0.38~1.64)	0.72(0.34~1.52)	1.27(0.58~2.79)	1.08(0.43~2.72)
<i>Status of children born (ref. = one child)</i>						
two children	1.28(0.92~1.76)	1.21(0.88~1.67)	1.15(0.84~1.59)	1.30(0.95~1.80)	1.20(0.84~1.73)	1.42(0.96~2.12)
infertile or other	0.66(0.41~1.06)	0.85(0.54~1.36)	0.71(0.45~1.13)	0.61(0.38~0.98)*	0.73(0.42~1.28)	0.99(0.54~1.83)
<i>Education level (ref. = associate degree or below)</i>						
bachelor's degree	1.80(1.27~2.55)**	2.26(1.59~3.22)***	1.46(1.04~2.06)*	1.58(1.12~2.22)*	1.59(1.05~2.40)*	1.69(1.05~2.74)*
master's degree or above	2.20(1.33~3.65)**	3.23(1.94~5.37)***	1.64(0.99~2.71)	1.55(0.94~2.58)	1.67(0.92~3.04)	1.78(0.92~3.44)
<i>Career (ref. = doctor)</i>						
nurse	1.18(0.84~1.66)	1.18(0.84~1.66)	1.08(0.77~1.51)	1.35(0.96~1.88)	1.05(0.72~1.54)	1.05(0.68~1.61)
Other technical personnel	1.55(1.06~2.26)*	1.20(0.82~1.75)	1.45(0.99~2.11)	1.49(1.02~2.17)*	1.54(1.00~2.36)*	1.24(0.77~1.99)
administrative personnel	1.77(0.68~4.60)	0.82(0.31~2.17)	1.65(0.65~4.22)	1.86(0.72~4.79)	1.45(0.51~4.11)	2.79(1.02~7.61)*
<i>Professional and technical title (ref. = primary and below)</i>						
middle level	1.07(0.75~1.54)	1.13(0.79~1.62)	0.90(0.63~1.29)	1.19(0.83~1.70)	1.09(0.71~1.66)	1.25(0.78~2.02)
high level	1.03(0.60~1.77)	1.24(0.73~2.15)	0.85(0.49~1.45)	1.25(0.73~2.14)	0.98(0.53~1.83)	1.38(0.70~2.75)
<i>Years of working experience (Year) (ref. = &lt;5)</i>						
5~	0.67(0.45~1.01)	1.22(0.81~1.83)	0.93(0.62~1.39)	0.87(0.58~1.30)	0.69(0.43~1.12)	0.75(0.44~1.28)
10~	0.55(0.33~0.93)*	1.01(0.60~1.70)	0.87(0.52~1.46)	0.58(0.34~0.96)*	0.72(0.39~1.32)	0.56(0.28~1.11)
15~	0.88(0.52~1.51)	1.34(0.78~2.31)	1.33(0.78~2.28)	0.88(0.52~1.50)	1.00(0.54~1.87)	0.89(0.44~1.79)
<i>Average monthly income (CNY) (ref. = &lt;5000)</i>						
5000~	1.03(0.74~1.42)	1.07(0.77~1.48)	0.90(0.65~1.24)	1.09(0.79~1.51)	1.24(0.83~1.83)	0.99(0.64~1.53)
8000~	1.27(0.86~1.87)	1.38(0.93~2.04)	1.13(0.77~1.66)	1.31(0.89~1.93)	1.49(0.94~2.37)	1.30(0.79~2.15)
1000~	1.16(0.58~2.35)	1.26(0.62~2.55)	1.06(0.53~2.14)	1.17(0.58~2.36)	1.93(0.87~4.31)	1.58(0.68~3.63)

Notes \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ . Multiple logistic regression analysis was applied to estimate the OR and 95% CI for nutrition literacy. The final model is adjusted for gender, marital status, status of children born, education level, career, professional and technical title, years of working experience, average monthly income

and 65.78% were female. Within the healthcare industry, females are likely to be in the majority in nursing fields, which are often more closely associated with the dietary and nutritional management of patients. However, this is not uncommon, and it has been shown in many studies of medical personnel [38–41].

In previous studies [42–45], it is not difficult to find that females show an advantage in NL. In our study, it was found that the NL level of females in cognitive and skill domains was significantly higher than that of males, because females are more likely to choose a healthy and balanced diet [46]. In another word, females are largely influenced by socio-cultural factors and pay more attention to appearance and health, so they pay more attention to diet and nutrition [47]. This further reveals gender disparities in nutritional education and health awareness. But there is no difference between females and males in the critical NL. Critical NL is a capability that involves an individual's critical thinking skills in acquiring, processing, and evaluating nutrition-related information [48]. This literacy encompasses understanding basic nutritional knowledge and assessing the sources of nutrition information, understanding the scientific basis and

potential conflicts of interest behind nutritional advice, and making informed nutritional choices in everyday life. Most people are deficient in nutritional knowledge judgment. People focus mainly on nutritional knowledge but do not make good use of this knowledge in their lives and work, such as how to use nutritional labels to judge the nutritional value of food [49]. However, the presence of this phenomenon among medical personnel will also hinder the transmission of nutritional information to patients or their families. In an era where information is abundant and food advertising is ubiquitous, the development of critical NL competencies, such as information assessment skills, scientific understanding, health decision-making, and advocacy and action, is essential for improving public health and helping people make informed and rational nutritional choices in a complex and variable information environment. Healthcare providers and the education sector should strengthen NL education in their daily work, focusing on capacity-building, while feedback and evaluation mechanisms should be put in place to ensure that educational activities are in line with the actual improvement of the capacity of healthcare workers to critical assess NL.

There is a close relationship between educational level and NL [50]. Individuals with higher education levels tend to be more health-conscious, including in their diet and nutrition. Higher medical education usually includes nutrition courses, enabling healthcare professionals with higher education levels to better understand the importance of nutrition both theoretically and in practical application. Such courses often cover various aspects, including the functions of NL, the establishment of healthy eating habits, and the relationship between nutrition and diseases [51, 52]. Medical personnel often participate in continuing education and professional development courses throughout their careers. These courses help them update and expand their knowledge of nutrition. Healthcare professionals with higher education levels are more likely to enhance their professional skills through such courses.

One of the interesting things about our results is that the level of interactive NL of administrative personnel was higher than that of other personnel. This was not present in the other studies. Administrative personnel may have more opportunities to communicate with colleagues about food choices and which diets are healthier. However, the study did not show a correlation between nutrition literacy and working years or average monthly income. In addition, they are exposed to more nutrition-related policies [53].

### Limitations

In this study, the NL-SF12 was first used to comprehensively assess the level of NL among medical personnel and to capture the main factors influencing the level of NL. There are also some limitations in this study. Firstly, the study sample was mainly from tertiary hospitals in the Bengbu area, and the results may not apply to other areas or different levels of healthcare organizations; secondly, this is a cross-sectional study, which is not able to determine causality, but can only reveal associations between the variables; and thirdly, the healthcare professionals who took part in the study may have a higher level of health awareness, which may lead to positive bias in the results. Fourthly, the sample size should be expanded to allow for more accurate identification of NL levels for different characteristics. Finally, clarifying these limitations not only helps to interpret the results more objectively, but also provides directions for improvement in future studies.

### Conclusions

The study found that female medical personnel reported higher levels of total NL, cognition domain, skill domain, and interactive NL compared to males. Therefore, gender significantly influences NL levels among medical personnel. Medical personnel with a master's degree or above

demonstrated higher levels of total NL and cognition domain compared to those with an associate degree or lower. This indicates that higher education levels contribute to a better understanding and application of nutrition knowledge among healthcare professionals. Pharmacists, inspectors, and other technicians exhibited higher levels of total NL and functional NL. This may be associated with the nature of their professions and their specific needs for nutrition knowledge. Gender, education level, and career were identified as significant influencing factors of nutrition literacy among medical personnel. Understanding and considering these factors are crucial for developing targeted strategies to enhance nutrition literacy among healthcare professionals. Future efforts to improve nutrition literacy through training and interventions should be tailored to the characteristics of different groups, e.g., focusing on groups such as males and those with less than a master's degree in education, in order to effectively improve the competence and capacity of healthcare workers in terms of nutritional knowledge and practice.

### Abbreviations

NL	Nutrition Literacy
OR	Odds Ratio
CI	Confidence Intervals
CFA	Confirmatory factoranalysis
AGFI	Adjusted goodness-of-fit index
CFI	Comparative fit index
IFI	Incremental fit index
TLI	Tucker-Lewis index
NFI	Normal fit index
GFI	Goodness-of-fit index

### Acknowledgements

We would like to express thanks to all participants during the data collection process.

### Author contributions

GM and EZ: conceptualization. MJ, GM, and XG: methodology. JM, GM and SK: investigation and data management. GM: writing—original draft preparation. JM, GM, EZ, and XG: writing—review and editing. SK and XG: supervision. JM, GM and EZ: project administration. GM: funding acquisition. GM and EZ contributed equally to this work. All authors have read and approve of the published version of the manuscript.

### Funding

This research was funded by the Bengbu Science and Technology Innovation Guidance Category (20220139).

### Data availability

No datasets were generated or analysed during the current study.

### Declarations

#### Ethics approval and consent to participate

The study was conducted following the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the Bengbu Science & Technology Bureau (20220139). Informed consent was obtained from all participants.

#### Competing interests

The authors declare no competing interests.

Received: 31 May 2024 / Accepted: 31 July 2024

Published online: 15 August 2024

## References

- Noncommunicable diseases: Unhealthy diet. World Health Organization. 2023. <http://www.emro.who.int/noncommunicable-diseases/causes/unhealthy-diets.html> (accessed on 20 July 2023).
- Noncommunicable diseases: Main NCDs. World Health Organization. 2023. <https://www.emro.who.int/noncommunicable-diseases/diseases/diseases.html> (accessed on 20 July 2023).
- Noncommunicable diseases. Limit fat, salt and sugar intake. World Health Organ; 2023. <https://www.emro.who.int/nutrition/reduce-fat-salt-and-sugar-intake/index.html> (accessed on 20 July 2023).
- Sun Y, Dong D, Ding Y. The impact of Dietary Knowledge on Health: evidence from the China Health and Nutrition Survey. *Int J Environ Res Public Health* 2021, 18(7).
- Jeruszka-Bielak M, Kollajtis-Dolowy A, Santoro A, Ostan R, Berendsen AAM, Jennings A, Meunier N, Marseglia A, Caumon E, Gillings R, et al. Are Nutrition-related knowledge and attitudes reflected in Lifestyle and Health among Elderly people? A study across five European countries. *Front Physiol*. 2018;9:994.
- Liu B, Ren X, Tian W. Dietary inflammatory potential and the risk of nonfatal cardiovascular diseases in the China Health and Nutrition Survey. *Nutr (Burbank Los Angeles Cty Calif)*. 2024;124:112469.
- Lai JJ, Chang LC, Lee CK, Liao LL. Nutrition Literacy Mediates the Relationships between Multi-Level Factors and College Students' Healthy Eating Behavior: Evidence from a Cross-Sectional Study. *Nutrients* 2021, 13(10).
- Spronk I, Kullen C, Burdon C, O'Connor H. Relationship between nutrition knowledge and dietary intake. *Br J Nutr*. 2014;111(10):1713–26.
- Taylor MK, Sullivan DK, Ellerbeck EF, Gajewski BJ, Gibbs HD. Nutrition literacy predicts adherence to healthy/unhealthy diet patterns in adults with a nutrition-related chronic condition. *Public Health Nutr*. 2019;22(12):2157–69.
- Velardo S. The Nuances of Health Literacy, Nutrition Literacy, and food literacy. *J Nutr Educ Behav*. 2015;47(4):385–e389381.
- Qi Q, Sun Q, Yang L, Cui Y, Du J, Liu H. High nutrition literacy linked with low frequency of take-out food consumption in Chinese college students. *BMC Public Health*. 2023;23(1):1132.
- Gao T, Duan Y, Qi Q, Mo G, Han S, Liu H, Zhang M. Nutrition literacy differs based on demographics among University students in Bengbu, China. *Front Public Health*. 2023;11:113211.
- Svendsen K, Torheim LE, Fjølberg V, Sorprud A, Narverud I, Retterstøl K, Bogsrud MP, Holven KB, Myhrstad MCW, Telle-Hansen VH. Gender differences in nutrition literacy levels among university students and employees: a descriptive study. *J Nutritional Sci*. 2021;10:e56.
- Stokols D. Translating social ecological theory into guidelines for community health promotion. *Am J Health Promot: AJHP*. 1996;10(4):282–98.
- Mo G, Han S, Gao T, Sun Q, Zhang M, Liu H. Development and validation of a novel short-form nutrition literacy measurement tool for Chinese college students. *Front Public Health*. 2022;10:962371.
- Aihemaitijiang S, Ye C, Halimulati M, Huang X, Wang R, Zhang Z. Development and Validation of Nutrition Literacy Questionnaire for the Chinese Elderly. *Nutrients* 2022, 14(5).
- Camargo JT, Ramirez M, Gajewski BJ, Sullivan DK, Carlson SE, Gibbs HD. Nutrition literacy among Latina/x people during pregnancy is Associated with socioeconomic position. *J Acad Nutr Dietetics*. 2022;122(11):2097–105.
- Itzkovitz A, Maggio V, Roy-Fleming A, Legault L, Brazeau AS. Nutrition and food literacy among young Canadian adults living with type 1 diabetes. *Diabet Medicine: J Br Diabet Association*. 2022;39(11):e14921.
- Ashoori M, Soltani S, CC TC, Eini-Zinab H, Shakibazadeh E, Doustmohamadian A, Abdar-Esfahani B, Mazandarani M, Omidvar N. Food and nutrition literacy: a predictor for diet quality and nutrient density among late adolescents. *Turk J Pediatr*. 2023;65(2):290–300.
- Jones G, Macaninch E, Mellor D, Spiro A, Martyn K, Butler T, Johnson A, Moore JB. Putting nutrition education on the table: development of a curriculum to meet future doctors' needs. *BMJ Nutr Prev Health*. 2022;5(2):208–16.
- Blanar V, Pospichal J, Eglseer D, Grofová ZK, Bauer S. Evaluation of Malnutrition knowledge among nursing staff in the Czech Republic: a cross-sectional psychometric study. *Teach Learn Med* 2024:1–10.
- Zhang Y, Sun Q, Zhang M, Mo G, Liu H. Nutrition Literacy Measurement Tool with Multiple Features for Chinese adults. *FoodNutr Bull*. 2022;43(2):189–200.
- J FF, WKF: factor analysis in the development and refinement of clinical Assessment instruments. *Psychol Assess* 1995, 7(3):286–99.
- J CL, J SR: My current thoughts on Coefficient Alpha and Successor procedures. *Educational Psychol Meas* 2004, 64(3):391–418.
- Flamer S. Assessment of the Multitrait-Multimethod Matrix Validity of Likert Scales Via Confirmatory Factor Analysis. *Multivar Behav Res*. 1983;18(3):275–306.
- Fekih-Romdhane F, El Hadathy D, González-Nuevo C, Malaeb D, Barakat H, Hallit S. Development and preliminary validation of the Postpartum psychotic experiences Scale (PPES). *Psychiatry Res*. 2023;329:115543.
- Hong J, Yang N, Kim K. Development and validation of a Perceived Community Food Accessibility Measurement Questionnaire for Korean older adults. *Nutrients* 2023, 15(19).
- MW: Structural equation Model-AMOS Operation and Application. Chongqing: Chongqing University; 2010.
- Mengi Çelik Ö, Karacil Ermumcu MS, Ozyildirim C. Turkish version of the 'food and nutrition literacy questionnaire for Chinese school-age children' for school-age adolescents: a validity and reliability study. *BMC Public Health*. 2023;23(1):1807.
- Vrkatić A, Grujičić M, Jovičić-Bata J, Novaković B. Nutritional knowledge, confidence, attitudes towards Nutritional Care and Nutrition Counselling Practice among General practitioners. *Healthc (Basel Switzerland)* 2022, 10(11).
- Van Horn L, Lenders CM, Pratt CA, Beech B, Carney PA, Dietz W, DiMaria-Ghalili R, Harlan T, Hash R, Kohlmeier M, et al. Advancing Nutrition Education, Training, and Research for Medical Students, residents, fellows, attending Physicians, and other clinicians: Building competencies and Interdisciplinary Coordination. *Adv Nutr (Bethesda Md)*. 2019;10(6):1181–200.
- Alam L, Ali HF, Alam M, Khan J, Khan S. Knowledge and clinical practices of medical doctors regarding nutrition in cirrhosis patients - a multicentre study from Pakistan. *JPMA J Pakistan Med Association*. 2021;71(8):2009–13.
- van der Heide I, Heijmans M, Schuit AJ, Uiters E, Rademakers J. Functional, interactive and critical health literacy: varying relationships with control over care and number of GP visits. *Patient Educ Couns*. 2015;98(8):998–1004.
- Wood J. DE Gillis 2015 Exploring dietitians' Engagement with Health Literacy: Concept and Practice. *Can J Diet Pract Research: Publication Dietitians Can = Revue canadienne de la pratique et de la recherche en diététique : Une Publication des Diététistes du Can* 76 2 51–5.
- Zhao J, Sun J, Su C. Gender differences in the relationship between dietary energy and macronutrients intake and body weight outcomes in Chinese adults. *Nutr J*. 2020;19(1):45.
- Grzymisławska M, Puch EA, Zawada A, Grzymisławski M. Do nutritional behaviors depend on biological sex and cultural gender? *Adv Clin Experimental Medicine: Official Organ Wroclaw Med Univ*. 2020;29(1):165–72.
- Banna MHA, Hamiduzzaman M, Kundu S, Ara T, Abid MT, Brazendale K, Seidu AA, Disu TR, Mozumder N, Frimpong JB, et al. The Association between Bangladeshi adults' demographics, personal beliefs, and Nutrition literacy: evidence from a cross-sectional survey. *Front Nutr*. 2022;9:867926.
- Gebhard D, Neumann J, Wimmer M, Mess F. The second side of the Coin-Resilience, Meaningfulness and Joyful Moments in Home Health Care Workers during the COVID-19 pandemic. *Int J Environ Res Public Health* 2022, 19(7).
- Blanco-Donoso LM, Moreno-Jiménez J, Gallego-Alberto L, Amutio A, Moreno-Jiménez B, Garrosa E. Satisfied as professionals, but also exhausted and worried!! The role of job demands, resources and emotional experiences of Spanish nursing home workers during the COVID-19 pandemic. *Health Soc Care Commun*. 2022;30(1):e148–60.
- Peng S, Zhang J, Liu X, Pei M, Wang T, Zhang P. Job burnout and its influencing factors in Chinese medical staffs under China's prevention and control strategy for the COVID-19 pandemic. *BMC Public Health*. 2023;23(1):284.
- Dolatkhah N, Aghamohammadi D, Farshbaf-Khalili A, Hajifaraji M, Hashemian M, Esmaili S. Nutrition knowledge and attitude in medical students of Tabriz University of Medical Sciences in 2017–2018. *BMC Res Notes*. 2019;12(1):757.
- Neshatbini Tehrani A, Farhadnejad H, Salehpour A, Beyzai B, Hekmatdoost A, Rashidkhani B. The association between nutrition knowledge and adherence to a Mediterranean dietary pattern in Iranian female adolescents. *Int J Adolesc Med Health* 2019, 33(4).
- Yurtdaş Depboylu G, Kaner G, Süer M, Kanyılmaz M, Alpan D. Nutrition literacy status and its association with adherence to the Mediterranean diet, anthropometric parameters and lifestyle behaviours among early adolescents. *Public Health Nutr*. 2023;26(10):2108–17.
- Kalkan I. The impact of nutrition literacy on the food habits among young adults in Turkey. *Nutr Res Pract*. 2019;13(4):352–7.



45. Chaves CDS, Camargo JT, Zandonadi RP, Nakano EY, Ginani VC. Nutrition Literacy Level in Bank employees: the case of a large Brazilian company. *Nutrients* 2023, 15(10).
46. McNamara J, Kunicki ZJ, Olfert MD, Byrd-Bredbenner C, Greene G. Revision and psychometric validation of a Survey Tool to measure critical Nutrition literacy in young adults. *J Nutr Educ Behav.* 2020;52(7):726–31.
47. Zhang Y, Zhang Z, Xu M, Aihemaitijiang S, Ye C, Zhu W, Ma G. Development and validation of a Food and Nutrition Literacy Questionnaire for Chinese adults. *Nutrients* 2022, 14(9).
48. Grammatikopoulou MG, Katsouda A, Lekka K, Tsantekidis K, Bouras E, Kasapidou E, Poulia KA, Chourdakis M. Is continuing medical education sufficient? Assessing the clinical nutrition knowledge of medical doctors. *Nutr (Burbank Los Angeles Cty Calif).* 2019;57:69–73.
49. Karim SA, Ibrahim B, Tangiisuran B, Davies JG. What do healthcare providers know about nutrition support? A survey of the knowledge, attitudes, and practice of pharmacists and doctors toward nutrition support in Malaysia. *JPEN J Parenter Enter Nutr.* 2015;39(4):482–8.
50. Sanlier N, Kocaay F, Kocabas S, Ayyildiz P. The Effect of Sociodemographic and Anthropometric Variables on Nutritional Knowledge and Nutrition Literacy. *Foods (Basel Switzerland)* 2024, 13(2).
51. Yan W, Caihong H, Xuefeng Y, Jiayu Z. Evaluation of the nutrition literacy assessment questionnaire for college students and identification of the influencing factors of their nutrition literacy. *BMC Public Health.* 2023;23(1):2127.
52. Banna JC, Gilliland B, Keefe M, Zheng D. Cross-cultural comparison of perspectives on healthy eating among Chinese and American undergraduate students. *BMC Public Health.* 2016;16(1):1015.
53. Zhang Y, Wang Z, Liu D, Liu F, Wang C. Status and influencing factors of nutrition literacy of medical staff in grade-tertiary hospitals of Wuhan City. *Occupation Health.* 2023;39(05):589–92.

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.