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Original Article

# Levels of Nutrition Literacy and Influencing Factors Among Vocational College Students in Guangxi, China

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## Abstract

**Background:** Nutrition literacy (NL) is an indicator of nutrition status and is progressively applied in policy and research. Nevertheless, component skills of nutrition literacy, which are considered to be a crucial component of translating nutrition knowledge into positive dietary behaviour, have received little attention. Therefore, this study aimed to investigate NL and associated factors among vocational college students in Guangxi, China.

**Methods:** In this cross-sectional study, the participants included 1095 vocational college students aged 18–24 years in an ethnic minority area in Guangxi, China. The participants were assigned to low or high levels of NL and its five components (access, applying, interactive, media literacy, and decision-making skill) based on their median scores. We applied multiple logistic regression to investigate the associations between influencing factors and NL.

**Results:** Based on the results, 50.59% of the participants had low levels of NL. The influencing factors associated with NL, along with access and decision-making skills, included exercise, body mass index (BMI), and education and knowledge on the subject of nutrition. Moreover, BMI, nutrition education, and nutrition knowledge were affected by interactive and media literacy skills. Interestingly, only grade is influencing factors of applying skill with protective factor at sophomore (OR=0.20) and junior (OR=0.72).

**Conclusion:** The findings of the study indicate that exercise, BMI, nutrition education, and nutrition knowledge were affected by low NL levels. Therefore, improving NL might be an important step towards developing healthy dietary habits.

**Keywords:** Nutrition literacy, Influencing factors, Vocational college students

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## Introduction

Rapid socio-economic development and the COVID-19 pandemic have led to changes in eating habits and dietary patterns in China (1,2). Both factors may have led to increases in the prevalence of chronic non-communicable diseases such as obesity, type 2 diabetes, and cancer, which are critical public health problems. Additionally, alcohol use, smoking, and physical inactivity are basic risk factors for these diseases, and unhealthy eating habits may alter the mechanisms underlying their pathologies (3).

Nutrition literacy (NL) is a crucial aspect of health literacy that motivates people to consider nutrition information when making healthy dietary choices (4). NL is defined as the capability to understand, access, and implement nutrition information (5). The knowledge and skills provided by NL are crucial for the management of obesity in children and adults, as both internal and external factors in this case are affected by NL (6,7). Doustmohammadian et al (8), using a tool developed by Velardo (9), described food and NL based on the two cognitive and skill domains; the skill domain is divided into three dimensions and nine component skills with functional, interactive, and critical dimensions. Previous studies have focused on only three dimensions of NL skills without considering component skills (10-12). Adequate NL allows an individual to recognize important nutrition information and gives them the skills needed to make healthy dietary choices (8,13). Some studies have revealed that the component skills of NL improve health outcomes (14,15). Therefore, the component skills of NL are important for the development of NL; for example, media literacy involves increasing awareness of the risks of media use by enhancing skills, knowledge, assessments, and actions (16).

In recent years, the number of vocational college students in China has steadily increased, reaching 16709 million at the time of writing. These students are considered a vital component of Chinese education system (17).

Vocational college students have special characteristics and specific environments during their transition from adolescence to adulthood. Further, these students are strongly independent and personally invested in the self-management of their health (18). Therefore, this study examined the importance of NL skills in nutrition self-management.

Data on the association between influencing factors and NL among vocational non-medical college students remains limited, reinforcing the importance of studying these associations and interventions that could be implemented in this unique and important population. This study aims to explore the level of NL and its component skills and the influencing factors among vocational non-medical college students in ethnic minority areas in Guangxi, China.

## Materials and Methods

### *Participants*

The cross-sectional study was conducted with the participation of 1095 vocational non-medical college students aged 18–23 years old between January and May 2024 at the Guangxi Modern Polytechnic College in the city of He Chi, in ethnic minority areas in Guangxi, China. Guangxi Modern Polytechnic College is the largest polytechnic college in He Chi and includes eight schools. A stratified random sampling technique was used to recruit participants. The target sample size was computed using Daniel's formula (19). Considering a prevalence of 53.2% (7), with an accuracy level of 5% and a 95% confidence level, the minimum sample size required was calculated to be 985. However, after taking into account a potential drop-out rate of 10%, a total of 1095 participants were found to be required. The stratified sampling technique was applied to enroll the students who met the eligibility criteria. We divided them into eight strata. In each stratum, students were selected from each school as participants using the lottery method. Non-Chinese students, students over 25 years of age, and students suffering from chronic health conditions were excluded from the study.

### *Assessment of Outcome Variable*

A self-report NL questionnaire was developed to assess food and nutrition literacy (FNLIT) (8). It consists of 25 items measuring five component skills: (*a*) access (NL1 with 5 items), (*b*) application (NL2 with 5 items), (*c*) interactivity (NL3 with 5 items), (*d*) media literacy (NL4 with 5 items), and (*e*) decision-making (NL5 with 5 items) (Cronbach's $\alpha = 0.97$). A participant's total NL score is the sum of the scores for all items (ranging from 5 to 125) with scores of 66 or more taken as adequate (high level), and those under 66 as inadequate (low level). Each dimension score ranged from 1 to 25, with scores of 13 or more as adequate and those under 13 as inadequate. The participants were divided into 2 groups based on their median scores.

### *Exposure Variable*

Three exposure variables were considered in this study: demographic characteristics, exercise, and nutrition knowledge. Demographic characteristics included age, gender, grade, ethnicity, residence, expense, family income, nutrition status (as body mass index; BMI was categorized into underweight [BMI < 18.5 kg/m$^2$], normal [18.5–22.9 kg/m$^2$], overweight [23–24.9 kg/m$^2$] or obese [ > 25 kg/m$^2$] by following the international classification for BMI in Asia) (20), and nutrition education (6,10-11). Exercise levels were ranked as high (more than 300 min/wk of moderate activity), moderate (150-300 min/wk of moderate activity), or low (less than 150 min/wk of moderate activity) (21). The nutrition knowledge of the participants was tested with a 14-item questionnaire (Kuder-Richardson = 0.80) (22). Scores ranged from 0 to 14: scores of 9 or less were regarded as low, 10–11 as moderate, and 12 or more as high.

### *Statistical Analysis*

Data analysis was performed with IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated to describe the participants' characteristics. A chi-square test was used to describe the characteristics of the participants and evaluate the relationship between NL and the covariates. Multivariate logistic regression analysis was used to estimate associations while controlling for the effect of other covariates. Associations between exposure variables and NL were presented as adjusted odds ratios (OR) with 95% confidence intervals (CIs).

## Results

### *Participant Characteristics*

A total of 1095 vocational college students were enrolled in the study, and the effective response rate was 97.69%. Table 1 shows the students' demographic information. Their mean age was 19.66 ± 1.08 years, and their mean BMI was 20.50 ± 3.50 kg/m$^2$. Based on the results, 51.70% of the students were sophomores, 42.60 % were of Han ethnicity, and 68.86% had taken a nutrition education course at the college. Their mean nutrition knowledge score was 10.37 ± 2.31. Additionally, 29.68% of the students had a high level of nutrition knowledge, and 31.33% had a low level of nutrition knowledge. Their mean NL score was 68.83 ± 22.25, while the five components of NL had mean scores of 13.64 ± 5.03, 13.60 ± 4.73, 13.97 ± 5.14, 13.71 ± 4.72, and 13.92 ± 4.76, respectively. Interestingly, 50.59% of the vocational college students had a low level of NL. Differences in NL levels were observed across demographic groups based on gender, exercise, BMI, nutrition education, and nutrition knowledge ($P < 0.05$). Across the levels of NL, males who exercised had the highest levels of NL. Additionally, students who exercised and had nutrition education also had higher total NL scores.

**Table 1.** Demographic Characteristics of the Participants With Distribution of NL Level (n = 1095)

| Variable | All | Total NL | | *P* Value |
|---|---|---|---|---|
| | No. (%) | Low (n = 554) | High (n = 541) | |
| Age | | | | |
| <20 | 505 (46.10) | 265 (47.82) | 240 (44.33) | 0.275 |
| ≥20 | 590 (53.90) | 289 (52.18) | 301 (55.67) | |
| Gender | | | | |
| Male | 623 (56.81) | 337 (60.72) | 286 (52.90) | 0.009 |
| Female | 472 (43.19) | 217 (39.28) | 255 (47.10) | |
| Grade | | | | |
| Freshmen | 518 (47.30) | 244 (44.00) | 274 (50.60) | 0.091 |
| Sophomore | 566 (51.70) | 304 (54.90) | 262 (48.40) | |
| Junior | 11 (1.00) | 6 (1.10) | 5 (0.90) | |
| Ethnicity | | | | |
| Han | 466 (42.60) | 219 (39.50) | 247 (45.70) | 0.088 |
| Zhaung | 459 (41.90) | 249 (44.90) | 210 (38.80) | |
| Other | 170 (15.50) | 86 (15.50) | 84 (15.50) | |
| Residence | | | | |
| Urban | 92 (8.49) | 44 (7.94) | 48 (8.87) | 0.656 |
| Rural | 1003 (91.51) | 510 (92.06) | 493 (91.13) | |
| Expense | | | | |
| <1500 yuan | 609 (55.61) | 307 (55.41) | 302 (55.82) | 0.940 |
| ≥1500 yuan | 486 (44.39) | 247 (44.59) | 239 (44.18) | |
| Family income | | | | |
| <3000 yuan | 799 (72.96) | 401 (72.38) | 398 (73.57) | 0.709 |
| ≥3000 yuan | 296 (27.03) | 153 (27.62) | 143 (26.43) | |
| Exercise | | | | |
| Active | 515 (47.03) | 240 (43.32) | 275 (50.83) | <0.001 |
| Low | 195 (37.87) | 99 (41.25) | 51 (18.55) | |
| Moderate | 170 (33.00) | 70 (29.17) | 102 (37.09) | |
| High | 150 (29.13) | 71 (29.58) | 122 (44.36) | |
| Inactive | 580 (52.97) | 314 (56.68) | 266 (49.17) | |
| BMI | | | | |
| Underweight | 260 (23.74) | 140 (25.27) | 120 (22.18) | <0.001 |
| Normal | 512 (46.76) | 222 (40.07) | 290 (53.60) | |
| Overweight-obesity | 323 (29.50) | 192 (34.66) | 131 (24.22) | |
| Nutrition education | | | | |
| Yes | 754 (68.86) | 341 (61.55) | 413 (76.34) | <0.001 |
| No | 341 (31.14) | 213 (38.45) | 128 (23.66) | |
| Nutrition knowledge | | | | |
| Low | 343 (31.33) | 220 (39.71) | 123 (22.74) | <0.001 |
| Medium | 427 (38.99) | 175 (31.59) | 252 (46.58) | |
| High | 325 (29.68) | 159 (28.70) | 166 (30.68) | |

### *Factors Influencing NL Status*

Multiple linear regression was applied to measure the factors influencing NL level by considering five sub-dimensions. As Table 2 shows, students in the following categories were found to be less likely to have high levels of NL: inactive students (OR = 1.32, 95% CI = 1.02–1.70), overweight or obese students (OR = 0.55, 95% CI = 0.41–0.74), underweight students (OR = 0.64, 95% CI = 0.47 – 0.89), those who had not received nutrition education (OR = 1.72, 95% CI = 1.30–2.28), and those with medium (OR = 1.60, 95% CI = 1.15–2.23) or low (OR = 2.31, 95% CI = 1.71–3.14) levels of nutrition knowledge. This can be compared with a greater likelihood of high NL levels among those who actively exercised, had normal BMI, had received nutrition education, and had a high level of nutrition knowledge.

Regarding the five components of NL, the results indicate that the first component (NL1) was access skill; students who were inactive (OR = 1.58, 95% CI = 1.22–2.04), overweight or obese (OR = 0.67, 95% CI = 0.50–0.90), had not received nutrition education (OR = 1.08, 95% CI = 1.37–2.22), or had a medium (OR = 1.68, 95% CI = 1.21–2.32) or low (OR = 2.05, 95% CI = 1.52–2.77) level of nutrition knowledge were less likely to have a high level of NL1 than those who actively exercised, had normal BMI, had received nutrition education, and had a high level of nutrition knowledge. Additionally, decision-making skill (NL5) influenced NL1.

Interestingly, sophomore students (OR = 0.20, 95% CI = 0.05–0.81) and junior students (OR = 0.72, 95% CI = 0.55–0.96) who were overweight or obese (OR = 0.68, 95% CI = 0.51–0.91), had not received nutrition education (OR = 1.84, 95% CI = 1.40–2.42), and had a medium (OR = 1.43, 95% CI = 1.03–1.98) and low (OR = 1.76, 95% CI = 1.30–2.37) level of nutrition knowledge were less likely to report a high level of application skill (NL2).

Students with abnormal BMI (overweight or obese [OR = 0.65, 95% CI = 0.49–0.87]), having not received nutrition education (OR = 1.63, 95% CI = 1.23–2.14), and medium (OR = 1.62, 95% CI = 1.17 – 2.25) or low (OR = 2.15, 95% CI = 1.59–2.90) levels of nutrition knowledge were less likely to report a high level of NL3. The influencing factors of NL4 were similar to those of NL3, except for being underweight, which also had an influencing effect.

## Discussion

NL is regarded as a key factor in the health and nutrition status of individuals (23). To the best of our knowledge, this study is among the first studies to explore the associations between influencing factors, NL, and its five component skills based on FNLIT (8) (access, applying, interactive, media literacy, and decision-making skills) among vocational college students in ethnic minority areas in Guangxi, China, following the COVID-19 epidemic. The questionnaire results indicate that educational grade, exercise levels, BMI, nutrition education, and nutrition knowledge are independent factors influencing NL. Importantly, this finding represents evidence that can be used when preparing NL intervention strategies to implement nutrition education among non-medical college students in the future.

In this study, we found that the NL of most non-medical

**Table 2.** Multiple Logistic Regression Analysis of Variables Associated With the NL Level of Participants (n = 1095)

| Independent variable | Total NL | | | NL1 | | | NL2 | | | NL3 | | | NL4 | | | NL5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | *P* Value | OR | 95% CI | *P* Value | OR | 95% CI | *P* Value | OR | 95% CI | *P* Value | OR | 95% CI | *P* Value | OR | 95% CI | *P* Value |
| Grade (freshmen) | Ref. | | | | | | | | | | | | | | | | | |
| Sophomore | 0.55 | 0.16-1.94 | 0.352 | 0.84 | 0.24-2.92 | 0.789 | 0.20 | 0.05-0.81 | 0.024* | 0.53 | 0.15-1.85 | 0.322 | 0.54 | 0.16-1.88 | 0.334 | 0.55 | 0.16-1.93 | 0.355 |
| Junior | 0.78 | 0.59-1.03 | 0.083 | 0.81 | 0.61-1.07 | 0.134 | 0.72 | 0.55-0.96 | 0.023* | 0.77 | 0.58-1.02 | 0.071 | 0.783 | 0.59-1.04 | 0.088 | 0.81 | 0.61-1.07 | 0.135 |
| Exercise (active) | Ref. | | | | | | | | | | | | | | | | | |
| Inactive | 1.32 | 1.02-1.70 | 0.036* | 1.58 | 1.22-2.04 | <0.001** | 1.24 | 0.96-1.60 | 0.099 | 1.25 | 0.97-1.62 | 0.082 | 1.27 | 0.98-1.63 | 0.069 | 1.32 | 1.03-1.71 | 0.029* |
| BMI (normal) | Ref. | | | | | | | | | | | | | | | | | |
| Overweight-obesity | 0.55 | 0.41-0.74 | <0.001** | 0.67 | 0.50-0.90 | 0.008* | 0.68 | 0.51-0.91 | 0.010* | 0.65 | 0.49-0.87 | 0.004* | 0.66 | 0.49-0.89 | 0.005* | 0.66 | 0.49-0.89 | 0.005 |
| Underweight | 0.64 | 0.47-0.89 | <0.001** | 0.74 | 0.54-1.01 | 0.055 | 0.80 | 0.59-1.10 | 0.169 | 0.74 | 0.54-1.01 | 0.056 | 0.72 | 0.53-0.99 | 0.042 | 0.78 | 0.58-1.07 | 0.125* |
| Nutrition education (yes) | Ref. | | | | | | | | | | | | | | | | | |
| No | 1.72 | 1.30-2.28 | <0.001** | 1.08 | 1.27-2.22 | <0.001** | 1.84 | 1.40-2.42 | <0.001** | 1.63 | 1.23-2.14 | 0.001* | 1.60 | 1.22-2.12 | 0.001 | 1.65 | 1.25-2.18 | <0.001 |
| Nutrition knowledge (high) | Ref. | | | | | | | | | | | | | | | | | |
| Medium | 1.60 | 1.15-2.23 | 0.005* | 1.68 | 1.21-2.32 | 0.002* | 1.43 | 1.03-1.98 | 0.033* | 1.62 | 1.17-2.25 | 0.003* | 1.57 | 1.13-2.17 | 0.007* | 1.48 | 1.07-2.05 | 0.018* |
| Low | 2.31 | 1.71-3.14 | <0.001** | 2.05 | 1.52-2.77 | <0.001** | 1.76 | 1.30-2.37 | <0.001** | 2.15 | 1.59-2.90 | <0.001** | 2.22 | 1.64-3.00 | <0.001** | 1.86 | 1.38-2.51 | <0.001** |

college students was at a low level. This finding is similar to that of a much smaller study undertaken by Yan et al (24) among college students (medical and non-medical), which revealed that these students also had a low level of NL. Based on these findings, they recommended the acquisition of nutrition information not only from the classroom but also from additional channels. Low NL levels among non-medical students may be due to the insufficiency of health care providers in college, which could lead to poor dietary choices and a greater incidence of non-communicable diseases related to nutrition (25,26). Students' lack of nutrition knowledge can be addressed by the application of advanced information technologies to make nutrition information more accessible (27). Our results revealed that exercise, BMI, nutrition education, and nutrition knowledge are significantly associated with different NL levels. Therefore, we should also attend to the influence of exercise, BMI, nutrition education, and nutrition knowledge.

With regard to exercise and BMI, these results correspond to the findings of previous studies on adolescents (12,28). It should be noted that the NL level of non-medical students was lower than that of medical students, which relates to health literacy (24) because medical and health science students are taught about nutrition (29). The proportion of students who actively exercised with high NL levels was higher than that of students who were inactive, suggesting that students who exercised had better NL. This is similar to the results of Xu et al (6), who found that adolescents who exercised had higher NL level. However, the association between the BMI of non-medical college students and different levels of NL found in this study conflicts with the results of prior studies (30). Non-medical college students with different NL levels have different food consumption patterns, which leads to them having different BMIs. Therefore, exercise and good nutrition status are necessary behavioral factors in promoting health status and disease prevention (31), which corresponds to our finding that high levels of nutrition knowledge and receipt of nutrition education were associated with a greater total NL score. A previous study suggests that nutrition education may play an important role in improving knowledge-based nutrition and promoting healthy eating behaviors (32). Some studies have revealed that improving nutrition knowledge and skills through the development of NL can contribute to solving nutrition problems (12,30). Thus, NL is an important means of strengthening fundamental nutrition education among non-medical students.

By analyzing the five component skills (NL1 to 5) covering three dimensions of NL skills, we found that exercise, BMI, nutrition education, and nutrition knowledge were the influencing factors of NL1 and NL5 (access and decision-making skills). The possible justification maybe is that non-medical students who received nutrition education and had high levels of nutrition knowledge had higher levels of access and decision-making skills, affecting their BMI or nutrition status and their motivation to exercise. The access skill is the primary NL skill and component of the functional dimension of NL, while the decision-making skill is part of the critical dimension of NL (8). Related studies have found relationships between the

functional dimension of NL and being overweight or obese (32,33). Doustmohammadian et al (8) explained that access to food-related information is an external determinant of NL. However, previous research revealed that the critical dimension of NL, including decision-making skills, was not associated with being underweight or overweight/obese (11). Moreover, adolescents may not have critical skills, as their dietary habits are taught to them through healthy eating educational programs (34). Furthermore, if people lack nutrition knowledge, they will be unable to use their decision-making skills to make informed decisions (35). Some studies have found that high NL leads to healthy diet and physical health and that NL significantly influences nutrition decision-making (36). Students who exercise and have good nutrition status need more opportunities to receive nutrition education and nutrition knowledge; therefore, they can gain access to nutrition information and use decision-making skills to improve their NL.

With regard to the component skills NL3 and NL4, students with normal BMI, who had received nutrition education and had high levels of nutrition knowledge, were more likely to possess a high level of interactive and media literacy skills. A previous study found that high interactive skills are related to enhanced diet quality (37) because interactive skills help to estimate the authenticity and value of nutrition information (8). For this reason, it is critically important to implement intervention strategies that can improve NL. Furthermore, students were found to interact successfully through various forms of communication to access nutrition information; this provided them with a foundation for obtaining nutrition information in daily life and developing the quality of their diets (35). Additionally, it seems likely that the influencing factor with the most effect on communication skill is the interactive skill, because both these skills are components of the interactive NL dimension. Interactive skills are the cognitive and interpersonal skills needed to apply nutrition information to improve one's lifestyle (37). Nutrition information is provided through health programs at college. Furthermore, the ability to understand and apply information such as dietary guidelines, labels, and menus helped the students to increase their interactive and media literacy skills. Improving this skill could affect motivation or behavior change.

Finally, this study found that the component skill NL2 (application skill) was influenced by NL1 and three to five of the component skills of NL, except for the educational level of the student. Application skill is a component of functional NL and refers to applying healthy eating behaviors (37). Based on the results of a prior study, freshmen students have just finished their college entrance examinations, which require intense study, and they need to focus on learning, while high-grade students have adapted to college life and can apply nutrition concepts and improve them by incorporating their own knowledge. Some studies have suggested integrating diet quality patterns from the web into the daily lives of individuals to improve nutrition status (38). However, the application of nutrition information received via a variety of media channels may be challenging for non-medical college students because of their unique non-medical college environments.

This study is the first cross-sectional study of high-grade vocational non-medical college students in ethnic minority areas in Guangxi, China. One of the strengths of the current study is the large sample size and precise effect estimates adjusted for potential confounders. Nevertheless, this study has some limitations that should be declared. Some information bias may result from the data collection process (self-report survey). Our results are not representative of all vocational college students in Guangxi, China. Additionally, due to the cross-sectional nature of the study, causal inferences cannot be made.

## Conclusion

Based on the findings of this study, the NL level of the high-grade vocational non-college students in ethnic minority areas in Guangxi was high. Exercise, BMI, nutrition education, and nutrition knowledge were influencing factors for NL and its five sub-component skills among vocational non-college students. Interestingly, this study reveals educational level as an influencing factor for the application sub-component of NL. Specific measures (specific questionnaire or standard questionnaire each component skills of NL) are required for assessing component skills of NL, which can be applied in future strategies. Our evidence suggests that nutrition education should be provided to vocational non-college students, concentrating on freshmen students. Appropriate nutrition education channels such as the internet, mobile devices, and social media should be used to improve information access for vocational non-college students so that they can improve their NL.

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### Authors' Contribution

**Conceptualization:** Thidarat Somdee.
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### Competing Interests

The authors declare that they have no conflict of interests associated with the material presented in this paper.

### Ethical Approval

The study was approved by the Ethics Committee of Maha Sarakham University (Date and Number: 31012024/ECMSU048-570). All participants took part in the study voluntarily and gave informed

consent, as required by our Ethics Committee.

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