

Digital health literacy levels and influencing factors among college medical students in China during post-COVID-19 pandemic

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ABSTRACT

Digital health literacy (DHL) is the ability to identify, understand, and use health information from digital sources. DHL may differ among individuals due to many factors. Therefore, this cross-sectional study investigated DHL and its associated factors among 1065 vocational college medical students in Sichuan, China, after the COVID-19 pandemic. Their demographic data were collected using a DHL questionnaire, and their health information seeking was rated. Multivariate logistic regression was used to evaluate how different factors influenced DHL. The participants had a median age of 19 years, and 82.90% were female. Among the participants, 52.26% had high DHL. Participants' DHL was significantly influenced by age (adjusted odds ratio [AOR] = 0.83, $p = 0.037$), year of study (sophomore [AOR = 2.68, $p < 0.001$], junior [AOR = 1.82, $p < 0.001$], major (nursing [AOR = 0.63, $p = 0.006$], rehabilitation [AOR = 0.64, $p = 0.023$], medicine and food or education and sports [AOR = 0.60, $p < 0.001$]), having had a family member or friend infected with COVID-19 (AOR = 1.64, $p = 0.022$), health education (AOR = 2.00, $p = 0.002$), and health information seeking (AOR = 2.33, $p < 0.001$). Our findings indicate that the DHL of some vocational college medical students remains low. Therefore, improving these skills requires teaching strategies and curricula that encourage students to effectively locate and evaluate digital sources.

Keywords:

digital health literacy; influencing factors; vocational college medical students

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INTRODUCTION

The COVID-19 pandemic affected people's quality of life and interpersonal interactions. It increased health concerns among the population.¹ The internet became the primary source of health-related information as people searched for news about the progress of the COVID-19 pandemic and its health management implications, and digital health technologies became widespread.^{2,3} Social media platforms (e.g., Facebook, YouTube, Instagram, and TikTok) became a key means of accessing information.⁴ However, the potential disadvantages of internet access were invalid information and personal interpretation of information, which have implications for health management.⁵ As the internet becomes increasingly relevant, digital health literacy (DHL; also called eHealth literacy) skills are becoming vital.^{6,7} The DHL model proposed by van der Vaart and Drossaert⁸ comprises five subscales: searching for information, adding self-generated content, evaluating reliability, determining relevance, and handling information. Previous studies have revealed the focus on DHL during the COVID-19 pandemic and its association with sociodemographic and preventive behaviors.⁹⁻¹²

There were 16.709 million vocational college medical students in China during the COVID-19 pandemic. Medical students are a necessary component of China's healthcare system. Vocational college medical students exhibit particular characteristics and experience specific environments as they transition from adolescence to adulthood.¹³ Since they will become health professionals, they should be proficient in DHL to ensure the successful digital transformation of healthcare.¹⁴ However, a previous study revealed that vocational college medical students had low DHL.¹⁵ During the COVID-19 pandemic, 41.7% of Chinese

college students had adequate DHL, and Google, Bing, and Yahoo (92.0%) were the primary search engines for finding COVID-19 information.^{16,17}

While previous studies have emphasized the factors influencing DHL during the COVID-19 pandemic, data on these factors among vocational college medical students after the COVID-19 pandemic remain limited. Therefore, these factors and their associations should be studied to develop curricula or interventions for this unique population.¹⁸ This study aimed to determine whether the backgrounds of vocational college medical students in Sichuan, China, influenced their DHL. Our findings may be helpful for curriculum development or health education for this population and to guide national health policies for college students during future pandemics.

METHODOLOGY

Participants

This cross-sectional study was conducted between February and August 2024. Of the 9390 students aged 18–25 years at the Sichuan Vocational College of Health and Rehabilitation in Sichuan, China, 1062 participated. The Sichuan Vocational College of Health and Rehabilitation is Sichuan's largest medical polytechnic college. The target sample size was estimated using Daniel's formula,¹⁹ considering a prevalence of 52.6%,¹⁷ a precision of 3%, and a confidence level of 95%. The minimum sample size was estimated to be 956. Considering a dropout rate of 10, the minimum required sample size was increased to 1062. The participants were stratified by random sampling of five selected disciplines: nursing, rehabilitation, medicine and food, education and sports, and clinical medical technology.

Exposure variables

The exposure variables were 12 demographic characteristics: age, gender,

year of study, major, residence, family monthly income, having had family members or friends infected with COVID-19, health education, smoking, alcohol drinking, being overweight, and health information seeking.

The year of study was classified into freshmen, sophomore, and junior. The major was divided into nursing, rehabilitation, medicine and food, education and sports, and clinical medical technology. Having had family members or friends infected with COVID-19, health education, smoking, alcohol drinking, and being overweight were binary (yes/no). Our questionnaire asked about the health information seeking from different sources, rated from 1 (never) to 4 (often).

Assessment of outcome variables

A self-reported DHL questionnaire was developed based on van der Vaart et al.⁸ This questionnaire comprised 25 items measuring five subdomains: (1) searching information, (2) adding self-generated content, (3) evaluating reliability, (4) determining relevance, and (5) handling information (Cronbach's $\alpha = 0.91$). The total DHL score was the sum of the scores for all items (ranging from 5 to 125). A median score of <70 was considered inadequate (low level), whereas a median score of ≥ 70 was considered adequate (high level). For each domain, a score of at least 16 was required to be considered adequate.

Statistical methods

The studied variables are presented using descriptive statistics, including the frequency and percentage, except for age, which is reported as the median, and health information seeking, which is reported as the mean $\pm$ standard deviation (SD). The normality of their distribution was assessed using the Kolmogorov–Smirnov test; our data were not normally distributed. The DHL scores were computed; those above the median were classified as high, and those below the median were classified as

low. The associations between participants' characteristics and DHL were examined using chi-squared tests. Multivariate logistic regression was used to identify associations while controlling for the effects of other variables. A $p < 0.05$ was considered statistically significant. Data analyses were performed using SPSS (version 25.0; IBM Corp., Armonk, NY, USA).

Ethical approval

This study was approved by the Ethics Committee of Mahasarakham University (ECMSU523-543/2023). All participants took part in this study voluntarily and provided informed consent, as required by our ethics committee.

RESULTS

Participant characteristics

All participants responded to the study questionnaire. The characteristics of the 1062 vocational college medical students who participated in this study are shown in Table 1. Their median age was 19 years, 182 (17.10%) were male, and 880 (82.90%) were female. Among the participants, 36.00% were freshmen, and 35.10% majored in nursing. In addition, 78.20% were from rural areas, 87.90% had a family member or friend who had suffered from a COVID-19 infection, and 89.70% had taken health education courses in college. The median overall DHL score was 70, with 47.74% having a DHL score below the median (inadequate DHL) and 52.26% having a DHL score above the median (high overall DHL). The five DHL subdomains had median scores of 16, 12, 14, 15, and 13 points, respectively. Overall DHL was significantly influenced by year of study ($p = 0.000$), major ($p = 0.002$), having had a family member infected with COVID-19 ($p = 0.001$), and health education ($p = 0.000$).

Table 1. Demographic characteristics and distribution of DHL levels (n = 1062)

Variable	All	Total DHL		<i>p</i> -value
	N (%)	Low (n = 507)	High (n = 555)	
Gender				0.871
Male	182(17.10)	88(17.40)	94(16.90)	
Female	880(82.90)	419(82.60)	461(83.10)	
Year of study				<0.001
Freshmen	383(36.00)	158(31.20)	225(40.50)	
Sophomore	350(33.00)	160(31.60)	190(34.20)	
Junior	329(31.00)	189(37.30)	140(25.20)	
Major				0.002
Nursing	372(35.10)	189(37.30)	183(33.00)	
Rehabilitation	180(16.90)	93(18.30)	87(15.70)	
Medicine and food, or education and sports	209(19.70)	109(21.50)	100(18.00)	
Clinical medical technology	301(28.30)	116(22.90)	185(33.30)	
Residence				0.766
Urban	232 (21.80)	113(22.30)	119(21.40)	
Rural	830(78.20)	394(77.70)	436(78.60)	
Family monthly income				0.332
<5000 yuan	439(41.30)	221(43.60)	218(39.30)	
5000–9999 yuan	492(46.30)	228(45.00)	264(47.60)	
≥10000 yuan	131(12.30)	58(11.40)	73(13.20)	
Having had a family member or friend infected with COVID-19				0.001
Yes	838(87.90)	378(74.60)	460(82.90)	
No	224(21.10)	219(25.40)	95(17.10)	
Health education				<0.001
Yes	953(89.70)	437(86.20)	516(93.00)	
No	109(10.30)	70(13.80)	39(7.00)	
Smoking				0.482
Yes	53(5.00)	28(5.50)	25(4.50)	
No	1009(95.00)	479(94.50)	530(95.50)	
Alcohol drinking				0.791
Yes	60 (5.60)	30(5.90)	30(5.40)	
No	1002(94.40)	477(94.10)	525(94.60)	
Being overweight				0.756
Yes	43(4.00)	22(4.30)	21(3.80)	
No	1019(96.00)	485(95.70)	534(96.20)	

In addition, our study explored the frequency of health and related information searches from various online sources (Table 2). Our results revealed that a substantial number of students often sought information through social media (Douyin,

Weibo, and Weixin; 4.39 ± 0.87), search engines (Baidu, Bing, and Sougou; 4.13 ± 0.85), and Wikipedia and other online encyclopedias (3.74 ± 0.93). Furthermore, differences in overall DHL scores influenced health information seeking ($p =$

0.000; data not shown), with students who had a mean of 3.67 ± 0.37 for health

information seeking behavior exhibiting the highest DHL.

Table 2. Health and related information seeking on the Internet with corresponding means

Characteristics	Mean $\pm$ SD
Search engines (Baidu, Bing, and Sougou)	4.13 ± 0.85
Websites of public bodies (NCOC and provincial health departments)	3.62 ± 0.96
Wikipedia and other online encyclopedias	3.74 ± 0.93
Social media (Douyin, Weibo, and Weixin)	4.39 ± 0.87
BiliBili	3.57 ± 1.03
Blogs on health topics	3.46 ± 0.94
Community guidebooks	3.30 ± 0.90
Health portals	3.31 ± 0.92
Websites of doctors/pharmaceutical companies	3.28 ± 0.89
News portals (e.g., newspapers and TV stations)	3.35 ± 0.89

Factors influencing the DHL status

Odds ratios were calculated for factors associated with DHL after adjusting for confounding variables (Table 3). Higher overall DHL scores were associated with age (AOR = 0.83, 95% CI = 0.70–0.99), sophomore study year (AOR = 2.68, 95% CI = 1.79–4.00), junior study year (AOR = 1.82, 95% CI = 1.31–2.53), nursing major (AOR = 0.63, 95% CI = 0.45–0.87), rehabilitation major (AOR = 0.64, 95% CI = 0.43–0.94), medicine and food or education and sports major (AOR = 0.60, 95% CI = 0.41–0.86), those who had no family members infected with COVID-19 (AOR = 1.64, 95% CI = 1.20–2.24), those who had not received health education (AOR = 2.00, 95% CI = 1.29–3.07), and those with a higher frequency of health information seeking (AOR = 2.53, 95% CI = 1.76–3.63).

Regarding the DHL subdomains, our results indicated that grade, major, having had a family member or friend infected with COVID-19, health education, and health information seeking were significantly associated with the subdomains of searching information, adding self-generated content, evaluating reliability, determining relevance, and handling information subscales. Interestingly, younger students were less

likely to report a high level of information searching (AOR = 0.82, 95% CI = 0.69–0.97), adding self-generated content (AOR = 0.84, 95% CI = 0.71–0.99), determining relevance (AOR = 0.82, 95% CI = 0.69–0.98), and handling information (AOR = 0.83, 95% CI = 0.70–0.99).

DISCUSSION

Our study is the first to investigate the factors influencing DHL in vocational college medical students after the COVID-19 pandemic in Sichuan, China. It found that most participants had a high overall DHL. Year of study, academic major, having had a family member or friend infected with COVID-19, health education, and health information seeking were independent factors influencing overall DHL and the DHL subdomains (searching information, adding self-generated content, evaluating reliability, determining relevance, and handling information). Therefore, our results are meaningful for awareness of future pandemics.

We found that most medical college students had a high overall DHL. This finding is consistent with Tran,¹⁸ who reported high DHL scores for nursing students and revealed that nursing students with a better ability to pay for medication

had higher DHL scores. However, other studies have reported that nursing and medical students had low DHL scores.^{12,20-22} Therefore, medical students must develop appropriate DHL skills. As future healthcare providers, they must be considered a reliable health information source and educate their patients on health issues. Additionally, some research suggests that DHL skills should be integrated into medical and health science curricula.^{23,24} During the COVID-19 pandemic, the Government of China used social media and internet news channels to relay COVID-19-related information and encourage health behaviors.²⁵ Nguyen et al.²⁶ indicated that higher health literacy was related to lower awareness of COVID-19. A substantial proportion of our participants had low DHL skills (47.74%); therefore, adjusted interventions are needed to raise their DHL. DHL is key to managing healthcare resources and is thus crucial for medical and healthcare personnel.²⁷

Our study found that DHL first increased with the year of study and then decreased. This observation implies that college education lacks instruction on DHL. Previous studies have indicated that the digital aspect is vital for healthcare workers as they may influence their patients' DHL.^{28,29} In addition, the academic major influenced overall DHL scores, the reasons for which remain unclear and should be investigated. Future research may also conduct qualitative studies with students across different majors or analyze curriculum differences. We also found that participants who had family members or friends infected with COVID-19 had higher overall DHL scores than those who did not have people close to them infected with COVID-19. Moreover, participants who received health education had higher DHL scores than those who did not.

The multiple logistic regression analysis revealed that the year of study, academic major, having had a family

member infected with COVID-19, health education, and health information seeking behavior influenced overall DHL and the DHL subdomains: searching information, adding self-generated content, evaluating reliability, determining relevance, and handling information. Nevertheless, our results disagree with previous studies regarding the year of study.^{30, 31} Previous studies have shown that the year of study significantly increased DHL.³¹ However, our study found that DHL first increased with the year of study but then decreased, suggesting that this is a risk factor for overall DHL and its subdomains. Indeed, some studies have highlighted that younger people are more likely to use mobile health apps than older individuals.³²

The majors included in our study were nursing, rehabilitation, medicine and food, education and sports, and clinical medical technology. Students taking clinical medical technology had higher overall DHL scores than those taking other majors, which may be due to its curriculum, which develops a better understanding of DHL and its subdomains. Therefore, the major is a protective factor, especially for nursing students.

Furthermore, having had a family member or friend infected with COVID-19 correlated positively with overall DHL and its subdomains (especially handling information), possibly due to having a loved one experiencing an infection because the Government of China implemented family isolation measures throughout the COVID-19 pandemic. Moreover, the Government of China published information and guidelines for controlling and preventing COVID-19.^{9,33} One study in Japan identified family members as information sources,³⁴ indicating the importance of having a family with an enhanced DHL level, especially for handling information. In addition, the positive association between DHL and health education has been confirmed by several studies,^{35,36} including

ours. Therefore, even during the COVID-19 pandemic, health education is related to healthy behaviors through DHL. Indeed, DHL encouraged individuals to search for health information, follow healthy behaviors, influence public behavior, and ultimately stop the COVID-19 pandemic.³²

We found that health information seeking was closely related to DHL, particularly in the handling information subdomain. Information handling refers to managing data vital for medical students because they can make assessments and accurate judgments about health information.¹⁸ Interestingly, most participants relied on social media (Douyin, Weibo, and Weixin) to obtain health information. Therefore, DHL is crucial for strengthening the ability to find, understand, and evaluate health information from electronic platforms during future pandemics. However, we obtained different results regarding the evaluating reliability subdomain. We found that age was not related to evaluating reliability, disagreeing with previous studies^{3,37,36} that reported a negative association between age and DHL.³ Dadaczynski et al.³⁶ argued that students with higher DHL in the evaluating information reliability subdomain accessed the official websites of public bodies and agencies more often and turned less frequently to sources such as support communities, including forums and social media. In contrast, the vocational college medical students who participated in our study generally accessed information through social media (Douyin, Weibo, and Weixin). Therefore, it is crucial to implement intervention strategies to improve DHL, focusing on media literacy workshops or integrating social media analysis into the curriculum.

Finally, since this study was conducted after the COVID-19 pandemic in China, it has identified important sources for searching information during a pandemic, and its results may serve as a guide for enhancing DHL and promoting preventive behaviors in preparation for future pandemics.

In conclusion, the overall DHL of vocational college medical students was relatively high. More advanced students, those majoring in clinical medical technology, those having had a family member or friend infected with COVID-19, those receiving health education, and those exhibiting interest in health information seeking had a higher overall DHL and higher scores in the five DHL subdomains. However, this weighted sample may not represent all vocational college medical students in Sichuan, China. Moreover, since this study was not longitudinal, it could not confirm a causal association between independent and dependent factors.

RECOMMENDATIONS

DHL is vital for vocational college medical students who will become healthcare workers. Therefore, the curriculum should provide training adapted to specific factors to improve students' ability to find and use online information to enhance digital health services. Our study highlighted that seeking health information (especially on social media) is a preventive factor. Digital skills, health literacy against misinformation, and awareness of digital health services are needed to enhance DHL. Therefore, educational institutions should teach DHL skills.

Table 3. Multiple logistic regression analysis for the overall DHL level and five subscales of the participants (n = 1062)

Independent variable	Total DHL			Searching information			Adding self-generated content			Evaluating reliability			Determining relevance			Handling information		
	OR _{adj}	95%CI	p-value	OR _{adj}	95%CI	p-value	OR _{adj}	95%CI	p-value	OR _{adj}	95%CI	p-value	OR _{adj}	95%CI	p-value	OR _{adj}	95%CI	p-value
Age	0.83	0.70–0.99	0.037*	0.82	0.69–0.97	0.023*	0.84	0.71–0.99	0.048*	-	-	-	0.82	0.69–0.98	0.030*	0.83	0.70–0.99	0.033*
Year of study (Freshmen)	Ref.																	
Sophomore	2.68	1.79–4.00	<0.001**	2.57	1.72–3.84	<0.001**	2.61	1.75–3.89	<0.001**	2.32	1.56–3.46	<0.001**	2.61	1.75–3.89	<0.001**	2.72	1.82–4.06	<0.001**
Junior	1.82	1.31–2.53	<0.001**	1.83	1.31–2.54	<0.001**	1.81	1.30–2.51	<0.001**	1.74	1.25–2.42	<0.001**	1.84	1.32–2.55	<0.001**	1.84	1.32–2.55	<0.001**
Major (Clinical medical technology)	Ref.																	
Nursing	0.63	0.45–0.87	0.006*	0.65	0.47–0.91	0.011*	0.64	0.46–0.89	0.008*	0.63	0.46–0.88	0.006*	0.68	0.48–0.93	0.016*	0.66	0.47–0.92	0.014*
Rehabilitation	0.64	0.43–0.94	0.023*	0.63	0.43–0.93	0.021*	0.63	0.43–0.92	0.018*	0.62	0.42–0.92	0.016*	0.65	0.44–0.95	0.028*	0.64	0.43–0.94	0.023*
Medicine and food or education and sports	0.60	0.41–0.86	<0.001**	0.60	0.41–0.87	0.007*	0.63	0.44–0.91	0.014*	0.61	0.42–0.88	0.008*	0.61	0.42–0.89	0.009*	0.62	0.43–0.90	0.012*
Family member infected with COVID-19 (Yes)	Ref.																	
No	1.64	1.20–2.24	0.022*	1.62	1.18–2.21	0.003*	1.61	1.18–2.20	0.003*	1.60	1.17–2.18	0.003*	1.59	1.17–2.17	0.003*	1.68	1.23–2.30	0.001*
Health education (Yes)	Ref.																	
No	2.00	1.29–3.07	0.002*	2.34	1.51–3.63	<0.001**	2.10	1.36–3.24	0.001*	2.59	1.65–4.01	0.001*	1.94	1.26–2.99	0.003*	1.95	1.26–3.00	0.003*
Health information seeking	2.53	1.76–3.63	<0.001**	2.48	1.76–3.55	<0.001**	2.43	1.70–3.48	<0.001**	2.47	1.72–3.54	<0.001**	2.46	1.72–3.52	<0.001**	2.59	1.80–3.72	<0.001**

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CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

REFERENCES

1. Patil U, Kostareva U, Hadley M, Manganello JA, Okan O, Dadaczynski K, et al. Health literacy, digital health literacy, and COVID-19 pandemic attitudes and behaviors in US college students: implications for interventions. *Int J Environ Res Public Health*. 2021;18(6):3301. doi:10.3390/ijerph18063301
2. Syed Abdul S, Ramaswamy M, Fernandez-Luque L, John O, Pitti T, Parashar B. The pandemic, infodemic, and people's resilience in India: viewpoint. *JMIR Public Health Surveill*. 2021;7:e31645. doi:10.2196/31645
3. Dadaczynski K, Okan O, Messer M, Leung AYM, Rosário R., Darlington E, et al. Digital health literacy and web-based information-seeking behaviors of university students in Germany during the COVID-19 pandemic: cross-sectional survey study. *J Med Internet Res*. 2021;23(1):e24097. doi: 10.2196/24097
4. Kor PPK, Leung AYM, Parial LL, Wong EML, Dadaczynski K, Okan O, et al. Are people with chronic diseases satisfied with the online health information related to COVID-19 during the pandemic? *J Nurs Scholarsh*. 2021;53(1):75–86. doi: 10.1111/jnu.12616
5. Garavand A, Ameri F, Salehi F, Talebi AH, Karbasi Z, Sabahi A. A systematic review of health management mobile applications in COVID-19 pandemic: features, advantages, and disadvantages. *BioMed Res Int*. 2024; 2024:8814869. doi: 10.1155/2024/8814869
6. Smith B, Magnani JW. New technologies, new disparities: the inter-section of electronic health and digital health literacy. *Int J Cardiology*. 2019;292:280–282. doi:10.1016/j.ijcard.2019.05.066
7. Yang K, Hu Y, Qi H. Digital health literacy: bibliometric analysis. *J Med Internet Res*. 2022;24(7):e35816. doi: 10.2196/35816
8. Van der Vaart R, Drossaert, C. Development of the Digital Health Literacy Instrument: Measuring a Broad Spectrum of Health 1.0 and Health 2.0 Skills. *J Med Internet Res*. 2017;19(1):e27. doi: 10.2196/jmir.6709
9. Li S, Cui G, Kaminga AC, Cheng S, Xu H. Associations between health literacy, ehealth literacy, and covid19-related health behaviors among chinese college students: Cross-sectional online study. *J Med Internet Res*. 2021;23: e25600. doi: 10.2196/25600 PMID: 33822734
10. Amoah PA, Leung AYM, Parial LL, Poon ACY, Tong HH, Ng WI, et al. Digital Health Literacy and Health-Related Well-Being Amid the COVID-19 Pandemic: The Role of Socioeconomic Status Among University Students in Hong Kong and Macao. *Asia Pac J Public Health*. 2021; 33(5):613-616. doi: 10.1177/10105395211012230
11. Bak CK, Krammer JØ, Dadaczynski K, Orkan O, von Seelen J, Prinds C, et al. Digital Health Literacy and Information-Seeking Behavior among University College Students during the COVID-19 Pandemic: A Cross-Sectional Study from Denmark. *Int J*

- Environ Res Public Health. 2022; 19(6):3676. doi: 10.3390/ijerph 19063676.
12. Zakar R, Iqbal S, Zakar M, Fischer F. COVID-19 and health information seeking behavior: digital health literacy survey amongst university students in Pakistan. *Int J Environ Public Health*. 2021;18(8):4009-4029. doi:10.3390/ijerph18084009.
 13. Mei A, Gao D, Jiang J, Qiao T, Wang F, Li D. The medical education systems in China and Thailand: a comparative study. *Health Sci Reports*. 2022;5(6): e826. doi: 10.1002/hsr2.826.
 14. European Medical Students' Association (EMSA). Digital Health in the Medical Curriculum: Addressing the Needs of the Future Health Workforce. Belgium: EMSA. [Cited 2024 Sep 5]. Available from: https://emsa-europe.eu/wp-content/uploads/2021/06/Policy2019-04-Digital-Health-in-the-Medical-Curriculum_-_Addressing-theNeeds-of-the-Future-Health-Workforce.pdf
 15. Yang S, Luo Y, Chiang C. The associations among individual factors, eHealth literacy, and health-promoting lifestyles among college students. *J Med Internet Res*. 2017;19(1):e15. doi: 10.2196/jmir.5964
 16. Li D, Zou L, Zhang Z, Zhang P, Zhang J, Fu W, et al. The Psychological Effect of COVID-19 on Home-Quarantined Nursing Students in China. *Front*. 2021;12:652296. doi: 10.3389/fpsy.2021.652296
 17. Htay MNN, Parial LL, Tolabing MC, Dadaczynski K, Okan O, Leung AYM, et al. Digital health literacy, online information-seeking behaviour, and satisfaction of Covid-19 information among the university students of east and south-east asia. *PLoS One*. 2022;17:e0266276. doi: 10.1371/journal.pone.0266276
 18. Schulenkorf T, Krah V, Dadaczynski K, Okan O. Addressing health literacy in schools in Germany: Concept analysis of the mandatory digital and media literacy school curriculum. *Front Public Health*. 2021;9:687389. doi: 10.3389/fpubh.2021.687389
 19. Daniel WW. *Biostatistics: A Foundation for Analysis in the Health Sciences*. 7th Edition. New York: John Wiley & Sons. 1999.
 20. Tran HTT, Nguyen MH, Pham TTM, Kim GB, Nguyen HT, Nguyen NM, et al., Predictors of eHealth literacy and its associations with preventive behaviors, fear of COVID-19, anxiety, and depression among undergraduate nursing students: A cross-sectional survey. *Int J Environ Res Public Health*. 2022;19(7):3766. doi: 10.3390/ijerph 19073766
 21. Eun-Kyoung Lee O, Kim DH, Ah Beum K. Factors affecting information and communication technology use and eHealth literacy among older adults in the US and South Korea. *Edu Gerontology*. 2020;46(9):575–586. doi: 10.1080/03601277.2020.1790162
 22. Nguyen LH, Le TBT. E-Health literacy of medical students at a university in Central Vietnam. *Indian J Public Health Res Develop*. 2020;11(2):1299–304. doi: 10.37506/v11/i2/2020/ijphrd/195001
 23. Park H, Lee E. Self-reported eHealth literacy among undergraduate nursing students in South Korea: a pilot study. *Nurse Edu Today*. 2015;35(2):408-413. doi: 10.1016/j.nedt.2014.10.022
 24. Tubaishat A, Habiballah L. eHealth literacy among undergraduate nursing students. *Nurse Edu Today*. 2016; 42:47-52. doi: 10.1016/j.nedt.2016.04.003
 25. Niu Z, Wang T, Hu P, Mei J, Tang Z. Chinese public's engagement in preventive and intervening health behaviors during the early breakout of COVID-19: Cross-sectional study. *J Med Internet Res*. 2020;22(8):e19995. doi: 10.2196/19995.
 26. Nguyen HT, Do BN, Pham KM, Kim GB, Dam HTB, Nguyen TT, et al. Fear

- of COVID-19 scale-associations of its scores with health literacy and health-related behaviors among medical students. *Int J Environ Res Public Health*. 2020;17(11):4164. doi: 10.3390/ijerph17114164
27. Dheda K, Gumbo T, Maartens G, Dooley KE, Murray M, Furin J., et al. The lancet respiratory medicine commission: 2019 update: Epidemiology, pathogenesis, transmission, diagnosis, and management of multidrug-resistant and incurable tuberculosis. *Lancet Respir Med*. 2019;7:820–826. doi: 10.1016/S2213-2600 (19)30263-2
 28. Kayser L, Nøhr C, Bertelsen P, Botin L, Villumsen S, Showell C, et al. Theory and practice in digital behaviour change: a matrix framework for the co-production of digital services that engage, empower and emancipate marginalised people living with complex and chronic conditions. *Informatics. Multidisciplinary Dig Pub Institute*. 2018;5(4):41. doi: 10.3390/informatics5040041
 29. van Houwelingen CT, Moerman AH, Ettema RG, Kort HS, Ten Cate O. Competencies required for nursing telehealth activities: a Delphi-study. *Nurse Educ Today*. 2016;39:50–62. doi: 10.1016/j.nedt.2015.12.025
 30. Zhang Y, Zhang F, Hu P, Huang W, Lu L, Bai R, et al. Exploring health literacy in medical university students of chongqing, china: a cross-sectional study. *Plos One*. 2016;11(4):e0152547. doi: 10.1371/journal.pone.0152547
 31. Estrela M, Semedo G, Roque F, Ferreira PL, Herdeiro MT. Sociodemographic determinants of digital health literacy: a systematic review and meta-analysis. *Int J Med Info*. 2023;177:105124. doi: 10.1016/j.ijmedinf.2023.105124
 32. Ameri F, Dastani M, Sabahi A, Hooshangi F, Rahimkarimi M, Rajabi E, et al. The role of E-health literacy in preventive behaviors for COVID-19: a systematic review. *J Health Literacy*. 2022;6(4):88–97. doi: 10.22038/jhl.202161581.1241
 33. Bol N, Helberger N, Weert J.C. Differences in mobile health app use: a source of new digital inequalities? *Inform. Society*. 2018;34(3):83–93. doi: 10.1080/01972243.2018.1438550
 34. Inoue M, Shimoura K, Nagai-Tanima M, Aoyama T. The relationship between information sources, health literacy, and COVID-19 knowledge in the COVID-19 infodemic: Cross-sectional online study in Japan. *J Med Internet Res*. 2022;24(7):238332. doi: 10.2196/38332
 35. Rosário R, Araújo SB, Silva A, Barros S. Roles of the interaction with children and families in mediating the association between digital health literacy and wellbeing of early childhood teachers in Portugal: A cross sectional study. *PLoS One*. 2023; 18(9):e0291748. doi: 10.1371/journal.pone.0291748
 36. Kim J, Livingston MA, Jin B, Watts M, Hwang J. Fundamentals of digital health literacy: A scoping review of identifying core competencies to use in practice. *Adult Learning*. 2023;35(3): 131-142. doi: 10.1177/10451595231178298
 37. Chun H, Park E, Choi S, Yoon H, Okan O, Dadaczynski K. Validating the Digital Health Literacy Instrument in Relation to Covid-19 Information (Covid-Dhl-K) among South Korean Undergraduates. *Int J Environ Res Public Health*. 2022;19(6):3437. doi: 10.3390/ijerph19063437
 38. Morton E, Ho K, Barnes SJ, Michalak EE. Digital health literacy in bipolar disorder: International web-based survey. *JMIR Mental Health*. 2021;8(10):e29764. doi: 10.2196/29764