JOURNAL OF CLINICAL MEDICINE OF KAZAKHSTAN (E-ISSN 2313-1519)
Original Article DOI: https://doi.org/10.23950/jcmk/15791

Vaccination Literacy and Determinants of Vaccine Confidence Among University Students: Analyzing Attitudinal Barriers

Halima Abdigalimova[1], Zhanerke Bolatova[1], Zhaniya Dauletkaliyeva[1], Gaukhar Kayupova[1], Karina Nukeshtayeva[1], Aliya Takuadina[2], Nurbek Yerdessov[1], Olzhas Zhamantayev[1], Dinara Aubakirova[1]

[1]School of Public Health, Karaganda Medical University, Karaganda, Kazakhstan
[2]Department of Computer Science and Biostatistics, Karaganda Medical University, Karaganda, Kazakhstan

Received: 2024-10-29.
Accepted: 2024-12-30.

J Clin Med Kaz 2025; 22(1): 32–36

Corresponding author:
Zhanerke Bolatova.
Email: bolatovazhanerke93@gmail.com.
ORCID: 0000-0002-6392-3588.

Abstract

Introduction: Vaccination literacy plays a critical role in shaping vaccine attitudes and acceptance, especially among university students who are exposed to diverse sources of information. In Kazakhstan, limited awareness of the HPV vaccine, with only 52% of women attending gynecological clinics being informed, underscores a significant knowledge gap that demands effective communication strategies and public education. Addressing this gap has the potential to improve vaccine uptake and advance public health outcomes. This study aims to assess the level of vaccination literacy among students in Karaganda, Kazakhstan, and examine its determinants, including gender, academic field, and residence.

Methods: Using the HLS19-VAC questionnaire, we surveyed 1,327 students across different academic fields and analyzed vaccination literacy levels. A chi-square test assessed the association between literacy and demographic variables. Vaccination literacy was categorized as inadequate, problematic, adequate, or excellent.

Results: The majority of students demonstrated “adequate” or “excellent” vaccination literacy, with medical, female, and urban students exhibiting higher literacy levels. However, significant misconceptions regarding vaccine safety and side effects persisted, even among students with higher literacy. A positive association was observed between vaccination literacy and vaccine uptake, reinforcing the influence of informed literacy on health behavior.

Conclusion: The findings highlight the need for targeted educational efforts to address misconceptions and reduce literacy gaps among different demographic groups. Public health campaigns that counter vaccine myths and promote trust are essential for improving vaccine acceptance and supporting health outcomes within the university student population.

Keywords: Vaccination literacy, vaccine acceptance, university students, public health.

Introduction

Vaccination is a cornerstone of public health, reducing infectious diseases and improving well-being. It is essential for achieving herd immunity, with COVID-19 requiring vaccination rates of 78% to 89% [1]. Routine childhood vaccination has significantly contributed to the global decline in child mortality rates from 1970 to 2016, as reported by the Global Burden of Disease Study, highlighting the impact of increased vaccination coverage [2]. Vaccine hesitancy and misinformation, amplified by the COVID-19 pandemic and social media, have hindered immunization efforts, particularly among students, by reducing vaccine acceptance [3, 4]. Despite 98% of medical students acknowledging the importance of COVID-19 vaccines, 23% hesitated to receive it immediately after approval, primarily due to misinformation, perceived risks, and distrust in health authorities [5–7]. Targeted interventions improving vaccination literacy and involving trusted medical professionals can reduce misinformation and foster positive vaccine attitudes among students [7, 8]. Additionally, understanding the specific concerns and barriers faced by students can inform the development of effective strategies to

enhance vaccine acceptance [6, 9].

The relationship between health literacy and vaccination uptake is well-documented, indicating that individuals with higher health literacy are more likely to understand the importance of vaccines and, consequently, participate in vaccination programs [10; 11]. In Kazakhstan, where vaccine hesitancy has been a significant barrier to achieving herd immunity, enhancing health literacy is vital for improving vaccination rates. Lorini et al. has shown that health literacy encompasses not only the ability to read and understand health-related information but also the capacity to apply this knowledge effectively in making health decisions [11].

Aimagambetova et al. highlight the critical role of communication strategies and public education in addressing low awareness and negative perceptions of the HPV vaccine among women in Kazakhstan [12]. Issa et al. reveals that only 52% of women attending gynecological clinics were familiar with the HPV vaccine, underscoring a substantial knowledge gap requiring urgent intervention [13].

Vaccination literacy (VL) is essential for informed vaccine decisions, encompassing awareness, understanding of vaccine safety and efficacy, and the ability to critically evaluate information credibility [14; 15]. Higher vaccination literacy increases vaccine acceptance and advocacy, as evidenced by university students with better literacy showing greater willingness to receive the COVID-19 vaccine [16].

Enhancing vaccination literacy among students can reduce hesitancy and misinformation, enabling informed health decisions through educational interventions [17, 18]. University students' vulnerability to social media misinformation highlights the need to enhance vaccination literacy. In line with it, the study aims to assess the level of vaccination literacy among students in the city of Karaganda and examine the factors influencing vaccination literacy.

Materials and Methods

Participants were recruited based on the following inclusion criteria as enrollment as a student in Medical, Humanities Sciences, or Technical programs at higher educational institutions. Invitations to participate were disseminated to universities in Karaganda offering undergraduate programs in the specified fields. The invitations provided detailed information about the study objectives, the health literacy (HL) assessment tool, and the potential benefits of participation.

Three universities consented to participate and granted the research team access to their student populations. Designated university staff responsible for student engagement facilitated meetings between the research team and students. These sessions included a comprehensive briefing on the study objectives and detailed instructions for completing the questionnaire. Participants were given the option to complete the questionnaire either in paper format or electronically through a QR code linked to a Google Forms survey. Informed consent was obtained from all participants prior to their inclusion in the study.

The HLS19-VAC questionnaire is a four-item survey designed to measure adult population literacy in the field of vaccination and is part of the HLS19 health literacy measurement tools (HL) group [19]. The Local Bioethics Commission of the Medical University of Karaganda approved the study on 11 October 2022 (Protocol 1), with participants giving informed consent, receiving questionnaire instructions, and participating voluntarily with the option to withdraw at any time. The HLS19-VAC instrument has been applied in large samples across multiple countries, demonstrating its reliability and validity in diverse settings. The instrument's psychometric properties have been evaluated, confirming its suitability for assessing vaccination literacy in general adult populations [19].

Each survey question was rated on a four-point Likert scale, ranging from "very easy" to "very difficult," depending on the perceived level of difficulty. As such, the HLS19-VAC questionnaire represents a "subjective" version based on respondents' perceptions.

Vaccination literacy, as a significant indicator, can only be assessed for respondents with a complete data set for the four vaccination literacy items:

$$VL = \frac{(\text{Number of "easy" or "very easy" responses})}{4} * 100 \text{ [26].}$$

The result for vaccination literacy is expressed as a percentage and can take values of 0, 25, 50, 75, or 100. The classification thresholds for vaccination literacy are based on the following criteria: below 66.66 ("inadequate") and above 66.67 ("adequate").

To compare the distribution of categorical variables across groups, a chi-square test was conducted. This test assessed the relationship between variables and different groups. A p-value below 0.05 indicated a statistically significant difference.

Results

The survey involved 1327 students from 1st to 5th year. The largest proportion of respondents were 1st-year students (50.19%), while 2nd and 3rd-year students each accounted for 17.49%. The 4th-year students made up 12.06% of the total, and the smallest proportion of respondents were 5th-year students, at 2.71%.

The survey was conducted across three academic fields. The distribution of respondents by field was as follows: 27.16% in the humanities, 46.05% in medical fields, and 26.76% in technical fields.

The average vaccination literacy among students was 82.61 ± 29.25. A total of 265 students had "inadequate" vaccination literacy, while the majority, 1062 individuals, demonstrated an "adequate" level of vaccination literacy.

The levels of vaccination literacy within the sample are presented as follows: the "adequate" level is observed in 52% of females and 28% of males; the "inadequate" level is seen in 12.2% of females and 7.8% of males (Table 1). However, the chi-square analysis ($\chi^2 = 1.360$, $p = 0.243$) found no statistically significant relationship between gender and VL.

Table 1 Demographic Characteristics and Vaccination Literacy

Indicators/Vaccination Literacy Levels		Inadequate		Adequate		Chi-square; p-value
		n	%	n	%	
Gender	female	162	12,2	690	52,0	1,360; 0,243
	male	103	7,8	372	28,0	
Year of Study	1	111	8,4	555	41,8	22,360; 0,0001
	2	63	4,7	169	12,7	
	3	58	4,4	174	13,1	
	4	32	2,4	128	9,6	
	5	1	0,1	35	2,6	
Place of Residence	Rural area	108	8,1	397	29,9	5,123; 0,077
	Urban area	156	11,8	665	50,1	
Education Program	Humanities	92	6,9	269	20,3	22,227; 0,0001
	Medical	88	6,6	523	39,4	
	Technical	85	6,4	270	20,3	

In terms of field of study, medical students had the highest percentage of "adequate" VL (39.4%), followed by students in technical fields (20.3%) and humanities (20.3%). A chi-square analysis confirmed a statistically significant association between VL levels and academic discipline ($\chi^2 = 22.227$, $p < 0.0001$).

Place of residence also influenced VL, with 50.1% of urban students achieving “adequate” VL, compared to 29.9% of rural students. Inadequate literacy was slightly higher among urban (11.8%) than rural students (8.1%). However, chi-square test didn’t show a significant relationship between residence and VL levels ($\chi^2 = 5.123$, $p = 0.077$).

The majority of the participants, 90.7% reported receiving a vaccine within the past five years, with 73.9% demonstrating "adequate" VL and 16.8% showing "inadequate" VL, confirming a statistically significant association between VL and vaccination rates ($\chi^2 = 36.619$, $p < 0.0001$).

Participants' opinions on the effects of vaccines on the immune system also varied based on their VL. While 57.6% disagreed with the belief that vaccines weaken the immune system, 41.8% agreed. Among those with "adequate" VL, 49.3% disagreed with this statement, compared to 30.4% who agreed (Table 2). The association between VL and these opinions was found to be significant ($\chi^2 = 36.619$, $p < 0.0001$). Similarly, 39.5% of participants believed that vaccines could cause the diseases they are designed to prevent, while 59.8% disagreed. Among respondents with "adequate" VL, 29.6% agreed with this misconception, and 50.1% disagreed, showing a significant association between VL and beliefs about vaccine-caused disease ($\chi^2 = 20.191$, $p < 0.0001$). Concerns about severe side effects were expressed by 51.1% of participants, with 38.1% of those with "adequate" VL agreeing and 41.4% disagreeing. A statistically significant link between VL and opinions on vaccine side effects was confirmed ($\chi^2 = 32.066$, $p < 0.0001$).

Table 2 Vaccination Literacy Levels and Survey on the Effects of Vaccines on the Immune System

Questions		Inadequate		Adequate		Chi-square; p-value
		n	%	n	%	
Have you or your family members received any vaccines in the past five years?	Yes	223	16,8	981	73,9	17,518; 0,0001
	No	37	2,8	74	5,6	
Vaccines overload or weaken the immune system	Agree	151	11,4	403	30,4	36,619; 0,0001
	Disagree	110	8,3	654	49,3	
Vaccines may cause the diseases they are supposed to protect against	Agree	132	9,9	393	29,6	20,191; 0,0001
	Disagree	129	9,7	665	50,1	
Vaccines often cause severe side effects (excluding typical, temporary reactions in the first few days)	Agree	172	13,0	506	38,1	32,066; 0,0001
	Disagree	88	6,6	550	41,4	
Vaccination is important to protect myself and my children	Agree	156	11,8	925	69,7	117,794; 0,0001
	Disagree	104	7,8	136	10,2	
Overall, I consider vaccination to be safe	Agree	135	10,2	854	64,4	102,511; 0,0001
	Disagree	126	9,5	207	15,6	
Overall, I consider vaccination to be effective	Agree	141	10,6	876	66,0	106,631; 0,0001
	Disagree	120	9,0	185	13,9	
Vaccination aligns with my religious beliefs	Agree	144	10,9	825	62,2	64,991; 0,0001
	Disagree	116	8,7	235	17,7	
Vaccination is important to prevent the spread of serious diseases	Agree	168	12,7	957	72,1	125,970; 0,0001
	Disagree	92	6,9	105	7,9	
How high do you consider the risk of developing vaccine-preventable diseases if not vaccinated?	Low	110	8,3	295	22,2	25,292; 0,0001
	High	148	11,2	757	57,0	

The majority of participants (81.5%) valued vaccination as essential for personal and family protection, with 69.7% of those with "adequate" VL supporting this view. The chi-square analysis confirmed that VL significantly influenced opinions on the importance of vaccination ($\chi^2 = 117.794$, $p < 0.0001$). Regarding vaccine safety, 74.6% of participants considered vaccines safe, with 64.4% of respondents with "adequate" VL agreeing with this statement ($\chi^2 = 102.511$, $p < 0.0001$). Furthermore, 76.6% rated vaccination as effective, with 66% of participants with "adequate" VL strongly agreeing ($\chi^2 = 106.631$, $p < 0.0001$).

In addition, VL was significantly associated with beliefs about the compatibility of vaccination with religious views, as 62.2% of those with "adequate" VL agreed that vaccination aligns with their religious beliefs ($\chi^2 = 64.991$, $p < 0.0001$). Participants' perception of the risk of vaccine-preventable diseases also varied by VL. Among those with "adequate" VL, 57% rated the risk as high if not vaccinated, highlighting a significant association between VL and risk perception ($\chi^2 = 25.292$, $p < 0.0001$).

Discussion

This study provides valuable insights into vaccination literacy among university students, highlighting both promising trends and critical areas for improvement. A significant finding is that the majority of students exhibited "adequate" vaccination literacy, reflecting a generally well-informed population capable of making informed health decisions. Such literacy is crucial for promoting vaccine uptake, countering misinformation, and supporting public health efforts [20, 21].

However, disparities in vaccination literacy were evident across different subgroups. Significant variations were observed based on the year of study, field of study, and geographic location. Interestingly, no significant differences in health literacy levels were found between genders. While prior studies suggest that gender-specific educational strategies can improve engagement and comprehension, these findings indicate that broader, inclusive approaches may also be effective [22, 23].

Unsurprisingly, medical students demonstrated the highest vaccination literacy levels, likely due to their academic exposure to health-related information. This supports the notion that

educational background and field of study are closely linked to health literacy [24; 25]. Furthermore, students from urban areas outperformed their rural counterparts, highlighting geographic disparities in access to health education. The lower literacy levels among rural students underscore the need for targeted, region-specific programs that address barriers to information access unique to these communities [26, 27].

The positive association between vaccination literacy and vaccine uptake further underscores the importance of fostering health literacy. Students with higher literacy levels were more likely to be vaccinated, demonstrating that well-informed individuals are better equipped to evaluate health information, overcome vaccine hesitancy, and make confident vaccination decisions [28, 29]. Moreover, these students displayed greater confidence in vaccine safety, efficacy, and compatibility with personal and religious beliefs, highlighting the role of health literacy in shaping positive vaccination attitudes.

Despite these encouraging trends, significant misconceptions persist, with fewer than half of the students believed vaccines could not cause the diseases they aim to prevent, and concerns about severe side effects were prevalent among more than half of the participants. These misconceptions indicate persistent gaps in understanding, which demand targeted educational interventions. Research has consistently shown that misinformation, particularly around vaccine safety, is a major barrier to vaccine acceptance [30]. For instance, Shengelia (2021) warns that misinformation and "fake news" undermine public trust in vaccines, fueling hesitancy [31]. Similarly, Bogart et al. (2021) emphasize that mistrust is especially pervasive in marginalized communities, where misinformation exacerbates resistance to vaccination [32].

Improving vaccination health literacy among students is critical for reducing vaccine hesitancy and supporting public health. Tailored educational programs, as emphasized by Shon and Lee, effectively enhance knowledge and vaccine confidence by addressing students' specific health beliefs and literacy levels [14]. Integrating health literacy into school curricula further supports this goal, fostering informed decision-making and reducing health inequities [33]. Additionally, leveraging technology and social media offers scalable ways to engage students, build trust, and counter misinformation [34]. Combining these strategies ensures a comprehensive approach to improving vaccination literacy and promoting vaccine acceptance, ultimately advancing public health outcomes.

This study has certain limitations that should be acknowledged. First, the reliance on self-reported data to evaluate vaccination literacy may have introduced biases, as participants might overestimate or underestimate their actual knowledge. Second, the cross-sectional design of the study only provides a snapshot of the data, which restricts the ability to draw causal inferences or track changes over time. Despite these limitations, the study's notable strength lies in the application of validated instrument, which enhances the reliability and validity of the findings and adds robustness to the overall data quality.

Conclusion

This study provides an in-depth analysis of vaccination literacy among university students, revealing both strengths and challenges in promoting informed health decisions. A majority of students demonstrate "adequate" vaccination literacy, indicating a promising ability to make informed choices and resist vaccine misinformation. These findings highlight the need for targeted educational strategies to bridge literacy gaps and enhance access to reliable vaccination information. Additionally, persistent misconceptions about vaccine safety and side effects signal an ongoing need for public health campaigns that effectively address common myths and emphasize the scientific rigor behind vaccine safety. Enhancing vaccination literacy and addressing demographic disparities can promote positive health behaviors and support public health goals within university communities, ultimately contributing to improved health outcomes.

Author Contributions: Conceptualization, Zh. B. and H. A.; methodology, K. N., Zh. B., Zh. D.; validation, H. A., G. K., formal analysis, Zh. B., G. K., O. Zh; investigation, H. A., K. N., Zh. B., Zh. D., G. K., A. T., N. Ye., O. Zh.; resources, N. Ye.; data curation, Zh. D.; writing – original draft preparation, Zh. B., K. N..; writing – review and editing, N. Ye., A. T.; visualization, N. Ye., D. A.; supervision, A.T. All authors have read and agreed to the published version of the manuscript.

Disclosures: There is no conflict of interest for all authors.

Acknowledgments: None.

Funding: None.

References

1. Zhou M, Liu L, Gu S, Peng X, Zhang C, Wu Q-F, Xu X-P, You H.Behavioral intention and its predictors toward COVID-19 booster vaccination among Chinese parents: applying two behavioral theories. *International Journal of Environmental Research and Public Health*. 2022; 19(12): 7520. https://doi.org/10.3390/ijerph19127520.
2. Ameyaw E, Kareem Y, Seidu A, Yaya S. Decomposing the rural–urban gap in factors associated with childhood immunisation in sub-Saharan Africa: evidence from surveys in 23 countries. *BMJ Global Health.* 2021; 6(1): e003773. https://doi.org/10.1136/bmjgh-2020-003773.
3. Atuheirwe M, Otim R, Male KJ, Ahimbisibwe S, Sackey JD, Sande OJ. Misinformation, knowledge and COVID-19 vaccine acceptance: a cross-sectional study among health care workers and the general population in Kampala, Uganda. *BMC Public Health.* 2024; 24(1): 203. https://doi.org/10.1186/s12889-024-17678-9.
4. Mahmud MR, Reza R, Ahmed SMZ. The effects of misinformation on COVID-19 vaccine hesitancy in Bangladesh. *Global Knowledge Memory and Communication.* 2023; 72(1/2): 82–97. https://doi.org/10.1108/gkmc-05-2021-0080.
5. Venkatesan K, Menon S, Haroon NN. COVID-19 vaccine hesitancy among medical students. *Journal of Education and Health Promotion.* 2022; 11(1): 218. https://doi.org/10.4103/jehp.jehp_940_21.
6. Saied SM, Saied EM, Kabbash IA, Abdo SAE. Vaccine hesitancy: beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. *Journal of Medical Virology.* 2021; 93(7): 4280–4291. https://doi.org/10.1002/jmv.26910.
7. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. *Journal of Public Health.* 2021; 43(3): 445–449. https://doi.org/10.1093/pubmed/fdaa230.

8. Tavolacci M, Déchelotte P, Ladner J. COVID-19 vaccine acceptance, hesitancy, and resistancy among university students in France. *Vaccines*. 2021; 9(6): 654. https://doi.org/10.3390/vaccines9060654.
9. Doğan R, Çuvadar A, Narzullayeva R. Ebelik öğrencilerinin COVID-19 kontrolüne ilişkin algıları ile COVID-19 aşısına yönelik tutumları arasındaki ilişki. *Sağlık Profesyonelleri Araştırma Dergisi.* 2023; 5(3): 167–177. https://doi.org/10.57224/jhpr.1261722.
10. Badua AR, Caraquel KJ, Cruz M, Narvaez RA. Vaccine literacy: a concept analysis. *International Journal of Mental Health Nursing.* 2022; 31(4): 857–867. https://doi.org/10.1111/inm.12988.
11. Lorini C, Santomauro F, Donzellini M, Capecchi L, Bechini A, Boccalini S, Bonanni P, Bonaccorsi G. Health literacy and vaccination: A systematic review. Human vaccines & immunotherapeutics. 2017; 14(2): 478–488. https://doi.org/10.1080/21645515.2017.1392423.
12. Aimagambetova G, Babi A, Issa T. What factors are associated with attitudes towards HPV vaccination among Kazakhstani women? Exploratory analysis of cross-sectional survey data. *Vaccines*. 2022; 10(5): 824. https://doi.org/10.3390/vaccines10050824.
13. Issa T, Babi A, Akilzhanova A, Nurgaliyeva K, Abugalieva Z, Azizan A, Aimagambetova G. Knowledge and awareness of human papillomavirus infection and human papillomavirus vaccine among Kazakhstani women attending gynecological clinics. *Plos One.* 2021; 16(12): e0261203. https://doi.org/10.1371/journal.pone.0261203.
14. Shon E, Lee L. Effects of vaccine literacy, health beliefs, and flu vaccination on perceived physical health status among under/graduate students. *Vaccines*. 2023; 11(4): 765. https://doi.org/10.3390/vaccines11040765.
15. Arias A, Ladner J, Tavolacci M. Perception and coverage of conventional vaccination among university students from Rouen (Normandy), France in 2021. *Vaccines*. 2022; 10(6): 908. https://doi.org/10.3390/vaccines10060908.
16. Jiang F, Zhao Y, Bai J, Yang X, Zhang J, Lin D, Li X. Perceived health literacy and COVID-19 vaccine acceptance among Chinese college students: a mediation analysis. *Plos One*. 2022; 17(9): e0273285.
17. Xin M, Luo S, Wang S, Zhao J, Zhang G, Li L, Lau JT. The roles of information valence, media literacy and perceived information quality on the association between frequent social media exposure and COVID-19 vaccination intention. *American Journal of Health Promotion*. 2022; 37(2): 189–199. https://doi.org/10.1177/08901171221121292.
18. Riad A, Pokorná A, Antalová N, Krobot M, Zviadadze N, Serdiuk I, Koščík M, Klugar M. Prevalence and drivers of COVID-19 vaccine hesitancy among Czech university students: national cross-sectional study. *Vaccines*. 2021; 9(9): 948. https://doi.org/10.3390/vaccines9090948.
19. The HLS19 Consortium of the WHO Action Network M-POHL (2022): The HLS19-VAC Instrument to measure Vaccination Literacy. Factsheet. Vienna: *Austrian National Public Health Institute*, 2022.
20. Badua AR, Caraquel KJ, Cruz M, Narvaez RA. Vaccine literacy: a concept analysis. International Journal of Mental Health Nursing. 2022; 31(4): 857–867. https://doi.org/10.1111/inm.12988.
21. Njoku A, Joseph M, Felix R. Changing the narrative: structural barriers and racial and ethnic inequities in COVID-19 vaccination. *International Journal of Environmental Research and Public Health.* 2021; 18(18): 9904. https://doi.org/10.3390/ijerph18189904.
22. Jiang F, Zhao Y, Bai J, Yang X, Zhang J, Lin D, Li X. Perceived health literacy and COVID-19 vaccine acceptance among Chinese college students: a mediation analysis. *Plos One.* 2022; 17(9): e0273285. https://doi.org/10.1371/journal.pone.0273285.
23. Kittipimpanon K, Maneesriwongul W, Butsing N, Visudtibhan P, Leelacharas S. COVID-19 vaccine literacy, attitudes, and vaccination intention against COVID-19 among Thai older adults. *Patient Preference and Adherence.* 2022; 16, 2365–2374. https://doi.org/10.2147/ppa.s376311.
24. Sirikalyanpaiboon M, Ousirimaneechai K, Phannajit J, Pitisuttithum P, Jantarabenjakul W, Chaiteerakij R, Paitoonpong L. COVID-19 vaccine acceptance, hesitancy, and determinants among physicians in a university-based teaching hospital in Thailand. *BMC Infectious Diseases.* 2021; 21(1). https://doi.org/10.1186/s12879-021-06863-5.
25. Maki W, Ishitsuka K, Yamaguchi K, Morisaki N. Vaccine literacy, COVID-19 vaccine-related concerns, and intention to recommend COVID-19 vaccines of healthcare workers in a pediatric and maternity hospital: a cross-sectional study. *Vaccines*. 2022; 10(9): 1482. https://doi.org/10.3390/vaccines10091482.
26. Murthy B, Sterrett N, Weller D, Zell E, Reynolds L, Toblin R, Murthy N, Kriss J, Rose C, Cadwell B, Wang A, Ritchey MD, Gibbs-Scharf L, Qualters JR, Shaw L, Brookmeyer KA, Clayton H, Eke P, Adams L, Zajac J, Patel A, Fox K, Williams C, Stokley S, Flores S, Barbour KE, Harris LQ. Disparities in COVID-19 vaccination coverage between urban and rural counties — united states, december 14, 2020–april 10, 2021. *MMWR Morbidity and Mortality Weekly Report.* 2021; 70(20). https://doi.org/10.15585/mmwr.mm7020e3.
27. Biasio L, Bonaccorsi G, Lorini C, Pecorelli S. Assessing COVID-19 vaccine literacy: a preliminary online survey. *Human Vaccines & Immunotherapeutics.* 2020; 17(5): 1304–1312. https://doi.org/10.1080/21645515.2020.1829315.
28. Zhang F, Zhang H, Li Y, Peng S, Jiang Y, Huihui J. The effect of health literacy on COVID-19 vaccine hesitancy: the moderating role of stress. *medRxiv*. 2021.06.16.21258808. https://doi.org/10.1101/2021.06.16.21258808.
29. Feinberg I, Yoon J, Holland D, Lyn R, Scott L, Maloney K, Rothenberg R. The relationship between health literacy and COVID-19 vaccination prevalence during a rapidly evolving pandemic and infodemic. *Vaccines*. 2022; 10(12): 1989. https://doi.org/10.3390/vaccines10121989.
30. Bell S, Clarke R, Mounier-Jack S, Walker J, Paterson P. Parents' and guardians' views on the acceptability of a future COVID-19 vaccine: a multi-methods study in England. *Vaccine*. 2020; 38(49): 7789–7798. https://doi.org/10.1016/j.vaccine.2020.10.027.
31. Shengelia M, Verulava T. Factors associated with COVID-19 vaccine hesitancy in Georgia. *Journal of Health Science and Medical Research.* 2024; 42(3): e20241023. https://doi.org/10.31584/jhsmr.20241023.
32. Bogart LM, Dong L, Gandhi P, Klein DJ, Smith TL, Ryan S, Ojikutu BO. COVID-19 vaccine intentions and mistrust in a national sample of black Americans. *Journal of the National Medical Association.* 2022; 113(6): 599–611. https://doi.org/10.1016/j.jnma.2021.05.011.
33. Nash R, Elmer S, Thomas K, Osborne R, MacIntyre K, Shelley B, Murray L, Harpur S, Webb D. Healthlit4kids study protocol; crossing boundaries for positive health literacy outcomes. *BMC Public Health*. 2018; 18(1). https://doi.org/10.1186/s12889-018-5558-7.
34. Hurstak E, Farina FR, Paasche-Orlow MK, Hahn EA, Henault LE, Moreno P, Weaver C, Marquez M, Serrano E, Thomas J, Griffith JW. COVID-19 vaccine confidence mediates the relationship between health literacy and vaccination in a diverse sample of urban adults. *Vaccines*. 2023; 11(12): 1848. https://doi.org/10.3390/vaccines11121848.