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Knowledge and behavioral beliefs related to vaccination hesitancy among healthcare workers

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Knowledge and behavioral beliefs related to vaccination hesitancy among healthcare workers

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Editorial: Knowledge and behavioral beliefs related to vaccination hesitancy among healthcare workers

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KEYWORDS

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Editorial on the Research Topic
Knowledge and behavioral beliefs related to vaccination hesitancy among healthcare workers

Healthcare workers' vaccine attitudes

Healthcare workers (HCW) are at an elevated risk of occupational exposure to various infectious diseases, thus making vaccination a key driver in reducing spread and transmission amongst their patients and within their healthcare settings (1). Research indicates that higher vaccination rates among HCWs can lead to reduced morbidity and mortality, therefore benefiting both patients and healthcare systems (2). On the contrary, another study found that skepticism about vaccine safety, fear of side effects, and distrust of pharmaceutical companies or public health initiatives can lead to vaccine refusal (3).

Given the significant role of the HCWs in promoting public trust in vaccine uptake, understanding their personal beliefs about vaccines is crucial. A study by Schmid et al. (4) found that that personal attitudes toward vaccination, perceived social norms, and trust in health authorities influence HCWs' willingness to be vaccinated. Research has also indicated that HCWs who are well-informed about vaccine safety and efficacy are more likely to get vaccinated and recommend vaccines to patients (5).

Highlights from the Research Topic

Building on the importance of behavioral beliefs and their role in vaccination uptake, several studies provided insights into the challenges faced by HCWs in different contexts. Getachew et al. investigated COVID-19 vaccine acceptance among healthcare workers in Eastern Ethiopia, finding a low acceptance rate of 35.6%. Similarly, Asefa et al. study in the West Guji zone of Southern Ethiopia reported a slightly higher, but relatively low

acceptance rate of 38.1% as well. These studies identified key factors influencing willingness to vaccine acceptance such as age, professional role, prior vaccine side effects, positive attitudes toward vaccination, perceptions of susceptibility and severity of the disease, and knowledge about the vaccines.

Furthermore, study findings underscore the grave need for government and stakeholder collaboration to increase vaccine awareness, address safety concerns, and dispel any misconceptions through targeted campaigns. Enhancing vaccine education and promoting preventive practices among HCWs will be essential to improve acceptance rates in these geographic regions. Another study by Polla et al. investigated HCWs willingness in Italy to receive a second COVID- 19 vaccination booster dose. It found that only 52.6% of HCWs were willing to receive the COVID-19 booster and was driven primarily by a desire to protect their family members and patients. Key factors influencing their willingness include beliefs about COVID-19's severity and the vaccine's overall effectiveness. This study emphasizes the need for targeted educational interventions to enhance vaccine uptake and encourage HCWs to recommend it to their patients.

Beyond vaccine hesitancy, challenges faced by HCWs during COVID-19 pandemic extend to issues of burnout. The article by Gu et al. examines factors contributing to burnout among Chinese vaccination staff during the COVID-19 pandemic. This study identified key elements such as workload, emotional exhaustion, and support from colleagues as significant contributors to burnout levels. These findings suggest that addressing these factors through improved organizational support and mental health resources could mitigate burnout among vaccination staff, ultimately enhancing their wellbeing and effectiveness.

Expanding on the role of HCWs beliefs and behaviors in vaccination uptake, several studies examined vaccination patterns beyond COVID-19. The cross-sectional study by Mercogliana et al. explores tetanus, diphtheria, and pertussis (Tdap) booster vaccination among healthcare workers (HCWs) in a large academic hospital in Southern Italy. This study found that only 34.5% of HCWs had received the booster in the past 10 years. Factors such as job seniority influenced vaccination rates, with those employed for 5–9 years being less likely to receive it. Study findings highlight the need for targeted public health strategies to increase vaccine awareness and uptake, especially in high-risk healthcare settings.

Similarly, a study by Licata et al. analyzes pertussis vaccination among pregnant women in Italy by surveying HCWs like OB-GYNs, midwives, and primary care physicians. Although, most HCWs had good knowledge of the vaccine, their recommendation practices varied. Those with higher awareness of the vaccine's effectiveness were more likely to promote it. Midwives and primary care physicians were less likely to recommend vaccination, citing reasons like vaccine hesitancy and lack of knowledge. These findings highlight the importance of improved education and strategies to boost vaccine uptake among HCWs and their patients.

Fan et al. systematic review shift focuses to influenza vaccination revealing a global HCW vaccination rate of 41.7%. Furthermore, vaccination rates varied by region, with the highest in the Americas (67.1%) and the lowest in Africa (6.5%). Factors influencing vaccination uptake include age, education, length of service, awareness of risks, and belief in vaccine efficacy. This review calls for comprehensive strategies to promote flu vaccination, especially in regions with lower rates, and highlights the need for targeted interventions to improve uptake among HCWs.

Pouvrasseau and Jeannot's study offers insights into vaccine hesitancy among nursing and midwifery students in Switzerland, particularly focusing on the HPV vaccine. Using an online questionnaire, the study assesses students' general vaccine confidence, HPV vaccination rates, and willingness to recommend the HPV vaccine. It also explores factors such as socio- demographic characteristics and interest in complementary medicine. These findings highlight the need for targeted educational strategies to improve vaccine confidence among future healthcare professionals, ensuring better public health outcomes.

In the multicenter study In Istanbul, Turkey by Parlak et al., explores the perspectives of pediatricians, gynecologists, nurses, and mothers regarding the human papillomavirus (HPV) vaccine. It highlights the importance of healthcare professionals' recommendations in influencing mothers' attitudes toward HPV vaccination for their daughters. This study identifies barriers to vaccination, including lack of awareness and misconceptions about the vaccine's safety and efficacy. The authors emphasize the need for improved communication strategies among healthcare providers to enhance vaccination rates and protect against HPV-related diseases.

In the commentary by Finsterer, the author critiques a study that assessed the quality of life (QoL) of post-hospitalization COVID-19 patients 1 year following infection. Moreover, the author highlights methodological limitations, such as the use of telephone interviews and the generality of the SF-36 QoL questionnaire, which may not fully capture the specific long-term effects of COVID-19. The author advocates for more comprehensive assessments, including in- person evaluations and targeted questions about COVID-19 symptoms and vaccination impacts, to improve understanding of patient health outcomes.

Conclusion

Research on vaccine acceptance among HCWs reveals a complex mix of factors influencing vaccination uptake and decisions. Low uptake of vaccines such as COVID-19, Tdap, and HPV highlights existing barriers that require urgent attention. Future research to improve vaccine acceptance among HCWs must focus on developing targeted educational and behavioral interventions that address specific misconceptions and knowledge gaps. Lastly, longitudinal research studies are needed to assess the effectiveness and long-term impact of interventions on vaccination uptake and to further identify evolving factors influencing vaccination acceptance.

Author contributions

DSS: Writing – original draft, Writing – review & editing. RJ: Writing – original draft, Writing – review & editing. AB: Writing

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Acceptance of COVID-19 vaccine and associated factors among health care workers at public hospitals in Eastern Ethiopia using the health belief model

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Introduction: Acceptance of COVID-19 vaccination among Health Care Workers is mandatory to lessen and curve the spread of transmission of COVID-19. Even though the Health Belief Model is one of the most widely used models for understanding vaccination behavior against COVID-19 disease, COVID-19 vaccine acceptance among Health Care Workers in Ethiopia was not adequately explored by using the Health Belief Model domains.

Purpose: This study aimed to assess COVID-19 vaccine acceptance and associated factors among Health care workers in eastern, Ethiopia.

Methods: Institutional-based cross-sectional study design was used among 417 health care workers selected by a systematic random sampling method from June 1- 30/2021. The data were collected by face-to-face interviews using semi-structured questionnaires and analyzed using STATA version 14 statistical software. Multivariable binary logistic regression analysis with a 95% confidence interval was carried out to identify factors associated with willingness to COVID-19 vaccine acceptance and a statistical significance was declared at a P-value < 0.05.

Results: The willingness of health care workers to accept the COVID-19 vaccine was 35.6%. Age 30-39 (AOR = 4.16;95% CI: 2.51, 6.88), age ≥ 40 years (AOR = 3.29;95% CI: 1.47, 7.39), good attitude (AOR = 1.97; 95% CI: 1.00, 3.55), perceived susceptibility (AOR = 1.93; 95% CI: 1.12, 3.32), and perceived severity (AOR = 1.78; 95% CI: 1.03, 3.10) were factors significantly associated with Health Care Workers acceptance of COVID-19 vaccine.

Conclusion: The willingness to accept the COVID-19 vaccine among HCWs was low. Factors significantly associated with the willingness to accept the COVID-19 vaccine were age, good attitude, perceived susceptibility, and perceived severity of the disease. The low willingness of Health Care Workers to accept the COVID-19 vaccine was alarming and it needs more emphasis from the government in collaboration with other stakeholders to provide reliable information to avert misconceptions and rumors about the vaccine to improve the vaccine status of Health Care Workers to protect the communities.

KEYWORDS

COVID-19, vaccine acceptance, vaccine hesitancy, health care workers, Ethiopia

Introduction

The Coronavirus (COVID-19) pandemic is a public health concern, and there are no particular antiviral medicines available for COVID-19 at this time (1–3). The COVID-19 pandemic is projected to continue to wreak havoc on society and economies around the world, causing massive morbidity and mortality (4). Health Care workers (HCWs) are the primary responsible person for controlling COVID-19 and are at higher risk of contracting the virus (5). Health Care Workers (HCWs) Susceptibility to diseases like COVID-19 has several consequences particularly in low-income nations by limiting the number of HCWs which may result in crises in healthcare systems. Moreover, health professionals are always frontline with the case and frequently contact clients, they have the potential to infect others (6).

To achieve optimal vaccine coverage and avert ongoing public spread, COVID-19 control will most likely rely on successful vaccine development and distribution to a large segment of the population. Unprecedented efforts have been made to develop COVID-19 vaccinations to combat the pandemic (7). Several vaccines have been approved for use as early as the end of 2020 in Canada and the European Union since December 2020 (8, 9). All countries are battling the spread of COVID-19 with quarantine and lockdowns, social distancing measures, public usage of facemasks, and travel restrictions until vaccinations or effective treatments become available (10, 11). An effective vaccination, in combination with protective measures, will be the most effective strategy for mitigating the spread of COVD-19 and promoting positive clinical and socioeconomic consequences (12).

Abbreviations: AOR, Adjusted Odd Ratio; CI, Confidence interval; COR, Crude Odd Ratio; COVID-19, Coronavirus disease in the year 2019; EDHS, Ethiopian Demographic and Health Survey; FOMH, Federal Ministry of Health; HCW, Health Care Workers; USAID, United States Agency for International Development; WHO, World Health Organization.

COVID- 19 vaccinations are now accessible, and many countries, including Ethiopia, have already reserved supplies of the long-awaited vaccines. Any vaccination program's success, however, is contingent on high vaccine acceptability and uptake, and the fundamental problem presently facing the public is instilling public faith in an emergency-released vaccine. Vaccine acceptance is on the verge of becoming a reality without such assurance (13, 14).

Despite the enormous efforts made to develop viable COVID-19 vaccines, vaccine acceptability toward the approved and projected COVID-19 immunization remains a serious roadblock (14). COVID-19 vaccine reluctance among HCWs may be comparable to rates in the general population, according to evidence (15); a meta-analysis study revealed that only 51% of HCWs were willing to get the vaccine (16). The complacency of not getting infected, lack confidence in the vaccine and vaccination service system's safety and effectiveness, the ease of seeking service, and higher-than-expected costs may all contribute to a reduction in the likelihood of receiving the vaccination (17, 18).

In nations like Ethiopia, where the healthcare system is characterized by limited surveillance and laboratory capability, a paucity of healthcare human resources, and insufficient financial capacity, an outbreak of a cureless viral infection with no vaccination would be disastrous (18). Despite the Ethiopian government's significant initiatives and recognition of COVID-19's public health value (screening, quarantine, and treatment centers), there is a pressing need to increase HCWs' willingness to adopt the COVID-19 vaccine (19, 20). Numerous research demonstrated the value of interventions focusing on health belief model (HBM) constructs for boosting vaccination uptake (21, 22) and it's one of the most often employed models used for understanding vaccination behavior against COVID-19 (22, 23). According to this theory, many variables like perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action influence the health-related behavior of individuals (24). Perceived susceptibility refers to perceptions of vulnerability to infection while Perceived severity refers to perceptions of the consequences of catching

the infection. Perceived benefits and perceived barriers are terms used regarding vaccination; the former refers to a person's beliefs about getting immunized, while the latter refers to the notion that getting immunized is constrained by psychosocial, physical, or financial factors. Information, people, and events that direct or guide an individual to be vaccinated are examples of cues to action (25, 26).

The finding from previous and recent studies are showing that COVID-19 vaccination has substantially altered the course of the pandemic, saving tens of millions of lives globally (27). The global morbidity and death caused by COVID-19 are becoming reduced due to the wide distribution of COVID-19 immunization (28). However, unwillingness toward the vaccine is becoming a challenge and barrier to covering a large proportion of the vulnerable population, estimates of vaccine acceptance among HCWs were scarce and not addressed using the health belief model yet in Ethiopia. To the best of our knowledge, this is the first study that uses HBM components to assess the acceptance of the COVID-19 vaccine among HCWs. To do so, it's crucial to assess the HCWs level of vaccination acceptability of COVID-19 to combat the virus pandemic effects. Therefore, this study aimed to assess COVID-19 vaccination acceptance and associated factors among HCWs working in public hospitals in Eastern Ethiopia using the health belief model so that public health experts and the government could target the most vulnerable communities.

Materials and methods

Study design, setting, and period

An institutional-based cross-sectional study design was conducted among seven randomly selected public hospitals in eastern Ethiopia (Dilchora, Bisidimo, Haramaya, Gara Muleta, Deder, Chiro, and Gelemso hospitals) from June 1- 30/2021. Dilchora hospital is a referral hospital found in Dire Dawa city administration which gives comprehensive health services for both urban and rural populations surrounding the city. East Hararghe has a total population of 3,587,042. West Harerghe zone has a total population of 2,467,364.

Study population

The source populations were all HCWs who were working in public hospitals in Eastern Ethiopia. The study populations were all HCWs who were working in selected public hospitals in Eastern Ethiopia during the study period.

Eligibility criteria

All HCWs who were on duty during data collection, and have willing to participate in the study were included in the study. HCWs who were on annual leave, maternal leave, and sick leave during the study period were excluded.

Sample size determination and sampling procedure

The required sample size was determined by using the single population proportion formula ($n = (Z_{\alpha/2})^2 p\ (1\text{-}p)/\ d2$) with the following assumptions: the prevalence of COVID 19 vaccine acceptance among healthcare workers ($p = 56\%$), from a study conducted in the Democratic Republic of Congo (29); Confidence level at 95% ($Z_{\alpha/2}$) = 1.96, a margin of error (d) = 0.05 and non-response rate = 10%. So, the final sample size was 417. Seven public hospitals (Dilchora, Bisidimo, Haramaya, Gara Muleta, Deder, Chiro, and Gelemso hospital) found in the study area were randomly selected and included in the study. About 320, 182, 164, 142, 127, 108, and 102 HCWs were found in the hospitals listed above, respectively. The required study samples from each public hospital were allocated proportionally to the size of HCWs of each Hospital. The study subjects were selected using a systematic random sampling technique with (K = N/n, = 1145/416 = 2.75 = 3) based on staff registration for HCWs until the predetermined sample size was obtained. The first eligible study participant was selected randomly.

Measurement of variables

The data were collected by face-to-face interviews using a self-administered semi-structured questionnaire which was adapted from previous literature and some modification was made to suit the local context. The questionnaire contains four parts; which was designed to collect information on socio-demographic characteristics, COVID-19 Vaccine acceptance and health-related status of study participants, HCWs attitude toward the COVID-19 vaccine, and health belief measures using the Health Belief Model domain (30–32) and health belief measures using Health Belief Model (33).

In the sociodemographic characteristics section, personal details, including age, sex marital status, educational level, type of profession, number of family members, and monthly income, were queried. The HCWs' acceptance of the COVID-19 vaccine was measured by asking a single item "Will you take the COVID-19 vaccine when it becomes available?" with 'Yes', and 'No' response options. If the respondents' answered ''yes", he/she is considered as having the willingness to accept the COVID-19 vaccine and otherwise no (16). Again, HCWs were also asked if they were frontline workers, had an existing chronic disease, had

ever been diagnosed with a chronic disease, anybody aged > 64 years old in their family, and anybody diagnosed with chronic disease in their family.

HCWs attitude toward the COVID-19 vaccine was determined based on 10 attitude assessment questions. Each question score was based on a five-point Likert scale, in which a score of 1 to 5 was given from strongly disagree to strongly agree. Then, the score was computed with a total minimum score of 10 and a maximum score of 50. A mean score was calculated for the computed value and a score below the mean was considered as having a poor attitude and a score above the mean value was described as having a good attitude toward the COVID-19 vaccine (32).

The Health Belief Model (HBM) was composed of five dimensions, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action. The perceived susceptibility domain consisted of five items addressing HCW's sights about their possible risk of getting infected by COVID-19; I am susceptible to being infected due to my occupational exposure, COVID-19 infection is a very real possibility, People who are in good health can get COVID-19, COVID-19 is more likely to infect me because of my health, and I don't think I'll be able to protect myself from COVID-19 any better than other individuals. The perceived severity domain also consisted of five items to address HCWs' concerns about the seriousness of COVID-19.; COVID-19 has the potential to make some people severely sick and fatal, COVID-19 is more dangerous than the seasonal flu, I'll be unwell if I acquire COVID-19, If I contract COVID-19, I may need to be admitted to the hospital, I might die if I acquire COVID-19.

The perceived benefits domain consisted of six items to address perceived positive outcomes of getting vaccinated against COVID-19 in terms of reducing their susceptibility to contracting the illness or the severity of symptoms if being infected by COVID-19; Vaccination is a fantastic idea because it reduces my fear of contracting COVID-19, COVID-19 and its consequences are less likely to affect me if I am vaccinated, I safeguard my patients, family, and acquaintances from infection by being vaccinated, When I am vaccinated, the entire community benefits because COVID-19 is prevented from spreading, COVID-19 vaccine is a powerful tool for preventing and controlling the COVID-19 virus, and to stop the COVID-19 pandemic, high vaccine coverage is essential all across the world.

Perceived barriers domain consisted of thirteen items to address the HCWs concerns or negative beliefs toward COVID-19 vaccines; I am concerned about the COVID-19 vaccine's side effects, concerned about the COVID-19 vaccine's efficacy, concerned about the COVID-19 vaccine's safety, Concerned about the COVID-19 vaccine's price, Concerned about the vaccine's novelty, Concerned about the COVID-19 vaccine's availability, Concerned about the limited availability of the COVID-19 vaccination, Concerned about the halal status of the vaccines offered, Concerned about the manufacturer's and supply source's reliability, Concerned about the Ethiopian health system and vaccination distribution strategy, Concerned about the vaccine's administration mode (needles use), Concerned about the frequency of vaccines (number of doses required), and Concerned about the longevity of immunity (how much time I will be protected).

The cues to action domain included six items to address different clues or recommendations that promote the willingness of HCWs to get vaccinated against COVID-19.; Once credible information is provided, COVID-19 vaccination uptake, if health facilities recommend it, the COVID-19 vaccine up-taken, If the COVID-19 vaccination is recommended by the health authorities, it will up-taken, If the media recommends the COVID-19 vaccination, it will be accepted, if my work recommends it, I will get the COVID-19 vaccine, and if a large number of people get the COVID-19 vaccination, it will be accepted.

Respondents were asked to rate all HBM items on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). A total score for each dimension was computed and the mean score for each domain was calculated. Higher scores (above the mean) indicate greater levels of a specific domain of dimension except for the perceived barrier domain which was reversely coded (higher perceived barrier scores indicated lower levels of perceived barriers).

Data collection procedures

After full informed consent was obtained from each study participant, the data were collected by 2 diploma nurses and 2 midwives who are not working in the study area and supervised by four BSc holder nurses. A brief introductory orientation was given to the study participants by data collectors about the purposes of the study and the importance of their involvement. Then, HCWs who were volunteers were interviewed using semi-structured and pre-tested questionnaires. The data was collected for the duration of 1 month from June 1-30/021.

Data quality control

Before beginning actual data collection, a pretest was done at the local public hospital (Jegula hospital) on 5% of the sample size (21 HCWs). The pre-test findings and experiences were used to improve and reshape the data collection tools. Before data collection, data collectors and supervisors received training on the study's goal, the confidentiality of information, and how to respect respondent rights and privacy. The investigators evaluated the completed questionnaires for completeness,

accuracy, and clarity of data, and any necessary modifications were made immediately by the principal investigator and supervisors daily.

Data management and analysis

The data was collected with the Kobo Collect software version 2021.3.4 and then exported to STATA version 14 for analysis. Participants' socio-demographic characteristics, awareness of COVID-19, attitude toward the COVID-19 vaccine, and health belief measures utilizing HBM were described using descriptive statistical analyses such as simple frequency, mean, and standard deviation. Categorical variables were summarized using frequency and proportions, whereas continuous variables were summarized using mean and standard deviation. The data was then displayed using tables and frequencies. Collinearity was determined using VIF and tolerance, and the goodness of fit was determined using the Hosmer-Lemeshow statistic and the Omnibus test. The model was considered fit since it is found to be insignificant at $p < 0.05$. The chi-square test was used in the bivariate section while binary logistic regression was used to determine the factors that predict vaccination. Binary logistic regression was used because the dependent variable is dichotomous (HCWs vaccine acceptance classified as yes or no). In the multivariate analysis, the strength of statistical association for COVID-19 vaccine acceptance was assessed, along with the 95 percent confidence interval. Finally, a *p*-value of <0.05 was declared statistically significant.

Ethical consideration

Haramaya University's, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC) (reference number IHRERC/069/2021), provided ethical approval for this study. A letter of permission and support were provided to the selected seven public hospitals in which the study was carried out. Informed, voluntary, written, and signed consent was taken from the heads of each public hospital. Before the interview, each study participant gave their informed, voluntary, written, and signed consent, and they were offered the right to refuse or terminate the interview at any moment. Confidentiality of participants was maintained at all levels of the study throughout the data collection process. During data collection, the COVID-19 prevention protocol was strictly followed. There was no direct contact with patients and anonymity was maintained by using the identified number instead of the patient's name. Besides, the confidentiality of the data was kept and used for the study purpose only.

TABLE 1 Socio-demographic characteristics of HCWs working in public hospitals in Eastern Ethiopia, 2021 ($n = 416$).

Variable	Category	Frequency	Percentage (%)
Age	20–29	181	43.5
	30–39	197	47.4
	>40	38	9.1
Sex	Male	205	49.3
	Female	211	50.7
Marital status	Married	234	56.3
	Single	156	37.5
	Divorced	14	3.4
	Separated	10	2.4
	Widowed	2	0.5
Educational level	Diploma	53	12.7
	Degree	281	67.5
	Masters	47	11.3
	Third-degree (specialty)	35	8.4
Type of profession	Doctor	35	8.4
	Nurse	179	43.0
	Midwifery	96	23.1
	Pharmacist	36	8.7
	Laboratory	25	6.0
	Psychiatry nurse	27	6.5
	Anesthetist	18	4.3
Number of family members	1	24	5.8
	2	68	16.3
	>3	324	77.9

Results

Socio-demographic characteristics

Out of 417 study participants involved in this study, 416 HCWs were included in the final analysis making a response rate of 99.7%. The mean and standard deviation ages of study participants were 31 ± 17.24, respectively. The ratio of males to females was 0.97 to 1. About 288 (69.2%) HCWs have <5 years of experience and 233 (56.0%) have earned a salary of >6,000 Ethiopian birrs. Regarding the educational level, 281 (67.5%), and 35 (8.4%) HCWs were first-degree and third-degree (specialty) holders, respectively. Of the total HCWs participated in the study, 179 (43.0%) and 18 (4.3%) were Nurse and Anesthetist professionals, respectively (Table 1).

COVID-19 vaccine acceptance and health-related status health care workers

Of the total study participants, 147(35.3%) HCWs have a willingness to accept the COVID-19 vaccine. Unreliability of the vaccine due to its development within a short period of time 122 (45.4%), fear of side effects 102 (37.9%), and doubts about the vaccine 88 (32.7%) were some of the reasons for the non-acceptance of the vaccine. Out of the total study participants, 71 (17.1%) of them were frontline workers and 48 (11.5%) had an existing chronic disease (Table2).

The attitude of HCWs toward the Covid-19 vaccine

The mean score of attitude-related questions was 36.2 with a standard deviation of 5 ± 34. Among the total study participants, 216 (51.9%) HCWs have a positive attitude toward the Covid-19 vaccine. Of the total study participants, 15 (3.6%), 49 (11.8%), 135 (32.5%), 159 (38.2%), and 58 (13.9%) of study participants strongly disagreed, disagree, neutral, agree and strongly agreed with the idea of COVID-19 can be avoided with vaccination. About 9 (2.2%), 28 (6.7%), 31 (7.5%), 169 (40.6%) and 179 (43.0%) study participants strongly disagree, disagree, neutral, agree and strongly agree with the idea of COVID-19 vaccination is necessary for health care workers (Table3).

Health believes model measures

Two hundred sixty-nine (64.7%) and two hundred forty-one (57.9%) HCWs were scored above the calculated mean value on perceived susceptibility ($\alpha = 0.82$) and severity domain ($\alpha = 0.71$) of the HBM domain, respectively. Again, two hundred sixty (62.5%) and two hundred three (48.8%) HCWs scored above the mean value on perceived benefit ($\alpha = 0.89$) and barrier ($\alpha = 0.76$) of the HBM domain, respectively. Regarding the cues to action ($\alpha = 0.84$) domain of HBM, 262 (63%) HCWs scored above the mean value (Table 4).

Factors associated with COVID-19 vaccine acceptance

In the bivariate analysis, factors like age, sex, diagnosis with chronic disease, experienced Covid-19 infection, frontline workers, attitude, perceived susceptibility, perceived severity, perceived benefits, and cues to action were associated with COVID-19 vaccine acceptance. But in the multi-variable logistic regression only age (30-39 and >40 years old), attitude, perceived susceptibility, and perceived severity were significantly associated with COVID-19 vaccine acceptance.

HCWs who were 30–39 years were more likely (AOR = 4.16; 95% CI:2.51, 6.88) to accept the COVID-19 vaccine compared with those aged 20–29 years. Again, HCWs who were >40 years were more likely (AOR = 3.29; 95% CI:1.47, 7.39) to accept the COVID-19 vaccine compared to those aged 20–29 years. HCWs who had a good attitude were (AOR = 1.97; 95% CI: 1.00, 3.55) more likely to accept the COVID-19 vaccine compared to those who had a poor attitude toward the COVID-19 vaccine. Perceived susceptibility predicted the willingness to accept the COVID-19 vaccine by 1.93 (AOR = 1.93, 95% CI: 1.12, 3.32) whereas perceived severity and seriousness of the disease predict the willingness to accept the COVID-19 by 1.79 (AOR = 1.79; 95% CI: 1.03, 3.10) (Table5).

Discussion

The Willingness to accept the COVID-19 vaccine among HCWs was 35.6%. This study finding was in line with the study finding done in Ghana (34), and the United States (36%) (35), But the finding was higher than the study finding done in the general population of Ethiopia (31.4%) (36), and the democratic republic of Congo (27.7%) (37). The possible reason might be the time difference since the information about the COVID-19 vaccine was disseminated rapidly through various social media. Another reason might be there is a study population difference; the general population was the study population for a study done in Ethiopia while this study only done among healthcare workers.

However, the result of the study was significantly lower than the studies done in Ethiopia: in Southern Ethiopia (48.4%) (6), Gondar Zone Hospitals (45.3%) (30), and also studies conducted abroad in Beirut Lebanon (58%) (38), in China (39) in Pakistan (70.25%) (40), and in France (76.9%) (40). This difference might be due to study population differences, and differences in seriousness of the pandemic among different communities. Another reason might be there is varied information and doubts on social media about the vaccine. Furthermore, the low prevalence of willingness to accept COVID-19 acceptance might be explained by distribution of misinformation about the poor quality of the vaccine through mass Medias, and also there was rumors circulating in the healthcare providers about the vaccine side effects which made healthcare providers developed negative attitude, and affect their willingness to take COVID-19 vaccine.

Furthermore, the negative effects of social media and the propagation of misinformation regarding the vaccine's quality could explain the low acceptance (41, 42). The HCWs may have developed vaccine hesitation as a result of the widespread dissemination of disinformation and rumors about poor vaccine quality in the media, which may have influenced their decisions

TABLE 2 COVID-19 vaccine acceptance and health-related status of HCWs working in public hospitals in Eastern Ethiopia, 2021 ($n = 416$).

Variable	Category	Frequency	Percentage (%)
Willingness to accept COVID-19 vaccine	**Yes**	**147**	**35.3**
	No	269	64.7
If no, the reason for not taking the vaccine (multiple answers) ($n = 269$)	Fear of side effects	102	37.9
	It's a biological weapon	22	8.2
	Doubts about vaccine	88	32.7
	Unreliable due to short time development	122	45.4
	Not enough information	22	8.2
	The vaccine itself causes COVID-19	11	4.1
	Ineffective	7	2.6
	No vaccine is needed (Covid-19 is overrated)	6	2.2
Have you ever been diagnosed with a chronic disease	Yes	50	12.0
	No	366	88.0
Anybody aged > 64 in above in your family	Yes	80	19.2
	No	336	80.8
Anybody diagnosed with chronic disease in your family	Yes	54	13.0
	No	362	87.0

TABLE 3 Attitude of HCWs toward COVID-19 vaccine among health care workers working in public hospitals in Eastern Ethiopia, 2021 ($n = 416$).

Variable	Strongly disagree (%)	Disagree (%)	Neutral (%)	(Agree (%)	Strongly (agree (%)
Do you believe COVID-19 can be avoided with vaccination?	15(3.6)	49(11.8)	135(32.5)	159(38.2)	58(13.9)
Do you think the currently available vaccine will be effective in preventing COVID-19 infection?	2(0.5)	74(17.8)	80(19.2)	169(40.6)	91(21.9)
Do you believe the COVID-19 vaccine, which has been granted a license, has been thoroughly tested in clinical trials?	15(3.6)	49(11.8)	134(32.2)	160(38.5)	58(13.9)
Do you believe that COVID-19 vaccination should be necessary for health care workers?	9(2.2)	28(6.7)	31(7.5)	169(40.6)	179(43.0)
Do you think the COVID-19 vaccine that is now available is effective?	14(3.4)	51(12.3)	138(33.2)	157(37.7)	56(13.5)
Are you confident in the safety of the present COVID-19 vaccine?	7(1.7)	52(12.5)	138(33.2)	164(39.4)	55(13.2)
Do you trust the advice of professionals?	15(3.6)	49(11.8)	135(32.5)	159(38.2)	58(13.9)
Do you trust the vaccine information disseminated by the official media?	66(15.9)	117(28.1)	127(30.5)	72(17.3)	34(8.2)
Do you believe the information supplied by the Ethiopian Public Health authority about COVID-19 vaccination is accurate?	24(5.8)	44(10.6)	82(19.7)	172(41.3)	94(22.6)
Do you think the COVID-19 vaccination will be affordable and accessible for all populations?	19(4.6)	120(28.8)	82(19.7)	125(30.0)	70(16.8)

to accept vaccination and to promote the vaccine to their clients and the entire community.

Those HCWs whose age was found within the age category 30–39 and >40 years old were more likely to accept the COVID-19 vaccine compared to those found within the age category 20-29 respectively. This finding was in line with studies done in Hospitals of South Gondar Zone, Ethiopia (30), a national survey in Egypt (43), China (39), and also a study done in the United States (35). The reason behind this might be as the age increase the susceptibility to infectious disease will also increase (44, 45). Another reason might be as age increases the chance of having comorbid chronic disease also increased which put them at high risk to be infected with the pandemic, and it influences them to have the willingness to take the COVID-19 vaccine.

Compared to HCWs who have poor attitudes, those who have a good attitude were more likely to accept COVID-19. This finding was similar to the study finding in the Hospitals of South Gondar Zone, Ethiopia (30), southwestern Ethiopia (6), and the Democratic Republic of the Congo (37). The possible reason might be a good attitude toward the vaccine might avoid

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TABLE 4 HBM items: Perceived susceptibility, perceived severity, and seriousness, perceived benefits, perceived barriers, and cues of action status of HCWs working in public hospitals in Eastern Ethiopia, 2021 ($n = 416$).

Variable	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
Perceived susceptibility					
I am susceptible to being infected due to my occupational exposure	14(3.4)	69(16.6)	72(17.3)	170(40.9)	91(21.9)
COVID-19 infection is a very real possibility	20(4.8)	67(16.1)	62(14.9)	186(44.7)	81(19.5)
People who are in good health can get COVID-19	5(1.2)	14(3.4)	24(5.8)	227(54.6)	146(35.1)
COVID-19 is more likely to infect me because of my health	4(1.0)	6(1.4)	16(3.8)	214(51.4)	176(42.3)
I don't think I'll be able to protect myself from COVID-19 any better than other individuals	10(2.4)	11(2.6)	39(9.4)	225(54.1)	131(31.5)
Perceived severity and seriousness					
COVID-19 has the potential to make some people severely sick and fatal	5(1.2)	7(1.7)	10(2.4)	239(57.5)	155(37.3)
COVID-19 is more dangerous than the seasonal flu	34(8.2)	54(13.0)	36(8.7)	142(34.1)	150(36.1)
I'll be unwell if I acquire COVID-19.	91(21.9)	137(32.9)	37(8.9)	85(20.4)	66(15.9)
If I contract COVID-19, I may need to be admitted to the hospital	7(1.7)	46(11.1)	84(20.2)	181(43.5)	98(23.6)
I might die if I acquire COVID-19	8(1.9)	52(12.5)	136(32.7)	150(36.1)	70(16.8)
Perceived benefits					
Vaccination is a fantastic idea because it reduces my fear of contracting COVID-19.	12(2.9)	37(8.9)	74(17.8)	172(41.3)	121(29.1)
COVID-19 and its consequences are less likely to affect me if I am vaccinated.	12(2.9)	55(13.2)	78(18.6)	186(44.7)	85(20.4)
I safeguard my patients, family, and acquaintances from infection by being vaccinated.	13(3.1)	34(3.2)	27(6.5)	187(45.0)	155(30)
When I am vaccinated, the entire community benefits because COVID-19 is prevented from spreading.	5(1.2)	25(6.0)	39(9.4)	226(54.3)	121(29.1)
COVID-19 vaccine is a powerful tool for preventing and controlling the COVID-19 virus	7(1.7)	40(9.6)	71(17.1)	181(43.5)	117(28.1)
To stop the COVID-19 pandemic, high vaccine coverage is essential all across the world.	4(1.0)	26(6.3)	79(19.0)	205(49.3)	102(24.5)
Perceived barriers					
Concerned about the COVID-19 vaccine's side effects	78(18.8)	101(24.3)	68(16.3)	100(24.4)	69(16.6)
Concerned about the COVID-19 vaccine's efficacy	80(19.2)	116(27.9)	28(6.7)	99(23.8)	93(22.4)
Concerned about the COVID-19 vaccine's safety	60(14.4)	100(24.0)	72(17.3)	99(23.8)	85(20.4)
Concerned about the COVID-19 vaccine's price? (Willingness to pay)	62(14.9)	61(14.7)	22(5.3)	139(33.4)	132(31.7)
Concerned about the vaccine's novelty (not used before).	56(13.5)	67(16.1)	73(17.5)	137(32.9)	83.0(20.0)
Concerned about the COVID-19 vaccine's availability	72(17.3)	184(44.2)	50(12.0)	57(13.7)	53(12.7)
Concerned about the limited availability of the COVID-19 vaccination	65(15.6)	204(49.0)	57(13.7)	48(11.5)	42(10.1)
Concerned about the halal status of the vaccines offered	64(15.4)	54(13.0)	74(17.8)	136(32.7)	88(21.2)
Concerned about the manufacturer's and supply source's reliability	9(2.2)	64(15.4)	75(18.0)	178(42.8)	90(21.6)
Concerned about the Ethiopian health system and vaccination distribution strategy	55(13.2)	179(49)	53(12.7)	68(16.3)	61(14.7)
Concerned about the vaccine's administration mode (needles use).	7(1.7)	52(12.5)	138(33.2)	164(39.4)	55(13.2)
Concerned about the frequency of vaccines (number of doses required)	14(3.4)	174(41.8)	85(20.4)	94(22.6)	49(11.8)
Concerned about the longevity of immunity (how much time I will be protected)	30(7.2)	211(50.6)	59(14.1)	74(17.7)	43(10.3)
Cues to action					
Once credible information is provided, COVID-19 vaccination uptake	15(3.6)	50(12.0)	134(32.2)	159(38.2)	58(14.0)
If health facilities recommend it, the COVID-19 vaccine up-taken.	2(0.5)	74(17.8)	80(19.2)	169(40.6)	91(21.9)
If the COVID-19 vaccination is recommended by the health authorities, it will up-taken	7(1.7)	52(12.5)	138(33.2)	164(39.4)	55(13.2)
If the media recommends the COVID-19 vaccination, it will be accepted	15(3.6)	49(11.8)	135(32.5)	159(38.2)	58(13.9)
If my work recommends it, I will get the COVID-19 vaccine.	2(0.5)	74(17.8)	80(19.2)	169(40.6)	91(21.9)
If a large number of people get the COVID-19 vaccination, it will be accepted.	7(1.7)	52(12.5)	138(33.2)	164(39.4)	55(13.2)

TABLE 5 Factors associated with COVID-19 vaccine acceptance among HCWs Working in Public Hospitals in Eastern Ethiopia, 2021 ($N = 416$).

Variable	Category	COVID-19 vaccine acceptance		COR (95% CI)	AOR (95% CI)
		Yes	No		
Age	20–29	35	146	1	1
	30–39	95	102	3.89(2.45,6.17)	4.16(2.51,6.88)**
	>40	17	21	3.38(1.61,7.07)	3.29(1.47,7.39)**
Sex	Male	80	125	1.38(0.92,2.06)	1.48(0.93,2.35)
	Female	67	144	1	1
Diagnosed with chronic disease	Yes	18	32	1.03(0.56,1.91)	1.88(0.86,4.13)
	No	129	237	1	1
Experienced COVID-19 infection	Yes	23	25	1.81(0.99,3.32)	0.72(0.31,1.70)
	No	124	244	1	1
Frontline workers	Yes	31	40	1.53(0.91,2.57)	0.51(0.24,1.07)
	No	116	229	1	1
Attitude	Good	99	117	2.68(1.76,4.08)	1.97(1.00,3.55)*
	Poor	48	152	1	1
Perceived susceptibility	Yes	114	155	2.54(1.61,4.01)	1.93(1.12,3.32)*
	No	33	114	1	1
Perceived severity	Yes	107	134	2.60(1.75,4.16)	1.79(1.03,3.10)*
	No	40	135	1	1
Perceived benefits	Yes	106	154	1.93(1.25,2.98)	1.14(0.66,1.99)
	No	41	115	1	1
Cues to action	Yes	60	94	1.28(0.85,1.94)	0.57(0.33,0.98)
	No	87	175	1	1

* $p < 0.05$ and ** with $p < 0.001$; CI, Confidence Interval; COR, Crude Odd Ratio; AOR, Adjusted Odd Ratio.

misinformation, misunderstanding, and misconception toward the vaccine and outweigh its importance and then improves their willingness to accept the COVID-19 vaccine.

Another important finding was that significant differences were observed between the intention to get vaccinated and vaccination beliefs. HCWs who had higher perceived susceptibility to COVID-19 were more likely to accept the COVID-19 vaccine than their counterparts. This finding was supported by the study done in South Gondar Zone Hospitals, Ethiopia (30), and a study done in China (39). This might be due to the fact that the Health Belief Model is known to predict intention to receive the COVID-19 Vaccine (22, 33, 46, 47). In addition, because HCWs are involved in the treatment of patients they consider themselves at a higher risk of infection than others and are motivated to get vaccinated in need to build their immunity by taking the COVID-19 vaccine (48).

The likelihood of HCWs accepting the COVID-19 vaccine is more predicted by the higher perceived severity and seriousness of COVID-19 disease compared to their counterparts. This finding was supported by a study done among HCWs in China (39). The possible reasons are individuals who perceive the COVID-19 disease as severe and serious might choose to be vaccinated (49). Again, it's known that the health belief model (HBM) is a widely used model in vaccination behavior, particularly COVID- 19. The likelihood of an individual adopting a particular health behavior (e.g., getting the COVID-19 vaccine) is determined by the perceived susceptibility and severity of illness or disease (e.g., COVID-19), along with the belief in the effectiveness of the recommended health behavior (e.g., COVID-19 vaccination) (50). In addition, when there is perceived severity, stress was experienced and HCWs were more initiated to have the willingness to take the COVID-19 vaccine (51).

Conclusion

The Willingness to accept the COVID-19 vaccine among study participants was low. Factors significantly associated with the willingness to accept the COVID-19 vaccine were age, good attitude, perceived susceptibility, and perceived severity/seriousness of the disease. The low willingness of healthcare workers to accept the COVID-19 vaccine was alarming to mitigate the transmission of the pandemic from the clients to providers and vice-versa. It needs more emphasis from the government in collaboration with other stakeholders to

address the concerns and provide reliable information to avert misconceptions and rumors about the vaccine to improve the vaccine status of healthcare workers to protect the communities.

Strength and limitation

The strength of this study was data collection tool used for this study was different and modified from the previous study (we used the health belief model measures) to assess the HCWs' willingness to accept the COVID-19 vaccine. In addition, Cronbach's α of the HBM domain items were above the accepted standard criteria (showed a high internal consistency). The present study has several limitations. First, acceptance of getting the COVID-19 vaccine was self-reported by participants, and hence the information bias probably existed in this study. Second, this was a cross-sectional survey based on self-reported information; hence, causality inference can hardly be drawn, using a cross-sectional study design to show only a temporal link between exposure and outcome variables. Third, this study doesn't show that vaccine acceptance changes over time because of the ever-changing HCWs' perception of risk for COVID-19 and information related to vaccination safety and efficacy.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving human participants were reviewed and approved by Haramaya University's Institutional Health Research Ethics Review Committee (IHRERC), College of Health and Medical Sciences (ref. number. IHRERC/069/2021), provided ethical approval for this study. The patients/participants provided their written informed consent to participate in this study.

Author contributions

TG and AS: conceptualization, methodology, writing—original draft, investigation, project administration, and analysis. ML, AE, BB, AD, BE, MD, SM, AN, HB, GT, DT, KN, HA YD, and AA: conceptualization, methodology, data collection, and writing — review and editing. Moreover, the co-authors wrote the manuscript. All authors were involved in reading and approving the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Willingness to accept a second COVID-19 vaccination booster dose among healthcare workers in Italy

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Background: The coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is evolving,the newly emerged Omicron variant being the dominant strain worldwide, and this has raised concerns about vaccine efficacy. The purposes of this survey were to examine the extent to which healthcare workers (HCWs) intend to receive a second booster dose of the COVID-19 vaccine and the factors that influence their willingness to accept it.

Methods: The study was conducted among HCWs who were randomly selected from four public hospitals in the Campania region, Southern Italy.

Results: A total of 496 HCWs answered the questionnaire (a response rate of 61.2%). Among the respondents, 20.8% indicated a score of 10, using a 10-point Likert-type scale, regarding the usefulness of a second COVID-19 vaccine booster dose. Physicians, HCWs who believed that COVID-19 was a severe disease, and those who have acquired information about the second booster dose from scientific journals were more likely to have this positive attitude. Slightly more than half of HCWs self-reported willingness to receive a second booster dose. Respondents who believe that HCWs are at higher risk of being infected by SARS-CoV-2, those who have a higher belief that COVID-19 is a severe disease, and those who have a higher belief that a second booster dose is useful were more willing to receive a second booster dose. The main reasons for those who had a positive intention were to protect their family members and patients, whereas, the main reasons for not getting vaccinated or for uncertainty were that the dose does not offer protection against the emerging variants and the fear of its side effects. HCWs of younger age, physicians, those who have a higher belief that a second booster

dose is useful, and those who were willing to receive a second booster dose were more likely to recommend the booster dose to their patients.

Conclusion: This study's findings highlight the necessity for designing and implementing educational interventions for improving second booster dose uptake and beliefs among HCWs and their capacity to recommend the vaccine to the patients.

KEYWORDS

COVID-19, HCWs, Italy, second booster dose, vaccination, willingness

Introduction

The coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has generated more than half a billion confirmed cases and almost 6.5 million deaths around the world (1), including over 23.5 million and 179,000 people in Italy by 31 October 2022 (2). Several measures have been implemented to contain and prevent the spread of the disease, such as hand hygiene, social distancing, wearing a mask, and vaccination. However, SARS-CoV-2 is continuously evolving with the newly emerged Omicron variant being the dominant strain worldwide (3, 4), and this has raised concerns about vaccine efficacy. In Italy, on 11 July 2022, the Ministry of Health for this evolving scenario recommended an additional second booster dose or "fourth dose" of the currently available mRNA COVID-19 anti-Omicron variant vaccines, at least 4 months (120 days) after the first booster dose or the last post-booster infection (date of the positive test), to adults aged 60 years and above and individuals aged 12 years and above with concomitant/preexisting conditions (5). As of 19 September 2022, less than one-fourth of those eligible had received this second booster dose (6). Healthcare workers (HCWs), one of the most affected groups (7–9), have not been included, although, from 27 November 2021, the Italian government made vaccination with three doses mandatory for this group but this does not include the second booster dose (10). Moreover, HCWs also play an important role in transmitting the virus to their patients while providing care.

From this point of view, it is, therefore, extremely important and crucial to understand and assess HCWs' willingness to have the second booster dose of the COVID-19 vaccine; no literature is available on this topic. Therefore, the purposes of this present survey were to examine the extent to which a large sample of HCWs in Italy intends to receive a second booster dose of the COVID-19 vaccine and the factors that influence their willingness for accepting it.

Materials and methods

Setting and study population

The study was carried out from 12 July to 9 September 2022. The source population included all 4,000 HCWs who worked in different wards in four randomly selected public hospitals, one teaching and three nonteaching, located in the Campania region, Southern Italy. The sample for the present study included 496 HCWs who had been selected by a simple random sampling technique. A sample size of 384 HCWs was estimated assuming that 50% of the study population would intend to receive a second booster of the COVID-19 vaccine, 95% confidence interval, and a margin of error of 5%.

Data collection

Initially, the research team asked for permission from the health director of each hospital to conduct the study. After the approval, the team identified in each ward an HCW to distribute the questionnaire to the HCWs who were randomly selected from the list of those present at that moment in each ward and to collect the filled questionnaires within an envelope to maintain anonymity and to return the envelope. The questionnaire contained a brief introduction about the objectives, procedure, confidentiality, and anonymity of the survey, that the participation was voluntary, that the information provided will be used only for research purposes, and that the participant was able to withdraw at any moment. HCWs gave their informed consent to participate by handing in the questionnaire. The participants received no incentive to complete the questionnaire.

Survey development

All data were collected through a self-administered questionnaire adopted and modified from previously published

studies of the research group (11–20). The questionnaire required 5–10 min to complete and capture the following information: a) sociodemographic, general, and professional characteristics (14 questions), including gender, age, relationship status, degree of education, professional role, duration of employment in the healthcare profession, area of working activity, self-rated health status, and previous COVID-19 infection; b) source(s) from which they receive information related to the second booster dose and whether they would like to get additional information (2 questions); and c) attitudes and behaviors (7 questions). The first comprised 5 items concerning attitudes toward COVID-19 and the second booster dose, using a 10-point Likert-type scale with a response format ranging from 1 = not at all to 10 = a great deal and a 5-point Liker-type scale ranging from 1 = strongly disagree to 5 = strongly agree, assessing whether the responder had been/had not been vaccinated with a second booster dose and the related reason(s). Those unvaccinated were asked to indicate whether they were willing or unwilling to receive a second booster dose and the underlying reasons in favor of or against receiving this vaccination. The survey was first piloted and tested by the research team to assess the feasibility and acceptability of the questions.

Ethical approval of the study protocol and questionnaire was received from the Ethics Committee of the Teaching Hospital of the University of Campania "Luigi Vanvitelli."

Statistical analysis

All statistical analyses were conducted using the software STATA version 15.1. Descriptive statistics were used with frequency, mean, and standard deviation to describe the principal characteristics of the participants, as well as behavior and attitude toward having a second COVID-19 booster dose. Multiple logistic regression models were built using the strategy suggested by Hosmer et al. (21). Each variable was examined by univariate analysis, using the chi-square test and Student's *t*-test, to evaluate predictors of the different outcomes of interest. Only those variables with a $p < 0.25$ in the univariate analysis were entered into three multivariate logistic regression models to assess associations between the main dependent variables and the several independent variables. Then, multivariate logistic regression analysis with backward elimination of any variable that did not contribute to the model on the grounds of the Likelihood Ratio test (cut-off at $p = 0.05$) was performed. Variables whose exclusion altered the coefficient of the remaining variables were kept in the model. Backward stepwise selection has been used with a threshold of $p = 0.2$ and $p = 0.4$, respectively, for the entry or removal of the variables from the final models. Odds ratios (OR) and their corresponding 95% confidence intervals (CI) were calculated in the models. Three outcomes of interest have been identified: a) belief that a second booster dose of the COVID-19 vaccine was useful (1–9 = 0; 10 = 1) (Model 1); b) willingness to receive a second booster dose of the COVID-19 vaccine (no/do not know = 0; yes = 1) (Model 2); c) recommendation of a second booster dose of the COVID-19 vaccine to the patients (no = 0; yes = 1) (Model 3). The following potential determinants were included in all models: gender (female = 0; male = 1); age, in years (continuous); marital status (unmarried/separated/divorced/widowed = 0; married/cohabitant = 1); physicians (no = 0; yes = 1); length of practice, in years (less than three = 0; at least three = 1); having worked in a COVID-19 ward (no = 0; yes = 1); having underlying at least one chronic medical condition (no = 0; yes = 1); having been tested positive for COVID-19 (no = 0; yes = 1); at least one family member/colleague/friend who had been tested positive for COVID-19 (no = 0; yes = 1); perceived risk of getting infected with SARS-CoV-2 during the working activity (1–9 = 0; 10 = 1); belief that COVID-19 is a serious disease (1–9 = 0; 10 = 1); belief that HCWs are at a higher risk of being infected by SARS-CoV-2 (strongly disagree/disagree/undecided = 0; agree/strongly agree = 1); scientific journals as source of information about the second booster dose of the COVID-19 vaccine (no = 0; yes = 1); and needing additional information regarding the second booster dose of the COVID-19 vaccine (no = 0; yes = 1). Moreover, the variables belief that the second booster dose of the COVID-19 vaccine was useful (1–9 = 0; 10 = 1) and belief that the second booster dose of the COVID-19 vaccine was effective (1–9 = 0; 10 = 1) were included in Models 2 and 3; and the variable willingness to receive the second booster dose of the COVID-19 vaccine (no/undecided = 0; yes = 1) was included in Model 3. For all analyses, two-tailed tests were used and statistical significance was determined with a *p*-value equal to or less than 0.05.

Results

A total of 496 HCWs, out of the 810 selected, answered the questionnaire with a response rate of 61.2%. The main sociodemographic, general, and professional characteristics of the respondents are summarized in Table 1. The average age was 42.3 years, almost two-thirds were female participants, more than half were nurses/midwives, two-thirds worked in medical wards, almost one-third have had working experience in a COVID-19 ward, the mean length of working activity was 13.7 years, only 15.1% self-identified as having a chronic medical condition, more than half have had COVID-19, almost all had a family member/colleague/friend who tested positive for COVID-19, and only 25 of the 52 eligible has been vaccinated with a second booster dose.

The results regarding the attitudes, measured on a 10-point Likert-type scale, showed that the mean scores of the respondent's belief that COVID-19 was a severe disease and

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TABLE 1 Main sociodemographic and general characteristics of the sample.

Characteristics	*N*	%
Age, years (496)	42.3±12.4 (22-78)*	
Gender (493)		
Male	181	36.7
Female	312	63.3
Marital status (446)		
Married/cohabited with a partner	272	61.0
Unmarried/separated/divorced/widowed	174	39.0
Professional role (493)		
Physician	185	37.5
Nurse/Midwife	257	52.1
Other	51	10.4
Length of practice, in years (458)	13.7±11.7 (1-41)*	
Less than three	106	23.1
At least three	352	76.9
Current working area (496)		
Medical	369	74.3
Surgical	83	16.8
COVID-19 ward	44	8.9
Having ever worked in a COVID-19 ward (493)		
No	348	70.6
Yes	145	29.4
At least one chronic medical condition (495)		
No	420	84.9
Yes	75	15.1
Having been vaccinated against COVID-19 (490)		
No	1	0.2
Yes	489	99.8
With less than three doses	25	5.1
With at least three doses	464	94.9
Having been vaccinated against COVID-19 with a second booster dose (among eligible) (52)		
No	27	51.9
Yes	25	48.1
Having been tested positive for COVID-19 (493)		
No	210	42.6
Yes	283	57.4
Once (281)	244	86.8
More than once (281)	37	13.2
At least one family member/colleague/friend who tested positive for COVID-19 (476)		
No	27	5.7
Yes	449	94.3
Having been vaccinated against influenza in the previous year (496)		
No	331	66.7
Yes	165	33.3

In brackets is reported the number of respondents for each variable.
*Mean ± Standard deviation (range).

whether they feel at risk of being infected by SARS-CoV-2 during the working activity were 7.4 and 6.8, respectively, with 19.6% believing themselves to be at an elevated risk (as by indicated a value of 10). The mean scores regarding the usefulness and efficacy of a second booster dose of the COVID-19 vaccine were 6.7 and 6, respectively, with only 20.8% and 16.4% of participants who had indicated a score of 10. Table 2 presents the results from the three multivariate logistic regression models examining the relationship between several variables and the different outcomes of interest. The first model showed that a score of 10 regarding the usefulness of a second booster dose of the COVID-19 vaccine was more likely to be observed in physicians (OR: 1.99, 95% CI: 1.14–3.46), in those who have a higher belief that COVID-19 was a severe disease (OR: 4.47, 95% CI: 2.39–8.37), and in those who have acquired information about the second booster dose of the COVID-19 vaccine from scientific journals (OR: 2.24, 95% CI: 1.31–3.85).

Among those respondents who had not had the second booster dose of the COVID-19 vaccine, 52.6% self-reported a willingness to receive it, and 25.1% and 22.3% indicated that they had "no intention" or showed "uncertainty." The main self-reported reasons for those who had a positive intention were to protect their family members (49.6%) and their patients (42.9%) and the fear of acquiring the infection (37.6%). The main reasons for not getting vaccinated or for uncertainty, however, were that the dose does not offer protection against the emerging variants (54.6%) and the fear of its side effects (27%). Three variables were found to be associated with the HCWs' willingness to receive a second booster dose in the multivariate logistic regression analysis. Respondents who believed that HCWs are at higher risk of being infected by SARS-CoV-2 (OR: 1.89, 95% CI: 1.13–3.19), those who have a higher belief that COVID-19 was a severe disease (OR: 2.01, 95% CI: 1.06–3.77), and those who have a higher belief that a second booster dose is useful (OR: 2.71, 95% CI: 1.47–5.01) were more willing to receive a second booster dose of the COVID-19 vaccine (Model 2 in Table 2). A total of 75.3% of HCWs recommend the booster dose to their patients, whereas among those who did not recommend it, 83.6% were unwilling to make the recommendation. HCWs were more likely to recommend the booster dose to the patients if they were younger (OR: 0.96, 95% CI: 0.93–0.99), physicians (OR: 2.45, 95% CI: 1.20–4.97), have a higher belief that a second booster dose is useful (OR: 6.78, 95% CI: 1.88–24.43), and if they were more willing to receive a second booster dose (OR: 10.21, 95% CI: 5.19–20.06) (Model 3 in Table 2).

Almost all HCWs had received information about the second COVID-19 booster dose (96.6%). The internet (51.8%), mass media (48.6%), scientific meetings (48.2%), and scientific journals (41.5%) were indicated as primary sources for this information, followed by social networks (26.7%). More than one-third of the respondents expressed an interest in acquiring additional information about the second booster dose (36.3%).

TABLE 2 Results of the multivariate logistic regression analysis showing determinants of the different outcomes of interest.

Variable	OR	SE	95% CI	*p*
Model 1. Belief that a second booster dose of the COVID-19 vaccine was useful (Sample size=491)				
Log likelihood = −201.31, $\chi^2 = 62.76$ (6 df), $p < 0.0001$				
Higher perception of the severity of COVID-19	4.47	1.43	2.39-8.37	<0.001
Having received information on a second booster dose of the COVID-19 vaccine from scientific journals	2.24	0.62	1.31-3.85	0.004
Physicians	1.99	0.56	1.14-3.46	0.015
Higher perceived risk of being infected by SARS-CoV-2 during the working activity	1.86	0.61	0.98-3.53	0.058
Not having been tested positive for COVID-19	0.63	0.16	0.38-1.04	0.072
Knowing at least one family member/colleague/friend who tested positive for COVID-19	2.96	2.31	0.64-13.71	0.165
Model 2. Willingness to receive a second booster dose of the COVID-19 vaccine (Sample size=431)				
Log likelihood = −240.39, $\chi^2 = 45.16$ (8 df), $p < 0.0001$				
Higher perception of the utility of a second booster dose of the COVID-19 vaccine	2.71	0.85	1.47-5.01	0.001
Believing that HCWs are at high risk of being infected by SARS-CoV-2	1.89	0.51	1.13-3.19	0.016
Higher perception of the severity of COVID-19	2.01	0.65	1.06-3.77	0.031
Having received information on a second booster dose of the COVID-19 vaccine from scientific journals	1.54	0.37	0.96-2.47	0.072
No need to receive additional information about a second booster dose of the COVID-19 vaccine	0.74	0.17	0.47-1.16	0.19
Less than three years of practice	0.69	0.19	0.39-1.21	0.2
Physicians	1.32	0.34	0.79-2.21	0.282
Not having any chronic medical condition	0.73	0.24	0.39-1.39	0.344
Model 3. HCWs who recommend a second booster dose of the COVID-19 vaccine to their patients (Sample size=462)				
Log likelihood = −148.73, $\chi^2 = 102.35$ (7 df), $p < 0.0001$				
Willingness to receive a second booster dose of the COVID-19 vaccine	10.21	3.52	5.19-20.06	<0.001
Higher perception of the utility of a second booster dose of the COVID-19 vaccine	6.78	4.43	1.88-24.43	0.003
Younger	0.96	0.01	0.93-0.99	0.005
Physicians	2.45	0.88	1.20-4.97	0.013
At least three years of practice	1.96	0.85	0.84-4.58	0.12
Higher perceived risk of being infected by SARS-CoV-2 during the working activity	1.86	0.78	0.82-4.25	0.14
Not having received information on a second booster dose of the COVID-19 vaccine from scientific journals	0.73	0.24	0.38-1.40	0.173

Discussion

To our knowledge, this is the largest survey of HCWs' willingness to have a second booster dose of the COVID-19 vaccine and the factors associated with this decision conducted in Italy. The major findings can be summarized in the following five points. First, slightly more than 50% of the sample would accept a second booster dose of the COVID-19 vaccine. Second, the main reasons behind the willingness to have a second booster dose were to protect family members and patients. Third, the main reasons for the intention to not receive or uncertainty toward the second booster dose were the belief that it does not offer protection against the emerging variants and the fear of side effects. Fourth, scientific meetings and journals were among the primary sources of information on the second booster dose. Fifth, several determinants have been observed to be significantly associated with the different outcomes of interest.

Overall, the present survey revealed that only 52.6% of respondents self-reported a willingness to receive a second booster dose. Though it is only mandatory for HCWs to have the first COVID-19 booster dose, it was nonetheless a striking and unexpected finding that very few (48.1%) eligible HCWs had received a second booster dose. The prevalence of this willingness was lower than the values observed among HCWs

in Saudi Arabia (55.3%) (22), Czechia (71.3%) (23), and China (87%) (24). A surprising finding was that this value was also considerably lower than those in the general population in India (59.1%) (25), the Middle East and North Africa Region (60.2%) (26), China (91.1%) (27), Japan (97.8%) (28), university students and staff in Italy (85.7%) (15), and the United States (96.2%) (29). The finding of the present study is of great concern because HCWs have a higher risk of infection with SARS-CoV-2 than the general population; in Italy, since the beginning of the pandemic as of September 2021, there have been 3,970 deaths among HCWs out of a total of 124,000 (30). This alarming picture has had an important impact on the healthcare delivery system, with the difficulty in maintaining levels of care and in responding to the population's needs. Therefore, it is important to increase willingness and uptake of a second COVID-19 booster dose since it has been reported in the literature that vaccinated HCWs, as other groups of individuals, have a considerable influence on their patient's intention to get vaccinated or more likely to deliver the vaccinations (31–34).

This study highlighted that the protection of their family members and patients and the fear of acquiring the infection were the most frequent reasons for the willingness to receive a second booster dose of the COVID-19 vaccine. These findings are consistent with other recent similar research studies (35–38). A possible explanation for the protection of the family is that household transmission has been observed as one of the most common primary routes of SARS-CoV-2 transmission (39–43). Therefore, vaccines and boosters are the best primary interventions for preventing SARS-CoV-2 transmission since, in the household, it is not easy to maintain social distancing, avoid close contacts, and wear masks. Moreover, among those HCWs who did not intend to receive the second booster dose or were uncertain, concerns about the safety and effectiveness of the vaccine against the emerging variants were the most common reasons. Previous studies among different samples and geographic areas have linked these reasons with hesitancy or unwillingness to get vaccinated against COVID-19 (44–48). Addressing these concerns is of crucial importance to improve the uptake of a second booster dose also at the population level through evidence-based messages considering the pivotal role of the HCWs in community health.

The results of the multivariate logistic regression analysis showed that several factors were significant predictors of attitude, vaccine willingness, and vaccine recommendation. Of the several sociodemographic and professional characteristics, only age and professional role were associated with the outcomes of interest. Indeed, physicians indicated a higher score regarding the usefulness of a second booster dose of the COVID-19 vaccine, and as, those younger, they were more likely to recommend this booster dose to the patients and more willing to receive it. Moreover, three variables related to the respondents' attitudes have had a significant impact. HCWs who believed that COVID-19 was a serious disease and who believed that they are at higher risk of being infected by SARS-CoV-2 were more likely to believe that the second booster dose is useful and more willing to receive the booster dose, and HCWs who believed that the second booster dose is useful and who were willing to receive it were more likely to recommend the booster dose to the patients. Therefore, it is extremely important that the HCWs should be aware of the vaccine's effectiveness in preventing SARS-CoV-2 infection and to improve their attitudes as an effective way to enhance HCWs' willingness to be vaccinated with a second booster dose of the COVID-19 vaccine or to recommend it. Some of these associations have been observed in a previous investigation (49).

This present survey showed that almost all HCWs had received information related to a second booster dose of the COVID-19 vaccine, with scientific meetings and journals being two of the most trusted sources. It is important to highlight that scientific journals have a significant effect on the higher belief regarding the usefulness of a second booster dose. This finding confirms that these sources are an important factor in the vaccination process and decision. Indeed, this association is in accordance with previous studies that showed that scientific journals played a significant role in determining a higher level of knowledge, a more positive attitude, an increase in the willingness to receive a vaccine, and a higher vaccination coverage among those who have acquired information from these sources (17, 18). Moreover, it should also be noted that mass media, social media, and the internet were also accepted by many HCWs. However, these sources need to be carefully used because evidence indicated that there is the possibility of the spread of untrue and negative information, resulting in worry about the COVID-19 vaccination, lower coverage, and higher hesitancy (50, 51). It is interesting to observe that a systematic review of the reviews regarding infodemics and health misinformation indicated that social media has been increasingly propagating poor quality health-related information during pandemics and health emergencies (52).

The results from the present survey should also be considered with some potential methodological limitations. First, as in all cross-sectional studies, no causal relationships between the independent variables and the different outcomes of interest can be established. Second, the survey was administered to HCWs in a single geographic area, and therefore, the findings may not necessarily apply to other areas of Italy. Third, a self-reporting questionnaire may have introduced social desirability bias and the surveyed HCWs may tend to have more positive attitudes that lead to an overestimation of their intention to have a second booster dose of the COVID-19 vaccine. However, an anonymous questionnaire has been used to reduce this bias. Despite these limitations, this study was the first to assess the willingness to have a second booster dose among HCWs in Italy, and it thus provides an important picture with important implications for health policymakers.

In conclusion, this survey reveals a low willingness to receive a second booster dose, the facilitators and barriers influencing this willingness, and the factors associated with this choice. The findings have important implications and highlight the necessity for designing and implementing targeted education interventions for improving the second booster dose of the COVID-19 vaccine uptake among HCWs and their capacity to recommend the vaccine to the patients. In the future, investigations are expected to quantify the coverage level in HCWs and to evaluate whether they can promote this vaccination with special attention toward more vulnerable people.

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Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Teaching Hospital of the University of Campania Luigi Vanvitelli. The patients/participants provided their written informed consent to participate in this study.

Author contributions

GDP, GMdG, LF, and AN participated in the conception and design of the study and contributed to the data collection, data analysis, and interpretation. IFA the principal investigator, designed the study, was responsible for the statistical analysis and interpretation, drafted and wrote the article. All authors have read and approved the final version of the article and agree to be accountable for all aspects of the work.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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COVID-19 vaccine acceptance and associated factors among health workers in West Guji zone, Southern Ethiopia: Cross-sectional study

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Background: Currently, different COVID-19 vaccines are being developed and distributed worldwide to increase the proportion of the vaccinated people and as a result to halt the pandemic. However, the vaccination progress is different from place to place even among health care workers due to variation in vaccine acceptance. Therefore, this study aimed to assess the acceptance of COVID-19 vaccine and determinant factors among healthcare workers in west Guji zone, southern Ethiopia.

Method and materials: An institutional-based cross-sectional study design was employed to assess COVID-19 vaccine acceptance and associated factors among health care workers from July to August 2021. A simple random sampling technique was used to choose 421 representative healthcare workers from three hospitals in the west Guji Zone. The self-administrated questionnaire was used to collect data. Bivariate and multivariable logistic regression analyses were computed to identify factors associated with the acceptance of the COVID-19 vaccine. $P < 0.05$ was considered for significantly associated factors.

Result: From the representative health workers, 57, 47.02, and 57.9% of healthcare workers had good practice of COVID-19 prevention, adequate knowledge, and a positive attitude toward the COVID-19 vaccine consecutively. 38.1% of healthcare workers said they had a willingness to accept the COVI-19 vaccine. Profession (AOR-6, CI: 2.92–8.22), previous history of vaccine side effects (AOR: 3.67, CI: 2.75–11.41), positive attitude toward vaccine acceptance (AOR: 1.38, CI: 1.18–3.29), adequate knowledge toward COVID-19 vaccine (AOR: 3.33, CI: 1.36–8.12), and adequate practice of COVID-19 prevention measure (AOR: 3.45, CI: 1.39–8.61) were significant associated with COVID-19 vaccine acceptance.

Conclusion: The proportion of COVID-19 vaccine acceptance among health workers was found to be low. From the study variables, profession, previous history of vaccine side effects, positive attitude toward vaccine acceptance, adequate knowledge to ward off COVID-19 vaccine, and adequate practice of COVID-19 prevention measures were significantly associated with COVID-19 vaccine acceptance.

KEYWORDS

COVID-19, vaccine, acceptance, healthcare workers, Ethiopia

1. Background

The COVID-19 pandemic has been a worldwide problem, with which all were challenged to control the spread of COVID-19 (1, 2). Over 235 million confirmed cases of SARS- CoV-2 infection as of October 2, 2021, with over 4.8 million documented fatalities, were found in 223 different country parts of the world (3). Since there were no known treatments for this pandemic, a number of strong interventions were used, including lockdowns, travel bans, isolation, closing schools and workplaces, limiting the size of gatherings, and the release of guidelines that included stringent public health measures like the wearing of masks, frequent hand washing, cleaning of surfaces, and social distancing policies (4, 5).

Healthcare professionals are at significant risk of contracting COVID-19 despite the fact that COVID-19 affects the entire community since they are frequently exposed to SARS-CoV-2 patients (6, 7). Protecting them from infection is crucial for their own health as well as the preservation of healthcare resources as it is estimated that at least 20% of healthcare professionals have the virus (6). Vaccines save millions of lives each year by preventing disease, disability, and death (8, 9). In order to boost vaccination uptake and create herd immunity to COVID-19, achieving high vaccination coverage among healthcare professionals helps to preserve the lives of health workers and also makes them role models for their family and patients (attendants) (10). Because of past influenza experiences, vaccination has been identified as the most effective way to stop outbreaks, lower morbidity, and death, particularly for healthcare workers (11).

Starting from an early time, vaccine hesitancy (VH) is an emerging public health challenge resulting from misinformation related to vaccine effectiveness and safety (12, 13). Immunization program success is being hindered by the rise of vaccine hesitancy, which is posing a threat to outbreaks of diseases that can be prevented by vaccination (12). One of the top 10 dangers to world health, according to WHO in 2019, is vaccination reluctance (14).

A study conducted in Vietnam on COVID-19 vaccine acceptance among health care workers showed 76.10% willingness to be vaccinated (7). Another study done in Ghana discovered that 39.3% of healthcare workers intended to receive the COVID-19 vaccine, and variables like sex, category of healthcare workers, relative having the disease, and confidence in the effectiveness of the government's COVID-19 prevention measures proved to be important predictors of vaccine acceptability (15).

COVID-19 vaccinations are being donated to developing nations like Ethiopia by a variety of donor nations in order to immunize high-risk populations like medical personnel and persons with chronic conditions (16). Even though Ethiopia is gaining vaccines, COVID-19 vaccine acceptance among health workers and the factors affecting it are not known. As with previous studies on COVID-19 vaccine acceptance, they have demonstrated that the acceptability of the vaccine differs depending on socio-demographic factors, such as race and educational level, as well as attitudes and beliefs regarding COVID-19 infection and vaccination (7, 17, 18). Responses in various nations indicate that acceptability of the COVID-19 vaccine has a significant degree of heterogeneity, according to a global survey that included 19 countries (19). As a result, it's critical to understand a vaccine is accepted in a given nation or region. In order to provide recommendations for ways to have a successful and seamless vaccination roll out plan for COVID-19, this study sought to explore the COVID-19 vaccine acceptance and associated factors among healthcare personnel.

2. Material and methods

2.1. Study area and period

This study was conducted in west Guji, which is located in southern Ethiopia. It is bordered on the south by the Borena zone; on the west by the Southern Nations, Nationalities, and Peoples Region; on the north by the Gedeo Zone of the Southern Nations, Nationalities, and Peoples Region and Sidama Region; and on the east by the Guji Zone. Its administrative center is Bule Hora Town. This zone has a total population of 1,424,267, of whom 105,443 are urban residents. The West Guji Zone had a total of three hospitals and 656 health workers.

2.2. Study design

The COVID-19 vaccine acceptance and associated factors were studied using an institutional-based cross-sectional study design.

2.3. Source population

The source population in this study was total health workers in west Guji zone public health hospitals.

2.4. Study population

Randomly selected representative health workers were the study population.

2.5. Study variables

2.5.1. Dependent variable

COVID-19 vaccine acceptance.

2.5.2. Independent variable

- Socio-demographic factor.
  - ✓ Sex.
  - ✓ Age.
  - ✓ Marital status.
  - ✓ Educational status.
  - ✓ Profession.
  - ✓ History of COVID-19 infection.
  - ✓ Previous vaccination history.
  - ✓ Family morbidity/death due to COVID-19.
- Knowledge of the workers.
- Attitude of workers.

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2.6. Exclusion criteria

Worker on annual leave and severely ill during data collection.

2.7. Inclusion criteria

Nurses, medical doctors, midwife, medical laboratory workers, and other health workers were included in this study.

2.8. Sample size determination

The sample size was calculated using a single population proportion formula with a 95% confidence level assumption, a margin of error of 5%, and a 48.4% proportion of COVID-19 vaccine acceptance by health workers in south western Ethiopia (18) and a 10% non-response rate, yielding a final sample size of 421. Then the predetermined sample was proportionally allocated to three hospitals and a sample size of 211,114 and 96 health workers were drawn from Bule Hora Teaching Hospital, Melka Soda, and Kercha hospitals respectively.

2.9. Sampling technique and procedure

A simple random sampling technique was used to select study participants. The lists of total health workers, which serve as a frame of reference, were taken from hospitals' human resource offices. During data collection, the COVID-19 prevention measurement was implemented to minimize the risk of disease transmission. Questioners were distributed to the randomly selected health workers and fielded by them themselves (i.e., it was self-administrated).

2.10. A data collection tool

The structured self-administrated questionnaire was adapted after reviewing articles and guidelines (18, 20, 21). The questionnaire was prepared in English, translated to the local language, and then re-translated back to English to ensure consistency. The questionnaire contained eight parts, which were socio-demographic, health status and COVID-19 experience of health professionals, practice questions toward COVID-19, knowledge related factors of the respondents toward the COVID-19 vaccine, attitude toward the COVID-19 vaccine acceptance, and vaccine acceptance of health workers.

2.11. Quality control of data

Before actual data collection and revisions were completed, a pre-test was conducted on 5% of the sample of Yabelo hospital's medical staff. To guarantee the quality of the data, training was provided to data collectors and supervisors on the study's goal, its data collection methods, and its ethical considerations. The supervisors reviewed the accuracy and consistency of the data every day.

2.12. Data analysis

The data was checked, coded, and entered into Epi-data version 3.1 before being exported to SPSS version 26 for cleaning and analysis. Bivariate logistic regression was used to analyze the data and variables with a $p \leq 0.25$ were selected for the multivariable logistic regression analysis. Multivariable logistic regression was computed to identify factors associated with vaccine acceptance among health workers. The variables with a $p < 0.050$ were taken as statistically significant associated with vaccine acceptance of health workers. The association was also presented with an AOR (adjusted odd ration) and a 95% confidence interval. Model fitness was checked using the Hosmer Lemeshow test.

TABLE 1 The socio-demographic characteristics of health workers of west Guji Zone, South Ethiopia 2021.

S. no	Variable		Frequency	Percent
1	Age	>30	340	80.7
		31–40	44	10.4
		41–59	37	8.9
2	Sex	Male	248	58.9
		Female	173	41.1
3	Marital status	Single	175	41.6
		Married	233	55.4
		Widowed	13	3.0
4	Profession	Nurse	173	41.1
		Physician (doctor)	44	10.4
		Midwifery	129	30.7
		Medical laboratory	21	5
		Pharmacy	54	12.9
5	Qualification	Diploma	90	21.3
		Degree	325	77.2
		Masters	6	1.5
6	Income in dollar ($)	68.4	123	29.2
		91.2	94	22.3
		91.3–182.4	140	33.2
		>182.4	64	15.3
7	Use of broadcast media	Yes	311	73.8
		No	110	26.2
8	Trained on COVID-19	Yes	184	43.6
		No	237	56.4

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TABLE 2 The health status and COVID-19 experience of health the professionals 2021.

S. no	Variable		Frequency	Percent (%)
1	Personal history of COVID-19 infection	Yes	27	6.5
		No	394	93.5
2	Know any friends, neighbors, or colleagues infected by Coronavirus	Yes	171	40.6
		No	250	59.4
3	Have tested for COVID-19	Yes	125	29.7
		No	296	70.3
4	Result of COVID-19 test	Positive	27	21.7
		Negative	98	78.3
5	Heard about the COVID-19 vaccine	Yes	329	78.2
		No	92	21.8
6	Do you have any of the chronic disease	Yes	27	6.4
		No	394	93.6
7	Have receive any type of vaccine previously	Yes	313	74.3
		No	108	25.7
8	If Question no. 7 is "yes" is there any vaccine side effect that was manifested on you?	Yes	119	38.1
		No	194	61.9

2.13. Ethical clearance

Ethical clearance to undertake the study was obtained from the Bule Hora University Institute of Health Research and Community Service Directorate ethical review board. Informed consent was obtained from the chief clinical director of the hospitals and health workers after a brief explanation of the benefits of the study.

2.14. Operational definition

2.14.1. Adequate knowledge

Knowledge scores above or equal to the mean score were assigned for adequate knowledge.

2.14.2. Inadequate knowledge

Knowledge scores below the mean score were assigned for inadequate knowledge.

2.14.3. Adequate practice

Practice scores above or equal to the mean score were assigned for adequate practice.

2.14.4. Inadequate practice

Practice scores below the mean score were assigned for inadequate practice.

2.14.5. Positive attitude

Attitude scores above or equal to the mean score were assigned for positive attitude.

2.14.6. Negative attitude

Attitude scores below the mean score were assigned for negative attitude.

3. Results

3.1. Socio-demographic characteristics

A total of 421 self-administrated questions were returned with a response rate of 100%. The majority of the respondents were male (58.9%), aged > 30 (80.7%), married (55.4%), nurses (41.1%), degree holders (77.2%), and had an income of 91.3–182.4 dollars (33.2%) (Table 1).

3.2. The health status and COVID-19 experience of healthcare professionals

Of the total participants, 93.5% of them have no personal history of COVID-19. Of the health workers who have tested for COVID-19, 21.7% of the health workers tested positive for the virus. 73.4% of health workers have previously received any type of vaccine and in 38.1% of them, vaccine side effects were manifested (Table 2).

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TABLE 3 The COVID-19 prevention practice of health workers 2021.

S. no	Variable		Frequency	Percent
1	Did the outbreak of the COVID-19 virus make you increase the frequency of washing hands?	Yes	384	91.1
		No	37	8.9
2	Did you carry hand sanitizer with you during the outbreak in Ethiopia?	Yes	358	85.1
		No	63	14.9
3	Did you write down or store in your phone any helpline number to contact in case you suspected that you or someone you know has the COVID-19 virus?	Yes	219	52.0
		No	202	48.0
4	Did you maintain social distance during the outbreak?	Yes	365	86.6
		No	56	13.4
5	Did you cover coughs and sneeze with a tissue/handkerchief during the outbreak?	Yes	181	43.1
		No	240	56.9
6	Did you avoid unnecessary travel or outing during the outbreak?	Yes	189	45
		No	232	55
7	Did you dispose used mask in dust bin?	Yes	373	88.6
		No	48	11.4
8	Do you wash your hands after sneezing or coughing?	Yes	210	49.9
		No	169	40.1
9	Do you touch your face, nose, or mouth with your unclean hands?	Yes	184	43.6
		No	237	56.4
10	In order to prevent contracting and spreading COVID-19 I avoid handshaking, hugging and kissing	Yes	367	87.1
		No	54	12.9

3.3. Healthcare workers' COVID-19 prevention practices

Of total health workers, 57% of them had good practice of COVID-19 prevention measures. The majority (91.1%) had washed their hands regularly or frequently. However, 56.9 % of the workers didn't cover their cough and sneeze with tissue/handkerchief (Table 3).

3.4. Knowledge of the respondents toward the COVID-19 vaccine

Among the health workers, only 47.02% have good knowledge of the COVID-19 vaccine. 77.2% of the health profession responded that COVID-19 was not completely safe and 19.3% of the workers didn't know that the COVID-19 vaccine started in Ethiopia (Table 4).

3.5. Attitude toward the COVID-19 vaccine acceptance

From total health workers, 57.9% had a positive attitude toward the COVID-19 vaccine. Only 43.6% of health workers believed the COVID-19 vaccine was necessary to prevent COVID-19 and 93.1% of health workers believed the COVID-19 vaccine had side effects (Table 5).

3.6. Acceptance of the COVID-19 vaccine

Among the study participants, 61.9% didn't have the willingness to receive the COVID-19 vaccine and the major reasons for not accepting the vaccine were fear of side effects (34%) (Table 6).

3.7. Factors associated with COVID-19 vaccine acceptance

Multivariate analysis reveals that healthcare workers with a physician profession were 6 times more likely to accept the COVID-19 vaccine. Health workers who have adequate COVID-19 prevention practice were 3.45 times more likely to accept the COVID-19 vaccine than the rest (Table 7).

4. Discussion

Vaccines are one of the most important means of disease prevention during a pandemic (22). The effectiveness of vaccination is determined by the acceptance of vaccines by the community (23).

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TABLE 4 Knowledge of the respondents toward COVID-19 vaccine.

S. no	Variable		Frequency	Percent
1	Vaccine will help to provide long term immunity	Yes	384	91.1
		No	37	8.9
2	Vaccine helps to reduce risk of virus infection	Yes	400	95.0
		No	21	5.0
3	AstraZeneca and Covishield are the two vaccines used in Ethiopian	Yes	311	73.8
		No	110	26.2
4	Vaccination is an effective way to prevent and control COVID-19	Yes	117	27.7
		No	304	72.3
5	COVID-19 is affect more elder than young people	Yes	386	91.6
		No	35	8.4
6	COVID-19 vaccine is completely safe	Yes	96	22.8
		No	325	77.2
7	The vaccine of COVID-19 has started in Ethiopia	Yes	340	80.7
		No	81	19.3
8	Do you have a high risk of COVID-19 transmission at work	Yes	333	79.2
		No	88	20.8

TABLE 5 Attitude toward the COVID-19 vaccine acceptance.

S. no	Variable		Frequency	Percent
1	Do you have trust on COVID-19 vaccine	Yes	271	64.4
		No	150	35.6
2	Do you believe that COVID-19 vaccine has side effect	Yes	392	93.1
		No	29	6.9
3	Do you believe that taking COVID-19 vaccine can contradict with your religion	Yes	125	29.7
		No	296	70.3
4	Do you think you are susceptible to the infection of COVID-19 diseases	Yes	263	62.4
		No	158	37.6
5	Do you believe that the vaccine is necessary for the prevention of COVID-19	Yes	184	43.6
		No	237	56.4
6	It is not possible to reduce the incidence of COVID-19 without vaccination	Yes	325	77.2
		No	96	22.8

The recent studies focused on the COVID-19 vaccine acceptance by healthcare workers and associated factors. The response rate in this study was 100%, probably healthcare workers have an attitude to take part in survey or cross sectional study and response rate is higher than the one reported by similar studies (ranging from 63 to 90%) (24). One of the key elements influencing health care workers' intentions to obtain the COVID-19 immunization is knowledge. The findings of this study reveal that only 47.02% of the health workers had adequate knowledge about the COVID-19 vaccine. This finding was lower than studies conducted on health workers located in south western Ethiopia (16) and Pakistan (22). This discrepancy may be explained by variations in study environments, study times, and the involvement of regulatory bodies in the dissemination of COVID-19 vaccination knowledge.

In this finding, the knowledge of health workers toward vaccines was associated with COVID-19 vaccine acceptance (AOR = 3.33, 95% CI: 1.366–8.112) and it indicates improving awareness of health workers is necessary to increase COVID-19 vaccine acceptance in Ethiopia. This study was similar to a study conducted in Vietnam which found that people who had good knowledge were 3.37 times more likely to have vaccine acceptance (AOR = 3.37; 95% CI: 1.04–10.86, $P < 0.05$) (7).

Furthermore, this study also reveals that 57% of the health workers had adequate COVID-19 prevention practice but, specifically, 56.9% of the workers didn't use tissue/handkerchief to cover their cough and sneeze. Workers' practice was also associated with vaccine acceptance; those who had adequate practice for

TABLE 6 COVID-19 vaccine acceptance.

S. no	Variable		Frequency	Percent
1	Are you willingness to accept COVID-19 vaccine if it will available for you?	Yes	160	38.1
		No	261	61.9
2	If question above was No. what the reason?	Inadequate data about the safety of the vaccine	56	21.3
		Fear of adverse effects of the vaccine	89	34
		Vaccine causing COVID-19	4	1.5
		I prefer other ways of protection	18	7
		Prior adverse reaction to any vaccine	55	21
		Religion issue	40	15.2

TABLE 7 Factor associated with COVID-19 vaccine acceptance.

Variable	Univariate analysis		Multivariate logistic regression	
	COR (CI)	*P*-value	AOR (CI)	*P*-value
Profession				
Nurse	1	1	1	
Doctor	5.6 (3.03–7.91)	<0.001	6 (2.92–8.22)*	<0.001
Pharmacy	1.08 (0.55–12.75)	0.78	0.14 (0.01–2.83)	0.89
Midwifery	1.92 (0.60–5.35)	0.26	1.76 (1.97–2.18)	0.23
Medical laboratory	0.07 (0.02–9.55)	0.98	1.19 (0.78–3.76)	0.43
Marital status				
Single	1	1	1	
Married	2.14 (0.03–3.78)	0.54	1.22 (1.67–5.24)	0.114
Widowed	1.12 (0.45–2.87)	0.512	1.33 (0.026–0.67)	0.322
Divorced	0.89 (0.12–2.76)	0.887	0.18 (0.372–3.136)	0.97
Any vaccine side effect that was manifested previously (yes/no)	2.15 (1.196–3.858)	0.010	3.67(2.75–11.41)*	0.000
Sex (male vs. female)	0.529 (0.297–0.944)	0.31	1.23 (0.76–5.7)	0.13
Training on vaccine (yes/no)	2.93 (1.630–5.277)	0.012	1.49 (0.32–9.19)	0.071
Know any friends, neighbors, or colleagues infected by Coronavirus (yes/no)	1.95 (1.096–3.494)	0.023	0.99 (0.31–3.25)	0.993
Use of medias (yes/no)	0.540 (0.286–1.021)	0.158	0.245 (0.071–0.84)	0.56
Knowledge of vaccine (Adequate vs. Inadequate)	2.87 (1.592–5.181)	0.000	3.33 (1.36–8.12)*	0.008
Attitude toward vaccine (positive vs. negative)	2.031 (1.138–3.625)	0.017	1.38 (1.18–3.29)*	0.0369
Practice of other COVID-19 prevention measure (adequate vs. Inadequate)	2.37 (1.32–4.26)	0.004	3.46 (1.39–8.61)*	0.008

*Shows variable significant, COR, Crude odd ratio; AOR, Adjusted odd ratio; CI, Confidence interval.

COVID-19 prevention measures were more likely to accept vaccine when it became available to them (AOR = 2.37, 95% CI: 1.32–4.26, $P = 0.004$).

Regarding the attitude of the workers toward vaccines, 57.9% of health workers have a positive attitude and 43.6% of health workers believe the COVID-19 vaccine is necessary to prevent COVID-19. This study was lower than a study conducted in south western Ethiopia, which found 65.6% of workers have a positive attitude (18). A recent study found that vaccine acceptance has a significant association with having a positive attitude toward the vaccine (AOR, 2.031, 95% CI: 1.138–3.625, $p = 0.017$) and it was comparable with other studies (21, 23).

Moreover, 38.1% of the health workers had a willingness to accept the vaccine, which was lower than expected since willingness to accept COVID-19 was expected to be high among health workers. This study finding was lower than studies conducted in Vietnam (7), French (17), and Iran (25) which recorded 76,76.9, and 62.1% of healthcare providers would accept a vaccine, respectively. However, it was higher than the studies done in Congo and Hong Kong, ranging from 27.7 to 40% (20, 24). Acceptance of health workers

is related to educational status, profession, previous vaccine side effects, knowledge, and attitude. This association was supported by other studies conducted in Ethiopia (4, 12), which have found associations between vaccine acceptance and profession, attitude and preventive practice; and Vietnam, which have found associations between vaccine acceptance and profession, use of media, knowledge, and belief (7).

According to the results of the current study, doctors were nearly six times more likely than other health professionals to be willing to receive the COVID-19 vaccine. This result was consistent with another study that found that doctors were more likely than other health workers to accept the COVID-19 immunization (12, 19).

This study has limitations since it was a cross-sectional study and it was done only on health workers in west Guji zone hospitals; it did not include private health organizations or health workers in health centers and other government institutions. However, this finding has come up with concrete data about the vaccine acceptance of health workers in the west Guji Zone.

5. Conclusion

In conclusion, the vaccine acceptance rate (38.1%) of the health works was low. From the study variables, profession, previous history of vaccine side effects, positive attitude toward vaccine acceptance, adequate knowledge to ward off COVID-19 vaccine, and adequate practice of COVID-19 prevention measures were significantly associated with COVID-19 vaccine acceptance. The emphasis should be given for health care workers and the awareness creation should be done special on vaccine safety.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Fistum Demisse. The Ethics Committee waived the requirement of written informed consent for participation.

Author contributions

LA contributed to designing the study, analyzed the data, interpreted the results, and performed the manuscript drafting. DD, HL, and CD contributed to the results interpretation and manuscript drafting. All authors confirmed and approved the final version for submission.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.974850/full#supplementary-material

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Associated factors of burnout among Chinese vaccination staff during COVID-19 epidemic: A cross-sectional study

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Objective: During the COVID-19 epidemic, vaccination staff had three main aspects of work: routine vaccination for children and adults, COVID-19 vaccination and COVID-19 prevention and control. All these works significantly increased the workload of vaccination staff. This study aimed to investigate the prevalence and influencing factors of burnout among vaccination staff in Hangzhou, China.

Methods: A total of 501 vaccination staff from 201 community/township healthcare centers in Hangzhou were recruited using a cross-sectional survey through WeChat social platform. The Maslach Burnout Inventory-General Scale (MBI-GS) was used to assess the level of burnout. Descriptive statistics were made on the characteristics of participants. Univariate analysis using the chi-square test and multivariable analysis using binary logistic regression were conducted to determine the relative predictors of burnout. Univariate analysis and multiple linear regression were used to determine the relative predictors of exhaustive emotion, cynicism, and personal accomplishment.

Results: During the COVID-19 pandemic, 20.8% of the vaccination staff experienced burnout. Educational level above undergraduate education level, medium professional title, and more working time in COVID-19 vaccination work reported a higher degree of job burnout. The vaccination staff was experiencing a high degree of exhaustive emotion, cynicism, and low personal accomplishment. Professional title, working place, and working time for COVID-19 vaccination were associated with exhaustive emotion and cynicism. Professional title and participation time for COVID-19 prevention and control were associated with personal accomplishment.

Conclusions: Our findings suggest that the prevalence rate of burnout is high among vaccination staff during the COVID-19 pandemic, especially with a low level of personal accomplishment. Psychological intervention for vaccination staff is urgently needed.

KEYWORDS

prevalence, vaccination staff, COVID-19, burnout, China

1. Introduction

An unprecedented outbreak of pneumonia of unknown etiology in Wuhan, Hubei Province, China, emerged in December 2019 (1, 2). It was named coronavirus disease 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus type 2 (SARS-CoV-2) (3). On March 11, 2020, the World Health Organization (WHO) officially classified the global COVID-19 outbreak as a pandemic (4). Although countries worldwide have taken active and effective measures to control the epidemic, the current global epidemic is still severe (5). As of September 22, 2022, 610 million confirmed cases and 6.5 million deaths had been reported globally (6).

Since the outbreak, China, one of the countries with the most severe COVID-19 epidemic in the world, has implemented several strict but effective measures, such as lockdown cities, controlling traffic (7), mass isolation of individuals with cases (8), construction of Fangcang shelter hospitals (9), and public education campaigns encouraging the use of masks and hand washing (10). One of the most effective measures to prevent COVID-19 was COVID-19 vaccination. The COVID-19 vaccine is remarkably effective in preventing severe COVID-19 symptoms and death, and the COVID-19 booster vaccination can further improve the protective effect. Studies found that the risk of developing severe COVID-19 disease for those aged 18 to 59 who had received a booster COVID-19 vaccination was 94% lower than those who did not receive the vaccine. For people 60 and older, the figure is 95% (11). Since July 2020, China has officially launched emergency vaccination for high-risk exposed groups, including frontline medical workers, border and port staff, et al. In December 2020, the vaccination of key population groups, including cold chain logistics staff, medical staff, public transport workers, et al., was launched. Since then, China has gradually expanded the age range for COVID-19 vaccination from 18 years old and above to 3 years old and above. Currently, the inactivated COVID-19 vaccine in China is administered in three doses (12–14).

Vaccination staff at community/township health service centers are the leading force in COVID-19 vaccination in Hangzhou, China. Vaccination staff refers to all the personnel working in the vaccination clinic, including health prechecker, registration personnel, inoculator, logistics manager, etc. According to "Technical specifications for vaccination work" issued by the National Health Commission (15), each town (subdistrict) has a vaccination clinic set up in the community/township health service center. Before the COVID-19 epidemic, the vaccination staff was primarily responsible for childhood vaccination, including Expanded Program on Immunization (EPI) and Non-Expanded Program on Immunization (non-EPI) vaccination, as well as adult vaccination, such as flu vaccine, HPV vaccine, 23-valent pneumonia vaccine, and herpes zoster vaccine, et al. Their work included vaccination, cold chain management, adverse events following immunization (AEFI) reporting, report form filling, vaccine education, and other works. During the COVID-19 pandemic, the job of COVID-19 vaccination had fallen to them. Vaccine recipients are expanded from children and a few adults to the entire population over the age of three. In addition, vaccination staff, as primary care workers, also work on COVID-19 prevention and control, including nucleic acid sampling, elimination, hospital transmission, et al. (16). All these works significantly increased the working hours and workload of the vaccination staff.

According to previous studies, the epidemic of COVID-19 had placed a severe strain on healthcare workers (17–20) and significantly increased psychological problems of job burnout (20). As first described by Freudenberger (21), and subsequently developed by Maslach and Leiter (22) and Maslach et al. (23), chronic stress associated with emotionally intense work demands for which resources are inadequate can result in burnout. The three critical dimensions of this response are overwhelming exhaustion, feminism and detachment from the job, and a sense of ineffectiveness and lack of accomplishment (24). The exhaustion dimension is also described as wearing out, losing enerlosingletion, debilitation, and fatigue. The cynicism dimension was originally called depersonalization (given the nature of human services occupations), but is also described as negative or inappropriate attitudes toward clients, irritability, loss of idealism, and withdrawal. The inefficacy dimension was originally called reduced personal accomplishment and is also described as reduced productivity or capability, low morale, and an inability to cope (24). The first burnout measure based on a comprehensive program of psychometric research was the Maslach Burnout Inventory (MBI). It has been considered the standard tool for research in this field and has been translated and validated in many languages.

Prior studies showed that job burnout was high among medical staff during COVID-19. A survey has reported that 34.7% of physicians suffer from job burnout in Canada (25). In Huo et al. (11) study, about 34.5% of medical staff experienced burnout. For nurses, a study showed that about half of the nurses reported moderate and high work burnout in China (26). It is worth noting that job burnout could have many negative consequences. In terms of work, burnout is frequently associated with various forms of negative reactions and job withdrawal, including job dissatisfaction, low organizational commitment, absenteeism, turnover, lower productivity, and impaired quality of work (27–30). In addition, burnout can be "contagious" (31, 32). It could have a negative impact on colleagues, both by causing more significant personal conflict and by disrupting job tasks. In terms of personal health, burnout could contribute to poor health, which in turn contributes to burnout (33).

Vaccination staff plays an essential role in preventing and controlling the COVID-19 epidemic. They are responsible for routine and COVID-19 vaccination and, meanwhile, like other primary health care workers, for COVID-19 prevention and control. Currently, the COVID-19 pandemic continues to be a global threat, and SARS-CoV-2 is still developing (34). In the future, vaccination with a booster shot of the COVID-19 vaccine is still an important measure to prevent COVID-19 (35). Mass vaccination of the whole population will likely become routine work. Therefore, it is crucial to determine the influencing factors of job burnout of vaccination staff and reduce their job burnout.

There were many studies on job burnout in different medical specialties, such as nurses, doctors, physicians. No

studies on burnout among vaccination staff have been found. This paper filled this gap in the literature by providing an in-depth exploration of the mental health of vaccination staff during the COVID-19 pandemic. This study attempted to gain a deeper understand of this reality and to contribute as much as possible to this important group of vaccination staffs in pandemic. The findings not only offered a scientific foundation for group intervention research involving vaccination staff, but also provided scientific basis for further strengthening the vaccination campaign during the COVID-19 pandemic, and could be a reference for job burnout of vaccination staff in other regions of China.

2. Materials and methods

2.1. Study design and participants

We conducted a cross-sectional survey to assess the job burnout of vaccination staff in Hangzhou, China, during the COVID-19 epidemic from June 10 to 17. Hangzhou, the capital city of Zhejiang Province, is a well-developed city in eastern China. Under the jurisdiction of the City of Hangzhou are 10 urban districts, one county-level city, two counties, and a total of 191 towns (subdistricts). By the end of 2021, Hangzhou's permanent residents population totals 12.204 million (36). Hangzhou had few cases of COVID-19 before 2022, and all were imported cases. Since the beginning of 2022, locally transmitted confirmed cases of COVID-19 emerged in Hangzhou, and several cluster infections occurred. Hangzhou doubled down on efforts to prevention and control the epidemics. According to the above reasons, the information collection in this survey starts in January 2022. To calculate the sample size for this survey, we referred to previous literature (19) and hypothesized that 30% of vaccination staff would have a level of burnout at a margin of error ± 6%, and we assumed a 95% confidence interval, a power of 80%. Using a sample size calculator and considering 14 factors to be entered in the multivariable analysis, the target sample size was 457. Then we added a 10% non-respondent rate, giving a final sample size of 500. To avoid face-to-face interaction, we edited the questionnaire on the Wen Juan Xing online platform, formed a link to the questionnaire, and sent it to each survey respondent *via* WeChat, one of mainland China's most essential and widely used social tools. The respondents answered the self-administered questionnaire by visiting the Uniform Resource Location (URL) on their phones. All 201 vaccination clinics in Hangzhou participated in the survey, and at least two vaccination staff were randomly selected from each clinic to participate in the survey. Finally, a total of 501 vaccination staff were recruited. All the participants were given consent to participate and assured de-identification and confidentiality in handling their data before they answered the questionnaires.

The studies involving human participants were reviewed and approved by the Ethics Committee of the Hangzhou municipal center for disease control and prevention. The participants provided their *written* informed consent to participate in this study.

TABLE 1 Social-demographic and work-related situations of participants.

Variables		*N*	%
Sociodemographic characteristics			
Age	18–30	107	23.4
	31–40	253	50.5
	41–50	104	20.8
	>50	27	5.4
Gender	Men	74	14.8
	Women	427	85.2
Marriage status	Currently married	414	82.6
	Currently not married	87	17.4
Education level	<Undergraduate	132	26.3
	≧Undergraduate	369	73.7
Family income	<5,000 CYN	48	9.6
	5,000–9,999 CYN	205	40.9
	10,000–19,999 CYN	161	32.1
	20,000–29,999 CYN	45	9.0
	≧30,000 CYN	42	8.4
Working years	(Mean ± SD)	14.03 (8.1)	
Professional title	Junior	255	50.9
	Medium	216	43.1
	Senior	30	6.0
Working place	Urban	108	21.6
	Suburb	211	42.1
	Rural	182	36.3
Occupational classification	Health precheck	281	56.1
	Registration	366	73.1
	Inoculation	307	61.3
	Health observation after inoculation	135	26.9
	Logistics management	184	36.7
	Others	26	5.2
Daily vaccination work			
Daily number of vaccinations[a]	<100 persons	237	47.3
	100–199 persons	201	40.1
	200–299 persons	55	11.0
	≧300 persons	8	1.6
Vaccination working days per week	0.5 day	41	81.8
	1 day	182	36.3
	1.5–2 days	74	14.8
	2.5–3 days	159	31.7
	≧3.5 days	45	9.0

(Continued)

TABLE 1 (Continued)

Variables		N	%
COVID-19 vaccination work			
COVID-19 vaccination doses[b]	0–9,999 doses	140	27.9
	10,000–19,999 doses	126	25.1
	20,000–39,999 doses	85	17.0
	40,000–59,999 doses	62	12.4
	≧60,000 doses	88	17.6
Working time	Not participating	30	5.9
	During working hours	72	14.4
	A few of works take up time off work or rest days	299	59.7
	Most of work takes up time off work or rest days	82	16.4
	All the work takes up time off work or rest days	18	3.6
COVID-19 prevention and control work			
Working time	Not participating	23	4.6
	During working hours	45	9.0
	A few of works take up time off work or rest days	260	51.9
	Most of work takes up time off work or rest days	149	29.7
	All the work takes up time off work or rest days	24	4.8
Participation time	Not participating	23	4.6
	<1 week	20	4.0
	1 week−1 month	69	13.8
	1–2 months	107	21.4
	≧2 months	282	56.3

[a]: Daily number of vaccinations for routine vaccines in each vaccination clinic.
[b]: The doses of COVID-19 vaccination in each vaccination clinic in 2022.

2.2. Assessments tools

2.2.1. Assessment of socio-demographic and work-related factors

A self-administered questionnaire was designed to collect socio-demographic information. The following socio-demographic factors were assessed: gender (male/female), age, marital status (currently married, currently not married), education level (less than undergraduate, undergraduate and above), family income (< 5,000 CYN, 5,000–9,999 CYN, 10,000–19,999 CYN, 20,000–29,999 CYN, ≧30,000 CYN), working years, professional title (junior, medium, senior), working place (urban, suburb, rural).

We divided the work of vaccination staff during the epidemic of COVID-19 into three main categories: routine vaccination work, COVID-19 vaccination work, and COVID-19 control, and prevention work. Variables of routine vaccination work included the daily number of vaccinations in each vaccination clinic (< 100 persons, 100–199 persons, 200–299 persons, ≧300 persons), weekly vaccination working days for each vaccination clinic (0.5 days, 1 day, 1.5–2 days, 2.5–3 days, ≧3 days). Variables of COVID-19 vaccination work included the doses of COVID-19 vaccination in each vaccination clinic in 2022 (0–9,999 doses, 10,000–19,999 doses, 20,000–39,999 doses, 40,000–59,999 doses, ≧60,000 doses), the extent to which COVID-19 vaccination work takes up time off work or rest days (not participating, during working time, a few of works take up time off work or rest days, most of work takes up time off work or rest days, all the work takes up time off work or rest days). Variables of COVID-19 prevention and control work included the extent to which COVID-19 prevention and control work takes up time off work or rest days (not participating, during working time, a few of works take up time off work or rest days, most of work takes up time off work or rest days, all the work takes up time off work or rest days), and duration of participation in COVID-19 prevention and control work (not participating, < 1 week, 1 week-1month, 1-2 months, ≧2 months).

2.2.2. Assessments for burnout

The Chinese version of the Maslach Burnout Inventory General Survey (MBI-GS) (37) was used to assess job burnout in this survey, which has been widely used among healthcare workers in China. MBI-GS consists of three dimensions of job burnout: Emotional Exhaustion (EE): (5 items), which means feelings of being emotionally overextended and depleted of one's emotional resources; Cynicism (CY) (4 items), which means a negative, callous, or excessively detached response to other people; Personal Accomplishment (PA): (6 items), which means a decline in one's feelings of competence and achievement in one's work. Each item consists of a 7-point Likert scale: 0 = never, 1 = barely, 2 = occasionally, 3 = often, 4 = frequently, 5 = very frequently, and 6 = every day, ranging from 0 ("never") to 6 ("every day"). Higher scores on the dimensions of EE and CY indicate burnout, and so as the lower scores on the dimension of PA. The MBI-GS has shown good reliability and validity in previous studies in China (38, 39). In this study, the result of reliability analysis showed that the scale was in a high level of internal consistency in all three dimensions in the current sample. The Cronbach's alpha for all 15 items was 0.900, and for EE, CY and PA was 0.963, 0.942, and 0.936, respectively.

Based on several previous studies in China (19, 40), subscales scores are considered as low, moderate, or high level of burnout syndrome according to these cut-points: low EE < 9, moderate EE 9–13, high EE>13; low CY < 3, moderate CY 3–9, high CY>9; low PA < 18, moderate PA 30–18, high PA>30. High EE and high CY or low PA are conditions for burnout ("exhaustion+1"), which is considered to be the most effective categorization to distinguish between individuals with high and low burnout (41).

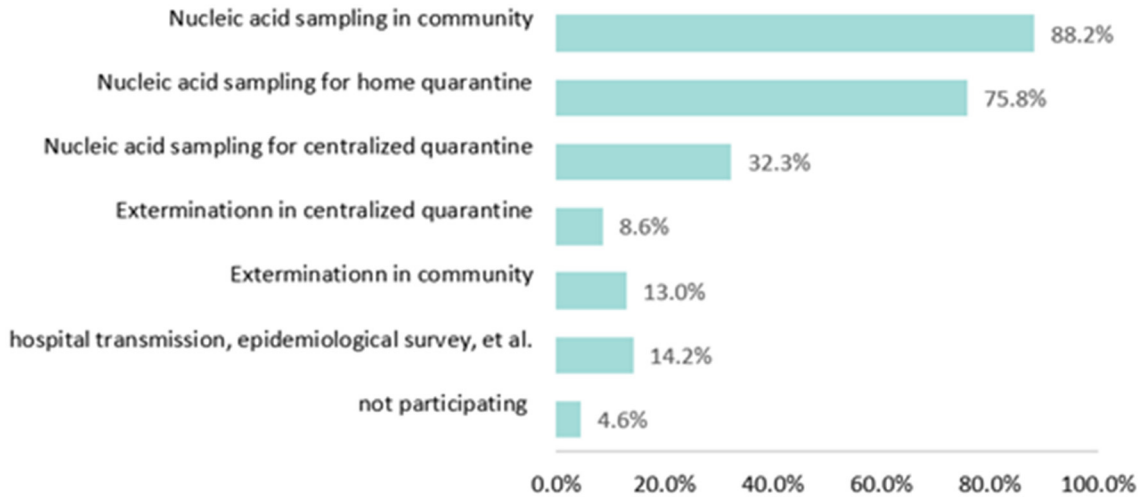

FIGURE 1
Distribution of different types of COVID-19 prevention and control work.

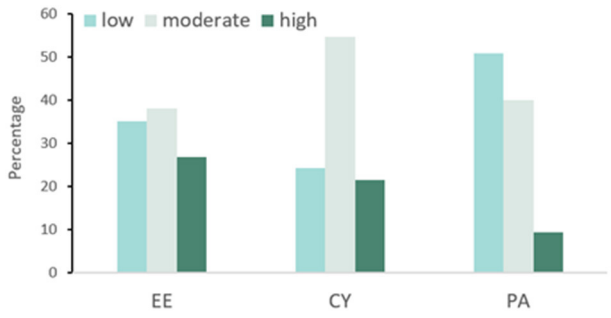

FIGURE 2
Distribution of different severity levels in different dimensions in burnout.

2.3. Statistical analysis

Frequencies and percentages were summarized for the categorical variables. Mean and standard deviation (SD) were calculated for continuous numerical data. Comparisons of sociodemographic and work-related variables of participants between the burnout group and the non-burnout group were analyzed by chi-square test. A multivariable analysis using binary logistic regression was conducted to determine the relative predictors of burnout when controlled for potential confounding among the various predictor variables. Correlates with a $P < 0.1$ in the univariate analysis were included in the multivariable analysis using the "Forward: LR" method. Then, to further identify the independent factors associated with MBI-GS scores, variables with $P < 0.1$ in the univariate analysis were entered into the multiple linear regression, with the MBI-GS subscores as dependent variables. All statistical analyses were conducted using SPSS (version 24.0).

3. Results

3.1. Demographic characteristics and work-related situations of participants

In total, 501 individuals were included in the analysis. Among all the participants, 85.2% were female, and 14.8% were male. Almost half of the participants were in the age range of 31–40 (50.5%). 50.9% had a junior professional title. The majority of participants were married (82.6%), undergraduate and above (73.7%), and had household incomes between 5,000–9,999 CNY (40.9%) and 10,000–19,999 CNY (32.1%). The average working years was 14.03 ± 8.1 years. 36.3% of the participants worked in urban areas, 42.1% in suburbs, and 36.3% in rural areas. Most participants held two or more jobs at the same time. Majority of participants were responsible for registration (73.1%), followed by inoculation (61.3%) and health pre-check (56.1%). Other jobs (5.2%) included report filling, administration, etc.

Regarding routine vaccination work, 47.3% of the participants worked in vaccination clinics with a daily number of vaccinations <100 people. 36.3 and 31.7% of participants worked in the vaccination clinic with 1 day per week and 2.5–3 days per week vaccination working time, respectively.

In terms of COVID-19 vaccination work, 27.9% of the participants worked in vaccination clinics that had administered 0–9,999 doses of COVID-19 vaccine, and the proportion administering 10,000–19,999 doses, 20,000–39,999 doses, 40,000–59,999 doses, and ≧60,000 doses were 25.1, 17.0, 12.4, and 17.6%, respectively. For COVID-19 vaccination working time, more than half of the participants (59.7%) reported that few works took up time off work or rest days.

In terms of COVID-19 prevention and control work, more than half of participants (51.9%) indicated that few works took up time off work or rest days. 56.3% of participants had been involved in this work for over 2 months.

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TABLE 2 Univariate analysis of the associated factors of burnout among vaccination staff.

Variables		No burnout		Burnout		*P*
		N	%	*N*	%	
Sociodemographic characteristics						
Age	18–30	99	84.6%	18	15.4%	**0.009**
	31–40	192	75.9%	61	24.1%	
	41–50	79	76.0%	25	24.0%	
	>50	27	100.0%	0	0.0%	
Gender	Men	59	79.7%	15	20.3%	0.911
	Women	338	79.2%	89	20.8%	
Marriage status	Currently married	323	78.0%	91	22.0%	0.141
	Currently not married	74	85.1%	13	14.9%	
Education level	<Undergraduate	117	88.6%	15	11.4%	**0.002**
	≧Undergraduate	280	75.9%	89	24.1%	
Family income	<5,000 CYN	36	75.0%	12	25.0%	0.102
	5,000–9,999 CYN	172	83.9%	33	16.1%	
	10,000–19,999 CYN	128	79.5%	33	20.5%	
	20,000–29,999 CYN	31	68.9%	14	31.1%	
	≧30,000 CYN	30	71.4%	12	28.6%	
Working years	0–4 years	40	83.3%	8	16.7%	0.34
	5–9 years	74	81.3%	17	18.7%	
	10–19 years	182	75.8%	58	24.2%	
	≧20 years	101	82.8%	21	17.2%	
Professional title	Junior	218	85.5%	37	14.5%	**0.001**
	Medium	154	71.3%	62	28.7%	
	Senior	25	83.3%	5	16.7%	
Working place	Urban	73	67.7%	35	32.4%	**0.002**
	Suburb	169	80.1%	42	19.9%	
	Rural	155	85.2%	27	14.8%	
Daily vaccination work						
Daily number of vaccinations	<100 persons	194	81.9%	43	18.1%	**0.024**
	100–199 persons	159	79.1%	42	20.9%	
	200–299 persons	36	65.5%	19	34.5%	
	≧300 persons	8	100.0%	0	0.0%	
Vaccination working days per week	0.5 day	31	75.6%	10	24.4%	0.264
	1 day	153	84.1%	29	15.9%	
	1.5–2 days	57	77.0%	17	23.0%	
	2.5–3 days	119	74.8%	40	25.2%	
	≧3.5 days	37	82.2%	8	17.8%	
COVID-19 vaccination work						
COVID-19 vaccination doses	0–9,999 doses	118	84.3%	22	15.7%	0.302
	10,000–19,999 doses	99	78.6%	27	21.4%	
	20,000–39,999 doses	63	74.1%	22	25.9%	
	40,000–59,999 doses	51	82.3%	11	17.7%	

(Continued)

TABLE 2 (Continued)

Variables		No burnout		Burnout		*P*
		N	%	*N*	%	
	≧60,000 doses	66	75.0%	22	25.0%	
Working time	Not participating	24	80.0%	6	20.0%	**<0.001**
	During working hours	64	88.9%	8	11.1%	
	A few of works take up time off work or rest days	248	82.9%	51	17.1%	
	Most of work takes up time off work or rest days	51	62.2%	31	37.8%	
	All the work takes up time off work or rest days	10	55.6%	8	44.4%	
COVID-19 prevention and control work						
Working time	Not participating	23	100.0%	0	0.0%	**<0.001**
	During working hours	40	88.9%	5	11.1%	
	A few of works take up time off work or rest days	216	83.1%	44	16.9%	
	Most of work takes up time off work or rest days	104	69.8%	45	30.2%	
	All the work takes up time off work or rest days	14	58.3%	10	41.7%	
Participation time	Not participating	23	100.0%	0	0.0%	**0.026**
	<1 week	19	95.0%	1	5.0%	
	1 week−1 month	55	79.7%	14	20.3%	
	1–2 months	86	80.4%	21	19.6%	
	≧2 months	214	75.9%	68	24.1%	

The bold values in the table indicate that the variables are statistically significant.

More detailed information about participants' demographic and job-related characteristics is shown in Table 1.

As shown in Figure 1, the majority of the vaccination staff participated in nucleic acid sampling work in the community (88.2%) and nucleic acid sampling work for home quarantine (75.7%). About one-third of vaccination staff (32.3%) participated in nucleic acid sampling for centralized quarantine. 14.2% of vaccination staff participated in other prevention and control work for COVID-19, including nucleic acid sampling at highway chokepoints, epidemiological investigation of close contacts, hospital transmission, et al. (Figure 1).

3.2. Prevalence of burnout in vaccination staff

The prevalence of burnout in vaccination staff was 20.8% (104/501). For EE, 26.7% (134/501), 38.1% (191/501), and 35.1% (176/501) vaccination staff were at a high, moderate, and low level, respectively. For CY, high, moderate, and low levels accounted for 21.4% (107/501), 54.5% (273/501), and 24.2% (121/501), respectively. For PA, almost half of the vaccination staff were at a low level (50.7%, 254/501), 39.9% (200/501), and 9.4% (47/501) were at a moderate and a high level (Figure 2).

3.3. Factors associated with burnout

Chi-squared tests revealed that there were significant differences between burnout and non-burnout groups in terms of age, education level, professional title, working place, the daily number of vaccinations, COVID-19 vaccination doses, working time of COVID-19 vaccination, working time and participation time of COVID-19 prevention and control (all $P < 0.1$). The burnout rates of each type of variable are shown in Table 2.

Further, the binary logistic regression model revealed that the possibility of having burnout symptoms was significantly higher in participants who had high education level (OR = 2.186, 95% CI:1.188–4.022, $p = 0.012$), medium professional title (OR = 2.095, 95% CI:1.303–3.369, $p = 0.002$), most (OR = 4.001, 95% CI:1.656–9.666, $p = 0.002$) and all (OR = 5.061, 95% CI:1.507–16.999, $p = 0.009$) of COVID-19 vaccination work takes up time off work or rest days (Table 3).

3.4. Factors associated with MBI-GS three components in vaccination staff

The average burnout score was 10.73 ± 6.41 on the EE subscale, 6.74 ± 5.27 on the CY subscale, and 17.95 ± 7.83 on the PA subscale. MBI-GS subscale scores after grouping according to

demographics and work-related variables were present in Table 4. Univariable analysis showed that all variables for COVID-19 vaccination work and COVID-19 prevention and control work were statistically associated with EE and CY. Based on this, variables associated with CY added age, education level, working years, professional title, working place, and vaccination working days per week. Compared with CY, EE added the statistically significant variables of family income and the daily number of vaccinations. Regarding PA, only age, working years, professional title, and participation time for COVID-19 prevention and control were statistically significant ($P < 0.1$) (Table 4).

TABLE 3 Binary logistic regression results of burnout among vaccination staff.

Variable	*P*	Odd ratio (OR)	95% Confidence interval (CI)	
Education level				
<Undergraduate	Ref	Ref	Ref	Ref
≧Undergraduate	**0.012**	2.186	1.188	4.022
Professional title	0.006			
Junior	Ref	Ref	Ref	Ref
Medium	**0.002**	2.095	1.303	3.369
Senior	0.901	0.935	0.326	2.680
Working time of COVID-19 vaccination work	0.000			
During working hours	Ref	Ref	Ref	Ref
A few of works take up time off work or rest days	0.482	1.339	0.593	3.020
Most of work takes up time off work or rest days	**0.002**	4.001	1.656	9.666
All the work takes up time off work or rest days	**0.009**	5.061	1.507	16.999
Not participating	0.431	1.609	0.493	5.259

The bold values in the table indicate that the variables are statistically significant.

Then multiple linear regressions were performed to identify independent related factors to each MBI-GS subscale. EE was independently correlated with professional title ($\beta = 1.647$, $t = 2.998$, $p = 0.003$), working place ($\beta = 1.403$, $t = 3.108$, $p = 0.002$), working time for COVID-19 vaccination ($\beta = 1.079$, $t = 3.717$, $p < 0.001$). CY was independently correlated with professional title ($\beta = 1.460$, $t = 3.216$, $p = 0.001$), working place ($\beta = 0.971$, $t = 2.671$, $p = 0.008$), working time for COVID-19 vaccination ($\beta = 0.755$, $t = 3.119$, $p = 0.002$). PA was independently correlated with professional title ($\beta = 1.677$, $t = 2.534$, $p = 0.012$) and participation time for COVID-19 prevention and control work ($\beta = 1.047$, $t = 2.804$, $p = 0.005$) (Figure 3).

4. Discussion

During the COVID-19 pandemic, the work of COVID-19 vaccination and epidemic control has greatly increased the workload of vaccination staff, therefor it is necessary to investigate the burnout situation of vaccination staff. The main findings of this study were: (1) The overall prevalence of burnout syndrome among vaccination staff was 20.8% in Hangzhou, China. (2) The predictors associated with job burnout were educational level, professional title, and COVID-19 vaccination working time. (3) The vaccination staff was experiencing a high degree of exhaustive emotion, cynicism, and especially low personal accomplishment.

As far as we know, there has not been much consensus on the "diagnosing" of burnout. First, different criteria were used to distinguish the high and low levels of the three dimensions. For example, studies used 9 and 13 as the cutoff to distinguish the different levels of EE (19). However, other studies used 11 and 15 (42, 43) or 11 and 14 (44). Second, the criteria for determining burnout are inconsistent. Studies used the three components' weighted score as criteria (44–46), and other studies used any of the components to classify the level of burnout (43, 47). In this study, referring to Huo et al. (19) and Li et al.'s (48) studies, we used the "exhaustion+1" criterion to define burnout symptoms and distinguish different levels of burnout. Brenninkmeijer et al. indicated that a categorization in which both high exhaustion and high distance or low competence were conditions for burnout ("exhaustion+1"), resulted in a relatively small chance of an inaccurate qualification of burnout and seemed to be an effective categorization for mapping differences in burnout (42).

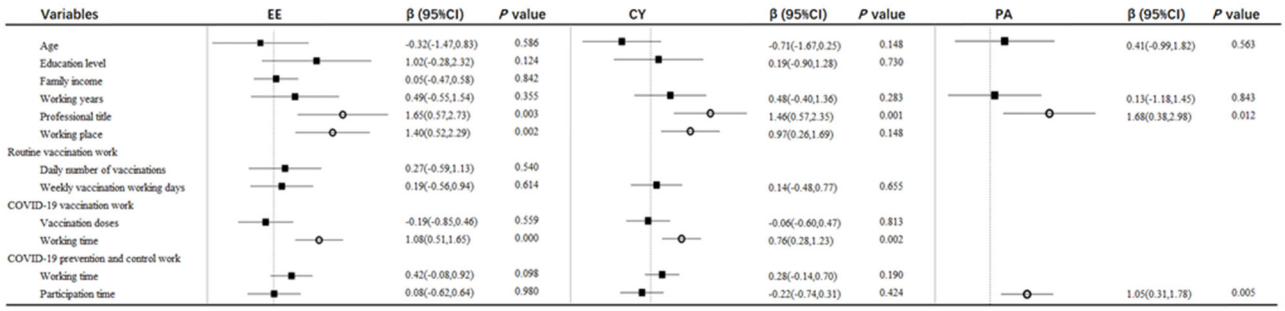

FIGURE 3
Multivariable analysis of the risk factors for EE, CY, and PA among vaccination staff.

TABLE 4 MBI-GS subscale scores in grouped demographics and work-related variables.

Variables		EE			CY			PA		
		$x \pm s$	F/t	*P*	$x \pm s$	F/t	*P*	$x \pm s$	F/t	*P*
Sociodemographic characteristics										
Age	18–30	9.17 ± 6.08	5.553	**0.001**	5.86 ± 4.90	2.884	**0.035**	16.52 ± 7.68	3.759	**0.011**
	31–40	22.09 ± 6.53			7.08 ± 5.38			17.76 ± 7.54		
	41–50	12.17 ± 6.60			7.37 ± 5.53			19.99 ± 7.98		
	>50	8.52 ± 3.76			5.04 ± 3.93			17.96 ± 9.36		
Gender	Men	9.96 ± 6.16	1.250	0.264	6.18 ± 5.10	1.006	0.316	17.68 ± 8.91	0.103	0.748
	Women	10.86 ± 6.45			6.84 ± 5.30			17.99 ± 7.64		
Marriage status	Currently married	10.91 ± 6.52	1.980	0.160	6.77 ± 5.31	0.046	0.830	18.06 ± 7.90	0.529	0.467
	Currently not married	9.85 ± 5.80			6.63 ± 5.10			17.39 ± 7.53		
Education level	<Undergraduate	9.21 ± 5.48	10.221	**0.001**	5.92 ± 4.73	4.437	**0.036**	17.39 ± 7.94	0.915	0.339
	≧Undergraduate	11.27 ± 6.63			7.04 ± 5.42			18.15 ± 7.80		
Family income	<5,000 CYN	11.77 ± 7.13	2.225	**0.065**	7.25 ± 5.31	1.425	0.224	17.65 ± 7.77	1.399	0.233
	5,000–9,999 CYN	9.80 ± 6.05			6.11 ± 4.85			17.13 ± 7.66		
	10,000–19,999 CYN	10.99 ± 6.34			6.98 ± 5.42			18.42 ± 7.69		
	20,000–29,999 CYN	12.13 ± 7.30			7.53 ± 6.03			19.78 ± 8.30		
	≧30,000 CYN	11.60 ± 6.14			7.52 ± 5.60			18.50 ± 7.80		
Working years	0–4 years	8.81 ± 6.32	3.295	**0.020**	5.17 ± 4.83	2.154	**0.093**	17.60 ± 9.23	3.758	**0.011**
	5–9 years	9.64 ± 6.65			6.27 ± 5.70			15.95 ± 7.06		
	10–19 years	11.11 ± 6.37			7.09 ± 5.18			17.96 ± 7.38		
	≧20 years	11.54 ± 6.14			7.03 ± 5.18			19.54 ± 8.38		
Professional title	Senior	12.10 ± 5.03	16.182	**< 0.001**	7.17 ± 4.22	14.179	**< 0.001**	21.30 ± 7.80	6.333	**0.002**
	Medium	12.37 ± 6.71			8.08 ± 5.70			18.74 ± 7.64		
	Junior	9.18 ± 5.91			5.56 ± 4.71			16.88 ± 7.84		
Working place	Urban	12.88 ± 7.22	12.888	**< 0.001**	8.32 ± 6.11	8.616	**< 0.001**	17.73 ± 8.04	0.402	0.669
	Suburb	11.04 ± 5.86			6.82 ± 4.86			18.31 ± 7.30		
	Rural	9.09 ± 6.10			5.71 ± 4.50			17.65 ± 8.32		
Daily vaccination work										
Daily number of vaccinations	< 100 persons	9.69 ± 6.61	4.328	**0.005**	6.24 ± 5.23	1.783	0.149	17.75 ± 7.89	0.685	0.562
	100–199 persons	11.65 ± 5.94			7.10 ± 5.29			18.17 ± 7.65		
	200–299 persons	12.00 ± 6.89			7.75 ± 5.46			17.47 ± 8.15		
	≧300 persons	9.63 ± 3.07			5.88 ± 2.95			21.38 ± 8.91		
Vaccination working days per week	0.5 day	11.02 ± 5.40	3.548	**0.007**	6.88 ± 4.42	2.918	**0.021**	18.05 ± 6.99	0.585	0.673
	1 day	9.45 ± 6.29			5.80 ± 5.12			17.65 ± 7.88		
	1.5–2 days	10.93 ± 5.39			6.91 ± 4.63			18.11 ± 7.07		
	2.5–3 days	12.02 ± 6.83			7.73 ± 5.61			18.53 ± 8.37		
	≧3.5 days	10.76 ± 7.00			6.67 ± 5.80			16.69 ± 7.74		

(Continued)

TABLE 4 (Continued)

Variables		EE			CY			PA		
		$x \pm s$	F/t	*P*	$x \pm s$	F/t	*P*	$x \pm s$	F/t	*P*
COVID-19 vaccination work										
COVID-19 vaccination doses	0–9,999 doses	9.63 ± 5.58	4.171	**0.002**	6.05 ± 4.78	3.902	**0.004**	17.63 ± 7.44	0.328	0.859
	10,000–19,999 doses	10.17 ± 6.65			6.04 ± 5.10			18.29 ± 7.94		
	20,000–39,999 doses	12.64 ± 6.89			8.41 ± 6.19			17.73 ± 7.77		
	40,000–59,999 doses	10.06 ± 6.38			6.39 ± 5.30			17.42 ± 8.99		
	≧60,000 doses				7.49 ± 4.89			18.53 ± 7.59		
Working time	Not participating	9.70 ± 6.51	16.276	**< 0.001**	6.03 ± 5.45	10.578	**< 0.001**	18.57 ± 6.922	0.254	0.907
	During working hours	7.83 ± 5.69			4.74 ± 4.49			18.15 ± 8.88		
	A few of works take up time off work or rest days	10.17 ± 5.75			6.38 ± 5.06			17.67 ± 7.91		
	Most of work takes up time off work or rest days	14.89 ± 6.31			9.55 ± 5.00			18.50 ± 6.93		
	All the work takes up time off work or rest days	14.33 ± 9.45			9.11 ± 7.05			18.11 ± 7.99		
COVID-19 prevention and control work										
Working time	Not participating	5.30 ± 3.94	18.645	**< 0.001**	2.52 ± 3.29	13.536	**< 0.001**	19.83 ± 11.52	0.748	0.559
	During working hours	7.98 ± 6.31			4.80 ± 5.15			18.11 ± 8.26		
	A few of works take up time off work or rest days	9.82 ± 5.92			6.13 ± 5.05			17.45 ± 7.67		
	Most of work takes up time off work or rest days	13.22 ± 6.09			8.71 ± 5.09			18.42 ± 7.24		
	All the work takes up time off work or rest days	15.42 ± 7.25			8.88 ± 5.40			18.33 ± 8.26		
Participation time	Not participating	5.30 ± 3.94	7.006	**< 0.001**	2.52 ± 3.29	5.123	**< 0.001**	19.83 ± 11.52	2.266	**0.061**
	< 1 week	7.20 ± 4.60			5.10 ± 3.63			14.60 ± 8.18		
	1 week−1 month	10.72 ± 6.92			7.22 ± 5.36			17.10 ± 7.13		
	1–2 months	10.52 ± 5.85			6.43 ± 4.86			17.06 ± 7.38		
	≧2 months	11.50 ± 6.49			7.21 ± 5.46			18.57 ± 7.71		

The bold values in the table indicate that the variables are statistically significant.

The results of this study showed that vaccination staff had a high level of burnout (20.8%), and the prevalence of EE, CY, and PA at high in this study was 26.7, 21.4, and 50.7%, respectively. Compared to previous studies using the same criterion, the level of burnout in vaccination staff was lower than that in medical staff (36.5%) (19). The high level of EE and CY in vaccination staff was also lower than that in medical staff (EE: 40.9%, CY: 63.7%) and frontline health professionals (EE: 34.2%, CY: 50.8%), respectively (19, 48). Based on this, it could be assumed that the situation of job burnout, EE and CY for vaccination staff was better than that for other medical staff during the COVID-19 epidemic in China. Exhaustion emotion is the central quality of burnout and is associated with workload, including working hours (49, 50), work shifts (51), and work pressure (52). Compared with

vaccination staff, other medical workers, especially the frontline health professionals (48), had a heavy workload to save and care for COVID-19 patients, and they were under tremendous pressure, such as the high risk of contracting the virus and bringing to their families (52). All of this could cause them to have higher levels of EE. Cynicism emerged from the presence of work overload and social conflict. It prompted medical staff to take action to distance themselves emotionally and cognitively from their work. Previous studies have indicated that deteriorating doctor-patient relationships could lead to a high level of CY in medical staff (53, 54). In China, the doctor-patient relationship has always been a big problem (55, 56). According to previous studies, difficulty in seeing a doctor, poor communication, high medical expenses, and high expectations for doctors were all the influencing factors for bad doctor-patient relationships (18). These conditions were more common in medical staff in hospitals than in vaccination clinics. Therefore, we hypothesized that these factors lead to higher levels of EE and CY in medical workers than in vaccination staff. However, on the contrary, regarding the low level of PA, the situation is much worse in the vaccination staff than in other medical staff. From Guo and Li's study, the level of PA at low in medical staff was 35.2 and 46%, respectively (19, 48), which was lower than that in vaccination staff (50.7%) in this study. The component of PA represents the self-evaluation dimension of burnout and refers to feelings of incompetence and a lack of achievement and productivity in work (57). First, vaccination staff is public health providers working in primary care institutions. In China, the social status of primary medical institutions is generally lower than that of hospitals. People are more willing to bypass primary medical institutions to seek care at hospitals (58). Similarly, public health providers have a lower social status than clinicians. People trust clinicians more than public health providers. All these factors contributed to the low PA of vaccination staff (59). Second, for the work of vaccination staff, on the one hand, the main work was to vaccinate the population. Their sense of job accomplishment was not as apparent as doctors treating patients and saving lives. On the other hand, vaccine hesitancy is widespread in the population (60–62). Vaccination staff who regularly interact with vaccine-hesitant people was prone to question their competence and had a higher level of burnout and lower level of job satisfaction (63), which could lead them to doubt the value of their work. In addition, during the COVID-19 period, like clinicians, vaccination staff made an outstanding contribution to the fight against the COVID-19 epidemic. However, compared with clinicians and other medical workers, vaccination staff had low income, low returns, low social status, and low social support (64). All these reasons contributed to the low level of PA in vaccination staff (26). In the future, more studies are needed to study the interventions to reduce the PA in vaccination staff.

In this study, the score of the three components of EE, CY, and PA were 10.73 ± 6.41, 6.74 ± 5.27, and 17.95 ± 7.83, respectively. According to previous studies, during the COVID-19 epidemic in China, vaccination staff had lower scores of EE and CY but higher scores of PA than other health professionals (19, 48, 65, 66). The results were consistent with the distribution of high levels of EE, CY, and low levels of PA in vaccination staff and medical staff discussed above. However, it was worth mentioning that although the EE and CY scores of vaccination staff were lower than those of medical workers, it did not mean that the EE and CY levels of vaccination staff were not high. To Lu's study, the scores of EE and CY in biosafety laboratory staff were 10.00 ± 5.99 and 4.64 ± 4.59, which were lower than that in vaccination staff during the COVID-19 epidemic (52). With the arrival of COVID-19, the workload of vaccination staff has dramatically increased. In addition to routine work of vaccinations for children and some adults, they also needed to vaccinate people over the age of three. This study found that nearly 80% of participants reported that the COVID-19 vaccination work took up time off work and rest days. Furthermore, the vaccination staff was involved in the COVID-19 prevention and control work. They need to concrete implementation of COVID-19 prevention and control. Figure 1 shows that 88.2% of participants worked for nucleic acid sampling in the community, 75.8% worked for nucleic acid sampling for home quarantine, and 86.4% of participants in this study reported that the COVID-19 prevention and control work took up time off work and rest days. As a result, the workload and working hours for vaccination staff had increased significantly, which caused the high level of EE. After that, vaccination staff became indifferent and repulsive to their service objects and to their own profession, thus causing a high level of CY (23). On the other hand, as we know, there may be an tiny chance of adverse events following vaccination. The amount of COVID-19 vaccine inoculated is enormous. Therefore, the number of people with adverse events becomes obvious in public view. Some people attributed the adverse events to vaccination staff and even attached violence to them. This would worsen the working environment of vaccination staff and cause high CY. To better understand the level of EE, CY, and PA among vaccination staff and to compare them with other health care workers, further work is required to establish a norm for medical workers and to monitor the job burnout level of vaccination staff in a long-term manner.

Among the related factors of job burnout, we found that vaccination staff with higher education level had more job burnout than those with lower education level. This was consistent with previous findings studied in medical staff (67–69). A possible explanation for this might be that highly educated vaccination staff usually had more responsibility and expectations (67). They would have a more important role played in work, which pushed them to suffer from a greater risk of job burnout (52).

Another finding was that vaccination staff with the medium professional title had a higher level of burnout, EE, and CY. Previous studies also reported this finding in primary healthcare workers and nurses in China (45, 70). There were several possible explanations for this result. First, according to China's medical system and the professional title system of health professionals (71), vaccination staff with medium titles were always in middle age and the central workforce in vaccination clinics, during which the heavy workload might result in a high level of EE (72). Second, vaccination staff with medium professional titles were in the promotion period of careers. However, in China, the work resource for health care workers is very scarce (45, 64). Only a tiny percentage of vaccination staff with medium professional titles could upgrade to senior professional titles (73), which inevitably leading to competition among colleagues. The lack of critical resources and the poor quality of colleague relationships

would reduce job satisfaction and increase CY in vaccination staff (24). In terms of PA, a possible explanation might be that with the rise of professional title, the workability and work sense of accomplishment of vaccination staff were also gradually increased, and they were more able to appreciate their personal and work value.

The result of this study showed that working place was associated with EE and CY. The EE and CY scores of vaccination staff were highest in urban areas and lowest in rural areas. Related conclusions from previous studies were mixed. A general practitioner study showed no difference in EE, CY, and PA between urban and rural areas (74). Another study showed that compared with rural areas, public health service providers in urban areas had higher EE and CY but no statistical difference in PA (59). Within the context of our study setting, there were several possible explanations for the finding in this study. First, in Hangzhou, vaccination-related work has been done better in urban areas than in suburban or rural areas. Vaccination staff in urban areas have higher requirements for their work, such as a higher vaccination rate, better service attitude, and a more convenient service experience. These might lead to an increase in workload, and increase their working pressure. Previous literature had reported an association between working pressure and burnout (20). Secondly, the massive influx of migrants in urban areas has brought considerable challenges to the COVID-19 prevention and control efforts, making COVID-19 epidemic prevention and control more difficult (75). Thirdly, compared with urban areas, rural or suburban areas had relatively better health care environments and better doctor-patient relationships (76). All these factors might cause result in high EE and CY in the urban area.

Regarding the job-related factors, we found that vaccination staff who reported that the work of COVID-19 vaccination took up more time off work or rest days was more likely to be burnout and have a high level of EE and CY. The more work that takes up time off work or rest days, the longer work hours will be. Moreover, the relationship between prolonged working hours and burnout, EE, and CY has been well demonstrated (49, 54, 67, 77). Considering that COVID-19 vaccination is currently a positive and effective way to prevent COVID-19 (78), and booster shots of COVID-19 vaccine might be needed in the future (35), it is essential to improve the efficiency of COVID-19 vaccination and arrange working hours reasonably to reduce the job burnout among vaccination staff.

The current study found that the longer time vaccination staff participated in COVID-19 prevention and control, the more personal accomplishment they felt. Since 2022, there have been multiple COVID-19 outbreaks in Hangzhou. The vaccination staff was involved in the COVID-19 prevention and control work, including nucleic acid sampling, extermination, and hospital transmission, et al. (Table 1). Through the joint efforts of vaccination staff and the whole society, the epidemic in Hangzhou has been controlled at a stable level (79), which might give vaccination staff a great sense of accomplishment and work value. Furthermore, vaccination staff who participated in COVID-19 prevention and control work might get more honors, more bonuses, and higher social support from superior and organization, which could improve their PA.

This study has strengths and limitations. To our knowledge, this is the first study to investigate burnout among vaccination staff in China. The three main aspects of work for vaccination staff during COVID-19, including routine vaccination work, the COVID-19 vaccination work, and the COVID-19 prevention and control work, were all considered in this study. However, this study has some limitations. First, there is no consensus on the diagnosis of job burnout. We only selected one of the diagnosis methods, so it was difficult to directly compare the prevalence of job burnout with other studies. Second, the indicators of workload in this paper were not very precise. We could not determine the amount of vaccination for each vaccination staff, so the vaccination dose for each vaccination staff's clinic was used. In addition, regarding working hours, we used the subjective judgment method of vaccination staff' self-assessment, which may be biased compared to the specific assessment time. It was better to use concrete numbers, i.e., 40 h per week, to measure burnout. Third, because this survey was conducted by online questionnaire, compared with a face-to-face questionnaire survey, it was inevitable that there would be some problems with survey quality, such as unclear questionnaire questions and filling errors.

5. Conclusion

The present study found that vaccination staff in Hangzhou, China, had high levels of job burnout, EE and CY, and these conditions were better than than other medical staff The level of PA among vaccination staff was much worse than other medical staff. The factors influencing burnout included level of education, professional title, and working time for COVID-19 vaccination work. The professional title, working place, and the working time for COVID-19 vaccination were associated with the degree of EE and CY. For PA, the associated factors were professional title and participation time for COVID-19 prevention and control. Interventions should be taken to reduce the level of job burnout and alleviate psychological pressure in vaccination staff, especially to enhance their personal achievement. Further research should conduct to reach consensus on the "diagnosing" of burnout, and the research on the norm of burnout among medical staff is warranted.

Data availability statement

The datasets presented in this article are not readily available because the data that support the findings of this study are available from the corresponding author upon reasonable request. Requests to access the datasets should be directed to YL, smileforever81@126.com.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the Hangzhou Center for Disease Control and Prevention. The patients/participants provided their written informed consent to participate in this study.

Author contributions

WG and YL planned and designed the study. ZL, YX, XuZ, and JC were responsible for data management. JuW, XC, and JiW for data analysis. WG drafted the manuscript. JD and XiZ for supervision. All authors contributed to interpretation of study results, critical revision of the paper and approval of final version, and agree to be accountable for all aspects of this article.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Pertussis immunization during pregnancy: results of a cross-sectional study among Italian healthcare workers

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Background: This study aimed to assess whether Italian healthcare workers (HCWs) recommend the reduced antigen content tetanus-diphtheria-acellular pertussis vaccination (Tdap) to pregnant people, as well as what variables could predict their decision to advise and recommend immunization to pregnant people.

Methods: This cross-sectional study took place between August 2021 and June 2022 in a sample of obstetricians-gynecologists, midwives, and primary-care physicians in two regions of Southern Italy. A self-administered questionnaire was used to gather the data.

Results: The results showed 91.3% (379) of participants knew that receiving the Tdap vaccine during pregnancy protects against pertussis in both the expectant person and the newborn before active immunization. Only 68.9% (286) knew that the Tdap vaccination has to be administered during the third trimester of gestation. A small but still significant proportion of participants (14.7%) (61) believed that the potential risks of vaccines administered during pregnancy outweighed the benefits. An improvable proportion of HCWs regularly provided information [71.8% (298)] and recommended [81% (336)] Tdap vaccination to pregnant people. The strongest factors that drove HCWs to inform pregnant people about the Tdap vaccination were to be aware that vaccinating those in close contact with newborns is an effective strategy to prevent pertussis (OR: 2.38; 95% CI: 1.11–5.13) and that the Tdap vaccine is provided only in the third trimester of pregnancy (OR: 1.74; 95% CI: 1.06–2.86). Informing pregnant people about the possibility of receiving the Tdap vaccine during pregnancy (OR: 60.13; 95% CI: 23.50–153.8) was the strongest predictor of having recommended the Tdap vaccination during pregnancy.

Conclusion: Educational and informative interventions to improve HCWs' knowledge about the importance of the Tdap vaccine and their communication skills to properly counsel pregnant people are needed. Beyond vaccine recommendations, how well immunization strategies are implemented in real-world situations impacts vaccination uptake. Therefore, during regular care visits, expecting people must have easy access to vaccines. Prenatal immunizations should become common practice, and there should be no conceptual doubt about vaccinations among HCWs to safeguard pregnant people and their unborn children from vaccine-preventable diseases.

KEYWORDS

healthcare workers, immunization, pertussis, pregnancy, Tdap, vaccination

Introduction

Evidence exists to indicate that maternal pertussis vaccination can reduce the risk of pertussis, hospitalization, or death among infants by between 69 and 95% (1). Pertussis can be deadly, especially in babies below 3 months of age (2). Therefore, vaccination campaigns among pregnant people have been introduced in many countries, including Italy, to protect newborns through the natural transmission of passive immunity (3, 4). The Italian Ministry of Health enacted a National Immunization Plan in which it is stated that reduced antigen content tetanus-diphtheria-acellular pertussis vaccine (Tdap) is recommended to be administered from the 27th to the 36th week of pregnancy (ideally at the 28th week) and at each pregnancy (5), to provide adequate protection of newborns. Nevertheless, immunization coverage among pregnant people remains below the recommended threshold of 95% (2). One potential reason for this could be found in vaccine hesitancy, defined as a delay in acceptance or refusal of vaccines, despite the availability of vaccination services (6). Hesitancy is then considered one of the most important global health issues by the World Health Organization (WHO) (7). Acceptance or rejection of vaccines among pregnant people may depend on many variables. Women can show hesitancy toward vaccines during pregnancy as a consequence of their vaccination reluctance in general or because of a lack of information, as well as previous negative individual experiences with vaccines that can strongly contribute to this phenomenon (8). Looking specifically at the Italian population, low vaccine knowledge among those with a low level of education appeared to be the most common determinant of low levels of vaccination uptake during pregnancy (9). However, considering that vaccine hesitancy is context-dependent (10), lack of information may represent just one of the reasons underlying the phenomenon. Hence, the contact and conversation between healthcare workers (HCWs) and parents when discussing parental vaccination concerns is not only widely acknowledged as being crucial in informing parents about vaccines but also in easing parental anxieties (11). Even vaccine-hesitant parents, in fact, consider HCWs as a trusted channel to address common doubts about vaccines (12). HCWs then, i.e., primary-care physicians (PCPs), pediatricians, gynecologist-obstetricians (OB-GYNs), and nurse-midwives, play an important role in providing clear information about vaccines and in addressing parents' concerns (13). Therefore, considering the aforementioned data, it appears interesting to assess whether Italian HCWs recommend the Tdap vaccination to pregnant people, how valuable they consider their contribution in implementing vaccination uptake during pregnancy, and which attitudes influence their practices. We also decided to evaluate their degree of knowledge on the topic, trying to frame the southern Italy reality when it comes to enhancing immunization plans among pregnant people. Furthermore, seeing as healthcare operators' point of view can be a resource in understanding which strategies might implement recommended vaccine uptake during pregnancy, part of the assessment has been dedicated to it.

Materials and methods

Study design and setting

The present study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for observational studies (14). This cross-sectional study was conducted between August 2021 and June 2022 in a sample of OB-GYNs, midwives, and PCPs in two regions of southern Italy: Calabria and Sicily. A multi-stage sampling design was used. First, we selected using simple random sampling at two teaching hospitals and two tertiary care public hospitals. In addition, PCPs practicing in those regions were randomly selected from a publicly available frame.

Data collection and study sample

Data were collected using a self-administered paper questionnaire distributed by trained medical staff.

Before starting to collect questionnaires, a letter was sent to the management staff of the selected hospital to explain the purposes of the study and obtain their written consent to carry out the survey in their institution. All participants were informed of the background, objectives, and privacy rules related to the survey. A signed informed consent form was obtained from all participants who agreed to participate in the study clarifying that anonymity and confidentiality of collected data were guaranteed. HCWs who declined to sign the informed consent were excluded from the study. We purposively recruited participants who met the following eligibility criteria: OB-GYN, PCP, or registered midwife and having a good command of Italian. The participants did not receive any form of payment or incentives for taking part in this study.

Sample size

A minimum sample size of 368 was calculated using the Raosoft sample size calculator (15) providing a confidence level of 95% with a margin of error of 5%. The article by Kissin et al. (16) reported that mean response rates for similar surveys were 42.3%; therefore, to maximize the number of responses, 696 surveys were distributed.

Questionnaire design

The questionnaire was developed after an extensive literature review (16–20). The questionnaire's comprehensibility, clarity, and ease of administration use were evaluated using a pilot test (10 HCWs not included in the final sample). Minor refinements were made based on the feedback received from this phase. The final questionnaire used a combination of checkboxes and free text answers, which consisted of 17 items divided into five sections. It took approximately 10 min to complete all items. The first section of the questionnaire collected information about the sociodemographic and professional characteristics of the participants (four items, closed-ended with multiple answers and open-ended) including age, gender, professional specialty, and years in practice. The second section (three items with multiple answers "true, false, do not know") investigated general knowledge about vaccinations during pregnancy. The third section (four items on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree") tested attitudes and beliefs regarding the benefits and risks of vaccinating pregnant people. The fourth section (four items with multiple answers and open options) explored providers' vaccination behaviors, whether they informed and advised pregnant people on Tdap vaccination, and also assessed strategies and

interventions to increase uptake of vaccination during pregnancy. The last section (two items, closed-ended with multiple answers and open options) analyzed the sources of information on vaccination, the level of satisfaction with these different sources, and the need to receive additional information about recommended vaccination during pregnancy. This study received approval from the Calabria Center Local Human Research Ethics Committee (ID No. 275/2021/07/15).

Statistical analysis

All collected variables were obtained by means and standard deviations when normally distributed. In cases of deviations from normality, medians and interquartile ranges were utilized. Categorical variables were expressed in percentages. Logistic regression models were developed to explore the role of potential predictors of the following outcomes of interest: having informed about the Tdap vaccination during pregnancy (no = 0; yes = 1) (Model 1) and having recommended the Tdap vaccine during pregnancy (no = 0; yes = 1) (Model 2). The following selected independent variables were included in both models: age in years (continuous), sex (male = 0; female = 1), profession (OB-GYNs = 0; PCPs = 1; 2 = midwife), number of years of practice (continuous), knowledge that Tdap vaccine administered during pregnancy protects only the expectant person (I do not know/true = 0; false = 1), in addition to knowledge that vaccinating pregnant people and those in close contact with newborns is an effective strategy to prevent pertussis (I do not know/false = 0; true = 1), and knowledge that Tdap vaccine is provided only in the third trimester of pregnancy (I do not know/false = 0; true = 1), belief that improving adherence to vaccinations in pregnancy is an efficient prevention strategy (Uncertain/strongly disagree/disagree = 0; Strongly agree/agree = 1), belief that the potential risks of vaccinations administered during pregnancy are greater than the benefits (Uncertain/agree/strongly agree = 0; strongly disagree/disagree = 1), belief that vaccinating pregnant people against pertussis is an effective way to reduce the risk of pertussis in the unborn child (Uncertain/strongly disagree/disagree = 0; Strongly agree/agree = 1), and belief that providing detailed information about the effectiveness and safety of vaccinations is a useful strategy to improve vaccine uptake in pregnancy (Uncertain/strongly disagree/disagree = 0; Strongly agree/agree = 1). In Model 2, the variable informing pregnant people about the possibility of receiving the Tdap vaccine during pregnancy (never/rarely/sometimes = 0; often/always = 1) was also included. The Hosmer and Lemeshow test assessed the goodness of fit of the logistic model and visual investigation of the lowess curve fitting liner predictor (log-odds) values by Pearson's standardized residuals. The statistical significance level was fixed at a value of p of <0.05. Adjusted odds ratio (OR) and 95% confidence interval (CI) were calculated. Statistical analysis was developed using the STATA software program, version 16.1 (21).

The dataset was deposited in the Mendeley Data repository (doi: 10.17632/7x785tzhyh.2).

Results

Participants' demographics

Of the eligible 696 HCWs approached, 415 agreed to participate for a response rate of 59.6%. The study sample consisted of 415 HCWs, including OB-GYNs (64.8%), midwives (21.7%), and PCPs (13.5%) with an average age of 42.8 years (±11.3). Of the participants, 60.5% were female and 39.5% were male. The mean number of years in practice was 14 (± 11.5). Table 1 shows participant characteristics.

TABLE 1 Characteristics of the study population (415 respondents).

	N	%	Mean±SD
Age, in years			42.8 ± 11.3
Sex			
Male	164	39.5	
Female	251	60.5	
Professionals			
OB-GYN	269	64.8	
Midwife	90	21.7	
PCP	56	13.5	
Number of years of practice			13.4 ± 11.6

OB-GYN, obstetrician-gynecologist; PCP, primary care physician.

Healthcare workers knowledge of vaccinations and attitudes toward vaccines during pregnancy

HCWs' knowledge and attitudes toward recommended vaccinations during pregnancy and vaccine-preventable diseases (VPDs) were investigated. The results are shown in Table 2. Almost all of the participants (91.3%) knew that the Tdap vaccine administered during pregnancy protects the expectant person and the newborn; 87.5% of the sample was aware that vaccinating those in close contact with newborns (i.e., cocoon strategy) is an effective way of preventing pertussis in children during their first months of life. Lastly, even though more than half (68.9%) of the respondents correctly affirmed that the Tdap vaccine is provided only in the third trimester of pregnancy, a good percentage (31.1%) answered incorrectly.

Almost the entire sample (96.1 and 96.4%, respectively) believed that improving adherence to vaccinations in pregnancy is an efficient prevention strategy, and providing detailed information about the effectiveness and safety of vaccinations is a useful strategy to improve vaccine uptake in pregnancy. In total, 85.3% of the interviewed considered that the potential risks of vaccines administered during pregnancy are lesser than the benefits. Furthermore, 89.2% supposed that vaccinating pregnant people against pertussis is an effective way to reduce the risk of infection in the unborn child.

Healthcare workers behaviors about vaccinations recommended during pregnancy

Almost three quarters (71.8%) of the interviewed HCWs often/always provided information about Tdap vaccination to pregnant people, but, on the other hand, 20.8% of OB-GYNs, 32.1% of PCPs, and 47.8% of midwives affirmed they never or rarely or sometimes do it; moreover, 81% of the sample often/always recommended pregnant people to get vaccinated for Tdap during pregnancy. Among those who

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TABLE 2 HCWs' level of knowledge and attitudes toward recommended vaccinations during pregnancy.

Knowledge statements (415 respondents)	Correct	
	N	%
Tdap vaccine administered during pregnancy protects only expectant people (false)	379	91.3
In addition to vaccination during pregnancy, vaccinating those in close contact with newborns is an effective strategy to prevent pertussis (true)	363	87.5
Tdap vaccine is provided only in the 3rd trimester of pregnancy (true)	286	68.9

Attitudes statements (415 respondents)	Strongly disagree/ disagree		Uncertain		Strongly agree/ agree	
	N	%	*N*	%	*N*	%
Improving adherence to vaccinations in pregnancy is an efficient prevention strategy	8	1.9	8	1.9	**399**	**96.1**
The potential risks of vaccinations administered during pregnancy are greater than the benefits	**354**	**85.3**	16	3.9	45	10.8
Vaccinating pregnant people against pertussis is an effective way to reduce the risk of pertussis in the unborn child	15	3.6	30	7.2	**370**	**89.2**
Providing detailed information about the effectiveness and safety of vaccinations is a useful strategy to improve vaccine uptake in pregnancy	2	0.5	13	3.1	**400**	**96.4**

HCWs, healthcare workers; Tdap, Tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis.
In bold are number and percentages referring to positive attitudes.

TABLE 3 HCWs' behaviors about Tdap vaccination during pregnancy.

Statements	Never/rarely/ sometimes		Often/always	
	N	%	*N*	%
Informing pregnant people about the possibility of receiving Tdap vaccine during pregnancy (415)	117	28.2	298	71.8
OB-GYNs (269)	56	20.8	213	79.2
PCPs (56)	18	32.1	38	67.9
Midwives (90)	43	47.8	47	52.2
Recommending pregnant people to get vaccinated for Tdap during pregnancy (415)	79	19	336	81
OB-GYNs (269)	26	9.7	243	90.3
PCPs (56)	17	30.4	39	69.6
Midwives (90)	36	40	54	60

Reasons for the non-recommendation of Tdap vaccination during pregnancy								
Statements*	Total sample (39)		OB-GYN (269)		PCPs (56)		Midwives (90)	
	N	%	*N*	%	*N*	%	*N*	%
Outside the scope of practice	20	51.3	-		2	10	18	90
Vaccine hesitancy among pregnant people	14	35.9	5	35.7	1	7.1	8	57.2
Lack of knowledge	13	33.3	-		2	15.4	11	84.6
Lack of time	7	18	-		3	42.9	4	57.1
Fear of adverse events	3	7.7	1	33.3	1	33.3	1	33.3
Skepticism about the effectiveness of vaccines	1	2.6	-		1	100	-	

HCWs, Healthcare workers; Tdap, reduced antigen content tetanus-diphtheria-acellular pertussis vaccine; OB-GYNs, obstetricians-gynecologists; PCPs, primary-care physicians.
*Multiple responses allowed.

recommended vaccination never or rarely or sometimes, 9.7% were OB-GYNs, 30.4% were PCPs, and 40% were midwives (Table 3). The results of the multiple logistic regression analysis (Model 1 in Table 4) indicated that the strongest factor that had driven HCWs to inform pregnant people about the Tdap vaccination was having good knowledge about it, in particular, knowing that vaccinating pregnant people and those in close contact with newborns is an effective strategy to prevent pertussis (OR: 2.38; 95% CI: 1.11–5.13) and that the Tdap vaccine is provided only in the third trimester of pregnancy (OR: 1.74; 95% CI: 1.06–2.86). Among the subjects who often or always recommended vaccination, 93.7% stated that the Tdap vaccine must be recommended to all pregnant people, 2.9% to women with high-risk pregnancies, 2.3% to women with chronic diseases, and 1.1% to HIV+ women. Informing pregnant people about the possibility of receiving the Tdap vaccine during pregnancy (OR: 60.13; 95% CI: 23.50–153.8) increased almost 60-fold the odds of having recommended Tdap vaccination during pregnancy. Similarly, believing that improving adherence to vaccinations during pregnancy is an efficient prevention strategy (OR: 5.38; 95% CI: 1.06–27.35) is indipendently associated with having recommended Tdap vaccination. Otherwise, a negative association was shown for participants who were PCPs (OR: 0.32; 95% CI: 0.11–0.98) or midwives (OR: 0.20; 95% CI: 0.08–0.55) (Model 2 in Table 4). The most common reasons cited for not recommending vaccination against pertussis included the belief that it was outside the scope of their practice (51.3%) and, among those, 90% were midwives and 10% were PCPs; vaccine hesitancy among pregnant people (35.9%) and, among those, 57.2% were midwives, 35.7% were Obs, and 7.1% were PCPs; and lack of knowledge (31.3%) and, among those, 84.6% were midwives and 15.4% were PCPs (Table 3). On the other hand, HCWs indicated the

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TABLE 4 Results of the regression model for potential determinants of the outcomes of interest.

Model 1: Outcome: having informed about Tdap vaccination during pregnancy. Log-likelihood=−218.10082; Prob>chi2<0.001; Obs=415		
Variables	**OR**	**95% CI**
Knowledge that vaccinating pregnant people and those in close contact with newborns is an effective strategy to prevent pertussi		
I do not know/false*	1.00	
True	2.38	1.11–5.13
Knowledge that Tdap vaccine is provided only in the 3rd trimester of pregnancy		
I do not know/false*	1.00	
True	1.74	1.06–2.86
Professionals		
OB-GYN*	1.00	
Midwife	0.54	0.28–1.03
PCP	0.66	0.32–1.37
Knowledge that Tdap vaccine administered during pregnancy protects only the expectant person		
I do not know/true*	1.00	
False	2.10	0.91–4.86
Belief that improving adherence to vaccinations in pregnancy is an efficient prevention strategy		
Uncertain/strongly disagree/disagree*	1.00	
Strongly agree/agree	2.76	0.79–9.58
Age in years, continuous	1.06	0.98–1.15
Number of years of practice, continuous	0.95	0.88–1.03
Belief that vaccinating pregnant people against pertussis is an effective way to reduce the risk of pertussis in the unborn child		
Uncertain/strongly disagree/disagree*	1.00	
Strongly agree/agree	1.39	0.66–2.93
Belief that the potential risks of vaccinations administered during pregnancy are greater than the benefits		
Uncertain/agree/strongly agree*	1.00	
Disagree/strongly disagree	1.34	0.69–2.59
Belief that providing detailed information about the effectiveness and safety of vaccinations is a useful strategy to improve vaccine uptake in pregnancy		
Uncertain/strongly disagree/disagree*	1.00	
Strongly agree/agree	0.75	0.20–2.85
Sex		
Male*	1.00	
Female	0.91	0.54–1.52

Model 2: Outcome: having recommended Tdap vaccination during pregnancy. Log-likelihood=−96.788919; Prob>chi2<0.001; Obs=415		
Variables	**OR**	**95% CI**
Informing pregnant people about the possibility of receiving Tdap vaccine during pregnancy		
No*	1.00	
Yes	60.13	23.50–153.87
Professionals		
OB-GYN*	1.00	
Midwife	0.20	0.08–0.55
PCP	0.32	0.11–0.98
Belief that improving adherence to vaccinations in pregnancy is an efficient prevention strategy		
Uncertain/strongly disagree/disagree*	1.00	
Strongly agree/agree	5.38	1.06–27.35
Belief that providing detailed information about the effectiveness and safety of vaccinations is a useful strategy to improve vaccine uptake in pregnancy		
Uncertain/strongly disagree/disagree*	1.00	
Strongly agree/agree	6.15	0.90–41.90
Sex		
Male*	1.00	
Female	1.60	0.69–3.70
Belief that the potential risks of vaccinations administered during pregnancy are greater than the benefits		
Uncertain/agree/strongly agree*	1.00	
Disagree/strongly disagree	1.67	0.64–4.35
Knowledge that vaccinating pregnant people and those in close contact with newborns is an effective strategy to prevent pertussis		
I do not know/false*	1.00	
True	1.73	0.55–5.45
Knowledge that Tdap vaccine administered during pregnancy protects only the expectant person		
I do not know/true*	1.00	
False	0.77	0.21–2.76
Belief that vaccinating pregnant people against pertussis is an effective way to reduce the risk of pertussis in the unborn child		
Uncertain/strongly disagree/disagree*	1.00	
Strongly agree/agree	0.85	0.25–2.90
Age in years, continuous	0.98	0.88–1.09
Knowledge that Tdap vaccine is provided only in the 3rd trimester of pregnancy		
I do not know/false*	1.00	
True	0.97	0.44–2.17
Number of years of practice, continuous	1.01	0.90–1.11

Tdap, reduced antigen content tetanus-diphtheria-acellular pertussis vaccine; OB-GYNs, obstetricians-gynecologists; PCPs, primary-care physicians.
*Reference category.

following as possible strategies to improve vaccine uptake in pregnancy: offering vaccinations during regular care visits in pregnancy (58.8%), informing and educating expectant people about the availability, effectiveness, and safety of vaccinations during pregnancy (55.9%), improving accessibility to vaccination services (e.g., flexible schedules and weekend vaccination sessions) (44.3%), making a vaccine clinic available at the hospital (38.7%), allowing midwives to vaccinate pregnant people (21.1%), and reminding/offering vaccination through text messages or emails (16.5%) (Table 5).

TABLE 5 Possible strategies to improve vaccine uptake in pregnancy reported by HCWs.

Statements*	Total sample (413)		Informing about Tdap vaccination (297)[#]		Recommending about Tdap vaccination (335)[$]	
	N	%	*N*	%	*N*	%
Offering vaccinations during regular care visits in pregnancy	243	58.8	185	62.3	215	64.2
Informing and educating expectant people about the availability, effectiveness, and safety of vaccinations during pregnancy	231	55.9	162	54.5	186	55.5
Improving accessibility to vaccination services (e.g., flexible schedules, weekend vaccination sessions)	183	44.3	137	46.1	156	46.6
Making a vaccine clinic available at the hospital	160	38.7	128	43.1	146	43.6
Midwives vaccinating pregnant people	87	21.1	64	21.5	68	20.3
Reminding/offering vaccination through text messages or email	68	16.5	54	18.2	61	18.2

*Multiple responses allowed.
[#]Eligible HCWs were those who reported having often/always informed pregnant people about Tdap vaccinations.
[$]Eligible HCWs were those who reported having often/always recommended pregnant people about Tdap vaccinations.

Sources of information

Regarding the preferred sources of information used by HCWs, the highest percentage (85.4%) was represented by conferences with a degree of satisfaction equal to 74.6%, while the lowest one (0.5%) was the Internet. In addition to the aforementioned results, it was found that almost two-thirds (60.2%) of the sample declared the need to have more information about recommended vaccinations during pregnancy.

Discussion

Despite a monitoring system is not yet in place at the national level, Tdap coverage during pregnancy seems to be suboptimal in Italy against recommendations (22). Since the single best predictor of vaccination among pregnant people is a strong HCWs' recommendation coupled with an offer of vaccination (23–26), we hypothesized that HCWs who are knowledgeable about the importance of vaccination in pregnancy and have positive attitudes toward it are more likely to persuade pregnant people to accept the vaccine, as previously demonstrated in other contexts (27, 28). With this in mind, the findings of the present study provide up-to-date insight into immunization needed during pregnancy that will aid in improving HCWs' counseling techniques and assist them in their crucial role of guiding and supporting the decisions of pregnant people regarding the Tdap vaccine.

Four important points emerged from the study. In the first place, the results showed HCWs' lack of confidence and understanding about the proper time frame during which to administer the Tdap vaccine during pregnancy. The study's findings revealed that more than two-thirds of the sample did not know that pregnant people can only receive the Tdap vaccine during the third trimester of pregnancy. This is of concern, considering that to enhance maternal antibody response and passive antibody transfer to the fetus, the administration should take place between 27 and 36 weeks of gestation, ideally around the 28th week. To ensure that every infant obtains the best possible protection against pertussis at birth and until the third dose is administered, pregnant people should be advised to get vaccinated during the specific abovementioned time frame.

The second important and alarming result was that HCWs' perceptions of the benefits and risks of immunizations for unborn children and their mothers did not seem to be consistent with the desired outcome among this population. In the survey, a small but still significant proportion of HCWs claimed that the possible risks of immunizations given during pregnancy outweigh the benefits. In addition, some of the responders did not consider the Tdap vaccine as an effective strategy to reduce the risk of pertussis in the unborn child. On the contrary, the WHO SAGE Committee, the Centers for Disease Control (CDC), the American College of Obstetricians and Gynecologists (ACOG), and the British Joint Committee on Vaccination (JCVI) all contributed to state that maternal Tdap vaccination gives babies passive protection while also helps expectant people avoid contracting and spreading pertussis to their children. Given serious and sometimes life-threatening complications among babies younger than 1 year of the infection (29), pregnancy is the best time to immunize and to achieve protection for both the expectant person and the fetus from VPDs.

In Italy, a strong inverse link between hospitalization rates and vaccination rates, especially for infants under 1 year old, was shown. Moreover, most side effects from Tdap vaccination during pregnancy are mild or moderate and self-resolving, and no safety signals among pregnant people or their babies after Tdap vaccination were found. On the other hand, nearly one-third of babies younger than 1 year who get pertussis needing care in the hospital, and 1 out of 100 babies who get treated in the hospital die (29, 30). Therefore, according to research (31), increasing HCWs' awareness of pertussis infection and the effectiveness and safety of vaccination may boost their likelihood of recommending the Tdap vaccine.

Third, almost one-third of the respondents reported they did not counsel or notify expectant people about the potential of obtaining the Tdap vaccine during pregnancy, missing an opportunity for immunization. In this situation, immunizations are not seen as a top

priority, especially if the HCW staff has not made a clear recommendation for them, in both the pre-service and in-service phases. The fact that pregnant people cannot rely on HCWs to inform them about immunizations during pregnancy raises concerns since they must be aware of the possibility of receiving the Tdap vaccine to choose whether to get vaccinated or not. Poor knowledge and concern about vaccine safety are displayed as the main reasons for vaccine hesitancy among pregnant people (32). The tendency to associate serious side effects with vaccines and the underestimation of risks of severe illness during pregnancy are important drivers of the phenomenon of vaccine hesitancy among pregnant people (32). The finding that informing pregnant people about the possibility of receiving the Tdap vaccine is the strongest predictor of having recommended Tdap vaccination during pregnancy underlines the crucial role of accurate information about maternal immunization. Hence, lack of advise or the fact that the OB-GYN discourages them from getting the Tdap vaccine might lead pregnant people not to get vaccinated (33). Each and every part of the healthcare system needs to be comfortable with and in charge of informing and counseling individuals about the vaccines that are recommended during pregnancy. As evidenced by the fourth significant finding, the most often cited justifications for not advising Tdap immunization during pregnancy were that HCWs considered it outside the scope of their practice, or they accepted vaccine hesitancy during pregnancy as a non-modifiable factor. Therefore, responsibility for individual education should fall especially on the HCWs' staff, and if HCWs do not stock or administer vaccines in the office, it is important to provide a referral to another immunization provider, making sure that everyone who needs immunization receives it. In the context of the study findings, midwives and PCPs seem to be the HCWs who deserve greater attention since they believed that recommending vaccination against pertussis was outside the scope of their practice. Among the HCWs, midwives and PCPs represent the first-line healthcare providers who have several interactions with pregnant people (34). However, in Italy, the role of those HCWs as reliable resources for expectant people counseling is largely neglected. As such, the need for adequate training to ensure proper management of vaccination during pregnancy is essential. Brief vaccine communication skills training for PCPs and midwives that include helpful advice on how to effectively communicate information in a health context could improve the uptake of maternal immunization (35). However, despite the benefits of maternal pertussis vaccination, implementation has not yet become standard practice, and it is frequently severely constrained because of structural and socio-cognitive barriers (36). Pregnant people expect HCWs who routinely follow them during pregnancy to provide information on the effectiveness and safety of Tdap vaccination and to act as trustworthy interlocutors for doubts, questions, and explanations. Therefore, a start in the right direction would be more HCW involvement in decision-making processes relating to vaccination recommendations and policies that they are actively implementing, with HCWs getting vaccination training to be knowledgeable about and confident in their ability to conduct the maternal immunization program, which will increase the uptake of vaccines during pregnancy and after birth. It is reasonable then to consider the latter as a contributing factor to the perceived lack of responsibility.

Limitations

The interpretation of the study findings should consider some limitations. The first limitation attains the possibility of desirability bias as the data were self-reported, but the direct observation was not feasible due to the expense involved and the risk of producing observation bias. Nevertheless, assurance of anonymity and confidentiality of the data in the survey minimizes the probability of this bias. Second, the response rate is lower than the desired, but it could be considered satisfactory for surveys conducted on HCWs (37–39), suggesting that non-response bias had no substantial effect on the results. Furthermore, the data were collected in two Italian regions, which might not represent Italian HCWs but may represent the southern part of Italy.

Conclusion

The advice given by HCWs about immunization during pregnancy must be backed up by recent, reliable scientific evidence. Beyond vaccine recommendations, how well immunization strategies are implemented in real-world situations impacts vaccination uptake. Therefore, during regular care visits, expecting people must have easy access to vaccines. Prenatal immunizations should become common practice, and there should be no conceptual doubt about vaccinations among HCWs to safeguard pregnant people and their unborn children from VPDs.

Author note

The preliminary results (on 94 out of 415 HCWs) of this study were presented as an E-Poster at the 15th European Public Health Conference held in Berlin, Germany in November 2022 and published in the European Journal of Public Health, Volume 32, Supplement 3, 2022.

Data availability statement

The dataset presented in this study can be found in online repository. The names of the repository and accession number can be found at: Mendeley Data repository (doi: 10.17632/7x785tzhyh.2).

Ethics statement

The studies involving human participants were reviewed and approved by the Calabria Centre Local Human Research Ethics Committee (ID No. 275/2021/07/15). The participants provided their written informed consent to participate in this study.

Author contributions

AB, FL, and MR participated in the conceptualization and design of the study. MR contributed to the data collection. MR,

FL, GDG, and EAC contributed to the data analysis and interpretation. MR, FL, and EAC contributed to the preparation of the first draft of the manuscript. AB was responsible for funding acquisition and resource provision, the principal investigator, designed the study, coordinated and supervised data collection, was responsible for the statistical analysis and interpretation, and wrote the final article. All the authors have given final approval of the version to be published and agreed to be accountable for all aspects of the study.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Knowledge and attitude factors associated with the prevalence of Tdap (tetanus, diphtheria, and acellular pertussis) booster vaccination in healthcare workers in a large academic hospital in Southern Italy in 2022: a cross-sectional study

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Introduction: In Europe, there is still suboptimal tetanus, diphtheria, and acellular pertussis (Tdap) booster coverage. This study aimed to assess coverage status, knowledge, and attitude on Tdap vaccination in healthcare workers (HcWs) of the University Hospital "Federico II" in Naples, Southern Italy, in 2022, to improve current vaccination strategies.

Methods: A cross-sectional study was conducted using a validated anonymous questionnaire. Knowledge and attitude were measured as scores. Multivariable logistic and linear regression models were employed to identify correlates of Tdap booster and knowledge and attitude toward the vaccination, as appropriate. Models were controlled for age, sex, profession, department, and job seniority.

Results: A total of 206 questionnaires were administered among HcWs, and 143 (69.4%) were medical doctors. In total, 71 (34.47%) HcWs received the Tdap booster. Those who have worked 5–9 years at the hospital had a 78% lower likelihood of being vaccinated with the Tdap booster (5–9 years—OR: 0.22, CI: 0.06 | 0.85) as compared with newly hired HcWs. No differences in the average knowledge score were found. Other healthcare workers had a lower attitude as compared to medical doctors (Other—Coef. −2.15; CI: −4.14 | −0.15) and, as compared with those who worked in a clinical department, those who worked in a diagnostic–therapeutic department or medical management had 3.1 and 2.0 lower attitude scores, on average, respectively (diagnostic–therapeutic—Coef. −3.12, CI: −5.13 | −1.12; public health—Coef. −1.98, CI: −3.41 | −0.56).

Discussion: The study findings support the necessity to implement public health strategies and improve knowledge and attitude toward vaccinations and specifically highlight the importance of Tdap booster every 10 years as a prevention tool to protect high-risk populations.

KEYWORDS

Tdap, vaccine, pertussis, knowledge, questionnaire, attitude, booster, healthcare

Introduction

The burden of vaccine-preventable diseases is still a global concern. In the decade 2010–2019, epidemic outbreaks of pertussis have been reported in several countries worldwide (1), although this figure is in contrast with what has been observed in the past 3 years. For instance, in 2021, pertussis cases almost halved compared with previous years (2). In Europe, the cases reported in 2021 were 2,157 compared with more than 12,000 in 2020 (3). However, the main factor responsible for the observed reduced incidence in this period is likely to be the implementation of non-pharmaceutical interventions (NPI) to reduce the impact of the COVID-19 pandemic on Health Systems (e.g., the use of filtered masks, continuous hand hygiene, and contact ban) rather than specific preventive strategies for pertussis, such as tetanus, diphtheria, and acellular pertussis (Tdap) vaccination (4, 5).

Data provided by the World Health Organization show that globally the coverage of vaccination against pertussis among 1-year-old children has decreased from 2019 to 2021 by 5% (from 86 to 81%), with an estimated loss of approximately 25 million pediatric vaccinations (6). In Europe, although the reduction was more contained, a drop between 1 and 5% in the 0–24 months and 0–6 years of vaccination coverage between 2018 and 2021 has been documented (7). This reduction in vaccination coverage is worrisome and might considerably impact population health in the upcoming years of transition from pandemic to endemic. Despite a strong initial reduction in the incidence of respiratory infectious diseases, the implementation of NPIs has only a transient effect, with a backlash effect when lifted (8).

In Italy, according to the national vaccination plan, the primary cycle and the booster doses are provided free of charge (9), the official 2021 National Health System data reported that the average coverage for Tdap vaccinations in the 0–24 months population was 94 and 72–73% for the 0–18 years booster coverage, below the WHO threshold and with profound inter-regional differences (10).

The perdurance of vaccine protection is not established, hence, booster dose coverage is pivotal. Numerous studies evidence decreasing levels of anti-pertussis immunoglobulin G over time from vaccination, suggesting that immunity wanes in the years following the last dose of Tdap (11).

In Italy, tetanus, diphtheria, and acellular pertussis booster doses are recommended for adolescents and then every 10 years in adults to reduce the transmission and to protect the community, especially since Italy, in 2018, accounted for 39.1% of all notified cases of Tetanus in EU/EEA countries (11–14). Furthermore, in Italy, cases of pertussis have increased from 503 to 962 during 2015–18 (15), with a strong likelihood to be underreported (16). The implementation of the active offer to professional categories at risk is particularly important, given the high contagiousness of infectious diseases, such as pertussis to newborns, who have not yet been vaccinated (17).

Although healthcare workers (HcWs) are a target group to achieve high vaccination coverage (18), they usually show a low awareness of work-related risks (19) and can be a source of infection for susceptible patients and relatives, as well as other HcWs (20–23).

Despite the importance of reaching immunization targets for HcWs, there is a paucity of evidence related to the topic. A systematic review conducted in 2019 found only 28 studies that examined Tdap coverage on HcWs; in the included studies, the highest coverage rate observed was 63.9%, despite that, on average was just 40.0% (24).

This study aimed to estimate the Tdap coverage status in HcWs at the University Hospital "Federico II" in Naples, a large university hospital in Southern Italy, in 2022 and to assess knowledge and attitude on Tdap vaccination and their correlates to improve current vaccination strategies and implement prevention counseling in health surveillance.

Methods

Study design

This cross-sectional study has been conducted to estimate Tdap coverage, knowledge, and attitude toward vaccinations in HcWs. Data were collected through the administration of an anonymous questionnaire. All HcWs at the University Hospital "Federico II" of Naples, the largest university hospital in Southern Italy, were invited to participate in the study between October and December 2022. The study was approved by the University Hospital Ethical Committee (Prot. N. 00018993–11/08/2022) and conducted in accordance with good clinical practice and the Declaration of Helsinki.

Study variables

Study variables were retrieved from a questionnaire that was adapted from a previously validated questionnaire (25). Before the questionnaire administration to our target population, it was discussed by a focus group composed of physicians and other healthcare workers to evaluate its comprehensibility and intelligibility. The questionnaire in its final form is available in the Supplementary Figure 1.

Study variables included the following sociodemographic characteristics: sex (male and female), age (up to 34 years old, 35 years, and older), and educational attainment (high school and below and degree and above). Additional variables related to the job status were as follows: profession (medical doctors, non-medical healthcare workers, such as nurses and healthcare assistants, and other healthcare workers including biologists and administrative staff), department (clinical, surgery, diagnostic–therapeutic, and medical management), job seniority (0–4 years, 5–9 years, and more than 10 years), and vaccination history (vaccinated against measles, mumps, rubella, hepatitis B, polio, chicken pox, *Haemophilus influenzae*, and tuberculosis; coded as yes/no/not sure). For vaccination history, a score of 3 was assigned to the answer "yes", 2 to "not sure", and 1 to "no" (26). Based on these answers, we constructed a score ranging from 8 to 24.

Outcome variables included the Tdap booster coverage in the past 10 years and the attitude and knowledge about vaccines. The knowledge section included 15 questions regarding recommended vaccinations. A score of 3 was assigned to the answer "yes", 2 to "not

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TABLE 1 Characteristics of the study population.

Study population	*N*	Percentage
Sample size	206	
Sex		
Male	103	50.00
Female	103	50.00
Age		
<35 years	117	26.80
≥35 years	89	43.20
Education		
Less than degree	13	6.31
Degree or higher	193	93.69
Profession		
Medical doctors	143	69.42
Non-medical healthcare workers	39	18.93
Others healthcare workers	24	11.65
Department		
Clinical	66	32.04
Surgery	31	15.05
Diagnostic–therapeutic	21	10.19
Medical management	88	42.72
Job seniority (years)		
0–4	154	74.76
5–9	25	12.14
≥10	27	13.11

sure", and 1 to "no" (26). Based on these answers, we constructed a score ranging from 15 to 45. Attitude toward recommended vaccinations was measured as a score (ranging from 3 to 30) obtained through three questions regarding the perception of the risk of contracting an infection and the usefulness of vaccination for HcWs to protect themselves and patients. Each question comprised a scale from 1 to 10. The final score was obtained by summing up the three values.

Statistical analyses

Study population characteristics were summarized using descriptive statistics, as appropriate. Multivariable regression models controlled for gender, age, profession, education, department, and job seniority were employed to assess correlates of vaccination coverage, knowledge, and attitude. To better assess the contribution of each variable, we first controlled the regression model for gender and age (partially adjusted model), then we also included education, job, department, and job seniority (fully adjusted model). Only for boosters, we also considered a third model including knowledge, attitude, and vaccination history. Specifically, multivariable logistic regression models were employed for binary outcomes and linear regression models for continuous outcomes. The results are presented as odds ratios (ORs), statistical coefficients (Coef.), and 95% confidence intervals (95%CIs), as appropriate. The results were considered significant if the *p*-value was <0.05. Statistical analyses were performed using Stata MP 15.0 statistical software.

Results

During the study period, 206 questionnaires were completed. The demographic characteristics of participants are presented in Table 1. In total, 50% of the sample participants were women: 26.8% were <35 years old and 43.2% were ≥35 years old. The majority of the sample participants, 93.7% (193), had a degree or higher education and 6.3% (13) did not. As per the job status, 69.4% of the subjects (143) were medical doctors, 18.9% (39) were non-medical HcWs, and the remaining workers were 11.6% (24). In total, 32.0% of the study population (66) was working in a clinical department, 15.0% (31) in a surgical department, 10.2% (21) in a diagnostic–therapeutic department, and the remaining 42.7% (88) in a medical management department. Most of the subjects, 74.8% (154), had worked for the university hospital for 0–4 years, 12.1% (25) for 5–9 years, and the remaining 13.1% (27) for 10 or more years.

One-third of the sample (34.5%) had a Tdap vaccination booster over the past 10 years. The results from the multivariable logistic regression model showed that as compared with those with 0–4 years of employment at a university hospital, those with 5–9 years of job seniority had a 78% lower likelihood of being vaccinated with the booster dose (5–9 years—OR: 0.22, CI: 0.06 | 0.85) (Figure 1).

The average knowledge score was 36.94 (CI: 35.93|37.95) out of 45. No differences in the average knowledge score were found between sub-groups (Figure 2). The average attitude score toward vaccination was 23.16 (CI: 22.59| 23.73) out of 30. When compared with medical doctors, other HcWs had a lower attitude score of 2.2, on average, (other—Coef. −2.15 on 30; CI: −4.14 | −0.15) and when compared with those who worked in a clinical department, on average, those who worked in a diagnostic–therapeutic department or medical management had lower attitude scores of 3.1 and 2.0, respectively (diagnostic–therapeutic—Coef. −3.12 on 30, CI: −5.13 | −1.12; medical management—Coef. −1.98 on 30, CI: −3.41 | −0.56) (Figure 2).

Discussions

In our cross-sectional study, conducted in the University Hospital "Federico II" of Naples, the largest university hospital in Southern Italy, we found that only one-third (34.5%) of the study population had a booster vaccination for Tdap, with a lower likelihood of receiving a booster dose for those with a 5–9 year employment history when compared with those employed for <5 years. No differences were found regarding the vaccination knowledge between sub-groups, while attitude toward vaccination was lower in the other HcWs (administrative employees, biologists) when compared with medical doctors and in HcWs employed

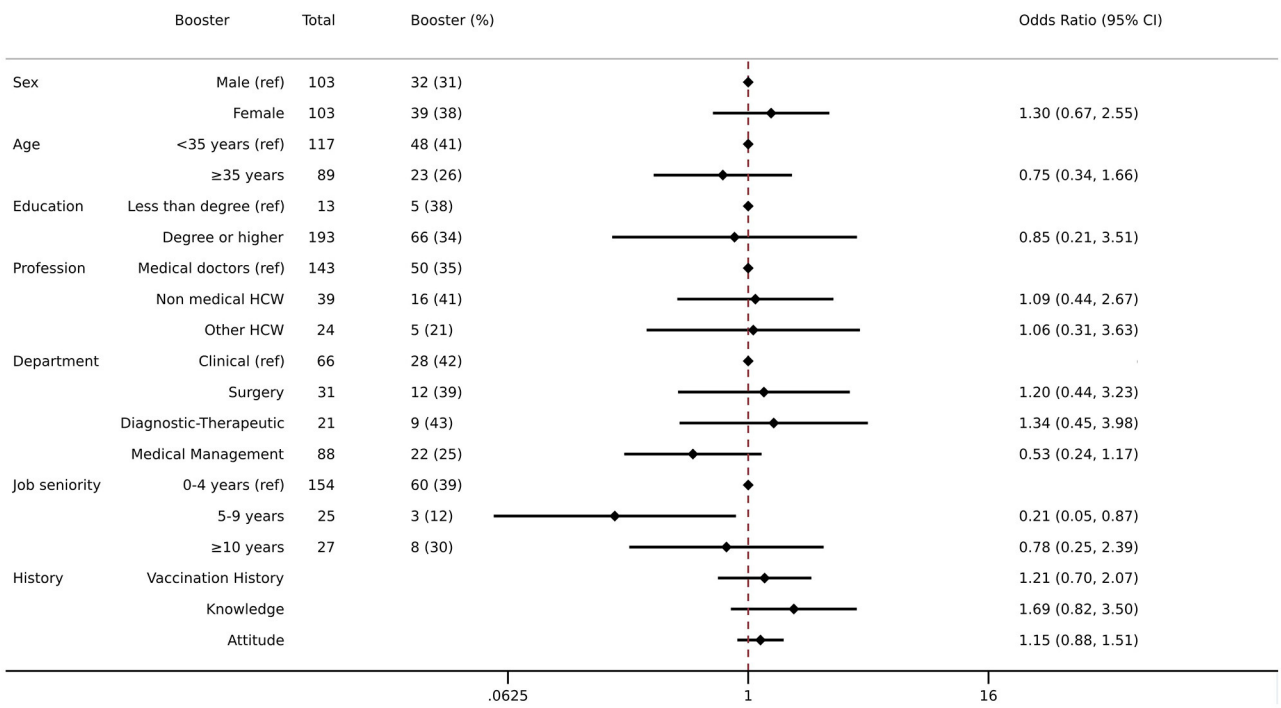

FIGURE 1
Association between demographic, job status, knowledge, attitude, vaccination history, and booster dose for Tdap. Multivariate logistic regression was employed including Tdap booster as an outcome variable and controlled for the following variables: sex, age, education, profession, department, job seniority, vaccination history, knowledge, and attitude. The results are presented as odds ratios (ORs) and 95% confidence intervals (95%CIs). The left column shows the crude number of those who received the booster Tdap and the proportion of them among the total.

in diagnostic–therapeutic and medical management departments when compared with clinical departments.

Overall, the prevalence rate of Tdap booster vaccination in the sample was as low as 34.47%. This evidence, although in the lower range, has been reported in similar studies conducted in the USA with values ranging from 34.7 to 47.2% (27–29) and in Turkey (36% of HcWs with at least one booster dose in the past) (30). Interestingly, we found no sex differences in the proportion of Tdap boosters received, although the previous literature suggested that HcWs of the female sex were more likely to receive the Tdap (31–33). We also found a weak positive association between younger age and the likelihood of Tdap booster vaccination (Supplementary Table 1), which, however, was not confirmed in the fully adjusted model. However, this evidence has been confirmed by previous studies conducted in similar settings (24, 29, 34, 35).

In the partially adjusted model, younger participants, as compared with those participants of 35 years and older, had a higher knowledge regarding recommended vaccines for the HcWs (Supplementary Table 2), although this was a weak association not confirmed in the fully adjusted model. This finding might be explained by the shorter time period since obtaining their degree. Furthermore, this evidence is consistent with a study conducted in similar settings (36).

Attitude toward vaccination varied according to occupation. In line with previous evidence (29), we found that medical doctors had significantly higher attitude than other HcWs, which might also be explained by their perception of being at high risk and the frequency of contacts with other high-risk groups, i.e., patients (37). We also found that attitude toward vaccination was higher for HcWs working in clinical departments, where the intensity of contact with high-risk patients is higher when compared with those working in diagnostic and medical management departments, which is in line with recent evidence conducted in similar settings (30, 38–41).

We conducted our research on HcWs working in the largest university hospital in Southern Italy. Hence, the results might be generalized to similar healthcare settings in the country. However, several considerations merit discussion. First, responses may be influenced by difficulty in recalling their vaccination status, particularly for pediatric vaccinations. However, when recall bias is equally distributed in every study participant, the overall effect of the bias on study findings is reduced (42). Second, although the questionnaire was designed to be anonymous, responses or the lack of participation may have been influenced by the fear of the vaccinations or being targeted for vaccination campaigns, especially after the COVID-19 pandemic and the decision by the Italian NHS to enforce the COVID-19 vaccination for HcWs. Third, this specific analysis was based on a relatively small sample, and the results might be influenced by possible selection bias, as only personnel more willing to share their experiences might have decided to participate. Finally, another limitation of the study was to assess knowledge in a yes-no-don't know system. Although this approach might limit the precision of the outcome derivation, this choice was made to avoid altering the original questionnaire.

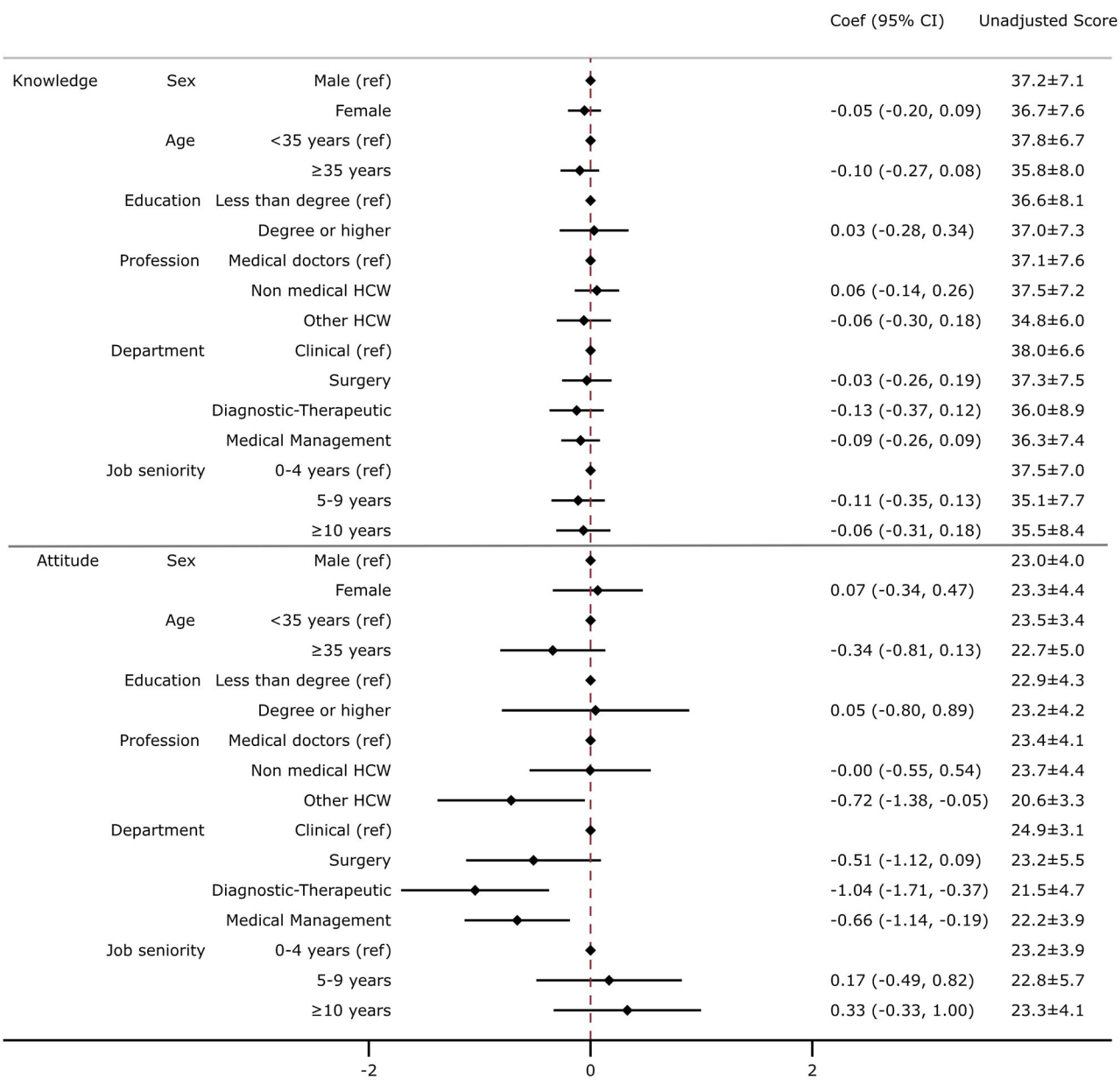

FIGURE 2
Association between demographic, job status, and knowledge or attitude toward vaccination. Multivariate linear regression was employed including knowledge **(top)** or attitude **(bottom)** as an outcome variable and controlled for the following variables: sex, age, education, profession, department, and job seniority. The results are presented as a coefficient (Coef) and 95% confidence intervals (95% CIs). In the right column, the unadjusted average score and standard deviation for attitude and knowledge are displayed. The knowledge score was calculated considering the average score of 15 questions regarding recommended vaccination (with a score ranging from 1 to 3 for each question, with a final score ranging from 15 to 45). The attitude score was calculated considering the average score of three questions regarding the perception of the risk of contracting an infection and the usefulness of vaccination for HcWs to protect themselves and patients (with a score ranging from 1 to 10 for each question, with a final score ranging from 3 to 30).

Policy

Healthcare workers are a high-risk population for infectious disease exposure and transmission. Low vaccine coverage for HcWs can lead to severe disease outbreaks, decreasing productivity, increasing absenteeism, and is also costly to the health system (43–46). Improving attitude and belief regarding vaccination among HcWs is important to avoid drops in the vaccination coverage rates and may also influence patients' responses to immunization campaigns (47). Our findings highlighted the importance to implement effective information and communication strategies, mostly among more experienced staff, to refresh and update information regarding vaccination in HcWs. Specifically, tailored strategies should be undertaken to improve Tdap booster coverage because, although the booster is offered free of charge in line with the national vaccination plan,

there is no monitoring strategy in place as the quantitative serum immunoglobulin test is not included as a minimum requirement in the protocol of health surveillance for HcWs.

Conclusion

In the present study, we found that only one-third of the HcWs employed at the University Hospital "Federico II" of Naples, the largest academic hospital in Southern Italy, had a Tdap vaccination booster in the past 10 years. Longer employment history was associated with a lower likelihood of receiving the Tdap booster. Medical doctors had a higher attitude toward vaccination than other HcWs. Our findings support the need to implement public health strategies to improve information and awareness toward vaccinations and specifically highlight the importance of actively including the Tdap booster every 10 years as a prevention tool to protect high-risk populations.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors upon request and approbation from the ethical committee.

Ethics statement

The studies involving human participants were reviewed and approved by University Hospital Ethical Committee of "Federico II". The patients/participants provided their written informed consent to participate in this study.

Author contributions

RP and MT conceived the study and devised the study methodology and supervised the study. MM, CF, FE, MS, PM, and AP contributed to the acquisition of data for the study. RP and MM performed the formal data analysis. RP, MM, CF, FE, and MS wrote the first draft of the manuscript. RP had final responsibility for the decision to submit for publication. All authors reviewed and edited the manuscript, contributed to the article, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1173482/full#supplementary-material

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Influenza vaccination rates among healthcare workers: a systematic review and meta-analysis investigating influencing factors

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Introduction: Healthcare workers risk of exposure to the influenza virus in their work, is a high-risk group for flu infections. Thus WHO recommends prioritizing flu vaccination for them—an approach adopted by >40 countries and/or regions worldwide.

Methods: Cross-sectional studies on influenza vaccination rates among healthcare workers were collected from PubMed, EMBASE, CNKI, and CBM databases from inception to February 26, 2023. Influenza vaccination rates and relevant data for multiple logistic regression analysis, such as odds ratios (OR) and 95% confidence intervals (CI), were extracted.

Results: A total of 92 studies comprising 125 vaccination data points from 26 countries were included in the analysis. The meta-analysis revealed that the overall vaccination rate among healthcare workers was 41.7%. Further analysis indicated that the vaccination rate was 46.9% or 35.6% in low income or high income countries. Vaccination rates in the Americas, the Middle East, Oceania, Europe, Asia, and Africa were 67.1, 51.3, 48.7, 42.5, 28.5, and 6.5%, respectively. Influencing factors were age, length of service, education, department, occupation, awareness of the risk of influenza, and/or vaccines.

Conclusion: The global influenza vaccination rate among healthcare workers is low, and comprehensive measures are needed to promote influenza vaccination among this population.

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KEYWORDS

influenza vaccine, vaccination rate, healthcare workers, influencing factors, meta-analysis

Introduction

The World Health Organization (WHO) reports that the flu causes 3 to 5 million severe cases and contributes to 290,000 to 650,000 respiratory disease-related deaths globally p.a (1). Thus flu imposes a substantial impact on both public health and the economy, i.e., the flu resulted in 145,000 deaths, 9.459 million hospitalizations, and 81.536 million hospitalization days due to lower respiratory tract infections (LRTIs), with the flu accounting for 11.5% of LRTI cases in

2017 (2). This aligns with that indirect costs accounted for 88% of the overall economic burden of flu in the 18–64 age group, with 75% of direct costs attributed to hospitalization. Additionally, the costs associated with flu increase with age and the presence of underlying diseases within the 18–64 age group (3).

Annual flu vaccination is widely recognized as an effective preventive measure against the flu. Evidence from a systematic review of randomized controlled trials indicates that inactivated flu vaccines administered to healthy adults can prevent 59% of laboratory-confirmed flu cases, furthermore, when the vaccine strains closely match the circulating flu virus strains, it has been shown to reduce the incidence of influenza-like illness (ILI) by 42% (4).

Healthcare workers face a significant risk of exposure to the flu virus in their daily work, making them a high-risk group for flu infections. A meta-analysis revealed that the incidence of lab-confirmed flu among non-vaccinated healthcare workers was 18.7%, which is 3.4 times higher than the rate observed in healthy adults (5). When healthcare workers contract the flu, it can lead to heightened absenteeism, causing disruptions in medical services and a greater risk of hospital-acquired infections. Furthermore, continuing to work while infected can potentially facilitate the transmission of the flu to other individuals, particularly their family members.

Influenza vaccination is the most significant prevention measure. Recognizing the importance of protecting healthcare workers and preventing the spread of flu, WHO recommends that healthcare workers be given priority for flu vaccination. This recommendation has been adopted by over 40 countries and regions worldwide. However, vaccination coverage exhibited significant variations from one country to another (6), and in some instances, it was notably low (7). In this current systematic review, our objective is to examine the influenza vaccination rates among healthcare workers and the factors that impact their adherence to flu vaccination.

Methods

Study type

This meta-analysis included cross-sectional studies that reported the seasonal influenza vaccination rate among healthcare workers.

Study population

The study population consisted of healthcare workers and healthcare professionals directly involved in providing health services globally.

Outcome measures

The primary outcome measure of interest was the seasonal influenza vaccination rate, which was defined as the percentage of vaccinated individuals among the total survey population.

Inclusion criteria

To be included in this meta-analysis, studies had to meet the following criteria:

1. Studies reporting the seasonal influenza vaccination rate among healthcare workers and/or its influencing factors.
2. The study population included healthcare workers and healthcare professionals directly involved in providing health services globally.
3. Studies provided specific information on sample size, vaccination rates, and the number of vaccinated individuals within a given year.
4. Studies were published in either Chinese or English.
5. The study design was cross-sectional.

Exclusion criteria

The following criteria were used to exclude studies from this meta-analysis:

1. Studies reporting on types of influenza vaccines other than seasonal influenza vaccines.
2. Studies that did not report key data such as sample size, vaccination rates, and the number of vaccinated individuals, or studies that did not specify the vaccination year or only reported combined vaccination rates for multiple years.
3. Studies that focused solely on healthcare institutions or the overall population of a country, without specific data on healthcare workers.
4. Duplicate publications, where the same study was published in multiple sources.
5. Studies with logical errors or inconsistencies in the reported data.

Literature search strategy

Computer-based searches were performed in multiple databases, including PubMed, EMBASE, CNKI, CBM, Wanfang, and VIP. The search aimed to identify cross-sectional studies that reported the seasonal influenza vaccination rate among healthcare workers. The search was conducted from the inception of each database up to February 26, 2023. The search strategy utilized a combination of subject terms and free-text terms, Search, terms like "Influenza Vaccine*," "Flu Vaccine*," "Influenza Virus Vaccine*," "Universal Influenza Vaccine*," "Universal Flu Vaccine*," "Immunization Coverage*" and "Vaccination Coverage*" were utilized. This comprehensive search strategy was designed to capture relevant studies and gather a wide range of literature on the seasonal influenza vaccination rate among healthcare workers (Supplementary Table S1).

Literature screening and data extraction

The identified literature was imported into Endnote literature management software, and duplicate records were removed. Two researchers independently screened the literature and performed data extraction. In cases of discrepancies, a third senior researcher was consulted for discussion and to reach a consensus. Initially, the title and abstract of each article were reviewed to exclude obviously

irrelevant studies. Subsequently, the full text of the remaining articles was thoroughly examined to determine their eligibility for inclusion in the meta-analysis.

Data extraction encompassed various key aspects, including the first author's name, publication year, survey region, sampling location, study population, vaccination time, sample size, number of vaccinated individuals, and relevant data from multiple logistic regression analysis, such as odds ratios (ORs), 95% confidence intervals (CIs), and reference objects. This rigorous screening and data extraction process ensured that relevant and reliable information was obtained from the selected studies for further analysis.

Evaluation of bias risk in included studies

To assess the methodological quality of the included cross-sectional studies, a checklist was developed based on recommended guidelines. This checklist incorporated items from the cross-sectional study quality evaluation tool endorsed by the Agency for Healthcare Research and Quality (AHRQ) and the JBI Analytic Cross-Sectional Study Quality Evaluation Scale.

The checklist consisted of nine key items aimed at evaluating the potential biases in the included studies. These items included:

1. Clearly stating the source of data (e.g., survey, literature review).
2. Clearly defining the inclusion criteria for the study population.
3. Providing detailed descriptions of the study population and study site.
4. Offering an explanation for the exclusion of certain study subjects from the analysis.
5. Summarizing the patient response rate and data collection completeness.
6. Explaining how missing data was handled during the analysis if the research data was incomplete or had missing values.
7. Describe how confounding was assessed and/or controlled.
8. Whether to use effective and credible methods to measure outcome indicators.
9. Whether the data analysis method is appropriate.

By systematically assessing these aspects, the checklist enabled a comprehensive evaluation of the methodological quality of the cross-sectional studies. This evaluation helped to identify any potential biases that may have influenced the study results and ensured the reliability of the findings.

Data analysis

The data extraction and analysis were performed using Excel 2016 and STATA 12.0 software. To assess publication bias, Egger's test and funnel plot were utilized. A significance level of 0.05 or 0.01 was considered statistically significant. Given the anticipated heterogeneity, a random-effects model was employed for the analysis. Sensitivity analysis was conducted to assess the robustness and reliability of the overall vaccination rate estimate. Additionally, subgroup analysis was performed to explore potential sources of heterogeneity.

For the analysis of vaccination rates, the formula used was as follows:

Influenza vaccine vaccination rate = number of vaccinators / sample size.

The standard error of the rate was calculated using the formula:

Standard error of rate = sqrt (rate × (1-rate) / sample size).

When adequate data were available from the included articles, the random effects model was utilized to estimate the odds ratios (OR) of the influencing factors. This approach allowed for a comprehensive assessment of the relationship between the influencing factors and the vaccination rates.

These analytical methods were employed to ensure a comprehensive evaluation of the data and to derive reliable and robust outcomes from the study. By utilizing these methods, we aimed to provide accurate and valid insights into the influencing factors of influenza vaccination rates among healthcare workers.

Results

During the literature screening process

A comprehensive search of relevant articles yielded a total of 6,502 records. Following the screening process, 92 cross-sectional studies were considered eligible for inclusion in the analysis. The detailed process and results of the literature screening are presented in Figure 1. These 92 studies encompassed 125 data points on influenza vaccination, with sample sizes ranging from 106 to 8,975 participants. The reported vaccination rates varied between 3.1 and 99.6%. The studies were conducted in 26 countries across Asia, Europe, the Americas, Africa, Oceania, and the Middle East, providing a diverse geographical representation.

It is summarized that the key characteristics of the included studies, including their basic information and vaccination data (Table 1). The evaluation of literature quality resulted in an average score of 7.86 points. Among the included articles, one was rated as low-quality, 30 as medium-quality, and 61 as high-quality studies.

Influenza vaccination rate and subgroup analysis

The meta-analysis included a total of 92 cross-sectional studies, and a random effects model was employed. The analysis revealed that the global influenza vaccination rate among healthcare workers was 41.7% (95% CI [35.7, 47.7%)]. However, it is noted that significant heterogeneity was observed among the studies ($I^2 = 99.9\%$, $p < 0.001$). To further explore the sources of heterogeneity, subgroup analyzes were conducted based on the country's level of development, geographic region, and time of vaccination.

The countries included in the analysis were categorized as low income or high income according to their economic levels. It was revealed that the influenza vaccination rate among healthcare workers in developed or developing countries was 46.9% or 35.6%. Furthermore, the study regions were classified into Asia, Europe, America, Africa,

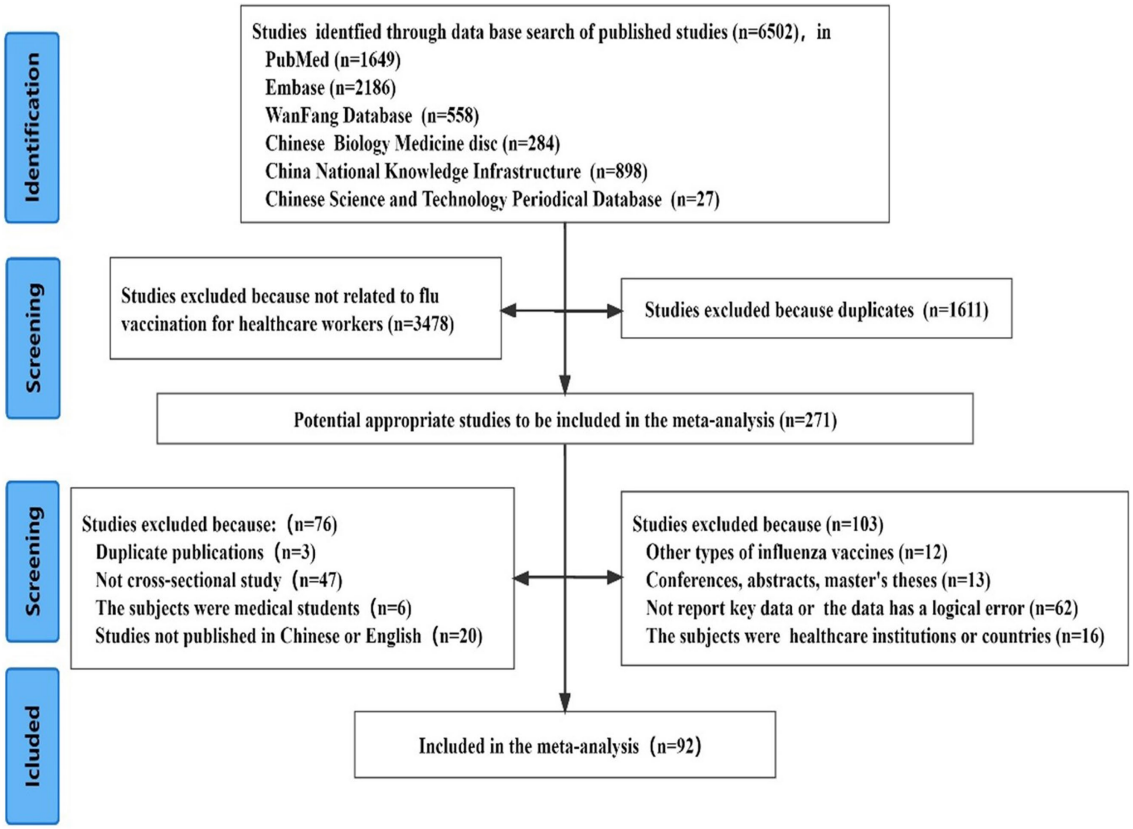

FIGURE 1
The detailed process and results of the literature screening.

Oceania, and the Middle East based on their geographical locations. Subgroup analysis revealed that America had the highest vaccination rate at 67.1%, followed by the Middle East, Oceania, Europe, and Asia with rates of 51.3, 48.7, 42.5, and 28.5%, respectively. Africa had the lowest vaccination rate at 6.5%. The study periods were divided based on the occurrence of the H1N1 influenza pandemic (March 2009 to August 2010) and the COVID-19 epidemic (from the end of December 2019). The vaccination rates were separately analyzed for different periods: before 2009, 2009–2012, 2013–2016, 2017–2019, and 2020-present. The subgroup analysis showed that the highest vaccination rate was observed since 2020 at 52.8%, followed by the period of 2009–2012 at 46.7%, 2013–2016 at 46.5%, before 2009 at 39.4%, and the lowest rate was during 2017–2019 at 31.4%.

Despite the subgroup analysis, there remained high heterogeneity in the vaccination rates within each subgroup, indicating that the level of economic development, geographical location, and different vaccination periods were not the primary sources of heterogeneity. The detailed results of the subgroup analysis can be found in Table 2.

Publication bias test

A funnel plot was generated using the 125 vaccination rate data included in the study (Figure 2), which showed that the scatter was relatively dispersed and roughly symmetrical. The Egger's test confirmed that there was no significant publication bias in the studies ($t = -0.33$, $p = 0.741$), indicating that this study had low publication bias.

Sensitivity analysis

A sensitivity analysis was performed by systematically excluding individual studies from the meta-analysis. The results indicated that the effect size remained consistent, ranging from 41 to 43%, even when each study was removed, suggesting that the meta-analysis findings were robust and stable (Supplementary Table S2).

Factors influencing influenza vaccination

A total of 32 factors were identified from the included studies that significantly influenced healthcare workers' uptake of influenza vaccine. Several factors played a significant role in influencing vaccination uptake among healthcare workers, including age, length of employment, education level, department of work, occupation, presence of chronic diseases, perception of being at risk of infection, belief in vaccine effectiveness, willingness to receive vaccination, recommendation of influenza vaccine to patients, previous COVID-19 vaccination, participation in influenza or influenza vaccine training and health education, and knowledge of vaccination timing.

TABLE 1 Basic information of literatures of included studies.

Study	Sampling location	Population	Vaccination time	Study region	Sample size	Vaccination population	Quality score
Sheng et al. (8)	Internet survey	Nurses	2017	Mainland China	773	31	8
Liu et al. (9)	Community health centers	All HCWs	2018	Mainland China	1,359	424	9
Wang et al. (10)	Hospital	All HCWs	2012	Mainland China	569	171	9
Gao et al. (11)	Hospital	All HCWs	2013	Mainland China	369	51	8
Liu et al. (12)	Hospital	Nurses	2018	Mainland China	299	68	9
Yang and Chen (13)	Hospital	Nurses	2013	Mainland China	650	284	9
Gan et al. (14)	Community health centers	All HCWs	2018	Mainland China	106	24	9
Wang (15)	Hospital	All HCWs	2007	Mainland China	199	15	6
Bu et al. (16)	Hospital	All HCWs	2012	Mainland China	1,521	98	8
Yang et al. (17)	Hospital	All HCWs	2016	Mainland China	1941	107	9
Wang et al. (18)	Internet survey	Nurses	2017	Mainland China	510	16	8
Zhang et al. (19)	Hospital	All HCWs	2017	Mainland China	943	131	9
Kong et al. (20)	Hospital/Community health centers /CDC	All HCWs	2019	Mainland China	8,975	2,241	9
Ma et al. (21)	Hospital	All HCWs	2017	Mainland China	3,260	226	8
Gan et al. (22)	Influenza sentinel surveillance hospital/Hospital	All HCWs	2018	Mainland China	1,412	237	8
James et al. (23)	Hospital	All HCWs	2016	Sierra Leone	706	46	8
Liu et al. (24)	Internet survey	All HCWs	2018	Mainland China	4,078	472	9
Hosamirudsari et al. (25)	Hospital	All HCWs	2015	Iran	378	218	7
Alhammadi et al. (26)	Hamad Medical Corporation	All HCWs	2013	Qatar	230	151	9
Boey et al. (27)	Hospital/Nursing homes	All HCWs	2014	Belgium	450	334	9
Barbadoro et al. (28)	National Health Surveys.	All HCWs	2012	Italy	5,336	1,110	6
Wong et al. (29)	Hospital	Nurses	2017	Hong Kong	708	309	5
Kyaw et al. (30)	Hospital	All HCWs	2015	Singapore	3,873	3,191	9
Rabensteiner et al. (31)	Health Service	All HCWs	2015	Italy	4,091	425	9
Garcell and Ramirez (32)	Hospital	All HCWs	2012	Qatar	325	231	6
Esposito et al. (33)	University Hospital	All HCWs	2006	Italy	2,143	432	9
Hudu et al. (34)	Hospital	All HCWs	2013	Malaysia	527	271	7
Costantino et al. (35)	University	Medical residents	2011	Italy	2,506	299	9
Jimenez-Garcia et al. (36)	National Health Surveys.	All HCWs	2003	Spain	518	102	8
Von Perbandt et al. (37)	Hospital	All HCWs	2014	Switzerland	200	30	8
Haridi et al. (38)	Medical City	All HCWs	2014	Saudi Arabia	447	394	9

(Continued)

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TABLE 1 (Continued)

Study	Sampling location	Population	Vaccination time	Study region	Sample size	Vaccination population	Quality score
Sočan et al. (39)	Slovenian Medical Chamber	Physicians and dentists	2009	Slovenia	1718	890	8
Domínguez et al. (40)	Healthy primary facilities	All HCWs	2011	Spain	1749	887	9
Rehmani and Memon (41)	Hospital	All HCWs	2008	Saudi Arabia	512	176	9
Kan et al. (42)	Hospital	Nurses	2011	Mainland China	895	295	9
Kent et al. (43)	Public Health Directorates	All HCWs	2007	America	1,203	871	9
Hagemeister et al. (44)	Hospital	All HCWs	2012	Germany	675	286	7
Castilla et al. (45)	Hospital	All HCWs	2008	Spain	1965	1,203	8
Ball et al. (46)	National opt-in Internet panels	All HCWs	2012	America	1944	1,400	7
Black et al. (47)	National opt-in Internet panels	All HCWs	2013	America	1882	1,415	7
Black et al. (48)	National opt-in Internet panels	All HCWs	2014	America	1914	1,480	7
Black et al. (49)	National opt-in Internet panels	All HCWs	2015	America	2,258	1784	7
Black et al. (50)	National opt-in Internet panels	All HCWs	2016	America	2,438	1916	7
Black et al. (51)	National opt-in Internet panels	All HCWs	2017	America	2,265	1776	7
CDC (52)	National opt-in Internet panels	All HCWs	2010	America	1931	1,226	7
Ball at al. 2012 (53)	National opt-in Internet panels	All HCWs	2011	America	2,348	1,571	7
Tanguy et al. (54)	Hospital	All HCWs	2009	France	532	119	5
Amodio et al. (55)	University Hospital	Medical residents	2009	Italy	202	44	8
Hakim et al. (56)	Hospital	All HCWs	2018	Egypt	3,534	1,087	9
Hussain et al. (57)	Hospital	All HCWs	2013	Canada	896	654	7
Tagajdid et al. (58)	Hospital	All HCWs	2011	Morocco	721	122	6
Dorribo et al. (59)	University Hospital	All HCWs	2009	Switzerland	472	245	9
Bazán et al. (60)	Hospital/Health centers	All HCWs	2010	Peru	672	544	9
Yi et al. (61)	Internet survey	All HCWs	2019	Mainland China	4,366	2,927	8
Sánchez-Payá et al. (62)	University Hospital	All HCWs	2010	Spain	3,126	762	8
Yu et al. (63)	Internet survey	Nurses	2017	Mainland China	4,153	257	8
Groenewold et al. (64)	Nursing homes	Nurses	2004	America	2,873	107	6
Hajiabdolbaghi et al. (65)	Hospital	All HCWs	2019	Iran	637	189	5
Dubnov et al. (66)	Hospital	All HCWs	2004	Israel	256	42	7
Buxmann et al. (67)	Hospital	All HCWs	2016	Germany	124	49	9
Khazaeipour et al. (68)	University Hospital	All HCWs	2008	Iran	139	93	7
Lu and Euler (69)	National Health Surveys.	All HCWs	2006	America	484	226	6

(Continued)

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TABLE 1 (Continued)

Study	Sampling location	Population	Vaccination time	Study region	Sample size	Vaccination population	Quality score
Domínguez et al. (70)	Hospital	All HCWs	2011	Spain	1749	886	8
Toledo et al. (71)	community health centers	Pharmacists	2013	Spain	463	116	9
Loulergue et al. (72)	Medical departments	All HCWs	2006	France	395	204	8
Madewell et al. (73)	Hospital	All HCWs	2018	America	706	393	8
Harrison et al. (74)	Hospital	Nurses	2013	Austria	107	45	8
Petek and Kamnik-Jug (75)	Primary care centers	All HCWs	2014	Slovenia	250	30	9
Murray and Skull (76)	Hospital	All HCWs	1999	Australia	269	131	7
Mojamamy et al. (77)	Primary care centers	All HCWs	2015	Saudi Arabia	368	320	7
Vírseda et al. (78)	University Hospital	All HCWs	2009	Spain	527	262	8
Amani et al. (79)	Hospital/community health centers	All HCWs	2019	Egypt	980	131	9
Hämäläinen et al. (80)	University Hospital	All HCWs	2015	Finland	985	586	7
Khazaeipour et al. (81)	University Hospital	All HCWs	2008	Iran	139	93	9
Jiang et al. (82)	Hospital	All HCWs	2019	Mainland China	2,974	713	8
Fan et al. (83)	Hospital	All HCWs	2019	Mainland China	6,654	1,037	7
Yan et al. (84)	Hospital	All HCWs	2019	Mainland China	1,332	614	7
Li et al. (85)	Hospital	All HCWs	2020	Mainland China	4,135	2,460	9
Zhang et al. (86)	Hospital	All HCWs	2019	Mainland China	775	255	9
Wu et al. (87)	Hospital	All HCWs	2018	Mainland China	3,507	413	8
Lv et al. (88)	Community health centers	All HCWs	2018	Mainland China	1,483	216	8
Fan et al. (89)	Hospital	All HCWs	2020	Mainland China	769	670	9
Lei et al. (90)	Influenza sentinel surveillance Hospital	All HCWs	2020	Mainland China	1854	419	9
Ma et al. (91)	Internet survey	All HCWs	2021	Mainland China	1,697	600	9
Papageorgiou et al. (92)	Health care services institutions	All HCWs	2019	Cyprus	962	306	8
Ajejas Bazán et al. (93)	Public Health Directorates	All HCWs	2020	Spain	832	590	8
Bertoni et al. (94)	Cancer research institute	All HCWs	2020	Italy	579	334	8
Marinos et al. (95)	Athens Medical Association	All HCWs	2020	Greece	1993	1,523	7
Shi et al. (96)	Hospital/Community health centers	All HCWs	2020	Mainland China	2,192	868	8
Jędrzejek and Mastalerz-Miga (97),	Hospital	All HCWs	2019	Poland	165	101	8
Costantino et al. (98)	Community health centers	Pharmacists	2020	Italy	1,450	841	7
Ogliastro et al. (99)	University Hospital	All HCWs	2021	Italy	4,753	1,423	4

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TABLE 2 Influenza vaccination rate of HCWs in different groups.

Groups	Reference(n)	Test of heterogeneity result			Meta-analysis results	
		P	I^2(%)	Effect model	Rate (%)	95% CI
Economic development levels						
Developing country	67	<0.001	99.9	Random	46.9	(38.0, 55.9%)
Developed country	58	<0.001	99.8	Random	35.6	(30.1, 41.1%)
Geographic region						
Asia	45	<0.001	99.8	Random	28.5	(23.2, 33.8%)
Europe	45	<0.001	99.9	Random	42.5	(31.2, 53.8%)
America	17	<0.001	99.9	Random	67.1	(48.9, 85.4%)
Africa	1	–	–	Random	6.5	(4.7, 8.3%)
Oceania	1	–	–	Random	48.7	(42.7, 54.7%)
Middle East	16	<0.001	99.6	Random	51.3	(38.1, 64.5%)
Vaccination time						
~2008	13	<0.001	99.8	Random	39.4	(21.9, 56.8%)
2009–2012	28	<0.001	99.8	Random	46.7	(37.9, 55.6%)
2013–2016	33	<0.001	99.8	Random	46.5	(35.8, 57.2%)
2017–2019	39	<0.001	100.0	Random	31.4	(18.5, 44.3%)
2020~	12	<0.001	99.7	Random	52.8	(41.9, 63.8%)
Total	125	<0.001	99.9	Random	41.7	(35.7, 47.7%)

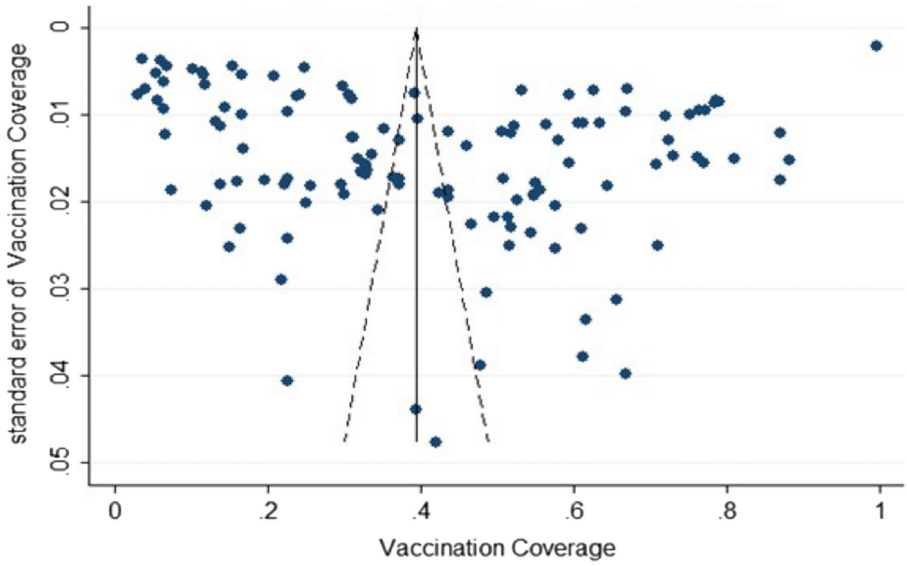

FIGURE 2
Funnel plot with pseudo 95% confidence limits.

Compared with the younger age group, the middle-aged and older adult groups were more likely to receive the vaccine. Healthcare workers with more than 10 years of experience were more likely to be vaccinated than those with less than 10 years of experience. Non-clinical staff were more likely to receive the vaccine than clinical staff. Among healthcare workers who had chronic diseases, perceived themselves to be at high risk of infection, believed in the effectiveness of the vaccine, had the willingness to receive the vaccine, recommended the vaccine to patients, had previous COVID-19 vaccination, and had knowledge of vaccination timing, were more likely to receive the influenza vaccine.

Subgroup analysis of influencing factors showed that gender, marital status, professional title, perception of vaccine safety, source of vaccine information, and whether the workplace provided free vaccines may also be factors influencing healthcare workers' uptake of influenza vaccine. The detailed findings of these significant factors are summarized in Table 3.

TABLE 3 Factors associated with influenza vaccination rates among health care workers.

Factor	Test of heterogeneity result			Meta-analysis results		*P*
	P	I^2(%)	Effect model	OR	OR95%CI	
Sex	<0.001	78.5	Random	1.197	(0.987, 1.452)	0.068
Female	<0.001	71.3	Random	0.960	(0.787, 1.171)	0.687
Male	0.001	85.3	Random	1.656	(1.289, 2.127)	<0.001
Age	<0.001	95.1	Random	1.700	(1.600, 1.807)	<0.001
Younger age	0.001	70.6	Random	1.575	(1.104, 2.247)	0.012
Middle-aged	<0.001	91.0	Random	2.278	(1.790, 2.900)	<0.001
Older adult	<0.001	90.5	Random	2.824	(1.669, 4.779)	<0.001
Whole population	0.001	77.6	Random	1.018	(1.002, 1.034)	0.030
Length of service	<0.001	93.7	Random	1.286	(1.179, 1.402)	<0.001
≤10	<0.001	90.6	Random	1.214	(0.888, 1.659)	0.224
11–30	<0.001	81.6	Random	1.397	(1.203, 1.622)	<0.001
>30	<0.001	84.9	Random	1.414	(0.775, 2.582)	0.259
Other	0.373	0.0	Random	1.009	(0.999, 1.018)	0.075
Education level	<0.001	73.1	Random	0.837	(0.723, 0.969)	0.017
College degree or below	<0.001	76.5	Random	0.721	(0.582, 0.895)	0.003
Bachelor degree	0.154	37.9	Random	0.829	(0.666, 1.033)	0.095
Master degree or above	0.005	70.2	Random	1.076	(0.809, 1.431)	0.616
Marital status	0.054	44.6	Random	1.139	(0.976, 1.329)	0.100
Married/Cohabitant	0.027	60.4	Random	1.096	(0.854, 1.406)	0.473
Separated/Divorced	0.922	0.0	Random	1.086	(0.896, 1.318)	0.400
Widowed	0.716	0.0	Random	1.583	(1.162, 2.158)	0.004
Professional title	0.058	41.6	Random	1.123	(0.992, 1.270)	0.066
Associate senior or above	0.015	67.6	Random	1.238	(0.939, 1.633)	0.130
Middle	0.434	0.0	Random	1.139	(1.027, 1.264)	0.014
Primary	0.110	60.8	Random	1.059	(0.581, 1.933)	0.851
No title	0.857	0.0	Random	0.762	(0.481, 1.208)	0.248
Department	<0.001	77.2	Random	1.435	(1.148, 1.794)	0.241
Clinical	<0.001	89.6	Random	1.177	(0.896, 1.546)	0.002
Non-clinical	<0.001	85.2	Random	1.781	(1.243, 2.551)	0.002
Occupation	<0.001	86.7	Random	1.757	(1.503, 2.055)	<0.001
Nursing staff	<0.001	93.1	Random	1.371	(1.006, 1.868)	0.046

(Continued)

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TABLE 3 (Continued)

Factor	Test of heterogeneity result			Meta-analysis results		*P*
	P	I^2(%)	Effect model	OR	OR95%CI	
Others	0.016	49.3	Random	1.397	(1.160, 1.682)	<0.001
Clinician	<0.001	80.0	Random	2.365	(1.868, 2.993)	<0.001
Hospital level	<0.001	88.9	Random	0.941	(0.660, 1.340)	0.734
Primary	0.002	84.5	Random	1.315	(0.907, 1.907)	0.148
Secondary	0.033	70.6	Random	0.618	(0.376, 1.015)	0.057
Have children at home	0.465	0.0	Random	1.024	(0.907, 1.155)	0.706
Have old people at home	0.047	62.3	Random	1.347	(0.987, 1.838)	0.060
Have chronic medical condition	0.399	4.5	Random	1.707	(1.441, 2.021)	<0.001
They consider themselves to be at high risk of infection	<0.001	87.7	Random	1.981	(1.256, 3.126)	0.003
Think the vaccine is effective	<0.001	87.7	Random	2.101	(1.249, 3.534)	0.005
Whether the vaccine is safe	<0.001	87.1	Random	1.413	(0.921, 2.169)	0.113
Safe	<0.001	90.2	Random	1.619	(1.008, 2.601)	0.046
Unsafe	0.440	0.0	Random	0.741	(0.349, 1.577)	0.437
Support HCWs to receive influenza vaccination	<0.001	95.2	Random	2.279	(0.824, 6.308)	0.113
Worried about vaccine side effects	0.041	76.0	Random	0.693	(0.312, 1.537)	0.367
That vaccines cause the flu	0.074	68.7	Random	0.834	(0.443, 1.570)	0.575
Protect patients	0.011	84.4	Random	2.154	(0.971, 4.778)	0.059
Willing to vaccinate	0.792	0.0	Random	4.104	(2.421, 6.956)	<0.001
Whether to recommend vaccines to patients	<0.001	86.1	Random	2.193	(1.315, 3.658)	0.003
No	0.293	9.5	Random	1.320	(0.877, 1.986)	0.183
Yes	<0.001	86.1	Random	2.739	(1.524, 4.922)	0.001
COVID-19 vaccination	0.001	91.2	Random	5.922	(1.136, 30.876)	0.035
Have participated in flu or flu vaccine training, health promotion	0.003	89.0	Random	0.773	(0.259, 0.309)	0.645
Yes	..	..	Random	1.288	(1.034, 1.604)	0.024
No	..	..	Random	0.420	(0.420, 0.840)	0.014
Sources of information	<0.001	84.5	Random	1.060	(0.814, 1.380)	0.666
People around me	0.099	63.3	Random	1.174	(0.714, 1.928)	0.527
Mass media	<0.001	92.4	Random	0.665	(0.320, 1.382)	0.275
Professional organization or publication	0.245	24.2	Random	1.301	(1.113, 1.520)	0.001
Know the vaccination time	<0.001	85.2	Random	2.224	(1.165, 4.244)	0.015

(Continued)

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TABLE 3 (Continued)

Factor	Test of heterogeneity result			Meta-analysis results		
	P	I^2(%)	Effect model	OR	OR95%CI	*P*
Know the vaccine priority groups	<0.001	84.7	Random	1.327	(0.857, 2.053)	0.205
Know that the vaccine is the most effective way to prevent flu	<0.001	88.7	Random	1.031	(0.310, 3.432)	0.960
Know that the vaccine is given once a yea	<0.001	88.5	Random	1.028	(0.612, 1.729)	0.916
Work units participate in the influenza sentinel network	0.850	0.0	Random	0.920	(0.698, 1.213)	0.555
Free vaccination at workplace	<0.001	98.9	Random	0.746	(0.317, 1.756)	0.502
Yes	<0.001	98.3	Random	1.533	(0.525, 4.479)	0.435
No	<0.001	99.4	Random	0.644	(0.087, 4.777)	0.667
Unclear	<0.001	94.6	Random	0.279	(0.088, 0.886)	0.030
Have vaccination sites at workplace	<0.001	91.5	Random	1.377	(0.764, 2.480)	0.287
Workplace attitudes toward influenza vaccination of medical staff	<0.001	95.7	Random	0.897	(0.498, 1.617)	0.718
Ask for or support encouragement	<0.001	94.0	Random	1.602	(0.944, 2.717)	0.081
Do not require or encourage	0.725	0.0	Random	0.300	(0.207, 0.435)	<0.001
Unclear	..	..	Random	0.090	(0.038, 0.216)	<0.001

Reasons for accepting or refusing influenza vaccination

Among the 92 studies included, 47 studies reported on the reasons why healthcare workers chose to get vaccinated against influenza, while 55 studies reported on the reasons for refusing vaccination. The comprehensive data are summarized in Table 4, providing insights into the factors that influenced healthcare workers' decisions to either receive or decline influenza vaccination.

Discussion

The present study encompasses a broad range of countries, including 26 nations across 7 different regions. The meta-analysis findings indicate a relatively low global influenza vaccination rate among healthcare personnel, estimated at 41.7%. Subgroup analysis reveals a notable disparity between developed and developing countries, with higher vaccination rates observed in the former. Among regional subgroups, the Americas exhibit the highest vaccination rate, followed by the Middle East, Oceania, and Europe, while Africa demonstrates the lowest rate. These results suggest that variations in socio-economic development, vaccine accessibility, cost, healthcare service standards, healthcare personnel's knowledge regarding influenza and influenza vaccines, as well as disparities in awareness of preventive healthcare and vaccination, contribute to the observed differences in influenza vaccination rates across countries. This is consistent with a previous report, which highlights that while Chinese clinical workers possess extensive knowledge about disease diagnosis and treatment, their understanding of health maintenance and disease prevention is comparatively lacking (22).

Subgroup analysis based on vaccination time reveals that rate is gradually increased over the period of 14 years, suggesting that the H1N1 influenza pandemic in 2009 and the subsequent COVID-19 epidemic have played a role in promoting the seasonal influenza vaccination rate among healthcare personnel, likely due to increased awareness of the contagious nature of these diseases (95, 99). However the influenza vaccination rate gradually declined since 2009 pandemic, which aligns with the decreasing impact of the influenza outbreak. However, the occurrence of the COVID-19 epidemic led to a surge in the influenza vaccination, reaching its highest level. This could be attributed to heightened focus on self-protection during the influenza season, increased awareness of the importance of influenza vaccines, and a general promotion of vaccination practices.

The analysis of influencing factors reveals that several characteristics contribute to the higher likelihood of healthcare personnel receiving influenza vaccinations, including age, tenure, education level, professional designation (clinical doctors compared to nurses), and their inclination to recommend influenza vaccines to patients. These findings are in line with studies conducted in China (21, 22) and Cyprus (92), which similarly indicate that doctors are more likely to be vaccinated compared to nurses. This discrepancy may be due to doctors increased exposure to influenza patients due to their longer experience in the field, resulting in a stronger sense of identification as a high-risk group for influenza infection. Consequently, doctors exhibit heightened attention and awareness regarding influenza-related knowledge and information on influenza vaccines.

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TABLE 4 Self-reported reasons for accepting or refusing influenza vaccination in healthcare workers.

Reasons for refusing	Reference(n)	Reasons for accepting	Reference(n)
1. The vaccine is considered to have poor or limited preventive effect	43	1. Protect myself	30
2. Concerns about adverse reactions or vaccine quality	38	2. Protect my family, patients, and people around me	26
3. I'm too busy at work to have time	33	3. Worried about spreading it to the people around me	19
4. They are considered to be in good physical condition or have strong immunity and do not need vaccination	23	4. Vaccines are free or cheap	17
5. Think the flu is mild and will not cause serious illness	21	5. The vaccine is considered effective in preventing influenza and its complications	16
6. Vaccines are out-of-pocket or too expensive	20	6. Consider myself at high risk for the flu and its complications	13
7. Vaccinations are inconvenient or lacking	19	7. A work organization or employer requires or performs professional obligations	13
8. There are contraindications to vaccination	16	8. Recommended or influenced by leaders, colleagues, relatives and friends	12
9. Do not know about influenza vaccination and related information	14	9. Vaccination sites are available or readily available in the workplace	11
10. Not considered to be at high risk of catching the flu	14	10. That flu is a serious illness with serious effects	10
11. Adverse reactions after vaccination (e.g., flu-like symptoms, pain at injection site)	12	11. Avoid infection affecting my work	8
12. Not knowing when and where to get flu shots	11	12. It is recommended by government health authorities or the technical guidelines for influenza vaccines	7
13. Forget to vaccinate	11	13. Old age, underlying disease or chronic disease, fear of complications after infection	7
14. Fear of injection	8	14. Believe in the safety of flu vaccines	4
15. It is considered easy to treat with drugs or prevent with hygiene measures or other drugs	8	15. Doctor's recommendation	3
16. Concerned about the safety of vaccines	7	16. I had the flu last season	3
17. Being pregnant or lactating	7	17. Participate in multidisciplinary campaigns or influenza vaccination campaigns	2
18. Requires annual vaccinations or immunization procedures	5	18. Have a history of influenza vaccination	2
19. Vaccination is not mandatory or recommended by the workplace	5	19. Familiarize with flu vaccination	1
20. Does not believe in or oppose vaccination	5	20. Flu infections take an economic toll	1
21. Personal choice, reduce drug use	4		
22. There is no awareness of getting the flu vaccine	1		
23. Had the flu this year and do not need to get vaccinated	1		

A study conducted in Spain focused on healthcare personnel in the armed forces, the proportion of vaccinated individuals increased with age and years of service in the 2016–2017 season, but the vaccination rate among younger/middle-ranking officers actually surpassed that of the older adult, indicating a notable shift in vaccination behavior in the 2019–2020 season (93). Such outcome could be attributed to the evolving health knowledge system, which now places greater emphasis on disease prevention and health maintenance. In another survey conducted among nurses in Northeastern China, showing an inverse correlation between vaccination and flu among nurses, maybe due to lack of knowledge among these nurses regarding influenza vaccines, necessitating further education and awareness campaigns to emphasize the importance of vaccination.

Our present findings offer valuable insights for promoting flu vaccination, particularly among healthcare workers. This may involve strategies such as cost reduction or even the implementation of mandatory vaccination policies for specific high-risk population groups. Furthermore, our current data could serve as a foundation for future studies and investments in healthcare worker well-being. Our data underscores the critical importance of flu vaccination for these healthcare workers, who often find themselves in more vulnerable conditions, serving both the older adult and other high-risk groups. This relevance is further emphasized by the ongoing threat of viral

mutation and the persistence of long-term consequences from COVID-19, even though it is no longer classified as a pandemic. Hence, our present data strongly underscores the critical importance of flu vaccination for healthcare workers, especially those in more vulnerable roles, such as caring for the older adult and other high-risk groups. This relevance is further accentuated by the context of the ongoing COVID-19 outbreak, even if it is no longer considered a pandemic. The continuous viral mutation and the lingering presence of long-term COVID-19 complications make this vigilance particularly vital.

In conclusion, the influenza vaccination rate among healthcare workers globally remains low. To address this issue effectively, it is crucial to implement comprehensive measures that promote influenza vaccination among this population, as well as the general public. Efforts should be focused on raising awareness about the importance of vaccination, providing accessible and convenient vaccination services, and enhancing education regarding influenza and its prevention. By implementing these measures, we can strive to improve the influenza vaccination rates among healthcare workers and the wider population, leading to better overall public health outcomes.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in the article/Supplementary material.

Author contributions

JF: Conceptualization, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing. SX: Data curation, Formal analysis, Writing – original draft. YL: Data curation, Visualization, Writing – review & editing. XM: Data curation, Formal analysis, Software, Writing – review & editing. JC: Data curation, Formal analysis, Investigation, Writing – review & editing. CF: Conceptualization, Project administration, Validation, Writing – review & editing. SB: Conceptualization, Project administration, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1295464/full#supplementary-material

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Vaccine hesitancy among nursing and midwifery undergraduate students in Switzerland: protocol for an online national study

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Background: Vaccine hesitancy is a persistent challenge in public health, exacerbated by the proliferation of anti-vaccine sentiments facilitated by social networks. The COVID-19 pandemic has underscored the importance of addressing vaccine hesitancy, designated by the WHO as a top global health threat. This study explores vaccine hesitancy among nursing and midwifery undergraduate students in Switzerland—a cohort crucial to public health given their future roles as healthcare professionals—with a particular emphasis on the HPV vaccine, which exhibits lower confidence levels compared to other vaccines.

Methods: This study will employ an online questionnaire distributed to nursing and midwifery undergraduate students from various healthcare universities. The questionnaire will collect data on vaccine hesitancy (general confidence in vaccines and specifically in the HPV vaccine), HPV vaccine coverage, socio-demographics, likelihood to recommend vaccines to patients, perception of vaccination education and interest in complementary medicine.

Conclusion: The study's findings will contribute to our understanding of vaccine hesitancy among nursing and midwifery undergraduate students, providing insights that can inform targeted interventions and education strategies to bolster vaccine confidence among future healthcare professionals, thereby enhancing public health efforts.

KEYWORDS

vaccine hesitancy, vaccine confidence, HPV, nurse, midwife, student, Switzerland

1 Introduction

Vaccine hesitancy is a phenomenon as old as vaccines themselves, but recent developments in our societies, particularly social networks, provide means for the widespread dissemination of anti-vaccine ideas. The COVID-19 pandemic has also brought this phenomenon to light. While vaccine hesitancy has always existed, it now represents a major challenge and was identified by the World Health Organization (WHO) as one of the top 10 threats to public health in 2019 (1). Experts agree that pandemics like COVID-19 will not be the last humanity will have to face (2). In such a context, ensuring population adherence to public health recommendations and vaccination becomes crucial. It has been established that vaccine hesitancy is a complex, multifactorial phenomenon that varies greatly across regions and time (3–5). As a result,

obtaining data tailored to each target population is essential for targeted interventions. Thus, conducting studies on this topic in Switzerland, focusing on specific populations and/or vaccines, is highly relevant.

The concept of "vaccine hesitancy," often poorly defined in the literature, encompasses a wide range of attitudes, from hesitancy toward vaccination to complete refusal, and this varies depending on the vaccines (3, 6). Its determinants are as varied as the definition is broad. Socio-demographic factors associated with vaccine hesitancy include being female, young (as younger people feels less at risk), having a low level of education, a low level of income, living in a rural area, and belonging to an ethnic minority (3–5, 7). Many other factors come into play: the historical political and socio-cultural context; trust in institutions (policy makers, health system, pharmaceutical industries etc.) and in vaccines (safety, efficacy); the attitude of health professionals toward vaccination; cultural factors, social pressure and religious or personal convictions; the influence of the media, the Internet and social networks; and at a more individual level we find the perceived importance of vaccination and the perceived risk and knowledge about vaccination (3, 6–9). Using vaccination coverage or vaccine uptake as an indicator to measure vaccine hesitancy is not sufficient, as being vaccinated does not exclude the presence of doubts and concerns about vaccination (7).

The lack of a clear definition of "vaccine hesitancy" is also accompanied by a lack of consensus on which tools should be utilized to best measure it, which poses challenges in research and makes it difficult to compare results. To address this issue, the World Health Organization (WHO) established a Strategic Advisory Group of Experts (SAGE) to work on vaccine hesitancy in 2012, with the task to propose a definition of vaccine hesitancy and a model for categorizing its determinants. The WHO-SAGE emphasized the need for the scientific community to use a common definition, and to develop and validate tools for measuring vaccine hesitancy (9, 10). After a thorough mapping of vaccine hesitancy determinants, the WHO-SAGE proposed the following definition:

> "Vaccine hesitancy refers to a delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place, and vaccines. It is influenced by factors such as complacency, convenience and confidence" (9).

The adopted definition is rooted in the "3 Cs" model, which identifies complacency, convenience and confidence as the essential components of vaccine hesitancy. In short, convenience is defined as the ease of accessing vaccination services and the practicality of the vaccination process; complacency as the perception of disease risk and the recognition of the importance of immunization; and confidence as:

> "trust in (i) the effectiveness and safety of vaccines; (ii) the system that delivers them, including the reliability and competence of the health services and health professionals and (iii) the motivations of policy-makers who decide on the needed vaccines" (9).

Before and since, several survey tools have been developed (11–13), but there is still no agreed-upon measure of vaccine hesitancy. Similarly, the definition developed by the WHO-SAGE is still the subject of debate (14, 15), as illustrated in a recent systematic literature review by Bussink-Voorend et al., with authors proposing to rather define vaccine hesitancy as a state of indecisiveness (16). However, as the WHO-SAGE definition is the most widely accepted to date, and as the tool we chose for this study is based on it, this is the definition we will use here.

Founded in 2010 by Heidi Larson, the Vaccine Confidence Project (VCP) team conducted extensive research to comprehensively examine global confidence issues about vaccination in the general public, the healthcare professionals and pregnant women (3, 10, 17–24). In 2015, Larson et al., highlighted that among the various factors that can modulate vaccine hesitancy as previously defined by the WHO-SAGE, the leading ones were confidence issues (24). More specifically, confidence in safety and efficacy of vaccines, the perceived importance of vaccination (complacency), and religious or personal beliefs were among the key drivers. Based on these studies, the VCP developed the Vaccine Confidence Index™ (VCI) that was tested on a large scale, in 67 countries (22). The VCI has been used to assess vaccine confidence from 2015 to the present day, in over 150 countries worldwide offering a mapping of vaccine confidence around the world and its evolution (25). Since 2018, the VCP has been mandated by the European Union Commission to monitor vaccination confidence within member countries. Switzerland was surveyed in 2018 by the VCP, but not in subsequent years.

The VCI has the advantage of being simple and short, while effectively assessing confidence, making it a very useful tool. It consists of 4 questions that are answered on a 4-point Likert scale, as follows: "overall, I think vaccines are important for children to have; overall, I think vaccines are safe; overall, I think vaccines are effective; vaccines are compatible with my religious, personal or philosophical beliefs." These questions are then adapted for different vaccines to assess confidence in specific vaccines. A set of questions has also been developed to target healthcare professionals. The utilization of these questions through the Vaccine Confidence Project to map and monitor the fluctuations in confidence across numerous countries worldwide renders it an ideal tool for ensuring the comparability of research results. As Switzerland had been previously surveyed in 2018 in the general population and in 2021 (26) in the healthcare population, we will be able to compare the results of our study with them. For all these reasons, we decided to use the VCI in the present study.

There are limits to the VCI. First, it assesses only a subset of the determinants of vaccine hesitancy. Confidence in vaccination in terms of perceived efficacy, safety, importance, and compatibility with personal beliefs are key determinants of vaccine hesitancy but are not the only ones. Second, although the VCI has been developed on the basis of research studies and tested on a large scale, the tool has not been formally validated. However, a recent study showed an association between the tool measurements and vaccine uptake rates, where a decline in confidence was later translated into a decline in vaccine uptake (27). These results shows that the questions are useful to predict the evolution of vaccine uptake, which is an important information for policy makers.

In this study, we have chosen to target nursing and midwifery students, future healthcare professionals and future key players in vaccination. Research indicates that healthcare professionals play a significant role in influencing their patients' decisions to get vaccinated (6, 12, 28–30). Vaccine hesitancy also affects these professionals and influences their intention to recommend vaccination to their patients

(12, 26, 31–35). A strong association has been observed between healthcare professionals' confidence in vaccination and the general population's trust in vaccination (34). Nurses and midwives, in particular, tend to be more hesitant compared to physicians, a difference that could be explained by different training and lack of knowledge regarding vaccination (26, 31, 36). Indeed, studies have shown that there is a difference in the level of knowledge and the presence of more misconceptions among nurses and midwives than among doctors, with the most common barrier being a perceived lack of effectiveness (36, 37).

Therefore, ensuring healthcare professionals' training and commitment to vaccination plans is essential to combat vaccine hesitancy and maintain adequate population vaccination coverage. Students in particular need to be adequately trained on this subject to be able to promote vaccination later. Most studies on this field of research focus on healthcare workers, but few target nurses and/or midwives in training (38–40). A recent study, with very similar goals to ours, assessed vaccine confidence among healthcare students in South Africa using the VCI (41). In Switzerland, studies targeting the same population evaluated factors influencing HPV vaccination, as vaccination coverage for this vaccine is still too low (42, 43).

Vaccine hesitancy also varies based on the type of vaccine. General confidence in the HPV vaccine tends to be lower than for influenza or Measles, Mumps, and Rubella (MMR) vaccines in the general population, as well as among healthcare professionals (34). Among healthcare professionals, studies have identified gaps in knowledge about the Human Papillomavirus (HPV) vaccine, particularly regarding its functioning and potential benefits (44). A recent study conducted in Italy among university students enrolled in health programs such as medicine, healthcare and pharmacy, showed major gaps in knowledge of HPV infection and preventive measures, and the self-reported vaccination rate was very low (45). This lack of knowledge influences their willingness to get vaccinated, recommend vaccination to their patients, or participate in HPV vaccination recommendation programs (44). These are reasons why we have chosen to focus on the HPV vaccine.

Although there is limited literature on vaccine hesitancy in Switzerland, trends observed align with findings in the global scientific literature. A multicenter study from 2022 examining healthcare professionals' attitudes toward vaccination showed that Switzerland is one of the countries where nurses and midwives are less confident in the safety, importance or effectiveness of vaccines in general (26). Across the three studied vaccines (COVID-19, HPV, and MMR), the HPV vaccine had the lowest percentage of healthcare professionals inclined to recommend it to their patients (64% in Switzerland). The Federal Office of Public Health (OFSP) has recognized the need to improve healthcare professionals basic education on vaccination (46). A study also revealed healthcare professionals' interest in further education on the subject due to their relatively low comfort level in advising patients (47). Consequently, surveying nursing and midwifery students will also help assess their perception of the training they receive on vaccination.

Several studies have also demonstrated that the use of complementary or alternative medicine (CAM) by healthcare professionals is often associated with a lower vaccination status, both among practitioners and patients (6, 7). This trend holds true in Switzerland, where practitioners often have a healthcare background (48, 49). Thus, we have also chosen to evaluate this variable in our population.

In conclusion, we have chosen to target a population with a significant role in vaccination and a strong influence on the public. We aim to assess vaccine confidence among these future professionals, who tend to exhibit higher levels of hesitancy according to studies: nurses and midwives. Using the VCI we will assess vaccine confidence in a general sense, vaccine confidence toward the HPV vaccine, and the likelihood to recommend the HPV vaccine to patients as a future healthcare professional. The student status of our population will allow us to assess their perception of the training they receive on vaccination. Additionally, we will evaluate their interest in complementary medicine, determining whether a link exists between vaccine hesitancy and interest in these practices, as illustrated by other studies. We will also ask their vaccination status for the targeted HPV vaccine, to determine whether this population is already vaccinated or if awareness campaigns could be useful to increase vaccination coverage. This data can also be compared with the results of previous studies conducted on this same population to assess any changes in vaccination coverage (42, 43) and with the results of the 2018 VCP survey for Switzerland (25).

2 Methods and analysis

2.1 Study objectives and design

This study follows a quantitative approach, utilizing an online questionnaire that will target nursing and midwifery undergraduate students from multiple health universities called "High School of Health" (Hautes écoles de Santé, HES) across Switzerland. This research project aims to achieve the following objectives:

- Assess vaccine hesitancy among nursing and midwifery university students in French, German and Italian-speaking Switzerland. This includes assessing their general confidence in vaccines and their confidence specifically in the HPV vaccine.
- Assess HPV vaccine coverage within the same student population.
- Assess likelihood to recommend HPV vaccine to patients as a future healthcare professional.
- Investigate the presence of predictive factors for vaccine hesitancy based on socio-demographic data and interest in complementary medicine.
- Evaluate students' perceived adequacy of the vaccination education they have received.

2.2 Primary and secondary endpoints

For this study, the main variables of interest are vaccine hesitancy and HPV vaccine coverage among nursing and midwifery students in French, German and Italian-speaking Switzerland. To fulfill our objectives, we have developed a questionnaire based on previous research.

To assess vaccine hesitancy and likelihood to recommend HPV vaccine to patients, we selected the Vaccine Confidence

Index™ (VCI), focusing on questions relevant to our study's objectives (50). Additionally, we included two questions assessing HPV vaccination status, adapted from a previous study on the same population (43). This question will allow us to assess both vaccine coverage within the targeted population and whether there is an association between HPV vaccine history and confidence in the HPV vaccine.

Socio-demographic factors such as age, gender, nationality, education level, and interest in complementary medicine may influence vaccine hesitancy and coverage. These factors will be recorded and considered in statistical analyses to identify potential associations with the variables of interest. Such insights will allow comparisons with socio-demographic factors associated with vaccine hesitancy, as documented in relevant studies (4, 5). Identifying these factors (or their absence) could aid targeted awareness campaigns.

To evaluate students' perceived adequacy of the education they receive on vaccination, we included a question borrowed from a similar US study by Dybsand et al. (38), whose survey questions were based on previously validated templates.

We also added a question to gauge interest in complementary medicine, drawing from studies that explored the link between these practices and vaccine hesitancy (48).

The questionnaire comprises 7 items and a total of 24 questions. It is designed for quick completion (estimated time: 5 min). The complete questionnaire is provided in Supplementary Appendix.

2.3 Population and recruitment

The study will involve nursing and midwifery undergraduate university students (HES) in Switzerland. Inclusion criteria are as follows:

- Students enrolled in nursing or midwifery programs at one of the HES institutions of French, German and Italian -speaking Switzerland.
- Participants must be at least 18 years of age.
- Participants should understand the study procedures and willingly participate.

All HES institutions in Switzerland will be contacted for participation. The recruitment process will involve collaboration with program heads at the participating institutions, who will distribute the survey link to students via email. Participation is voluntary. No compensation is planned for participants.

2.4 Sample size

The total population of HES midwifery and nursing students in Switzerland is 4,979 (statistics from the Swiss Federal Statistical Office, 2022–2023). The population proportion is based on the results of the 2018 VCP survey, that showed that 52% agreed with the statement "vaccines are safe." The sample size is calculated to obtain a 95% confidence interval. With a total population of 4,979 students, an alpha of 0.05 and a beta of 0.80, and a 52% vaccine confidence figure, we obtain a sample size of $N = 357$.

2.5 Study procedures

The study entails a single questionnaire comprised of 24 questions, self-administered online and taking approximately 5 min to complete. LimeSurvey, a web-based data-collection software, will be used for data collection. The questionnaire link will be sent by program heads, ensuring participant anonymity. Each participant will be assigned a code, with emails and IP addresses stored separately. Data analysis will be performed on coded data, maintaining participant anonymity. A consent form explaining the study's objectives and procedures will appear at the start of the questionnaire. The duration for data collection will be 20 days, with a reminder email sent after 10 days. The questionnaire will undergo pre-testing with a small sample from the target population before widespread distribution. Participants can withdraw their consent after submitting the questionnaire, provided their data has not been analyzed yet.

2.6 Statistical analysis

Data will be analyzed using STATA 17 software, involving descriptive analyses (averages, frequencies, percentages) and multivariate analyses to identify variables significantly associated with vaccine hesitancy. Statistical tests, such as Student's t-test and chi-squared test, will assess significance at $p < 0.05$.

The VCI questions are answered in a 4-point Likert scale, with the possibility to answer "I do not know." Responses are recoded to produce just two categories as follows:

- the answers "strongly agree" and "tend to agree" are recoded as "agree"
- the answers "tend to disagree," "strongly disagree" and "do not know" are recoded as "do not agree."

The reason for recoding "do not know" as "do not agree" is that respondents who are uncertain or lack the requisite information to formulate definitive responses to these inquiries should be characterized as exhibiting hesitancy.

As the study aims to determine the presence or absence of vaccine hesitancy rather than measure its degree, participants are categorized as either hesitant or non-hesitant, without establishing a specific threshold. For this purpose, responses are recoded into two categories where "agree" reflects confidence in vaccination (or in specific vaccines), and "disagree" reflects a low level of confidence, indicating hesitancy. Results will be presented as the percentage of respondents who "agree" or "disagree" with each item (importance of vaccines, effectiveness of vaccines, safety of vaccines, compatibility of vaccines with one's beliefs). The same procedure applies to the question set concerning the likelihood of recommending the HPV vaccine. Multivariate analysis will be used to gauge if socio-demographic factors and interest in CAM are associated with a low level of confidence in vaccination, and with an unlikelihood of recommending the HPV vaccine to patients. For the HPV vaccine, the results from the VCI questions will be compared to the vaccine status of the respondents.

As for the set of questions regarding students' perception of vaccination training received during school, which is also answered on the same Likert scale, we will apply the same method except for

the answer "do not know" which will not be recoded as "do not agree." Indeed, although this question is only asked of final-year students, there is always a chance that teaching on vaccination has not been completed in its entirety depending on the school. The nature of the question is also different from the previous ones. While being unsure about the VCI questions may reflect hesitation and therefore be included in the "disagree" category, we cannot make the same inference about perception of training. Therefore, results for this set of questions will be presented as the percentage of respondents who "agree," "disagree" or "do not know" with each item.

The results of the study will then be compared with findings from previous studies that surveyed Switzerland using the same questions (25, 26); with other studies surveying the same population in Switzerland using a different questionnaire (42, 43) and with vaccine confidence results from other countries (25, 26, 41).

2.7 Handling of missing data

All questions within the online questionnaire are mandatory, thereby ensuring the absence of missing data. However, participants will be given the option to provide responses such as "do not know," "do not remember," or "undecided" where such responses are contextually relevant. In the latest version of the VCI, the response "do not know" is coded as "do not agree." This coding strategy serves the dual purpose of preventing data loss and capturing the nuances of vaccine hesitancy.

3 Discussion

Vaccine hesitancy presents a complex and significant challenge to public health efforts worldwide. The impact of misinformation propagated throughout the internet and social media platforms has amplified this concern, undermining vaccination campaigns and threatening herd immunity. In response to this pressing issue, our study will help understanding vaccine hesitancy among nursing and midwifery students in Switzerland, contributing to the broader discourse on addressing vaccination skepticism.

Healthcare professionals play a crucial role in patients' attitudes toward vaccination. The anticipated results of this study have the potential to drive evidence-based interventions to combat vaccine hesitancy among nursing and midwifery students, before their own beliefs have crystallized. Insights into determinants of hesitancy can help inform improvements in curricula and training programs, ultimately strengthening the role of healthcare professionals as vaccine advocates. Moreover, assessing the HPV vaccine coverage within this population informs the need for awareness campaigns to increase vaccination rates and contribute to public health goals. The inclusion of the HPV vaccine, which often attracts higher levels of hesitancy, adds specificity to our investigation, aligning with the global need to improve HPV vaccine acceptance.

It is essential to acknowledge the limitations of this study protocol. While our design aims to gather valuable insights, cross-sectional studies have inherent limitations in establishing causality. Additionally, self-reported data might introduce response bias when participants provide inaccurate or misleading information in their responses. Voluntary participation can also lead to selection bias, where those most critical of vaccination may be over or under-represented in our sample. Finally, our questionnaire only assesses a subset of the determinants of vaccine hesitancy.

The findings, their implications as well as limitations will be discussed from the perspective of previous studies and future research directions may also be highlighted.

Ethics statement

The studies involving humans were approved by the Ethics Committee of Cantonal Commission for Research Ethics (CCER) in Geneva, with the registration AO_2023-00037. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AP: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. EJ: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1302676/full#supplementary-material

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Actions speak louder than words; pediatricians, gynecologists, nurses, and other mothers' perspectives on the human papillomavirus vaccine: an Istanbul multicenter study

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Introduction: Gynecologists and pediatricians have an essential duty to prevent cervical cancer. In this study, we compared the compliance of gynecologists ($n = 22$) and pediatricians ($n = 49$) with nurse/midwife ($n = 66$) and non-medical moms ($n = 120$) with regards to cervical cancer precautions.

Methods: A questionnaire was used to gather data on their demographics, personal vaccination and screening practices, children's immunization status, and awareness of cervical cancer prevention.

Results: The findings demonstrated that gynecologists and pediatricians were better than others at understanding the risk factors and prevention of cervical cancer. It was noted that compared to other groups, physician mothers and their offspring had higher vaccination rates ($n = 13$, 18.3%; $n = 10$, 29.4%, respectively). Medical professionals typically provided thorough and accurate answers to informational questions. More frequent Pap smear tests were performed by gynecologists. It was noted that mothers who worked as pediatricians and nurses/midwives neglected their own screening needs.

Discussion: This questionnaire survey sought to ascertain Istanbul's health professionals' present opinions regarding HPV vaccination. Healthcare professionals should be the first to receive information on HPV vaccination and cervical cancer incidence reduction. The public could then readily use them as an example.

KEYWORDS

HPV vaccine, physician mothers, attitude, questionnaire, cervical cancer, cervical screening

Introduction

The most prevalent sexually transmitted infection is called human papillomavirus (HPV) (1). Cervical cancer, the fourth most common cancer in women, is caused by it (2). Every year, about 310,000 women pass away from this; 90% of these deaths take place in developing nations (2). Every year in our nation, there are 1,245 fatal cases of cervical cancer and 2,532 new cases (3). Following its expedited FDA approval in June 2006, the European Medicines Agency authorized Gardasil™ for marketing in the entire European Union in September of that same year (4). The World Health Organization (WHO) lists cervical cancer as a public

health issue that needs to be eradicated. To that end, interventions like the evidence-based HPV vaccine and ongoing cervical cancer screening should be implemented widely (2).

Mothers are more prone to cervical cancer awareness. Gynecologists/pediatricians and nurses/midwives are in charge of organizing and carrying out cervical screenings as well as recommending and delivering the HPV vaccination. These reasons led us to focus our study on gynecologist/pediatrician and nurse/midwife mothers. Our H_1 hypothesis is "Mothers who are pediatricians and gynecologists tend to have their children vaccinated against HPV more than the general population." In order to increase awareness about cervical cancer that can be prevented by vaccination, we set out to assess mothers' attitudes and level of knowledge. In previous studies, surveys about HPV vaccines have been conducted with parents, students, nurses, midwives, and doctors. In Turkey, mothers are typically the ones who look after the children. The physician groups that provide information to mothers on this subject are generally pediatricians and gynecologists. In our literature review, we were unable to notice any study comparing the knowledge and attitudes of pediatrician and gynecologist mothers with nurses, midwives, and non-healthcare mothers. Individuals were more likely to get vaccinated or vaccinate their children if they received a favorable recommendation from the their physician. Our goal was to determine whether mothers who work in medicine vaccinated their kids to a degree that would serve as a model for the community. The fact that nurses are more numerous, see patients more frequently, and spend more face-to-face time with them puts them in a great position to provide information and set an example about the HPV vaccine. For this reason, nursing education is also crucial.

Although HPV vaccines are approved by the Ministry of Health in Turkey, national immunization schedule does not include HPV vaccinations, yet. There is a precedent court decision regarding repayment by the Social Security Organization.

Materials and methods

With permission from the Istanbul Faculty of Medicine Clinical Research Ethics Committee, dated 04/01/2021–1,065, a preliminary study was carried out. The Istanbul Faculty of Medicine Clinical Research Ethics Committee decision, dated 25.02.2022 and numbered 770,003, granted approval for the multi-center study. It is a doctoral thesis.

The authors consulted previous research while creating the questionnaire. The references used to prepare the questionnaire are mentioned on Supplementary File S1–S3.

There were fifteen questions about personal data in the first section of the questionnaire (Supplementary File S1). Twenty-five knowledge questions about HPV, HPV vaccination, risk factors for cervical cancer, and cervical screening tests were included in the second section of the questionnaire (Supplementary File S2). Eight attitude questions about the HPV vaccine and cervical screening were included in the third section of the questionnaire (Supplementary File S3).

In this study, we compared the knowledge and attitudes of pediatricians ($n=49$) and obstetrician-gynecologists ($n=22$) about HPV and HPV vaccines with nurse/midwives ($n=66$) and non-medical mothers ($n=120$). We requested responses to a three-part questionnaire from gynecologists/pediatricians, nurses, and midwives mothers at all seniority levels who worked at the Istanbul Faculty of Medicine's Department of Child Health and Diseases, Department of Gynecology and Obstetrics, and Marmara University Pendik Training and Research Hospital between February 2021 and May 2022. Mothers received the majority of the printed surveys, a small portion was sent via social media accounts in the preliminary study.

Mothers who did not work in healthcare were given questionnaires to fill out while in line at the Istanbul Faculty of Medicine's social pediatrics outpatient clinic, general pediatrics outpatient clinic, and gynecology outpatient clinic. The questionnaires were collected in the same order as the mothers received them.

The survey was distributed without any rewards or punishments for taking part. They agreed to take part voluntarily. Informed consent was added to the survey's introduction to ensure respondents' anonymity and their freedom to leave the study at any time. The study contained no identifiers or personal information. They were given rights assurances and had an opportunity to ask questions prior to the interview.

Statistical analysis

Data analysis was evaluated with the IBM Statistical Package for Social Sciences (SPSS) 15.0 for Windows statistical package program. Nominal (discrete) variables were evaluated with the chi-square test with Yates correction and the Fisher exact probability test. The significance limit was taken as $p<0.05$ and two-sided. Continuous variables are given as median, standard deviation, minimum, maximum by t test and One-way ANOVA, and discrete variables are given as frequency and percentage. The relationship between categorical variables is given as the Phi coefficient or Cramer's υ coefficient. Statistical calculations were made on a question-by-question basis, calculated only on those who answered that question.

One hundred thirteen mothers received the survey in the pilot study. Ten minutes was found to be the average survey response time. Research issue was "Mothers who are pediatricians and gynecologists tend to have their children vaccinated against HPV more than the general public." When type 1 error is 5% (bidirectional), and type 2 error is 5% (power 95%), two-way $Z\alpha/_2$ constant value is 1.96, and the constant value of Z_β is 1.645. Those who wanted to vaccinate their children were 56% in the first group and 19% in the second group. The number of samples was calculated as 114 people in total, with 38 people in each group. The equation was:

$$n=\frac{\left(Z\alpha/_2+Z\beta\right)^2\left[\left(P_1\left(1-P_1\right)+P_2\left(1-P_2\right)\right.\right.}{\left(P_1-P_2\right)^2}$$

$$n=\frac{\left(1.96+1.645\right)^2\left[\left(0.56\left(1-0.56\right)+0.19\left(1-0.19\right)\right.\right.}{\left(0.56-0.19\right)^2}$$

$$n=38$$

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Mothers whose daughters were born after 1980 and whose sons were born after 1983 participated in the study. These mothers were gynecologists, obstetricians, pediatricians, nurses, midwives and non-healthcare workers. The chosen ones were mothers whose daughters were no older than 26 in 2006, the year the vaccine was first approved. In other words, mothers who had daughters were born in as early as 1980 (2006–26 =) were included. The birth date of 1983 (2009–26 =) was used as the basis for boys since Gardasil™ was authorized for use in 2009 for boys aged 9 to 26.

Repeated surveys, inconsistent responses, fathers, physicians other than obstetrics and pediatrics or mothers without children, and those who answered only demographic questions were not included in the study.

Results

All in all, 276 surveys were completed, and 257 of them were evaluated, 19 were excluded. Group 1 consisted of gynecologists ($n = 22$) and pediatricians ($n = 49$). Group 2 included mothers who were not healthcare professionals ($n = 120$). Mothers who were nurses or midwives made up Group 3 ($n = 66$).

Demographic characteristics

Marital status, mean age, average child age, number of children over 9 years of age, smoking, and presence of cervical cancer in the immediate circle were found to be similar in all groups. When the sociodemographic characteristics of the groups were compared, no difference was found except of active working. Compared to Group 2, Groups 1 and 3 had higher rates of active work (97.2, 98.5, 44.2% respectively, p = 0.0001). 144 mothers with children age appropriate for HPV vaccination (over 9 years old) participated in our study. Demographic characteristics of the groups are presented in Table 1.

Group 1 generally have over 10 years of professional experience. 18 participants (25.4%) of Group 1 have 10 years or less of professional experience, 34 (47.9%) participants of Group 1 have 10–20 years of professional experience, and 17 (23.9%) participants of Group 1 have more than 20 years of professional experience.

It was determined that Group 1 mostly worked in university/education and research hospitals ($n = 39$; 54.9%), followed by state hospitals ($n = 13$; 18.3%). Others work in private universities, private hospitals, private clinics and private offices ($n = 19$; 26.8%).

The answers about attitude

Group 1 was more likely to receive the HPV vaccine ($n = 13$, 18.3%). Group 1 is different from the others, significantly. HPV vaccination status of Group 2 ($n = 5$, 4.2%) and Group 3 ($n = 1$, 1.5%) is similar in pairwise comparison ($p = 0.421$ Fisher's Exact test) (Table 2). Although physician mothers with 10–20 years of professional experience received HPV vaccination more often (10.3%) than other physicians, no statistical difference was found. According to the Phi-coefficient, an association of approximately 18% was found between the family's monthly income and HPV vaccination status (Fisher's exact test, $p = 0.009$). When monthly income was compared with the reasons for not getting the vaccine, as income increased, the number of people citing price as a justification decreased.

Group 1 is different from the others; physician mothers give more attention to their children. Their children had been vaccinated at a high rate ($n = 10$, 29.4%). Groups 2 ($n = 1$, 1.4%) and 3 ($n = 0$) whose children are eligible for vaccination have similar attitudes about vaccinating their children against HPV. ($p = 1{,}000$ Fisher's Exact test) (Table 3).

Group 1 with over 10 years of professional experience had over 9 years old children. It was found that physicians with more than 20 years of experience had their children vaccinated against HPV at a higher rate (21 years and above: $n = 8/16$, (%50), $p = 0.037$) (Table 4). In Group 1, among those with children aged 9 and over,

TABLE 1 Demographic characteristics of the groups.

		Group 1 (n = 71) (%100)	Group 2 (n = 120) (%100)	Group 3 (n = 66) (%100)	Mean	p
Marital status	Single n (%)	4 (5.6)	5 (4.2)	3 (4.6)		
	Married n (%)	63 (88.8)	114 (95)	60 (90.9)		0.375*
	Divorced n (%)	4 (5.6)	1 (0.8)	3 (4.5)		
Age yrs. mean (SD) (min–max)		41.69 (8.5) (28–65)	40.62 (8.3) (23–68)	39.05 (7.4) (24–59)	40.51 (8.2) (23–68)	0.162**
Children age yrs. mean (SD) (n)		11.7 (8.67) (115)	13.4 (11.8) (244)	9.8 (9.8) (105)	12.2 (9.3) (464)	0.243**
Anyone with a history of cervical cancer in your close circle n (%)		10 (14)	14 (13)	6 (9.5)		0.709*
Smoking	No	58 (81.7)	83 (69.2)	46 (69.7)		
	Yes	6 (8.5)	25 (20.8)	9 (13.6)		0.053*
	Occasionally	6 (8.5)	10 (8.3)	11 (16.7)		
Those with children over 9 years old n (%)		34 (47.9)	75 (62.5)	35 (53)		0.132*
Active work n (%)	Yes	69 (97.2)	53 (44.2)	65 (98.5)		**0.0001***
	No	2 (2.8)	59 (49.2)	1 (1.5)		

*Pearson Chi-square test. **One-way ANOVA.

TABLE 2 Have you had the HPV vaccine?

	Group 1 (n = 71)	Group 2 (n = 120)	Group 3 (n = 66)	N (%)	p = 0.0001
Yes n (%)	**13 (18.3)**	5 (4.2)	1 (1.5)	19 (7.4)	
No n (%)	58 (81.7)	112 (93.3)	65 (98.5)	235 (91.4)	
No answer n (%)	0	3 (2.5)	0	3 (1.2)	
N (%)	71 (100)	120 (100)	66 (100)	257 (100)	

Pearson Chi-square test, $\chi 2 = 17.164$, SD = 2.

TABLE 3 Mothers who had their children vaccinated against HPV among those whose children are suitable for vaccination.

	Group 1 (n = 34,%100)	Group 2 (n = 75,%100)	Group 3 (n = 35,%100)	N (%)	p = 0.0001
Yes n (%)	10 (29.4)	1 (1.4)	0 (0)	11 (7.6)	
No n (%)	24 (70.6)	74 (98.6)	35 (100)	133	
No answer	0	0	0	0/144	

Pearson Chi-square test, $\chi 2 = 22.136$, SD = 2.

TABLE 4 Based on the professional experience of Group 1, have you vaccinated your children aged 9 and above with the HPV vaccine?

	No	Yes	N (%)	p = 0.037
11–15 years n (%)	5 (100)	0	5	
16–20 years n (%)	11 (84.6)	2 (15.4)	13 (100)	
21 years and above n (%)	8 (50)	8 (50)	16 (100)	

Pearson Chi-square test, $\chi 2 = 6.582$, SD = 2.

TABLE 5 Answers of the question "Have you had your child vaccinated against HPV?" according to place of employment among those with children aged 9 and over in Group 1.

Working place	No n (%)	Yes n (%)	N (%)	p = 0.028
Public Hospital n (%)	3 (37.5)	5 (62.5)	8 (100)	
Private Hospital/Private Clinic/Private Practice/Private University Hospital n (%)	9 (69.2)	4 (30.8)	13 (100)	
University/Education Research Hospital n (%)	12 (92.3)	1 (7.7)	13 (100)	

Pearson Chi-square test $\chi 2 = 7.184$, SD = 2.

TABLE 6 Do you want your child to get the HPV vaccine?

	Group 1 (n = 71)	Group 2 (n = 120)	Group 3 (n = 66)	N (%)	p = 0.0001
No n (%)	16 (22.5)	52 (43.3)	28 (42.4)	96 (37.4)	
Yes n (%)	47 (66.2)	32 (26.7)	32 (48.5)	111 (43.2)	
Do not know n (%)	0 (0)	2 (1.6)	0 (0)	2 (0.8)	
No answer n (%)	8 (11.3)	34 (28.3)	6 (9.1)	48 (18.7)	
N (%)	71 (100)	120 (100)	66 (100)	257	

Pearson Chi-square test, $\chi 2 = 19.297$, SD = 2.

the rates of their children's HPV vaccination rates analyzed based on their place of employment. The rate of having their children vaccinated against HPV was higher in public hospitals (n = 5; 62.5%), and the lowest rate was among those working in university hospitals (n = 1; 7.7%) Public and University Hospital are different pairwise comparisons (Fisher's Exact test, p = 0.014) (Table 5). According to the Phi-coefficient, an association of approximately 32% was found between the monthly income of the family and the status of having their child vaccinated against HPV (Fisher's exact test, p = 0.001).

Group 1 wishes to vaccinate their children against HPV at a rate that is significantly higher than the others (n = 47, 66.2%). Groups 2 (n = 32, 26.7%) and 3 (n = 32, 48.5%) are similar in terms of wanting to have their children vaccinated against HPV (Table 6). Group 1 wants to vaccinate their children more than the others (n = 49, 70.1%), which is substantially different. When asked how many of their

children they would vaccinate, Group 2 ($n = 35$, 29.2%) and Group 3 ($n = 29$, 43.9%) gave comparable responses ($p = 0.372$ Fisher's Exact Test in pairwise comparisons) (Table 7). 28 (57%) wanted their daughters, 12 (24.5%) wanted their sons, and 9 (18.4%) wanted both their sons and daughters vaccinated.

The groups were found to be similar in terms of the distribution of the brands (Cervarix™, Gardasil™) of the vaccines and the recommended doses ($p = 0.075$, $p = 0.1$, respectively).

Among all groups, 55 (21%) participants stated that they did not receive the HPV vaccine because it was unnecessary. 50 (18.2%) of them had not vaccinated because of the price. 29 (10.5%) participants had not received the HPV vaccine due to side effects. The most common reasons for not getting the vaccine in the groups were 28 (42.4%) in Group 3 because it was expensive, 27 (22.5%) in Group 2 because they found the vaccine unnecessary, and 17 (23.9%) in Group 1 because the person is older (Table 8).

Group 2 recommends significantly less HPV vaccine to their close circle ($n = 46$, 38.3%) than the others. Despite the similarities between Groups 1 and 3, Group 1 advises the HPV vaccine to their circle at a higher rate ($n = 60$, 84.5%) (Table 9).

The groups are similar in terms of having regular Pap smear tests ($p = 0.167$). It was discovered that gynecologists ($n = 17$, 77.3%) paid considerably more attention to have routine Pap smear tests than pediatricians ($n = 20$, 41.7%) (Table 10). Pap smear test rates were found to be similar in all groups (Table 11). The Phi-coefficient showed a 15.2% correlation between routine Pap-smear testing and knowledge that HPV causes cervical cancer (Fisher's exact test, $p = 0.035$).

When univariate analyzes were performed, the results of the statistical tests were found as; age ($p < 0.0001$), marital status ($p = 0.023$), professional experience ($p < 0.0001$), smoking ($p = 0.519$), active employment ($p = 0.195$), number of children ($p = 0.134$). 11 participants out of 257 did not answer the questionnaire. Of the remaining 246 people, 235 said "no" and 11 said "yes" to having their children vaccinated. Since children over the age of 9 were vaccinated, 113 of the 257 people were excluded because they had children under the age of 9, and univariate analysis then multivariate logistic regression analysis were performed on the remaining 144 participants. Of these 144 people, 127 "did not vaccinate their children" (92%), and 11 of them "had their children vaccinated "(8%).

TABLE 7 How many of your children do you vaccinate?

	Group 1 *n* (%)	Group 2 *n* (%)	Group 3 *n* (%)	*N* (%)	$p = 0.004$
None of them	16 (22.5)	37 (30.8)	29 (43.9)	82 (31.9)	
One of them	30 (42.3)	15 (12.5)	15 (22.7)	60 (23.4)	
All of them	19 (27.8)	20 (16.7)	14 (21.2)	53 (20.6)	
No answer	6 (8.5)	48 (40)	8 (12.1)	62 (24.1)	
N (%)	71	120	66	257	

Pearson Chi-square test $\chi 2 = 15.135$, SD = 4.

TABLE 8 If you have not had the HPV vaccine, what is the reason?

	Group 1 *n* (%)	Group 2 *n* (%)	Group 3 *n* (%)	*N* (%)
Allergy	0	1 (0.8)	0	1
Do not know	0	18 (15)	1 (1.5)	19 (7.4)
Price	10 (14.1)	12 (10)	**28 (42.4)**	**50 (18.2)**
Unnecessary	12 (16.9)	**27 (22.5)**	16 (24.2)	**55 (21)**
Neglect	9 (12.7)	1 (0.8)	4 (6.1)	14 (5.5)
Side effects	4 (5.6)	21 (17.5)	4 (6.1)	**29 (10.5)**
Age	**17 (23.9)**	2 (1.6)	7 (10.6)	25 (9.7)
No answer	19 (26.8)	38 (31.7)	6 (9.1)	63 (24.5)
N (%)	71 (100)	120 (100)	66 (100)	257

TABLE 9 Do you recommend the HPV vaccine to your patients or your close circle?

	Group 1 *n* (%)	Group 2 *n* (%)	Group 3 *n* (%)	*N* (%)	$p = 0.0001$
Yes	60 (84.5)	46 (38.3)	41 (62)	147 (57.2)	
No	11 (15.5)	44 (36.7)	18 (27.3)	73 (28.4)	
No answer	0	30 (25)	7 (10.6)	30 (11.7)	
N (%)	71	120	66	257	

Pearson Chi-square test, $\chi 2 = 20.544$, SD = 2.

TABLE 10 The rate of regular Pap smear tests regarding of branch in Group 1.

	Pediatrist *n* (%)	Gynecologist *n* (%)	$p = 0.012$
No	28 (58.3)	5 (22.7)	
Yes	20 (41.7)	17 (77.3)	
Not answering	1 (2)	0	
N (%)	49	22	

Yates' Chi-square (continuity correction) test: $\chi 2 = 6.313$, SD = 1.

TABLE 11 The rate of regular Pap smear tests in each group.

21–65 years old range	Group 1 *n* (%)	Group 2 *n* (%)	Group 3 *n* (%)	*N* (%)	$p = 0.167$
No	33 (46.5)	61 (50.8)	34 (51.5)	128 (49.8)	
Yes	37 (52.1)	39 (32.5)	30 (45.5)	106 (41.3)	
No answer	1 (1.4)		2 (3)		
N (%)	71	120	66	257	

Pearson Chi-square test, $\chi 2 = 3.587$, SD = 2.

In this case, univariate analyzes results were found as; age ($p = 0.004$), marital status ($p = 0.02$), title ($p = 0.665$), monthly income ($p = 0.013$), and professional experience ($p = 0.037$).

Multivariate logistic regression was performed on variables with $p < 0.05$. The dependent variable was "vaccinated/did not vaccinate her child". Independent variables were age, marital status, workplace, monthly income, and professional experience which were found as statistically significant in the univariate analysis.

According to the logistic regression analysis; Classification Table: 70.6%, Nagelkerke R = 0.284, Omnibus Test of Model $p = 0.006$, Hosmer Lemeshow Test $p = 0.69$ were found. The only significant variable for the situation of "vaccinating your child" was "professional experience" ($p = 0.024$). Exp (β) = 0.65 (Risk). 95% CI for Exp (β) (1.258, 33.596). When the professional experience increases, the tendences for vaccinating the child also increases. On the other hand, one person who has her child vaccinated is a housewife, the other 2 doctors are people with 16–20 years of professional experience, and 8 doctors are people with 21 years or more of professional experience.

The answers about information

The other books and broadcastings (TV, newspaper, magazine, non-scientific journal) ($n = 54$, 21%) was at the top of all sources about HPV in all groups. "Social media" was the first source of reference in Group 2 ($n = 43$, 35.8%). Medical school was the most frequently mentioned source ($n = 25$, 35.2%) in Group 1. In Group 3, the most common answer regarding the source was "the other books and broadcastings" ($n = 28$, 42.4%) (Supplementary File S4).

All groups were different from each other in terms of the response to the query regarding the age range of the HPV vaccine target population. Group 1 gave the most correct answers ($n = 66$, 93%). Group 3 was in second place ($n = 43$, 68.3%), while Group 2 answered the least ($n = 54$, 45%) correct response rate (Supplementary File S4). Every group has different information regarding the cost of the HPV vaccine. While Group 3 stated that it was not reasonable at a higher rate ($n = 44$, 66.7%), Group 1 stated that it was reasonable at a higher rate ($n = 15$, 21.1%) (Supplementary File S4). Group 2 were less aware that multiple sexual partners increased the risk of HPV (Fisher's Exact Test $p = 0.011$, Group 1 and 2 in pairwise comparison) (Supplementary File S4). Group 1 knew 100% correctly that HPV was sexually transmitted. Pairwise comparisons revealed that while Groups 1 and 2 were different (Fisher's Exact test, $p = 0.005$), the other groups were similar (Supplementary File S4). The difference between Groups 2 and 3 was found to be significant regarding whether using a condom reduces the risk of HPV. Group 3 ($n = 55$, 83.3%) was more aware that condoms reduce the risk of HPV than Group 1 ($n = 56$, 79%) (Supplementary File S4). Group 2 ($n = 84$, 70%) knew that HPV could cause cervical cancer compared to the other groups at a lower rate. Group 1 and Group 3 responded similarly (Supplementary File S4). Compared to the other groups, Group 1 ($n = 70$, 98.6%) was more aware that an individual could have HPV infection and go years without realizing it (Supplementary File S4). Group 1 ($n = 69$, 97.2%) had the most knowledge that HPV was a common infection, while Group 3 ($n = 50$, 75.8%) had the least awareness of this fact (Supplementary File S4). Group 2 had the lowest rate of knowledge ($n = 77$, 64.2%), whereas Group 1 knew the most ($n = 70$, 98.6%) about the variety of HPV types (Supplementary File S4). Group 1 ($n = 69$; 97.2%) knew more than the other groups that sexual intercourse at an early age increases the risk of HPV. Group 2 had the lowest knowledge on this subject ($n = 62$; 51.7%) (Supplementary File S4). Compared to the other groups, Group 1 was considerably ($n = 63$, 88.7%) more aware that HPV could not yet be treated with antibiotics or antivirals. This rate was lowest in Group 3 ($n = 26$; 39.4%) (Supplementary File S4). Group 1 knew that HPV also infects men at a higher rate than the other groups ($n = 67$, 94.4%). Group 2 knew this issue the least ($n = 70$; 58.3%) (Supplementary File S4). Group 1 knew ($n = 71$, 100%) that the symptoms of HPV were not always visible. Groups 2 and 3 responded at similar rates ($n = 82$, 68.3%; $n = 51$, 77.3%, respectively) (Supplementary File S4). More people did not know that HPV causes genital warts in Group 2 than the other groups ($n = 12$, 10%). Group 1 and Group 3 were found to be similar (Supplementary File S4). Although Group 1 answered that HPV usually heals without treatment more correctly than the other groups, the majority of them answered wrong ($n = 27$, 38%) Groups 2 and 3 responded at similar rates ($n = 6$, 5%; $n = 5$, 7.8%, respectively) (Supplementary File S4). Group 1 knew that vaccinated girls should continue to have Pap smear test regularly correctly ($n = 71$, 100%). The answers of Groups 1 and 2 ($n = 88$,

73.3%) were significantly different. Groups 1 and 3 or Groups 2 and 3 are similar between themselves (Supplementary File S4). All groups know at similar rates that the HPV vaccine protects against many types of cervical cancer (Supplementary File S4). Group 3 had a higher rate of incorrect answers to the statement that someone who has been vaccinated against HPV will never develop cervical cancer ($n = 15$, 22.7%). There was a difference between Groups 1 and 3 ($\chi 2 = 4.121$, sd = 1, $p = 0.042$ Yates' Chi-square). Groups 2 and 3, Groups 1 and 2 gave similar responses among themselves (Supplementary File S4). Group 2 had a significantly higher rate of ignorance ($n = 36$, 30%) regarding the possibility that HPV could also cause other types of cancer (Supplementary File S4). Twenty-six (21.7%) individuals in Group 2 were unaware that the HPV vaccine offers protection against vaginal warts. Group 3 gave the least incorrect answers ($n = 7$, 10.6%) (Supplementary File S4). Group 1 ($n = 64$, 90.1%) was significantly more likely to know that men/boys should also be vaccinated compared to Group 3 ($n = 41$, 62.1%). Group 2 answered similar to other groups (Supplementary File S4). At least Group 2 knew that HPV vaccine is administered in 2 doses, 6 months apart, between the ages of 9–14 ($n = 53$, 44.2%). Other groups are similar between themselves (Supplementary File S4). Group 1 ($n = 57$, 80.3%) knew the most about the HPV vaccine, which is administered to individuals 15 years of age and older in three doses at 0, 2, and 6 months. Group 2 was at least aware ($n = 52$, 43.3%) Groups 1 and 2 answered differently (Supplementary File S4).

As observed in Additional File 4, the prevalence of missing answers in Group 2 is quite high compared to the other groups due to the lack of knowledge about HPV and the HPV vaccine among those who do not work in the healthcare industry. For this reason, most of them wrote "I do not know" next to the questions. Since HPV is popularly known as the wart virus or cervical cancer virus, it was thought that the definition of "HPV" increased the number of unanswered questions in face-to-face surveys.

Discussion

We analyzed survey data about knowledge of HPV and attitudes toward the HPV vaccine and cervical screening test from 71 mothers who were physicians, 66 mothers who were nurses or midwives, and 120 mothers who were not medical professionals. As anticipated, our findings demonstrated that mothers who work as pediatricians and gynecologists were more successful than mothers in other groups in getting themselves and their kids vaccinated against HPV. Our study included 13 (18.3%) vaccinated physicians. In Turkey, national immunization schedule does not include HPV vaccinations, yet. That's why vaccination rates are generally low. Although physician mothers had cervical cancer screening tests done more regularly than other groups, unfortunately this difference was not significant and was a low rate ($n = 37$, 52.1%). Lubeya MK et al., conducted a study in Zambia in 2022 with 121 doctors, including 26 (21.5%) gynecologists, 18 (14.9%) pediatricians, and 24 (19.8%) surgeons. Sixty-nine (65.3%) of the physicians in their survey study had more than 10 years of clinical experience. A total of 66 (54.6%) physicians recommended HPV vaccination (5). On the contrary, physicians were more likely to recommend the vaccine in our study. As the number of experienced doctors increases, vaccination recommendations seem to increase. Kurtoğlu E et al. conducted a survey with 53 family physicians in 2013, and it was determined that 17 (32.1%) physicians wanted to get the vaccine for their daughter, and 14 (26.4%) physicians wanted to get the vaccine for their son (1). The rate of physicians recommending vaccination to their patients was found to be only 33 (62.3%). It was observed that 32 (60.4%) of family physicians had insufficient knowledge about HPV vaccine (1). It can be thought that the awareness of pediatricians and gynecologists is higher than the family physicians in this study, as doctors in our study wanted to vaccinate their children at a higher rate and recommended the vaccine to their patients. It is noteworthy that as the rate of physicians updating their knowledge decreases, the rate of vaccine acceptance and recommendation to their patients decreases.

In our study, Group 1 knew that vaccinated girls should continue to have Pap smear test regularly correctly ($n = 71$, 100%). Group 1 is fully aware that HPV causes cervical cancer. Almazrou S, et al. did a study in Arabia in 2020. In this research, 58 (33%) physicians had professional experience more than 10 years. In his study conducted with 121 (70%) pediatricians and 52 (30%) family physicians (6). 102 (59%) physicians knew that vaccinated girls should continue to have Pap smear test regularly correctly. 6 (3.5%) physicians received HPV vaccination. These rates were low comparing with our study. The reason for this low rate may be that the vaccine is not on the national schedule in Arabia. 142 (82%) physicians said to want their daughters to be vaccinated against HPV. This rate was higher than our study. Physicians with over 10 years of experience were more likely to have a higher level of knowledge than those with less experience (6). In our study, we found that the tendency to vaccinate children increases as professional experience increases. These findings also support our study results.

In the survey study conducted by Katsuta T, et al. in 2019 via e-mail with 148 physicians, including 63 pediatricians, and 14 gynecologists, answered the questions. The median experience of physicians was 30 years. 26 (21%) physicians, 11 (22%) pediatricians, and 5 (36%) gynecologists recommend HPV vaccination to adolescents. These rates were lower than our study. Overall, Japanese physicians reported that HPV vaccine recommendations would improve most with policy changes (7). In Group 2 of our study, 5/120 (4.2%) of the mothers received a vaccination. This rate exceeded the vaccination rate of just 11 (1.2%) out of 909 Japanese mothers in the survey study conducted by Suzuki Y et al. It has been reported that one of the main barriers to HPV vaccination in Japan is vaccine hesitancy (8). Social media was the first source in Group 2. Della Polla G, et al. conducted a research with 435 parents, 57.9% of them reported that they had vaccinated their child against HPV and one-third (33.3%) participants were hesitant. Moreover, 56.7% of the remaining intended to vaccinate their child against HPV. In contrast to our results, the most reported source was health-care provider (63.2%), and the second most popular were internet and social media (42.1%) (9). In Italy, the fact that the public learns information from doctors rather than social media and the HPV vaccine is included in the national immunization schedule may explain why vaccination rates are higher than in our study.

In Chen S, et al.' survey study conducted with 2074 physicians in 2022, 20 surveys were disqualified, 36% gynecologists and 64% healthcare workers were evaluated in terms of HPV vaccine knowledge and recommendation. 68% of the participants stated that they recommended the HPV vaccine (10). This rate was low comparing with our study. The reason for this low rate may be that the vaccine is not on the national schedule in China. They thought that awareness, and knowledge level are lower in Southern China.

We did not find a relationship with vaccination against HPV and a family history of cancer. In the study of Walter LA, et al., there were 6 (7.6%) people with a family history of cervical cancer, and 20 (24.7%) vaccinated participants. Although this rate seems higher than our study, HPV vaccine is included in the national immunization schedule in Alabama (11). Yörük S, et al. conducted a survey in 2016 to examine the knowledge, attitudes and behaviors of female students studying at the faculty of health sciences and medicine regarding HPV, cervical cancer, and HPV vaccine. 92.7% of medical faculty students told that HPV is the causative agent of cervical cancer. 58.2% of nurse/midwife students knew that HPV caused cervical cancer. 6 (0.9%) students were vaccinated. They found that students who had a relative with cervical cancer were more likely to consider getting vaccinated. The reasons for neglecting vaccination were being unaware of vaccine (34.8%), price of vaccine (22.2%), side effects of it (17.4%), and giving up vaccination (15.5%). The HPV knowledge of the medicine students attending the faculty of was higher compared to the other students (12). These results overlap with ours except for the cervical cancer relationship.

In a survey of 704 mothers by Mendes Lobão W et al., 83% mothers had Pap smear test regularly. HPV vaccine acceptance was 92.8% for their daughters and 85.9% for their sons in that study. These were higher rate according to our study. 30% parents knew that HPV vaccine prevents genital warts. This knowledge's rate is low than ours. The most common reason for not vaccinating a child was found to be not vaccinating at school. HPV vaccine was included in the National Immunization Program in Brazil (13).

Smolarczyk K et al.' conducted a survey study in Poland in 2021 with 639 doctors, including 31.8% dermatologists, 32.1% gynecologists, 0.2% family physicians, and 33.8% pediatricians. In contrast to our study, 132 (20.7%) physicians, including 47 (23.2%) skin and venereal disease specialists, 51 (24.9%) gynecologists, and 32 (14.8%) pediatricians knew the HPV vaccine target population age. Furthermore, 53 (8.3%) physicians, including 20 (9.9%) dermatologists, 24 (11.7%) gynecologists and 8 (3.7%) pediatricians knew that HPV is transmitted was answered correctly. The dose of the HPV vaccine was known by 266 (41.6%) physicians, including 60 (29.6%) dermatologists, 78 (38%) gynecologists, 121 (56%) pediatricians correctly. 133 (66.5%) dermatologists, 153 (75.4%) gynecologists, and 134 (64.1%) pediatricians recommended the vaccine to their relatives. These rates were also lower than ours (14). Nagase Y, et al. conducted with 293 gynecologists, 248 (84.6%) gynecologists reported that they recommended HPV vaccination to their patients. Gynecologists vaccinated 11 of their 30 daughters (36.7%) against HPV (15). This was slightly better than our result of 10/34 (29.4%), even though it was in Japan when the vaccine was on hold. In their survey study with 318 midwives and nurses in 2021, Ebu NI, et al. found that 176 (55.3%) nurse-midwives had at least one Pap smear test, and 142 (44.7%) participants had no test. 56 (17.6%) participants were vaccinated, and 262 (82.4%) were not vaccinated (16). Although the HPV vaccine is not included in the national immunization schedule in Ghana, the vaccination rate is higher than in our study.

In contrast to our results, at the survey study conducted by Lin Y et al. with nurse students in 2022, 75.4% or nurses stated that HPV was not treated with antibiotics. 70.9% of students knew that vaccinated girls should continue to be screened for cervical cancer. Approximately 2/3 (64.6%) of the students do not know that HPV infection can be asymptomatic (17). Although the rates were determined better in our study, it seems that nurses should receive training about HPV and the HPV vaccine generally.

Karasu et al. (18) researched HPV vaccination attitude and knowledge at 499 nurses. Their vaccination status was 26 (4.3%). 237 (52.8%) nursing students reported that they were considering vaccinating their children. Of them, 86% were aware that HPV is a sexually transmitted infection. 59% of participants in their study knew that HPV infection could be asymptomatic. Of the nurses, 18.6% ($n = 66$) had smear tests performed. Their reasons for not getting vaccinated were: they were not at risk of HPV infection ($n = 106$, 34.9%), some of them said they were unaware of the vaccine ($n = 83$, 26.8%), 23 (7.4%) of the participants said that the vaccine had many side effects, 4 of them (1.3%) answered that the government did not cover the cost of vaccination (18). The fact that pap tests and vaccination rates are as low as ours indicates that nurses require training.

In the survey study conducted by Adesina KT et al. in 2018 with mothers of adolescent daughters in Nigeria, 161 (34.3%) mothers stated that HPV infection was sexually transmitted, 190 (40%). 40.4% mothers knew that it caused cervical cancer, and 162 participants (34.5%) knew that using a condom could prevent transmission. In this study, 1.1% mothers said that boys could also be vaccinated, and 9 (1.9%) participants had their children vaccinated. 211 (44.9%) of them stated that they wanted to vaccinate their children. 45 (9.6%) of them knew that the vaccine could prevent genital warts and 120 (25.5%) mothers knew that it could prevent cervical cancer. They obtained information from doctors ($n = 80$, 28.1%), mass media ($n = 61$, 21.4%), health meetings ($n = 60$, 21.1%), from newspapers and magazines ($n = 43$, 15.1%), from their peers and parents 11 (3.9%), 10 (3.5%), ($n = 18$, 6.3%) from social media, and 2 (0.7%) from their relatives (19). Unfortunately, in our society, social media has been found to be the preferred source of information rather than physicians. Shetty S, et al.' conducted a survey study with medical students (43.5%) followed by dental (27.9%), nursing (21.1%). Faculities (42.1%) were the most common information source followed by TV/internet (12.1%), family/friends (4.9%), and physician (2.9%). Most students (78%) knew HPV transmission by sexual route. 25.8% students were aware that HPV infection could be asymptomatic. 62.6% students stated that HPV could affect males. Only 37.2% of them were aware that HPV could cause oropharyngeal cancer. 49.5% of students knew that using a condom could prevent HPV infection. 6% of the students had got the HPV vaccine (20). The fact that the vaccine is not in the national immunization schedule in India may be one of the reasons for the low rate of vaccination.

Gynecologists were found to be more attentive in terms of regular smear tests compared to pediatricians. Although physician mothers with 10–20 years of professional experience received HPV vaccination more often than other physicians, no statistical difference was found. In contrast, in the Hershkovitz G et al. study, less experienced physicians were vaccinated more frequently and gynecologists were screened at the same rate as other physicians (21).

This is, as far as we are aware, the first study to look at HPV awareness among nurses, pediatricians, obstetricians/gynecologists, and mothers who are not in the medical field. Regretfully, attitudes regarding cervical cancer prevention have sadly fallen behind the curve for most healthcare professionals.

Strengths and limitations

There are some limiting aspects of our study. Some participants were reluctant to write their names and phone numbers because they thought it was related to their private lives. The name, telephone and e-mail address sections added after the preliminary study may have caused bias in answering. HPV is colloquially known as the wart virus or cervical cancer virus, the definition of "HPV" was thought to increase the number of unanswered questions in face-to-face surveys. It was observed that there was generally little information about HPV, and it was concluded that awareness would increase if a study was conducted before and after the training. In our study, the education levels of groups were not questioned, but their professions were asked. 2.3 times more participants than the sample calculated in the preliminary study participated in our research. Pediatrician and gynecologist mothers were included in the physician mothers group, the calculated sample size was exceeded, but a study including family physician mothers could also be considered. Having the sample from two esteemed universities—one on the European side and the other on the Anatolian side—in Istanbul, a multicultural city, is one of the research's advantages. In the initial social media study, the participants' response rate was higher when they were not required to provide their name, phone number, or email address. The study has social significance for improving vaccination coverage with the help of these experts.

Conclusion

Based on the data we obtained from the studies we compared, we thought that healthcare professionals did not make enough efforts to prevent cervical cancer. Although physicians recommend the vaccine at a higher rate, they are reluctant to encourage patients to get vaccinated for reasons such as cost concerns. Some physicians regrettably think the vaccine is unnecessary. The reason for the low vaccination frequency in our sample group may be that the importance of vaccination is not yet fully understood among healthcare professionals. The fact that gynecologists and pediatricians are well-versed in the HPV vaccine plays a significant role in their willingness to recommend it to patients and their acceptance of it.

It is necessary to equip physicians in all branches with knowledge who treat patients who may be affected by HPV-related diseases. To encourage behavioral change in young people, opportunities for discussions about sexuality and other culturally sensitive issues should be established with health professionals who possess the requisite knowledge and expertise about cervical cancer. Social media is a valuable resource for information about public health, but it can be challenging to weed out misleading material, so it's critical that the appropriate regulations and inspections are put in place now.

The importance of matching words and deeds can be taught to medical professionals. Taking action can help to achieve success, to build resilience, and to make a positive impact in the world.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The Istanbul Faculty of Medicine Clinical Research Ethics Committee decision, dated 25.02.2022 and numbered 770003, granted approval for the multi-center study. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

BP: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. FU: Conceptualization, Data curation, Formal analysis, Methodology, Resources, Validation, Writing – review & editing, Writing – original draft. EG: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – review & editing, Writing – original draft.

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Conflict of interest

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1361509/full#supplementary-material

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Commentary: One-year quality of life among post-hospitalization COVID-19 patients

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KEYWORDS

SARS-CoV-2 infection, quality of life, questionnaire, outcome, SARS-CoV-2 vaccination

A Commentary on
One-year quality of life among post-hospitalization COVID-19 patients

by Pérez Catalán, I., Roig Martí, C., Fabra Juana, S., Domínguez Bajo, E., Herrero Rodríguez, G., Segura Fábrega, A., Varea Villanueva, M., Folgado Escudero, S., Esteve Gimeno, M. J., Palomo de la Sota, D., Cardenal Álvarez, A., Mateu Campos, M. L., Usó Blasco, J., and Ramos Rincón, J. M. (2023). *Front. Public Health* 11:1236527. doi: 10.3389/fpubh.2023.1236527

Introduction

There is growing evidence that SARS-CoV-2 infections (SC2Is) can be complicated by chronic conditions that can last for weeks or months. For didactic reasons, these enduring complications are termed post-COVID syndrome (PCS) if they last for <12 weeks and long-COVID syndrome (LCS) if they last for >12 weeks. Although more and more studies are being conducted on these topics, the need for further discussion remains, as the following publication shows.

Study of interest

The interesting study by Perez Catalan et al. focused on the quality of life (QoL) 1 year after a SC2I in 486 patients through telephone interviews using the SF-36 QoL questionnaire (1). While the findings are compelling, certain aspects of the study warrant further discussion.

Discussion

The first point is that telephone interviews have several disadvantages. First, it cannot be determined whether the person called is indeed the patient in question. Second, there is no way to verify that the responses accurately reflect the actual events. Third, telephone interviews do not allow for the request of additional tests to generate new data.

The second point is the SF-36 questionnaire itself. The questions are not tailored specifically to SC2Is, focusing instead on general wellbeing. To effectively assess the outcome of SC2Is after 1 year, it would be desirable to ask specific questions about SC2Is and obtain detailed information on its common symptoms.

A third point is that within 1 year of suffering from SC2Is, patients might develop multiple diseases, receive new medications, or undergo various medical procedures. Therefore, it is crucial to inquire about any new comorbidities, medications, or treatments that have been introduced since the SC2I to fully assess their current health status and the ongoing impacts of the infection.

A fourth point is that the impact of the SARS-CoV-2 vaccination (SC2V) on QoL during the follow-up period was not discussed. In how many cases was the SC2V tolerated without side effects, and in how many patients was the SC2V complicated by adverse reactions? Sometimes, it may not be the SC2I itself but the vaccination that could impair QoL. Therefore, it would be beneficial to further address the potential impact of SC2V on QoL during the follow-up period. This discussion should include comprehensive and appropriate references on infection prevention and public health guidance, including the occurrence of any adverse reactions. These factors could significantly influence patients' health perceptions and outcomes. A more comprehensive understanding of the factors influencing PCS/LCS, along with the judicious use of artificial intelligence and machine learning algorithms, can facilitate real-time monitoring, sophisticated data interpretation, and agile decision-making in relevant and responsive National Immunization Programs (NIPs).

To assess QoL 1 year after a SC2I, on-site examinations are preferable to telephone questionnaires. For patients complaining of long-lasting COVID symptoms, further investigation should be planned to determine whether these symptoms are directly related to previous SC2I. Future research should prioritize face-to-face assessments, utilize targeted questionnaires, gather comprehensive medical histories, and conduct detailed analyses of vaccine effectiveness to provide a more accurate and thorough assessment of PCS and LCS.

Author contributions

JF: Conceptualization, Investigation, Methodology, Software, Supervision, Writing – original draft, Writing – review & editing.

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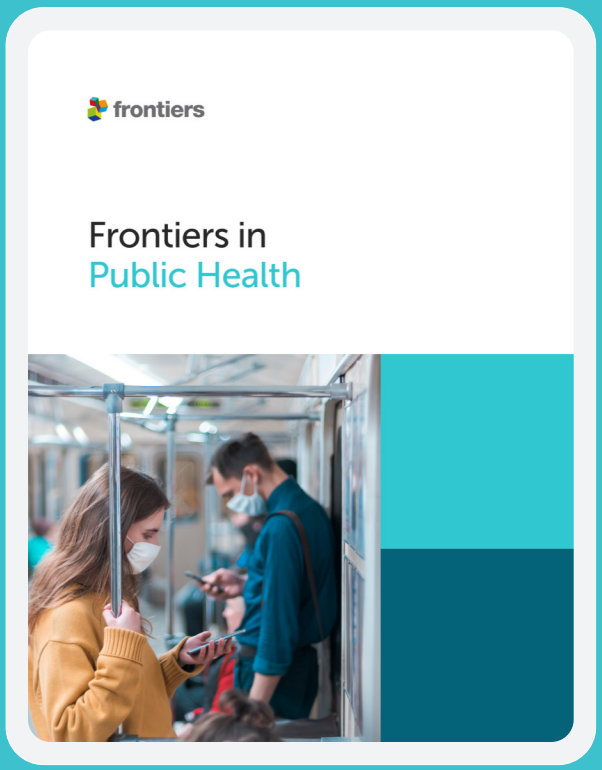

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