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General vaccination knowledge influences nurses' and midwives' COVID-19 vaccination intention in Cyprus: a nationwide cross-sectional study

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ABSTRACT

This cross-sectional study was conducted during the period between 08 and 28 December 2020 to investigate the association of nurses' and midwives' level of vaccination knowledge and the COVID-19 vaccine acceptance for themselves during the COVID-19 pandemic era in Cyprus. Participants included registered nurses and midwives working in public or private service provision. Data collection was achieved using a self-administered questionnaire with questions on socio-demographic characteristics, questions assessing participants' general vaccination knowledge, and questions related to COVID-19 vaccination. A total of 437 responders answered the survey, with 93% being nurses and 7% midwives. The results indicate that as the vaccination knowledge score increases (higher knowledge) the probability of accepting the COVID-19 vaccination increases too (OR = 1.30, 95% CI: 1.13–1.48). The association between vaccination knowledge and the intention to be vaccinated against COVID-19 remained statistically significant, even after adjusting for age and gender (OR = 1.28, 95% CI: 1.12–1.47), socioeconomic (OR = 1.29, 95% CI: 1.12–1.48), and demographic characteristics (OR = 1.29, 95% CI: 1.11–1.49). Also, as age increases, the probability of accepting the COVID-19 vaccination increases, while female respondents had a lower probability of accepting the COVID-19 vaccination than male respondents. This study demonstrated that COVID-19 vaccination acceptance is related to the vaccination knowledge of the nurses and midwives in Cyprus. Targeted vaccination campaigns are needed to improve nurses' and midwives' level of vaccination knowledge in order to achieve a better coverage among them, as well as to influence their patients' ultimate positive vaccine decision.

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Introduction

Humanity is experiencing an ongoing pandemic caused by a novel respiratory virus belonging to a different taxonomic family compared to past pandemics. An emerged coronavirus (SARS-CoV-2) was identified as a global threat to public health in 2020,[1] which forced governments, policymakers, and global organizations to implement measures to prevent its spread. Despite research efforts, the only effective preventive pharmaceutical product to date remains vaccination against COVID-19.[2] Consequently, the end of the pandemic relies on the vaccination rate required to achieve herd immunity.

Even though vaccine-mediated immunization has proved its effectiveness by eliminating several fatal diseases, vaccine hesitancy tends to undermine public health efforts.[3,4] Vaccine hesitancy is not a new phenomenon as it existed since the introduction of vaccines.[5] Given the importance of vaccination, the World Health Organization declared vaccine hesitancy as "one of the top ten threats to global health" in 2019.[6]

Beyond vaccine hesitancy, other important public health challenges arose during the COVID-19 pandemic. The estimation of COVID-19 vaccine acceptance is one of the challenges, since studies can overestimate or underestimate the COVID-19 vaccine acceptance (intention/willingness to receive the vaccine),[7] hence concealing the real intention and uptake (received the vaccine). Except for these, inequalities in health services can be observed due to COVID-19 vaccine shortage and distribution.[8,9] All these challenges directly impact herd immunity attainment, hence influencing viral spread and possible viral evolution toward lethal variants.[10,11] In addition, researchers identified an increase in anxiety and depression levels during the COVID-19 pandemic.[12–16] Mental health issues were also observed among healthcare professionals (HCPs).[17–22] Several factors interfere with HCPs' distress including the lack of personal protective equipment and inadequate support as well as concerns about risk of exposure to SARS-CoV-2.[23] HCPs could also experience increased psychological pressure due to the added workload which can severely affect their mental health.[18,24] Taking into consideration the forementioned, a high vaccination uptake can resolve the HCPs' mental distress.

The vaccine hesitancy phenomenon is also reported amongst HCPs.[25–27] A growing number of HCPs tend to delay or refuse vaccination,[3,4] even though they are at risk of being overexposed to infectious pathogens due to their profession.[28] Furthermore, vaccine hesitancy among HCPs may negatively influence adult patients' intention for

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vaccination[3] and consequently, younger ages vaccination coverage since HCPs' children are unable to decide for themselves.[29] Vaccine hesitancy is a multifactorial phenomenon[30] and seems to be associated with the level of information provided by both, HCPs and patients. Physicians are more likely to accept vaccination compared to other HCPs, such as nurses.[31–35] For instance, pediatricians due to their active role on children's vaccinations and their access to a high level of vaccine-related information are more likely to advise vaccination uptake than any other specialties, or other HCPs.[32,36,37] Additionally, HCPs' vaccination knowledge increases their ability to communicate the vaccination's usefulness to parents and positively affects their children's vaccination uptake.[38] Therefore, HCP's vaccine literacy is crucial for establishing high immunization rates in the general population.

During the study period (December 2020), no vaccine was yet available in Cyprus, whilst more than 20.000 SARS-CoV-2 infections were confirmed, and 133 deaths were reported at the end of December 2020.[39] With COVID-19 being a critical health issue, the government of Cyprus, similarly to other European Union countries, implemented an age and risk of death-based vaccination plan. Six different vaccination phases were developed to prioritize target groups in Cyprus. The initial vaccination schedule (phase 1) started on 27 December 2020 amongst residents and staff in care homes for older adults as well as in frontline HCPs who were in direct contact with COVID-19 patients. Subsequent phases followed by the vaccination of people > 80 years old with the age limit to be lowered at regular intervals, people ≥ 16 years with high risk for severe disease, people working in primary healthcare centers, followed by other health professionals, and residents in other closed structures (e.g., prisons and hosting centers for refugees and migrants) and then the rest of the population by age-groups. During all vaccination phases, priority was given to at-risk individuals (e.g., cancer, diabetes, chronic respiratory disease, heart failure of any etiology, etc.).[40]

Nurses comprise the largest group of HCPs workforce in Cyprus and are in direct communication with patients. However, data regarding the level of nurses' vaccination knowledge in Cyprus are sparse. Two recent studies in Cyprus identified the need for nurses to educate themselves since they self-reported a need to access further information regarding vaccines.[32,41] A recent study, which included 22% of the working nursing personnel in Cyprus, revealed the main reasons for vaccination refusal as the level of the provided information.[32] Therefore, the overall vaccination knowledge of nurses may interfere with their personal choice to accept or refuse vaccines. Thus, in the present study, we investigate the association of nurses' and midwives' vaccination knowledge and the COVID-19 vaccine acceptance for themselves during the COVID-19 pandemic era.

Material and methods

Design

This study is an online cross-sectional study involving registered nurses and midwives working in Cyprus. This study was reported following the Strengthening the Reporting of Observational Studies in Epidemiology.[42]

Study population and procedures

An online cross-sectional, self-administrated survey was conducted between 08 and 28 December 2020 (before introducing the COVID-19 vaccination programs in Cyprus). The study population included registered nurses and midwives working in the public or private sector. Any inpatient, outpatient, or outreach service in the community health care setting was eligible for this study. Only nurses and midwives that were in direct contact with patients were eligible to participate, thus, nursing students and nurses working in positions that did not provide direct care were excluded from the analysis.

Sample recruitment and data collection

Nurses and midwives were asked to participate in the study through an online self-administered questionnaire which was administered using Google Forms and dispersed using instant messaging apps, (e.g., WhatsApp, Viber), social media platforms (e.g., Facebook, Instagram), social networking sites (e.g., LinkedIn), and institutional e-mails. Before completing the questionnaire, the participants gave their consent by answering a "Yes/No" question on a written informed consent form. Due to the quarantine restrictions resulting from the ongoing COVID-19 pandemic, a convenience sampling approach was used, which may influence sampling possibilities. However, we compared our sample characteristics with statistics of the nurse population in Cyprus to look for potential selection bias. In Cyprus, as reported by the Statistical Service of Cyprus, there are 2911 nurses and 194 midwives.[43] Overall, we managed to keep a similar proportion of registered nurses among the five government-controlled districts of the Republic of Cyprus [Nicosia (46%), Limassol (26%), Larnaca (12%), Paphos (10%), and Ammochostos (6%)], job role (nurses and midwives), as well as a similar distribution of nurses working in public and private hospitals, as reported by the Statistical Service of Cyprus.[43]

Questionnaire

Data were collected by a self-administered, anonymous questionnaire developed by the researchers. The questionnaire was designed drawing upon published literature contained 28 closed-ended and multiple-choice questions in Greek language on socio-demographic characteristics (i.e., age, gender, marital, and educational status), questions assessing participants' general vaccine knowledge, and questions related to COVID-19 vaccination. Face validity was pilot tested by 40 nurses before the actual study for clarity and to identify any difficulties that may be occurred during data collection. Appropriate changes were made to ensure sample access to representative answers. The Cronbach's α-value for internal reliability was 0.743. Nurses' and midwives' vaccination knowledge was measured by 12 general vaccination-related questions. We also included questions concerning controversial subjects that are often related to vaccinations such as alleged links to autism and allergies, and whether vaccinations can be replaced by antibiotics. The questions that evaluated participants' knowledge toward vaccination had three possible answers: "True," "False," and "I do not know."

Ethics approval

This study was conducted according to the Declaration of Helsinki guidelines, and all procedures involving research study participants were approved by the Cyprus National Bioethics Committee (CNBC). Participation was anonymous, and all the participants were informed about the study aim and objectives before participating.

Statistical analysis

Participants' baseline characteristics are presented as median (q_1, q_3) for continuous measures with skewed distributions (i.e., age) while categorical variables (i.e., city of residency, marital status) were presented as absolute (n) and relative (%) frequencies. Normality was tested using Shapiro-Wilk test.

The Kolmogorov-Smirnov test was used to find any differences between the intention to accept the COVID-19 vaccine and the skewed socio-demographics and work-related characteristics of participants (i.e., age, years of experience). In addition, Pearson's chi-square test was employed to detect any differences between the intention to accept the COVID-19 vaccine and the categorical socio-demographic and work-related characteristics of participants (i.e., gender, marital and educational status). Moreover, the Kruskal-Wallis rank test was applied to find any differences between the socio-demographic and work-related characteristics of participants and the knowledge score.

Nurses' and midwives' vaccination knowledge was measured by twelve questions with three possible answers: "True," "False" and "I do not know." If the corresponding questions were answered correctly, then a score of 1 point was given. Alternatively, a score of 0 was given if the question was answered incorrectly or for "I do not know" answers. We calculated the knowledge score of the participants by adding the points of each of the 12 knowledge items (maximum score 12). Higher scores indicate a higher vaccination knowledge.

Hierarchical logistic regression models were used to identify the association between the intention to accept the COVID-19 vaccine and vaccination knowledge adjusting for social and demographic indicators (Table 2). Firstly, we adjusted for age and gender (Model 2), then added socioeconomic characteristics including educational, marital status, and the number of children (Model 3), and finally demographic characteristics, including country and geographical area (Model 4) were added. Moreover, a logistic regression model was applied to report the association between intention to accept the COVID-19 vaccine and vaccination knowledge after the adjusting for work-related factors (i.e., job role, workplace, and years of experience). All statistical hypotheses were two-sided with a statistical significance level set at $\alpha = 0.05$. Statistical analysis was conducted using STATA 14.0 statistical software (Stata Corp, College Station, TX, USA).

Table 1. Vaccination knowledge score by different socio-demographic and work-related characteristics of participants.

		Intention to vaccinate			Knowledge score	
	Overall (N = 437)	No/I do not know (N = 304)	Yes (N = 130)	p-value	[Median (q_1, q_3)]	p-value
Age[1]	34 (30, 42)	33 (29, 40)	36.5 (30, 43)	**<.01**[3]	0.09[6]	.15[6]
Gender (N = 435)[2]						
Male	126 (29.0)	70 (23.1)	54 (41.9)	**<.01**	9 (8–10)	.97[3]
Female	309 (71.0)	233 (76.9)	75 (58.1)		9 (8–10)	
Country (N = 436)[2]						
Greece	15 (3.5)	14 (4.6)	1 (0.8)	.05[4]	9 (9–10)	.25[3]
Cyprus	420 (96.5)	289 (95.4)	128 (99.2)		9 (8–10)	
City (N = 415)[2]						
Nicosia	191 (46.0)	123 (42.4)	66 (54.1)	.24[4]	9 (8–10)	.11[5]
Limassol	108 (26.0)	83 (28.6)	25 (20.5)		9 (8–10)	
Larnaca	51 (12.3)	36 (12.4)	14 (11.5)		9 (9–10)	
Paphos	42 (10.2)	32 (11.1)	10 (8.2)		9 (8–10)	
Ammochostos	23 (5.5)	16 (5.5)	7 (5.7)		10 (8–11)	
Marital status (N = 437)[2]						
Unmarried	92 (21.1)	67 (22.0)	24 (18.5)	.27[4]	9 (8–10)	.96[5]
Married/ In cohabitation	330 (75.5)	225 (74.0)	104 (80.0)		9 (8–10)	
Divorced/ Separated/ Widowed	15 (3.4)	12 (4.0)	2 (1.5)		9 (6–10)	
Education level (N = 434)[2]						
Bachelor's degree	235 (53.9)	168 (55.3)	66 (51.2)	.37[4]	9 (8–10)	**<.01**[5]
Master's degree	186 (42.9)	129 (42.4)	57 (44.2)		9 (8–11)	
PhD	14 (3.2)	7 (2.3)	6 (4.6)		10 (8–11)	
Job role (N = 435)[2]						
Midwife	32 (7.4)	280 (92.4)	121 (93.1)	.81[4]	9 (8–10)	.56[5]
Nurse	403 (92.6)	23 (7.6)	9 (6.9)		9 (8–10)	
Public or private hospital (N = 432)[2]						
Public	309 (71.5)	215 (71.2)	93 (72.7)	.76[4]	9 (8–10)	.48[5]
Private	123 (28.5)	87 (28.8)	35 (27.3)		9 (8–10)	
Years of experience (N = 429)[1]	10 (6, 18)	10 (5, 15)	13 (7, 20)	**<.01**[3]	0.08[6]	.08[6]

[1]Median (q_1, q_3), [2]Frequency (%), [3]Differences between the characteristics of participants were examined with Kolmogorov-Smirnov test, [4]chi squared test, [5]Kruskal-Wallis rank test [6]Spearman correlation test. Bold indicate statistically significant at a $p < .05$.

Table 2. Odds ratios and 95% confidence intervals of vaccination knowledge score in relation to intention to be vaccinated adjusted for a. age, gender, b. educational, marital status, and c. country and geographical area.

	Model 1: Crude model	Model 2: Crude model adjusted for age and gender	Model 3: Model 2 adjusted for socioeconomic characteristics	Model 4: Model 3 adjusted for demographic characteristics
Vaccination knowledge score	1.30 (1.13, 1.48)**	1.28 (1.12, 1.47) **	1.29 (1.12, 1.48)**	1.29 (1.11, 1.49)**
Age		1.04 (1.01, 1.06) **	1.04 (1.01, 1.07)**	1.03 (1.00, 1.07)*
Gender				
Male		*Ref*	*Ref*	*Ref*
Female		0.40 (0.25, 0.63) **	0.39 (0.24, 0.61)**	0.37 (0.23, 0.61)**
Marital status				
Unmarried			*Ref*	*Ref*
Married/ In cohabitation			0.95 (0.49, 1.84)	0.90 (0.45, 1.81)
Divorced/ Separated/ Widowed			0.31 (0.06, 1.65)	0.33 (0.06, 1.85)
Education level completed				
Bachelor's degree			*Ref*	*Ref*
Master's degree			0.88 (0.56, 1.38)	0.87 (0.54, 1.41)
PhD			1.35 (0.38, 4.75)	1.55 (0.42, 5.72)
Country				
Greece				*Ref*
Cyprus				6.50 (0.77, 54.82)
City				
Nicosia				*Ref*
Limassol				0.54 (0.30, 0.97)*
Larnaca				0.74 (0.35, 1.54)
Paphos				0.54 (0.23, 1.26)
Ammochostos				0.66 (0.24, 1.81)

*Indicates statistically significant at a $p < .05$; ** indicates statistically significant at a $p < .01$.

Results

Participants' characteristics

A total of 437 midwives (n = 32, 7.4%) and nurses (n = 403, 92.6%) in Cyprus completed the online questionnaire. The socio-demographic and the work-related characteristics of the respondents are described in Table 1. Most of the participants were from Cyprus (96.5%) and only 3.5% from Greece. The median age was 34 (q1 = 30, q3 = 42) years old and about 46% of the participants were from the capital of Cyprus, Nicosia. In addition, 75.5% of the participants were married/in cohabitation, and 53.9% had completed a bachelor's degree. Moreover, most of the participants work in a public hospital (71.5%), and the median years of experience of the participants was 10 (q1 = 6, q3 = 18) years.

COVID-19 vaccination intention and participants' characteristics

We reported that individuals who had the intention to accept the COVID-19 vaccine were significantly older (median = 36.5 years old) than those without intention to accept or they were undecided (median = 33 years old) ($p < .01$) (Table 1). Moreover, the largest difference between males and females for the intention to accept the COVID-19 vaccine was reported among those who had no intention to accept the COVID-19, or they were undecided. Specifically, 233 (76.9%) women reported that they had no intention, or they were undecided while 75 (58.1%) women reported that they had intention compared to 70 (23.1%) and 54 (41.9%) men, respectively (Table 1). Regarding the work-related characteristics of participants,individuals who had intention to accept the COVID-19 vaccine, had significantly more years of experience (median = 13 years) than the individuals who had no intention or they were undecided (median = 10 years) ($p < .01$).

Vaccination knowledge score and participants' characteristics

Regarding the level of vaccination knowledge and the influence of participants' characteristics, we found only one statistically significant association, individuals who had a PhD degree had a higher vaccination knowledge compared to those who had a bachelor's or a master's degree ($p < .01$) (Table 1). More details about the vaccination knowledge score by the different socio-economic and work-related characteristics of participants are presented in Table 1.

Intention to be vaccinated against COVID-19 and vaccination knowledge

We found that as the vaccination knowledge score increases (higher knowledge) the probability of accepting the COVID-19 vaccination increases too (Table 2, Model 1, unadjusted OR = 1.30, 95% CI: 1.13, 1.48). The association between vaccination knowledge and the intention to be vaccinated against COVID-19 remained statistically significant even after adjusting for age and gender (Table 2, Model 2, adjusted OR = 1.28, 95% CI: 1.12, 1.47), socio-economic (Table 2, Model 3, adjusted OR = 1.29, 95% CI: 1.12, 1.48) and demographic characteristics (Table 2, Model 4, adjusted OR = 1.29, 95% CI: 1.11, 1.49). Furthermore, in all the models (Table 2, Model 2, Model 3, and Model 4) we found that as age increases, the probability of accepting the COVID-19 vaccination increases too. Moreover, female respondents had a lower probability of accepting the

Table 3. Odds ratios and 95% confidence intervals of vaccination knowledge score in relation to intention to be vaccinated adjusted for work-related factors.

	OR (95% CI)
Vaccination knowledge score	1.28 (1.12, 1.47)*
Job role	
Midwife	*Ref*
Nurse	1.12 (0.48, 2.61)
Public or private hospital	
Public	*Ref*
Private	1.36 (0.80, 2.32)
Years of experience	1.05 (1.02, 1.07)*

*Indicates statistically significant at a $p < .01$.

COVID-19 vaccination compared to male respondents after adjusting for age and gender (Table 2, Model 2, adjusted OR = 0.40, 95% CI: 0.25, 0.63), socioeconomic (Table 2, Model 3, adjusted OR = 0.39, 95% CI: 0.24, 0.61) and demographic characteristics (Table 2, Model 4, adjusted OR = 0.37, 95% CI: 0.23, 0.61).

Table 3 presents the logistic regression model for the association of vaccination knowledge in relation to be vaccinated adjusted for work-related factors. We found that as the vaccination knowledge score increases (higher knowledge) the probability of accepting the COVID-19 vaccination increases (adjusted OR = 1.28, 95% CI: 1.12, 1.47). In addition, as the years of experience increase, the probability of accepting the COVID-19 vaccination increases too (adjusted OR = 1.05, 95% CI: 1.02, 1.07).

Discussion

This study aimed to evaluate the influence of existing vaccination knowledge on nurses' and midwives' decision to accept the COVID-19 vaccination in Cyprus. Nurses and midwives with a considerably high vaccination knowledge had a higher probability of accepting the COVID-19 vaccine. The most striking observation to emerge from our analysis was the preserved statistically significant association after adjusting for numerous factors including age, gender, socioeconomic, and demographic characteristics. Together, these results provide important insights into the crucial role of vaccination knowledge on nurses' and midwives' decision to accept a newly designed vaccine during the pandemic.

Adequate vaccination knowledge is necessary to ensure high vaccination uptake. A high level of general vaccination knowledge was associated with HCPs' positive COVID-19 vaccination attitude.[44] A higher level of knowledge regarding coronaviruses and COVID-19 was linked with a higher COVID-19 vaccination rate in nursing students and nurses across Europe.[45,46] Similar results were also observed with influenza vaccination knowledge among HCPs[33] and nurses.[47,48] A previous systematic review further supports the association between HCPs' vaccination knowledge and their intention to vaccinate individuals.[49] In addition, insufficient knowledge about the new vaccine and fears of long-term side effects were also reasons cited by HCPs for not being vaccinated.[50,51]

We demonstrated that older and more experienced nurses and midwives had a higher probability of accepting the COVID-19 vaccination, while doctoral degree holders had a higher vaccination knowledge. The reason for this is not clear but it can be hypothesized that older individuals with extensive experience have adept vaccination knowledge and appreciated the benefits of vaccination throughout their lifetime. These results reflect those of Yigit et al. 2021 who found that younger HCP were more hesitant toward COVID-19 vaccination, while the years of experience correlated with vaccine acceptance.[52] Older age was also associated with higher vaccination acceptance in both public and HCPs.[53–55] The reasons for higher COVID-19 vaccination acceptance among older HCPs can also be explained by the risk-benefit analysis, since older individuals are at higher risk of severe COVID-19 infection, hence susceptible to health-related problems.[56,57]

The continuing education of HCPs is a positive interference in vaccination acceptance. Recent evidence suggests that educational interventions and information about general biology and virology principles, information about COVID-19 vaccines, and vaccine hesitance increase HCPs' intention to receive the COVID-19 vaccine.[58] However, our previous study identified a gap in vaccination-related education of nurses and midwives in Cyprus, with the majority (83%) stating a lack of attendance to vaccination-related seminars, conferences, or other training programmes the last 2 years.[41] This is an important issue that needs attention since nurses' inadequate vaccination training has been associated in the past with lower vaccination coverage of children.[38] Also, our findings are further supported by the findings of a recent study conducted in Cyprus examining the same population with regards to their attitudes and beliefs toward vaccination. Nurses and midwives with positive attitude toward vaccination (promoting vaccination, the belief that nurses and midwives should be vaccinated against COVID-19, etc.) were likely to accept the COVID-19 vaccination for themselves.[59]

Several psychological models have been introduced to explain vaccine hesitancy. Among them, the health belief model,[60,61] the theory of planned behavior[62–64] and the protection motivation theory of health.[65,66] In each model, different factors are important such as individuals' susceptibility, health beliefs, and disease severity. Experts predict that vaccination-related safety and efficacy concerns and vaccines' usefulness worries can potentially influence vaccination uptake.[67–69] Therefore, understanding the populations' psychology toward COVID-19 vaccination using those models, can help public health policy makers to focus on specific interventions. For example, announcements focused on disease susceptibility may be less effective compared to announcements with focus on vaccination efficacy. Along with the physiological models, there are useful tools to measure factors that influence vaccination acceptance.[70,71] However, those have not been used to assess nurses' and midwives' COVID-19 vaccination acceptance in Cyprus. A further study with a focus on psychological factors is therefore suggested.

Except for physiological factors, other factors can influence vaccination acceptance. Health literacy is an important determinant of vaccination acceptance,[72] however, individuals' attitudes and beliefs toward vaccination can also interfere with their vaccination decision. Of note, compared with the public, HCPs are expected to have acquired evidence-based information on vaccines. We recognize the influence of

different factors in COVID-19 vaccination acceptance that were not evaluated in our study, although the outcome of the present study combined with the gap in nurses' and midwives' vaccination-related education should be acknowledged. In addition, previous studies support a link between inadequate vaccination knowledge and negative attitudes toward vaccination.[73,74]

Understanding HCPs' vaccine hesitancy has substantial implications on public health officials during epidemics. The findings of our study can aid to formulate pertinent policies aiming at increasing vaccination coverage and may also provide guidance for future public health emergencies. Furthermore, the current study's findings can guide the design of educational programs focusing on vaccination-related information. Since nurses and midwives represent the HCPs group with the closest contact with patients, they play a key role in patient education and health promotion. Multidisciplinary educational interventions have been used in the past to improve vaccination knowledge and acceptance with success.[75] Public health policymakers should act immediately to improve the extremely low COVID-19 vaccination acceptance among nurses and midwives in Cyprus.[32,41] The reasons for COVID-19 vaccination refusal are already established and consist of concerns about vaccine development and safety, fear of side effects, and lack of vaccine-specific information.[32,41] Since nurses' and midwives' perspectives on COVID-19 vaccination are recognized, government authorities should design future education interventions based on them, addressing the COVID-19 vaccination safety and development concerns, and provide further information regarding the novel vaccinology advances.[76] The government of Cyprus should also consider the development of a COVID-19 vaccination program, focusing on younger nurses and midwives, as this group expressed a lower intention to accept this vaccine according to our findings. Future research is also needed to evaluate the effectiveness of these promotion strategies as well as to explore potential future strategies in consciousness raising and attitude changing toward vaccination.

Limitations

There are some limitations to the present study. Despite the promising associations between vaccination knowledge and COVID-19 vaccination acceptance among nurses and midwives in Cyprus, these cannot be extrapolated for other professions or vaccinations. Another limitation of our study's design is the participants' recruitment method and data collection characterized by an online sampling approach which may be unrepresentative of the whole nurse population. The influence of psychological factors in COVID-19 vaccination acceptance was not measured in the present study. Also, this was a cross-sectional study and thus, causal inferences cannot be made. Also, it was not possible to calculate the response rate for our online survey since there is no way to ascertain how many individuals might have seen the survey or its links but declined to participate. Lastly, information bias and misreporting of self-report data is an additional limitation that can influence the association.

Conclusions

In conclusion, to our knowledge, this is the first study examining the link between general vaccination knowledge and COVID-19 vaccination behavior among nurses and midwives in Cyprus. The vaccination knowledge was assessed using general vaccination-related questions (such as the causative agent of flu, the usage of vaccines as preventing measurement, etc.) aiming to reflect the overall vaccination knowledge of nurses and midwives. This study found that the intention of accepting the COVID-19 vaccination is associated with general vaccination knowledge. Moreover, those in older age groups, with more years of experience and male nurses and midwives are more prone to accept the COVID-19 vaccination. Targeted vaccination campaigns and health promotion interventions are needed to improve nurses' and midwives' level of vaccination knowledge to achieve a better coverage among them as well as to influence their patients' ultimate positive vaccine decision.

Contribution to authorship

GF: Conceptualization, Investigation, Methodology, Writing-original draft. **MK**: Investigation, Formal analysis, Methodology, Visualization, Writing - original draft. **SI**: Writing-original draft **GT**: Conceptualization, Investigation, Methodology. **KG**: Conceptualization, Investigation, Formal analysis, Methodology, Project administration, Supervision, Writing - original draft. All the authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation. All authors read and approved the final manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethical approval

This study was conducted according to the Declaration of Helsinki guidelines, and all procedures involving research study participants were approved by the Cyprus National Bioethics Committee (CNBC) (ΕΕΒΚ ΕΠ 2020.01.255). Participation was anonymous, and all the participants were informed about the study aim and objectives before participating.

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