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ORIGINAL PAPER

COVID-19 vaccination among nurses: the role of personal and professional beliefs according to the Health Belief Model

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Abstract

Aim: To explore the factors influencing COVID-19 vaccination uptake among nurses in Greece using the Health Belief Model (HBM). *Design:* A cross-sectional study. *Methods:* Data were collected using a structured questionnaire assessing demographic characteristics, professional responsibilities, and the HBM dimensions. A total of 450 nurses from general hospitals, pediatric hospitals, and nursing homes were considered eligible for the study. *Results:* Higher educational attainment ($p = 0.03$), positions of responsibility ($p = 0.03$), and belief in vaccine effectiveness ($p < 0.001$) were positively associated with vaccination. Older nurses ($p < 0.001$) and those with more years of service ($p < 0.001$) were more likely to be vaccinated. Nurses who had personal or professional exposure to severe COVID-19 cases were significantly more inclined to be vaccinated ($p < 0.001$). Regular influenza vaccination also correlated with COVID-19 vaccine uptake ($p < 0.001$). Barriers such as fear of side effects and distrust in vaccine safety were prevalent among nursing home staff, particularly those with lower educational levels. Conversely, general hospital nurses exhibited higher confidence in vaccine safety and efficacy, likely influenced by access to reliable information and direct exposure to COVID-19 cases. *Conclusion:* Findings underscore the importance of tailored interventions to address vaccine hesitancy, underlining education, trust-building, and the role of workplace policies.

Keywords: COVID-19, Health Belief Model (HBM), nurses, vaccine hesitancy.

Introduction

Vaccination has proved one of the most effective public health interventions in history, significantly reducing mortality and morbidity associated with infectious diseases, including measles, polio, and smallpox. Its widespread implementation has markedly improved global life expectancy and quality of life (Shattock et al., 2024; World Health Organization [WHO] & United Nations Children's Fund [UNICEF], 2024; Zhou et al., 2024). National immunization programs, tailored to specific population needs, have been pivotal in controlling outbreaks such as seasonal influenza. By 2021, over 200 vaccine candidates were under development, with more than 60 in clinical trials and several receiving emergency or full authorization for use (WHO, 2023). Worldwide vaccination strategies prioritize health professionals (HPs), the elderly, and individuals with comorbidities. Despite breakthroughs, including the COVID-19 mRNA vaccines, vaccine hesitancy remains a critical barrier. Misinformation and conspiracy theories had undermined public trust even before COVID-19 (Islam et al., 2021). During the pandemic, concerns over rapid development and potential side effects exacerbated hesitancy (French et al., 2020). Social media played a significant role in amplifying these fears (Klimiuk et al., 2021). For example, in Cyprus, only 32% of nurses intended to accept the COVID-19 vaccine, while the majority (around 70%) expressed hesitancy or refusal, primarily due to concerns about the rapid development of the vaccine and potential side effects (Giannakou et al., 2021). Whereas in Italy, 64.5% of nurses expressed willingness to be vaccinated, influenced by trust in authorities

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and personal risk perception (Di Gennaro et al., 2021). Globally, factors like exposure to COVID-19 patients and previous vaccination history positively correlated with vaccine acceptance (Sethi et al., 2021; Shah et al., 2021). Barriers included concerns about side effects and distrust in vaccines (Papagiannis et al., 2020).

Several theories and models have been used as theoretical bases to examine constructs on COVID-19 vaccine uptake, with the Health Belief Model (HBM) being one of the most widely used models to interpret COVID-19 vaccination behavior (Limbu et al., 2022). The Health Belief Model (HBM) is widely used to explain health behaviors, linking decisions to beliefs about susceptibility, severity, benefits, barriers, and self-efficacy (Rosenstock et al., 1988). Studies using the HBM during the COVID-19 pandemic identified factors influencing vaccine uptake, such as perceived vulnerability, trust in vaccine safety, societal benefits, and previous vaccination history (Ruiz & Bell, 2021). Conversely, fears of side effects and mistrust in pharmaceutical companies reduced uptake (Wu & Chiang, 2023). Recent studies using the HBM have identified multiple factors influencing vaccine uptake among HPs during the COVID-19 pandemic. In Singapore, HPs' perceptions of vaccine effectiveness correlated with intentions to get vaccinated (Wong et al., 2020). These findings support the Health Belief Model premise that individuals' perceptions of benefits and susceptibility influence their health-related behaviors (Shattock et al., 2024; Wu & Chiang, 2023). Nurses' views on COVID-19 vaccination are vital for understanding public perceptions and preparing for future crises. The need to balance personal beliefs, institutional policies, and responsibilities for patient education underscores the complexity of nurses' roles in vaccine decision-making (Galanis et al., 2022). Understanding the factors influencing their vaccine decisions can guide interventions to address hesitancy, ensuring preparedness for future outbreaks.

Aim

The aim of the study was to explore the contributing factors to COVID-19 vaccination uptake among nurses through the context of the HBM.

Methods

Design

A cross-sectional study.

Sample

The target population was a convenience sample of nurses in two public hospitals (one general and one pediatric hospital) located in the Athens metropolitan area in Greece and designated as reference centers during the pandemic, and one nursing home. The inclusion criteria were permanent employment status and at least one year of work experience. A total of 450 nurses were recruited through voluntary participation using a convenience sampling approach, yielding a response rate of 84%. Although no formal power analysis was conducted, the sample size was sufficient for the planned statistical analyses.

Data collection

The study was conducted between February 2022 and April 2022. Nurses were informed about the purpose of the study from posters displayed outside hospital departments and nursing homes. Interested participants contacted the first author and received further explanation about the study's aim. The completion time was approximately 15–20 min. A secure collection box was placed in each health facility to collect the questionnaires.

Measures

Demographic characteristics

Demographic data included participants' gender, age, marital status, years of experience, working department, level of education and managerial position.

Intention for vaccination uptake based on the Health Belief Model

A questionnaire based on the Health Belief Model (HBM) was constructed, comprising six subscales. These included: susceptibility (3 items), exploring beliefs about the likelihood of contracting COVID-19 and the probability of severe illness; perceived severity (3 items), assessing the seriousness of COVID-19, its consequences, and associated fears; perceived benefits (2 items), evaluating perceptions of vaccination effectiveness in disease prevention, protection of others, and its social value; perceived barriers / costs (2 items), addressing concerns about vaccine safety, side effects, biotechnology use, vaccine preferences, and vaccine origin; cues to action (5 items), investigating vaccination intentions and the influence of social factors; and self-efficacy (2 items), exploring confidence in the vaccination process and perceptions of one's role as a frontline healthcare professional during the pandemic (Rosenstock et al., 1988). All items were rated on a 5-point Likert scale (1 = "strongly agree" to 5 = "strongly disagree"). Cronbach's alpha coefficients for the six subscales ranged from 0.82 to 0.86, demonstrating good to excellent internal consistency.

Other predictors of vaccination uptake

Participants reported on personal and family experiences with COVID-19, attitudes toward vaccines in general, and perceptions of information dissemination and procedural transparency.

In Greece, in the period when the study was conducted (February–April 2022), COVID-19 vaccination was mandatory for all healthcare professionals based on national public health policy (Ministerial Decision Δ1α/Γ.Π.οικ. 50933/2021). Healthcare personnel were not permitted to return to work without having received at least two doses of a COVID-19 vaccine. Consequently, all participants in the study had already completed the basic vaccination schedule. In this context, vaccination status was assessed through a self-reported, closed-ended question: "*Have you been vaccinated against COVID-19?*" (Yes / No). Although no cross-verification with official vaccination records was conducted, the strict enforcement of the mandatory vaccination policy ensured a high level of accuracy and consistency in participants' self-reports.

Data analysis

The IBM SPSS 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY, USA: IBM Corp.) was used for the analysis. Categorical variables were presented as numbers and percentages. while continuous variables were described using the mean and standard deviation. Spearman's rho was examined to determine the strength and direction of associations between the variables. The chi-square test was employed to compare categorical variables, with p-values less than 0.05 considered statistically significant.

Results

Sample characteristics

The majority of nurses in the survey were women (80%), with a mean age of 43 (± 10.5) years, were married (60%), had children (58.5 %) and held tertiary education qualifications (70%). Their means work experience was 16.3 (± 9.6) years. Demographic and professional characteristics are shown in Table 1.

Table 1 Demographic and professional characteristics of participants

Characteristics of Total of Participants			**General Hospital**		**Children's Hospital**		**Nursing Home**	
Gender	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
male	73	(16.2)	24	76.3	40	11.4	10	18
female	377	(83.8)	76	23.7	260	74.3	40	78
total	450		100		300		50	
Age	43.3[a]	10.5[b]	40.6 [a]	9.6[b]	43.5[a]	10.7[b]	48.2[a]	9.8[b]
Education level								
secondary	140	31.1	24	24	82	27.3	37	74
tertiary	241	53.6	61	61	167	55.7	11	22
MSc / PhD	69	15.3	15	15	51	17	2	4
Marital status								
married	246	54.6	48	48	173	57.7	30	60
unmarried	162	36	45	45	103	34.3	11	22
single	32	7.1	7	7	20	6.7	8	16
widow / widower	3	0.6	-	-	1	0.3	1	2
live with a partner	7	1.5	-	-	3	1	-	-
Children								
no	187	41.5	54	54	119	39.7	12	24
yes	263	58.5	46	46	181	60.3	38	76
Department								
specialized units (intensive care unit, COVID clinic)	220	49	55	55	123	41	-	-
medical departments	91	20.2	33	33	92	30.6	-	-
surgical departments	89	19.7	12	12	95	31.6	-	-
elderly care	50	11.1	-	-	-	-	50	100
Years of experience								
	16.3[a]	11.8[b]	13.6[a]	9.6[b]	17.6[a]	12.6[b]	14.3[a]	9.6[b]
Supervisor / manager								
no	360	80	78	78	244	81.3	38	76
yes	60	20	22	22	56	18.6	12	24

[a] – *mean;* [b] – *standard deviation*

Mean scores for the HBM dimensions related to nurses' intention to get vaccinated were above the midpoint (= 3) among general hospital nurses, indicating a positive intention. Similarly, nurses in pediatric hospitals scored above the midpoint (= 3) on all dimensions except for "Perceived Barriers." Nurses working in nursing homes reported the highest scores on the "Perceived Severity" dimension (4.09) and "External Cues" (see Table 2).

Table 2 Mean scores for HBM dimensions

Dimensions (HBM)	Children's Hospital (N = 300)	Nursing Home (N = 50)	General Hospital (N = 100)	Total (N = 450)
	M Score	M Score	M Score	M Score
Perceived Susceptibility	3.08	2.72	3.23	3.07
Perceived Seriousness	3.91	4.09	4.03	3.95
Perceived Benefits	4.04	4.17	4.18	4.08
Perceived Barriers	2.92	2.94	3.14	2.97
Cues to Action	3.78	3.86	3.85	3.81

HBM – Health Belief Model

Bivariate analysis between independent variables and related perceptions with COVID-19 vaccination

Higher educational level ($p = 0.03$), position of responsibility ($p = 0.03$), perception that the vaccine protects against infection ($p < 0.001$) and older nurses ($p < 0.001$) were statistically significantly associated with vaccination. In terms of the relationship between those who were vaccinated against COVID-19 and those who were not vaccinated, there was no statistically significant association between those vaccinated versus those not vaccinated. However, nurses who had contact with patients or belonged to a frontline group were more likely to be vaccinated ($p = 0.048$) (Perceived Susceptibility). Nurses who considered COVID-19 a serious health problem were vaccinated ($p < 0.001$). Meanwhile, those who had had contact with serious COVID-19 cases (family / friends) were more likely to be vaccinated ($p < 0.001$) (Perceived Seriousness). Vaccinated nurses also believed that vaccination effectively protected them against transmission and serious disease ($p < 0.001$) and believed in the social benefits of vaccination ($p < 0.001$) (Perceived Benefits). Contraindications (e.g., allergies or other concerns) significantly reduced the likelihood of vaccination ($p < 0.001$). However, general barriers, such as fear of side effects, were not statistically significantly correlated (Perceived Barriers). Social factors – such as whether others were vaccinated ($p < 0.001$) – and working in COVID-19 units or having contact with vulnerable groups ($p = 0.048$) significantly influenced nurses' decisions to receive the COVID-19 (Cues to Action) (Table 3).

Table 3 Factors Influencing Perceptions, Beliefs, and Behaviors Toward COVID-19 Vaccination (Part 1)

Questions	Perceived benefits to society from COVID-19 vaccination	Perceived barriers to COVID-19 vaccination	Views and beliefs about vaccination of other persons	Perceptions and beliefs about vaccination in general
Have you been vaccinated against COVID-19? (Yes / No)	10557.50*	-10.998ɪ	13585.0*	13555.50*
	-8.721**	0.60Ɨ	-6.043**	-6.173**
	p < 0.001	p < 0.001	p < 0.001	p < 0.001
Perceived Seriousness				
Do you think your vaccine protects you from the virus and from COVID-19? (Yes / No / Don't Know)	85.328‡	51.50ð	51.698‡	49.076‡
	p < 0.001	0.19ff	p < 0.001	p < 0.001
		p < 0.001		
Has anyone in your family, a family member, a dear friend or someone you are close to been seriously ill or hospitalized with COVID-19? (Yes / No)	15822.50*	1.173ɪ	15204.50*	14809.50*
	-0.017**	p = NS	-0.588**	-0.970**
	p = NS		p = NS	p = NS
Has anyone you know died from COVID-19? this question includes everyone you know, distantly and closely. (Yes / No)	21115.50*	-2.047ɪ	22003.50*	23649.0*
	-2.186**	0.68Ɨ	-1.455**	-0.220**
	p = 0.025	p = 0.041	p = NS	p = NS
Has anyone you know been seriously ill or hospitalized with COVID-19? This question includes everyone you know, distantly and closely. (Yes / No)	20349.50*	-2.407ɪ	21513.0*	23706.50*
	-2.745**	0.67Ɨ	-1.789**	-0.139**
	p = 0.006	p = 0.017	p = NS	p = NS
Perceived Barriers				
Has anyone you know been seriously ill or hospitalized with COVID-19? This question includes everyone you know, distantly and closely. (Yes / No)	8939.0*	14.018ɪ	12671.50*	12101.50*
	-9.842**	0.58Ɨ	-6.540**	-7.123**
	p < 0.001	p < 0.001	p < 0.001	p < 0.001
Has anyone you know been seriously ill or hospitalized with COVID-19? This question includes everyone you know, distantly and closely. (Yes / No)	10.682‡	159.22ð	5.321‡	2.641‡
	p = 0.004	0.26ff	p = NS	p = NS
		p < 0.001		
Has anyone you know been seriously ill or hospitalized with COVID-19? This question includes everyone you know, distantly and closely. (Yes / No)	8500.50*	7.732ɪ	9820.50*	9736.0*
	-6.035**	0.64Ɨ	-4.587**	-4.750**
	p < 0.001	p < 0.001	p < 0.001	p < 0.001
Has anyone you know been seriously ill or hospitalized with COVID-19? This question includes everyone you know, distantly and closely. (Yes / No)	1.459‡	0.745ð	2.514‡	0.006‡
	p = NS	p = NS	p = NS	p = NS

*NS – not significant; * – Mann–Whitney U test statistic; ** – Standardized test statistic (z-score); ɪ – regression coefficient (β); Ɨ – standard error of regression coefficient; ‡ – Chi-square test statistic; ð – Wald chi-square statistic; ff – standard error of Wald statistic; p – probability value*

Table 3 Factors Influencing Perceptions, Beliefs, and Behaviors Toward COVID-19 Vaccination (Part 2)

Questions	Perceived benefits to society from COVID-19 vaccination	Perceived barriers to COVID-19 vaccination	Views and beliefs about vaccination of other persons	Perceptions and beliefs about vaccination in general
Cues to Action				
When you first heard that the time to get vaccinated was approaching, what was your first thought? (No, I won't get vaccinated / Yes, I will get vaccinated / I haven't decided)	99.203‡ p < 0.001	72.073δ 0.25ff p < 0.001	54.980‡ p < 0.001	53.521‡ p < 0.001
Have you been in contact with people who have COVID-19? (Yes / No)	24517.0* -0.408** p = NS	0.101ɪ p = NS	24667.0* -0.286** p = NS	24940.0* -0.087** p = NS
Do you care for or treat patients with COVID-19? Does this mean daily contact in the context of your duties (ED, emergency room, COVID-19 clinic, emergency room, etc.)? (Yes / No)	21115.50* -1.104** p = NS	-2.530ɪ 0.67Ⅎ p = 0.012	19348.50* -2.444** p = 0.014	21591.50* -0.715** p = NS
Is there someone in your immediate environment who belongs to so-called vulnerable groups (due to age or illness)? (Yes / No)	16518.0* -2.537** p = 0.010	-1.354ɪ p = NS	18534.0* -0.781** p = NS	18695.50* -0.658** p = NS
Do you consider yourself a health professional fighting on the front line against the COVID-19 pandemic? (Yes / No)	20129.0* -3.255** p = 0.001	-3.789ɪ 0.67Ⅎ p < 0.001	19346.0* -3.745** p < 0.001	21361.0* -2.281** p = 0.022
Perceived Susceptibility				
Have you yourself become ill with UTI symptoms with COVID-19 or have you ever tested positive for coronavirus but remained asymptomatic? (Yes / No)	5745.50* -2.091** p = 0.038	1.870ɪ p = NS	6315.0* -1.250** p = NS	6142.0* -1.513** p = NS
Have you been seriously ill or hospitalized with COVID-19? (Yes / No)	729.50* -2.485** p = 0.010	1.980ɪ 0.68Ⅎ p = 0.048	978.50* -1.675** p = NS	1112.0* -1.301** p = NS
Has a family member, dear friend, or someone you are close to been ill with COVID-19? (Yes / No)	12382.50* -2.044** p = 0.039	1.290ɪ p = NS	11384.0* -2.953** p = 0.004	12207.50* -2.192** p = 0.030
Has a family member, dear friend or someone you have close contact with died from COVID-19? (Yes / No)	6666.50* -0.262** p = NS	0.207ɪ p = NS	6808.50* -0.055** p = NS	6192.0* -0.939** p = NS
Perceived Benefits				
Do you give or have you given the necessary vaccinations to your children according to your pediatrician's instructions? (This question does not apply to me / Yes / No)	1.114‡ p = NS	2.216δ p = NS	2.997‡ p = NS	5.996‡ p = 0.046
Do you generally (most years) get the flu vaccine? (Yes / No)	16430.0* -6.073** p < 0.001	-4.873ɪ 0.66Ⅎ p < 0.001	17820.0* -4.859** p < 0.001	17458.50* -5.219** p < 0.001

*NS – not significant; * – Mann–Whitney U test statistic; ** – Standardized test statistic (z-score); ɪ – regression coefficient (β); Ⅎ – standard error of regression coefficient; ‡ – Chi-square test statistic; δ – Wald chi-square statistic; ff – standard error of Wald statistic; p – probability value*

Discussion

This study highlighted the factors that influenced the acceptance of the COVID-19 vaccine by nurses in Greece, focusing on how their perceptions, as described in the Health Belief Model (HBM), shaped their attitudes towards vaccination.

One of the key factors affecting vaccination acceptance was the educational level of nurses. Nurses with higher education levels (e.g., master's or doctoral degrees) were significantly more likely to accept vaccination. This is likely due to enhanced scientific knowledge and critical assessment of information, as well as increased trust in scientific bodies. The study's findings align with those of Galanis et al. (2022), who suggested that healthcare professionals with higher education levels have greater confidence in the safety and efficacy of vaccines, while Karlsson et al. (2019) showed that healthcare professionals in Finland with higher education were more likely to recommend vaccination.

Nurses in leadership positions, who had greater experience and education, demonstrated higher vaccination rates, attributed perhaps to the heightened sense of responsibility and the need to serve as role models for their colleagues. Ngo et al. (2022) emphasized the importance of leadership in promoting health practices, as nurses in leadership positions have the ability to positively influence the workforce through their example. Furthermore, the increased education and experience often associated with individuals in leadership roles correlates with greater awareness of the importance of vaccination.

A strong correlation was also observed between belief in the protective effectiveness of vaccines and higher vaccination rates. Miles et al. (2024) confirmed that healthcare professionals who trust the effectiveness of vaccines are more likely to participate in preventive programs, while Peterson et al. (2022) highlighted the need to address doubts about vaccine efficacy to reduce hesitancy. In the context of this study, nurses who believed vaccines were effective were more willing to protect themselves and their patients, demonstrating the importance of trust in science as a key motivating factor.

Additionally, recent qualitative evidence has emphasized that emotional factors, such as fear of unknown long-term effects and influence from colleagues' personal vaccination experiences, significantly shape attitudes toward COVID-19 vaccines. For instance, Wu and Chiang (2023) found that both positive and negative word-of-mouth within healthcare teams moderated intention to vaccinate, highlighting the relevance of interpersonal and contextual elements in shaping behavior.

The analysis of different nursing environments (pediatric hospital, general hospitals, and nursing home) revealed significant differences in perceptions and attitudes toward vaccination. These interdepartmental differences clearly reflect the key constructs of the Health Belief Model. Pediatric nurses reported high levels of perceived severity and susceptibility, with relatively low perceived barriers, which likely contributed to their high vaccine acceptance. In contrast, nursing home staff reported similarly high perceived susceptibility but also significant perceived barriers – such as concerns about side effects and distrust in vaccine safety – that may have outweighed the perceived benefits. General hospital nurses, who faced direct and frequent contact with COVID-19 cases, experienced strong cues to action and demonstrated higher self-efficacy in vaccination decisions.

Nurses in the pediatric hospital had higher levels of perceived vulnerability and severity of the disease, linked to their increased responsibility for protecting children, a particularly vulnerable group. This finding agrees with the study by Olusanya et al. (2021), which suggests that pediatric nurses have a positive attitude toward vaccines due to their daily contact with children. In contrast, nurses in nursing homes showed higher levels of perceived severity and vulnerability but also faced greater barriers, particularly concerning vaccine side effects. Additionally, the analysis revealed that nurses in nursing homes were older and had more experience, which may increase their sense of belonging to vulnerable groups. Distrust in vaccine safety may also be attributed to lower education levels, as this affects their understanding of scientific information about vaccines, limits access to scientific sources, and reduces the ability to manage doubts and hesitations. This increases vulnerability to misinformation and the influence of negative views about vaccination. To address vaccine hesitancy among nurses with lower education levels, it is essential to implement communication strategies that are culturally appropriate, accessible, and free from medical jargon. Visual tools, peer-led discussions, and storytelling approaches may help clarify vaccine-related risks and benefits. Furthermore, engaging trusted staff members as vaccination champions and creating safe spaces for dialogue can shift the perceived meaning of vaccination from a medical obligation to a personal and professional protective measure. As suggested by French et al. (2020), pre-emptive strategies based on behavioral science should be tailored to specific

populations and focus on simplifying messages, fostering trust, and using credible messengers.

According to a study by Olusanya et al. (2021), nurses in nursing homes with lower education levels and greater age were more likely to show vaccine hesitancy, primarily due to concerns about side effects and limited access to reliable scientific information. The older age of nurses in nursing homes may influence their attitude for various reasons, such as a heightened concern about potential vaccine side effects, especially if they have pre-existing health conditions that they perceive as increasing the risk of adverse reactions, hesitancy to adopt new practices or interventions – particularly when accompanied by fears or misinformation – and a perception of themselves as a vulnerable group, which increased the perceived severity of COVID-19.

In general hospitals, nurses were mostly younger and reported lower perceived personal vulnerability to severe COVID-19 outcomes, likely due to their age and overall health status. However, this sense of invulnerability did not correspond to reduced trust in vaccines. On the contrary, younger nurses expressed greater confidence in the safety and efficacy of COVID-19 vaccines. This apparent paradox may be explained by their typically higher educational attainment, more frequent engagement with digital information sources, and routine exposure to institutional guidelines and scientific communication. Additionally, their direct involvement in the care of COVID-19 patients and participation in frontline response strategies may have reinforced their understanding of the vaccine's role in disease prevention, not only for personal protection but also as a professional and ethical obligation to safeguard patients and colleagues. Greater access to scientific information and higher education levels in these environments also contribute to the positive attitudes of nurses. Furthermore, the daily management of severe COVID-19 cases and the handling of high mortality rates likely reinforced their perception of the seriousness of the disease, making them more familiar with the real threat of the virus, reducing doubts or insecurities about the safety and efficacy of vaccines. This experience acts as a strong motivator for vaccination acceptance, as nurses recognize the immediate need to protect both themselves and their patients. The findings align with the study by Getachew et al. (2022), which found that nurses with higher education levels and access to reliable information were more likely to accept vaccination, and that nurses who perceived the disease as more severe were more likely to accept vaccination.

These findings underline the importance of designing targeted interventions at the departmental level. Educational initiatives should address the specific informational gaps and psychological barriers of each nursing population. For example, interventions in nursing homes could focus on addressing safety concerns and improving access to reliable information. In general hospitals, reinforcing peer role modeling and trust in science can further consolidate vaccine acceptance. Tailoring public health strategies based on department-specific perceptions may significantly enhance overall vaccination rates among nurses.

Limitation of study

The study's limitations should be considered, including the fact that data were collected at a single point in time, restricting the ability to establish causal relationships between the factors examined and vaccination behavior. Longitudinal studies would offer a better understanding of changes in attitudes and behaviors over time. While the study focused on nurses from two major hospitals and a nursing home in Athens, the findings may not be generalizable to all healthcare workers in Greece or other countries. While the HBM was used, other psychological frameworks, such as the Theory of Planned Behavior or Social Cognitive Theory, could provide additional insights into decision-making processes. Expanding the scope to include diverse populations, longitudinal approaches, and in-depth exploration of barriers and motivations would strengthen the evidence base and enhance tailored interventions. Finally, although vaccination status was self-reported, the legal requirement for healthcare workers to be fully vaccinated in Greece at the time minimized the risk of misreporting. Nevertheless, no verification of the number of doses, vaccine type, or booster status was performed, which limits the granularity of the vaccination data.

Conclusion

This study examined the factors influencing nurses' decisions to receive the initial COVID-19 vaccination series, using the Health Belief Model (HBM) as a theoretical framework. Nurses with higher education levels, leadership roles, or direct exposure to severe COVID-19 cases were more likely to be vaccinated, reflecting greater awareness, a sense of professional responsibility, and trust in scientific information. Conversely, concerns about side effects and misinformation were key barriers to vaccine acceptance. While the study offers insights into the psychological and organizational factors that shaped initial vaccination uptake during

the pandemic, it did not assess booster dose coverage or specific vaccine types. These omissions limit the broader interpretation of vaccination behavior. Future studies should include more detailed immunization data to better capture the evolving nature of vaccine acceptance. Nonetheless, the findings suggest that clear, evidence-based communication and targeted educational strategies, especially among frontline staff and leadership, are critical to improving vaccination engagement and preparedness for future public health crises.

Ethical aspects and conflict of interest

Permission was obtained from the scientific and ethical committees of the hospitals involved (approval number 684/15-02-2022). The study was conducted in accordance with the declaration of Helsinki. The authors report no conflict of interest.

Participants were informed of the study's purpose and goals. They were informed about the nature and aim of the study and that their participation was voluntary and anonymous. Those who agreed to participate were asked to sign a consent form. Description of how confidentiality and anonymity would be protected was provided by a cover letter accompanying the questionnaire.

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Author contributions

Conception and design (VG, GM), manuscript draft (GM, VG), critical review of the manuscript for important intellectual content (GM, VG, PV, AS, AT, ML, IK, DK), supervision (VG, GM), acquisition, analysis, or interpretation of data (ML, PV, AT).

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