Palestinian Medical and Pharmaceutical Journal (PMPJ). 2023; 8(3): 367-378

COVID-19 vaccination coverage among female healthcare workers: a look at the gender gap

Beesan Maraqa [1,2,†]; Zaher Nazzal[3, †,] & Qais Abu Hasan[3]*

[1] Primary Health Directorate, Ministry of Health, Ramallah, Palestine. [2] Department of Family and Community Medicine, Faculty of Medicine, Hebron University, Hebron, Palestine.
[3] Department of Medicine, Faculty of Medicine and Health Sciences, An-Najah National University, Nablus, Palestine.

†Contributed equally to this manuscript

*Corresponding author: znazzal@najah.edu

Received: (16/12/2022), Accepted: (8/2/2023)

ABSTRACT

The COVID-19 vaccine coverage has been shown to differ by gender, with females being more hesitant to vaccinate, even among healthcare workers. This study aimed to assess female healthcare workers' COVID-19 vaccination coverage and anti-vaccination attitudes. We conducted a cross-sectional study using an online questionnaire. We included healthcare workers from various professions and examined their sociodemographic characteristics and anti-vaccination attitudes using the Vaccination Attitudes Examination Scale and COVID-19 vaccination coverage. In addition, we assessed factors associated with coverage using multivariable analysis. Female healthcare workers had significantly lower vaccine coverage [59.6% (95%CI: 55.5%-63.7%)] than males [74.9% (95%CI: 70.7-78.8%)]. In addition, they have significantly higher anti-vaccination attitudes and lower perceived vaccine knowledge. Vaccine coverage is age-related in female healthcare workers, with 52.7% in the less than 30-year age group and 70.7% in the ≥50-year age group. The age group 40-49 and middle-income category are positively associated with vaccination coverage among female healthcare workers. In contrast, living with a child, having a history of COVID-19 infection, mistrust of vaccine benefits, and worries about unforeseen effects are all associated with lower coverage. In conclusion, female healthcare workers have significantly lower vaccine coverage, especially for the younger age groups, associated with mistrust of vaccine benefits and worries about unforeseen effects. These findings highlight the importance of addressing vaccine hesitancy among female HCWs as part of efforts to improve COVID-19 vaccination; evidence-based communications tailored to their concerns are needed.

Keywords: Vaccination Coverage; COVID-19; Healthcare workers; Gender; Attitudes.

INTRODUCTION

COVID-19 has quickly escalated into a major public health catastrophe, affecting millions of people and resulting in millions of deaths worldwide. Apart from implementing social distancing measures, it is critical to establish high vaccination coverage to prevent disease and death [1]. The race to develop COVID-19 vaccines was recognized early on that it would only be enough to stop the pandemic if the public widely accepted it. COVID-19 vaccination hesitancy has been extensively studied, with significant variation in willingness to be vaccinated across communities [2]. Males, older adults, persons of different racial and cultural backgrounds, and college and/or graduate degree holders are more likely to accept the vaccine if it is advised for them [3].

Palestine, a country in the grip of a chronic humanitarian crisis, faced numerous challenges. The World Health Organization (WHO) assisted in the evaluation of humanitarian health needs and the planning of responses, including the acquisition of necessary vaccines. However, there were no specific guidelines for administering specific types of vaccines to a specific age group or gender in this context; any vaccine that was available and accessible was regarded as a good vaccine [4].

Healthcare workers (HCWs) on the front lines contribute to the nation's fight against COVID-19, so vaccine acceptance and coverage should be taken seriously. HCWs, who are most educated about COVID-19 morbidity and mortality, are expected to

accept the vaccine more than others. While it is recommended that all HCWs get vaccinated, gender differences in vaccine acceptance and coverage have been documented. A scoping review providing a comprehensive global assessment of published evidence on COVID-19 vaccine hesitancy among HCWs found that male HCWs were likelier to receive the vaccine [5–7]. In addition, males were three times more likely than females in Palestine to accept the COVID-19 vaccine [8].

This gender disparity could be due to a variety of factors. However, there have been numerous media debates about fertility concerns; data from clinical trials also addressed whether the COVID-19 vaccines harm fertility [9, 10], with sparse but reassuring results. Moreover, even though a new expert guidance report states that there is "absolutely no evidence" that the COVID-19 vaccine affects women's or men's fertility [11].

Despite numerous studies assessing vaccination intentions worldwide, only some studies have evaluated actual HCW vaccination uptake. Furthermore, our study may be the first to examine COVID-19 vaccination coverage by gender, focusing on female HCWs, to identify the factors that keep them from receiving the vaccine. The study's findings will assist policymakers, and healthcare administrators develop protocols, policies, and interventions to promote vaccination coverage among female HCWs at their workplaces. The study's objectives are to determine the proportion of female and male HCWs who received the COVID-19 vaccine, compare anti-vaccination attitudes between female and male HCWs, and identify factors associated with COVID-19 vaccine coverage among female HCWs.

METHODS

Study design and participants

We used an anonymous online questionnaire to conduct this cross-sectional study. We targeted HCWs of different professions; physicians, nurses, and allied healthcare personnel (laboratory technicians, radiographers, physiotherapists, occupational therapists, etc.) working in governmental and non-governmental hospitals and primary healthcare centers. A convenience sampling technique utilizing Google Forms was implemented to collect responses. Raosoft software computed sample size using a 95% confidence level, a 50% prevalence estimate, and a 3% margin error. The sample size of 1024 was calculated.

Measurement Tool and variables

An online Google Form based on a pre-designed questionnaire was created and sent to the HCWs' accounts via social media, email, or other online systems. The questionnaire was accompanied by a consent form and an invitation letter describing the purpose of the study. We encouraged recipients to share the link with their coworkers via their accounts. It started with a mandatory question about whether or not the HCW wanted to participate. The data were collected between April and June 2021.

The questionnaire consisted of three questions: sociodemographic and work-related characteristics. The variables were chosen in light of the available literature and investigator input. HCWs were asked about their age, gender, marital status, job title, employment, having a child, years of experience, smoking status, physical activity, and monthly income. The second part explored HCWs' anti-vaccination attitudes using the Vaccination Attitudes Examination (VAX) Scale adjusted to the COVID-19 vaccine. It has 12 items and is sub-categorized into four sub-scales: (1) mistrust of vaccine benefits, (2) worries over unforeseen future effects, (3) concerns about commercial profits, and (4) preference for natural immunity. It is a self-reported measure validated in HCWs and takes 5 to 7 minutes to administer. Each item's score ranges from 1 (strongly agree) to 5 (strongly disagree), except for sub-scale #1, which has a coding range of 1 (strongly disagree) to 5 (strongly agree). A higher overall score indicates that HCWs have more negative attitudes toward COVID-19 vaccination. Previous research [12] has shown a high level of internal consistency. The authors of this study translated the VAX scale into Arabic, and a native English speaker checked the back-translation. Cronbach's alpha was calculated

to determine the scale's internal consistency for this study, which was 0.83.

The third part assessed the study's primary outcome variable, COVID-19 vaccine coverage (vaccinated vs. unvaccinated). This part also inquired about other COVID-19 vaccine variables such as the type, the number of doses received, side effects, perceived COVID-19 knowledge, and vaccine knowledge. People in Palestine were offered vaccines from Pfizer, Moderna, Sputnik V, and AstraZeneca. The campaign began with an AstraZeneca vaccine, and vaccination availability was contingent on the shipment of COVAX [13]. Perceived COVID-19 knowledge was assessed using a direct question, "How do you evaluate your COVID-19 vaccine knowledge?" with responses ranging from poor to excellent.

The questionnaire validation (face and content validity) was carried out by a panel of experts, including one family physician, a community medicine consultant, and a public health consultant. Then, we conducted an online pilot study with 30 HCWs to assess their clarity, understanding, and feasibility. Participants in the pilot study were excluded from the larger sample.

Data analysis

The statistical analysis was performed using IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages. We assessed continuous variables for normality and presented them using mean ± standard (SD). Bivariate analyses and cross-tabulation were used to determine differences between groups, using the Chi-square test and the independent t-test, as appropriate. Multivariable analyses using binary regression were used to identify factors independently associated with vaccination coverage. Two models were utilized, one for female HCWs and the other for male HCWs, and their results were reported as an adjusted Odds Ratio (aOR) with a 95% confidence interval (95%CI). Results were considered statistically significant at a p-value ≤ 0.05.

The study obtained ethical approval from the Institutional Review Board of An-Najah University (Ref #: Med. March. 2021/23). Before beginning the online survey, all participants were informed about the study's purpose, and their participation was voluntary. Using a web-based survey method allowed respondents to remain anonymous; when returning the questionnaire, web-based tools protect information confidentiality and prevent other participants from accessing it.

RESULTS

Background characteristics

Table 1 presents the sociodemographic and clinical characteristics of the participants. 560 (55%) female and 458 (45%) male HCWs participated in this study. Almost 40% of female and male HCWs are under 30. Most female HCWs (34.5%) were nurses, while most male HCWs (56.3%) were physicians. Almost two-thirds of male and female HCWs are married, have children, and most work in the government sector. In comparison to the 343 (74.9%) male HCWs (95%CI: 70.7-78.8%), 334 (59.6%) female HCWs received the COVID-19 vaccine (95%CI: 55.5-63.7%). There are no official vaccination statistics for each age group in Palestine; however, our findings show that the majority received the Pfizer, Sputnik V, and Moderna vaccines, with the Pfizer vaccine being the most common among younger age groups (Table 1).

Table (1): Female and Male healthcare workers' sociodemographic and clinical characteristics.

	Female HCWs (n=560) **n(%)**	**Male HCWs** (n=458) **n(%)**
Age group		
< 30 years	220 (39.3)	175 (38.2)
30-39 years	209 (37.3)	128 (27.9)
40-49 years	90 (16.1)	112 (24.5)
≥ 50 years	41 (7.3)	43 (9.4)
Profession		

	Female HCWs (n=560) **n(%)**	**Male HCWs** (n=458) **n(%)**
Physicians	180 (32.1)	258 (56.3)
Nurses	193 (34.5)	99 (21.6)
Others†	187 (33.4)	101 (22.1)
Marital status		
Married	372 (66.4)	313 (68.3)
Single	188 (33.6)	145 (31.7)
Monthly income *(NIS)*		
<4000	319 (57.0)	225 (49.1)
4000- <6000	205 (36.6)	156 (34.1)
≥6000	36 (6.4)	77 (16.8)
Health care setting		
Governmental	409 (73.0)	336 (73.4)
Non- Governmental	151 (27.0)	122 (26.6)
Patients contact per day		
<30 patients	280 (50.0)	270 (58.9)
30-50 patients	153 (24.1)	91 (19.9)
≥50 patients	145 (25.9)	97 (21.2)
Smoking		
Non-smoker	470 (83.9)	256 (55.9)
Smoker	90 (16.1)	202 (44.1)
Physical activity		
No	245 (43.8)	179 (39.1)
Yes- irregular	286 (51.1)	243 (53.1)
Yes- regular	29 (5.2)	36 (7.8)
Chronic disease		
No	479 (85.5)	377 (82.9)
Yes	78 (13.9)	78 (17.1)
Living with a child		
No	199 (35.6)	151 (33.0)
Yes	361 (64.5)	307 (67.0)
Received COVID-19 vaccine		
No	226 (40.4)	115 (25.1%)
Yes	334 (59.6)	343 (74.9%)
Type of the received vaccine		
Pfizer	131/334 (39.2)	108/343 (31.5)
Sputnik V	93/334 (27.8)	124/343 (36.2)
AstraZeneca	45/334 (13.5)	45/343 (13.5)
Sinopharm	33/334 (9.9)	26/343 (7.6)
Moderna	32/334 (9.6)	39/343 (13.1)

†Others include *Lab technicians, radiology technicians, and occupational and physiotherapists*.

Attitudes and perceived knowledge of the COVID-19 vaccine

Overall, female HCWs have significantly higher anti-vaccination attitudes; their VAX anti-vaccination scores and three subscales (mistrust of vaccine benefits, worries about unforeseen future effects, and concerns about commercial profits) are significantly higher than male HCWs; p-value <.05 for all. Additionally, female HCWs rated their COVID-19 and vaccine knowledge significantly poorer than male HCWs (P-value <.001). History of COVID-19 was reported by 39.8% and 38.2% of female and male HCWs, with no significant difference (Table 2).

Table (2): HCWs' attitudes towards the COVID-19 vaccine and their perceived knowledge by gender.

	Female HCWs n(%)	**Male HCWs n(%)**	**P-value®**
***Perceived* COVID-19 Knowledge as poor**	78 (13.9)	32 (7.0)	<.001
***Perceived* vaccine knowledge as poor**	120 (21.4)	49 (10.7)	<.001
History of COVID-19	223 (39.8)	174 (38.0)	.551
COVID-19 vaccine attitude (*Mean ± SD)*			
Overall attitude (total score)	36.7± 6.8	35.2 ± 6.6	<.001
Mistrust of vaccine benefits	7.1 ± 2.4	6.3 ±2.2	<.001
Worries over unforeseen future effects	11.7± 1.9	11.4 ± 1.9	.035
Concerns about commercial profits	8.0 ± 2.5	7.5 2.6	.010
Preference for natural immunity	10.2 ± 2.4	9.9 ± 2.4	.201
®*Independent t-test and Chi-squared test*			

Bivariate results of factors associated with vaccine coverage

Bivariate analysis showed that vaccine coverage is associated with monthly income (p-value <.001 & .007), age group (p-value .027 & .029), and smoking status (p-value .050 & .020) in both sexes. In addition, in females only, living with a child is associated with lower vaccine coverage (p-value .003). While in males only, it is associated with profession (p-value .001) and health care settings (p-value .002) (Table 3). Further sub-analysis of age groups revealed that vaccine coverage is significantly lower among females in the age groups less than 30 years and 30-39 years, with p values <.05 for both, while it is nearly equal for the age groups 40-49 and ≥50 years, with P values >.05 for both.

Table (3): Vaccine uptake and participants' background and demographic characteristics by gender.

	Female HCWs (n=560)			**Male HCWs** (n=458)		
	***Vaccinated* n(%)**	***Unvaccinated* n(%)**	***P-value®***	***Vaccinated* n(%)**	***Unvaccinated* n(%)**	***P-value®***
Age group						
< 30 years	116 (52.7)	104 (47.3)		144 (82.3)	31 (17.7)	
30-39 years	128 (61.2)	81 (38.8)	.027	92 (71.9)	36 (28.1)	.029
40-49 years	61 (67.8)	29 (32.2)		79 (70.5)	33 (29.5)	
≥ 50 years	29 (70.7)	12 (29.3)		28 (65.1)	15 (34.9)	
Profession						
Physicians	112 (62.2)	68 (37.8)		211 (81.8)	47 (18.2)	
Nurses	117 (60.6)	76 (39.4)	.467	65 (65.7)	34 (34.3)	.001
Others†	105 (56.1)	82 (43.9)		67 (66.3)	34 (33.7)	
Marital status						
Married	216 (58.1)	156 (41.9)	.284	220 (70.3)	93 (29.7)	.001
Single	118 (62.8)	70 (37.2)		123 (84.8)	22 (15.2)	
Monthly income *(NIS)*						
<4000	161 (50.5)	158 (49.5)		154 (68.4)	71 (31.6)	
4000- <6000	146 (71.2)	59 (28.8)	<.001	125 (80.1)	31 (19.9)	.007
≥6000	27 (75.0)	9 (25.0)		343 (74.9)	115 (25.1)	

	Female HCWs (n=560)			**Male HCWs** (n=458)		
	Vaccinated **n(%)**	***Unvaccinated*** **n(%)**	***P-value*®**	***Vaccinated*** **n(%)**	***Unvaccinated*** **n(%)**	***P-value*®**
Health care setting						
Governmental	236 (57.7)	173 (42.3)	.123	239 (71.1)	97 (28.9)	.002
Non- Governmental	98 (64.9)	53 (35.1)		104 (85.2)	18 (14.8)	
Patients contact per day						
< 30 patients	170 (60.7)	110 (39.3)		198 (73.3)	72 (26.7)	
30-50 patients	78 (57.)	57 (42.2)	.846	74 (81.3)	17 (18.7)	.287
≥50 patients	86 (59.3%)	59 (70.7)		71 (73.2)	26 (26.8)	
Smoking						
Non-smoker	272 (57.9)	198 (42.1)	.050	181 (70.7)	75 (29.3)	.020
Smoker	62 (68.9)	28 (31.1)		162 (80.2)	40 (19.8)	
Physical activity						
No	147 (60.0)	98 (40.0)		131 (73.2)	48 (26.8)	
Yes- irregular	166 (58.0)	120 (42.0)	.070	190 (78.2)	53 (21.8)	.319
Yes- regular	21 (72.4)	8 (27.6)		22 (61.1)	14 (38.9)	
Chronic disease						
No	284 (59.3)	195 (70.7)	.707	286 (75.9)	91 (24.1)	.449
Yes	48 (61.5)	30 (38.5)		56 (71.8)	22 (28.2)	
Living with a child						
No	135 (67.8)	64 (32.2)	.003	119 (78.8)	32 (21.2)	.175
Yes	199 (55.1)	162 (44.9)		224 (73.0)	83 (27.0)	

®*Chi-squared test, †Lab technicians, radiology technicians, and occupational and physiotherapists*

In both sexes, negative vaccination status is associated with poor COVID-19 and vaccine knowledge, absent history of a COVID-19 infection, and higher anti-vaccination attitudes. Unvaccinated female and male HCWs scored significantly higher on mistrust of vaccine benefits, worries about unforeseen future effects, commercial profits, and preference for natural immunity (Table 4). Further sub-analysis of the preference for natural immunity by stratification by COVID-19 history revealed that the difference between infected and uninfected groups remained significant.

Table (4): Female and male HCWs' COVID-19 vaccine perceived knowledge and attitudes.

Variables	**Female HCWs** *(n=560)*			**Male HCWs** *(n=458)*		
	Vaccinated **n(%)**	***Unvaccinated*** **n(%)**	***P-value*®**	***Vaccinated*** **n(%)**	***Unvaccinated*** **n(%)**	***P-value*®**
Perceived **COVID-19 Knowledge as poor**	42 (12.6)	36 (15.9)	.261	21 (6.1)	11 (9.6)	.210
Perceived **vaccine Knowledge as poor**	53 (15.9)	67 (29.6)	<.001	28 (8.2)	21 (18.3)	.002
History of COVID-19	113 (50.7)	110 (32.9)	<.001	62 (53.9)	112 (32.7)	<.001
A relative died of COVID-19	57 (25.2)	78 (23.4)	.612	27 (23.5)	98 (28.6)	.289

Variables	**Female HCWs** *(n=560)*			**Male HCWs** *(n=458)*		
	Vaccinated **n(%)**	***Unvaccinated*** **n(%)**	***P-value*®**	***Vaccinated*** **n(%)**	***Unvaccinated*** **n(%)**	***P-value*®**
COVID-19 vaccine attitude (*Mean ± SD)*						
Antivaccination total score	34.6 ± 6.1	40.1 ± 6.5	<.001	33.6 ± 5.9	39.9 ± 86.4	<.001
Mistrust of vaccine benefits score	6.2 ±1.9	8.4 ± 2.6	<.001	5.7 ± 1.7	8.2 ± 2.4	<.001
Worries over unforeseen future effects score	11.2 ± 1.9	12.4 ± 1.8	<.001	11.1 ±1.9	12.1 ±1.8	<.001
Concerns about commercial profits score	7.5 ± 2.4	8.7 ±2.3	<.001	7.2 ±2.5	8.3 ± 2.6	.001
Preference for natural immunity score	9.6 ± 2.3	10.7 ± 2.4	<.001	9.4±2.3	11.2±2.0	<.001

®*Independent t-test and Chi-squared test*

Multivariable results of factors associated with vaccine coverage

We conducted multivariate logistic regression to identify variables that predict COVID-19 vaccine coverage among HCWs (Table 5). Older female HCWs, those with high monthly incomes, and those working in non-governmental healthcare settings are likelier to get the vaccine. On the other hand, previous COVID-19 infection, living with a child, and mistrust of vaccine benefits are associated with lower vaccination uptake. On the other hand, among male HCWs, being single is positively associated with vaccination, whereas a history of COVID-19 infection and mistrust of vaccine benefits are negatively associated with vaccination.

Table (5): Logistic regression analysis of factors associated with COVID-19 vaccination coverage among female and male healthcare workers.

	Female HCWs *(n=560)*			**Male HCWs** *(n=458)*		
	SE	*aOR (95%CI)*	***P-value***	**SE**	*aOR (95%CI)*	***P-value***
Age group *(ref. < 30 years)*						
30-39 years	.255	1.9 (1.2-3.2)	.011	.484	.90 (.25-2.4)	.831
40-49 years	.342	2.7 (1.4-5.3)	.004	.522	1.1 (.39-3.0)	.892
≥ 50 years	.437	1.9 (.82-4.7)	.130	.601	.74 (.23-2.3)	.614
Profession *(ref. Others†)*						
Physicians	.294	1.1 (.56-1.8)	.972	.368	1.2 (.55-2.5)	.686
Nurses	.296	.89 (.46-1.5)	.520	.407	1.1 (.47-2.3)	.932
Marital status *(ref. Married)*						
Single	.254	.70 (.42-1.2)	.146	.494	2.6 (1.1-6.9)	.040
Monthly income *(ref. < 1100 EUR)*						
1100- <1700 EUR	.233	1.3 (.81-4.7)	.605	.484	2.1 (.82-5.5)	.120
≥1700 EUR	.459	1.7 (1.1-2.7)	.020	.475	1.3 (.49-3.2)	.640
Healthcare setting *(ref. Governmental)*						
Non-Governmental	.257	1.8 (1.1-2.8	.016	.368	1.9 (.96-4.1)	.064
Smoking *(ref. Non-smoker)*						
Smoker	.291	.74 (.29-1.3)	.307	.303	1.7 (.92-3.0)	.093
Living with a child *(ref. No)*						
Yes	.242	.47 (.29-.76)	.002	.362	1.3 (.66-2.7)	.415

	Female HCWs *(n=560)*			Male HCWs *(n=458)*		
	SE	*aOR (95%CI)*	***P-value***	**SE**	*aOR (95%CI)*	***P-value***
***Perceived* vaccine Knowledge** *ref. Poor)*						
Good to Excellent	.437	.1.5(.93-2.6)	.091	.409	1. 8 (.78-3.9)	.173
History of COVID-19 infection *(ref. No)*						
Yes	.212	.45 (.23-.67)	<.001	.295	.26 (.15- .47)	<.001
Mistrust of vaccine benefits score	.051	.69 (.63-.76)	<.001	.087	.58 (.50-.68)	<.001
Worries over unforeseen future effects score	.061	.84 (.75-.95)	.005	.083	.89 (.75-1.1)	.147
Concerns about commercial profits score	.061	.92 (.89-1.1)	.090	.062	.98 (.92-1.2)	.567
Preference for natural immunity score	.048	.98 (.92-1.1)	.694	.070	.90 (.78-1.03)	.130

*a**OR**= adjusted Odds Ratio, **CI**= confidence interval, ǂLab technicians, radiology technicians, and occupational and physiotherapists.*

DISCUSSION

A better understanding of COVID-19 vaccination barriers among HCWs, particularly females, is essential for developing intervention and promotion strategies. Numerous studies indicate that females are more concerned about the COVID-19 vaccine and have lower vaccination rates [8, 14–16]. Similarly, we found that female HCWs have lower vaccination coverage rates than males. In addition, young age, having a child, mistrust of vaccine benefits, worries about unforeseen side effects, and concerns about commercial benefits are associated with COVID-19 coverage among female HCWs, whereas for males, being single and having the same mistrust of benefits and worries about unforeseen side effects were reported as barriers.

Throughout history, females have shown a higher tendency for vaccine hesitation [17]. In addition, females often exhibit a heightened responsibility for the family's health [18]. Hence, they engage in medical research and consultations with experts but are exposed to negative news and social media opinions [19]. Therefore, these factors can interplay, among others, affecting females' negative attitudes towards vaccinations.

Fear of adverse effects on fertility is a significant factor in female COVID-19 vaccination reluctance in other regions [20, 21]. Our analysis also revealed a significantly low vaccination coverage among females under 30. Gender-related issues such as infertility, marriage, and pregnancy were particularly important, debating the difference between genders. In contrast, other factors such as profession and parenthood were proposed and reported as significant indicators for vaccine uptake, among others [22, 23]. The infertility myth persists despite the lack of evidence supporting this notion [11]. A recent study exploring the factors nurturing conspiracy theories regarding COVID-19 and its implication on vaccine coverage has found that 23% of respondents believed the COVID-19 vaccines could lead to infertility [24]. Conversely, individual trust, confidence, social support networks, cultural stereotypes, and civic and collective responsibility influence older women's decisions regarding COVID-19 vaccination [25].

In males, the relationship was inverted; males under 30 received the vaccine at a higher rate than older males. This is surprising given that our target group consists of HCWs who should know that men over 50 are more likely to be admitted due to COVID-19 than women [26]. In a pooled analysis, male gender and age over 50 were reported as enablers of the COVID-19 vaccine [14]. Surprisingly, male HCWs over 50 in Palestine were less likely to receive the COVID-19 vaccine. This necessitates a comprehensive analysis through qualitative research to unearth underlying causes.

Many recent studies have reported profession as an essential indicator of vaccination, with physicians having higher vaccination rates. Dror et al. found a significant difference between nurses and physicians concerning their desire to accept the vaccine themselves or even to vaccinate their children [22]. Another study in Greece discovered that doctors and dentists are more likely than pharmacists to support vaccination [23]. In this study, male physicians are higher than their female counterparts. In contrast, vaccination coverage among female physicians, nurses, and others was comparable. This implies that higher-status occupations, such as physicians, do not predict vaccine coverage but that gender plays a significant role. Being a female physician, nurse, or even administrative worker is associated with lower COVID-19 vaccine uptake.

Other studies have identified having a child as a negative predictive factor for vaccine coverage [22, 27]. For females, the trend is similar, according to our findings. Concerns regarding local and systemic reactions to immunization among unvaccinated females may make them hesitant to include children in such situations. This aligns with other reports that cited concerns about side effects as a significant barrier in the face of vaccination [28, 29].

Female nurses perceived they have good to excellent knowledge in this study, albeit significantly less than males. On the other hand, the overall negative attitude of female HCWs toward the vaccine could be a significant obstacle to healthcare in general and the resolution of the COVID-19 pandemic in particular. Smoking status was associated with vaccine coverage in both sexes, with smokers having higher vaccination coverage. This contradicts the findings of prior studies, notably among the general population, which revealed no association between cigarette use and COVID-19 vaccine hesitancy [30]. The higher vaccination coverage among smoking HCWs could be attributed to their increased awareness of the adverse effects of smoking on their respiratory health. As a result, they want to be protected against COVID-19 infection.

Despite the significant contributions made by this research, some limitations should be addressed. First, the generalizability of this study is limited due to its convenience-sampling approach. However, this exploratory study has provided insight into the current COVID-19 vaccine coverage in HCWs based on their gender. Second, using an online administered questionnaire may make estimating the response rate difficult, hence introducing non-response bias, undermining the study's generalizability. We did not require respondents to reveal their identities to avoid bias. Third, some potential confounders associated with female HCW vaccination uptake were not collected, such as being pregnant, planning to become pregnant shortly, vaccination-related fertility issues, or being already vaccinated for COVID-19. However, the VAX scale measures these issues indirectly through different items.

CONCLUSION

Female HCWs have significantly higher anti-vaccination attitudes, and lower vaccine coverage, especially for the younger age groups. In both sexes, a history of COVID-19 and mistrust of vaccine benefits are negatively associated with vaccination coverage. However, in female HCWs only, the age group 40-49 and middle-income category are positively associated with vaccination coverage, whereas living with a child and worries of unforeseen effects are negatively associated with vaccination coverage. We suggest further studies using mixed, qualitative, and quantitative methods to investigate vaccine hesitancy among female HCWs in greater depth, evaluate their vaccine-specific knowledge, and assess vaccination-related fertility concerns.

Ethics approval and consent to participate

All procedures involving human participants in this study followed institutional and/or national research committee ethical standards, the 1964 Helsinki declaration, and subsequent revisions or equivalent ethical standards. The study was approved by the Institutional Review Board of An-Najah National University (Ref #: Med. March. 2021/23), the Palestinian ministry of health.

Consent for publication: not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author's contribution

Beesan Maraqa: conceptualization, writing-original draft, data curation, formal analysis, methodology, and writing review & editing. **Zaher Nazzal:** conceptualization, writing-original draft, data curation, formal analysis, methodology, project administration, supervision, and writing review & editing. **Qais AbuHasan:** data curation, formal analysis, and writing review & editing.

Competing interest

The author(s) declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

FUNDING

No funding was received for this study from any source.

ACKNOWLEDGMENTS

We thank the Palestinian Ministry of Health and the Association of Palestinian Physicians for the help and contribution that they have given us in facilitating our study. In addition, we would like to thank all the healthcare workers involved.

REFERENCES

1] Ledford H. Six months of COVID vaccines: what 1.7 billion doses have taught scientists. Nature 2021;594:164–7. https://doi.org/10.1038/D41586-021-01505-X.

2] Lazarus J V., Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, et al. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med 2021;27:225–8. https://doi.org/10.1038/s41591-020-1124-9.

3] Malik AA, McFadden SAM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. EClinicalMedicine 2020;26:1657–63. https://doi.org/10.1016/j.eclinm.2020.100495.

4] WHO. Health conditions in the occupied Palestinian territory, including east Jerusalem , and in the occupied Syrian Golan Report 2008:1–9.

5] Biswas N, Mustapha T, Khubchandani J, Price JH. The Nature and Extent of COVID-19 Vaccination Hesitancy in Healthcare Workers. J Community Health 2021. https://doi.org/10.1007/s10900-021-00984-3.

6] Shekhar R, Sheikh AB, Upadhyay S, Singh M, Kottewar S, Mir H, et al. COVID-19 vaccine acceptance among health care workers in the united states. Vaccines 2021;9:1–18. https://doi.org/10.3390/vaccines902011.

7] Dzieciolowska S, Hamel D, Gadio S, Dionne M, Gagnon D, Robitaille L, et al. Covid-19 vaccine acceptance, hesitancy, and refusal among Canadian healthcare workers: A multicenter survey. Am J Infect Control 2021. https://doi.org/https://doi.org/10.1016/j.ajic.2021.04.079.

8] Maraqa B, Nazzal Z, Rabi R, Sarhan N, Al-Shakhrah K, Al-Keile M. COVID-19 vaccine hesitancy among health care workers in Palestine: A call for action. Prev Med (Baltim) 2021. https://doi.org/10.1016/j.ypmed.2021.106618.

9] Astrazeneca. Public Assessment Report Authorisation for Temporary Supply COVID-19 Vaccine AstraZeneca, solution for injection in multidose container COVID-19 Vaccine (ChAdOx1-S [recombinant]) D. Med Healthc Prod Regul Agency 2021;2:1–57.

10] Pfizer-BioNTech. Pfizer-BioNTech covid-19 vaccine (bnt162, pf-07302048) vaccines and related biological products advisory committee briefing document meeting date: 10 December 2020. 2020;23:92.

11] Iacobucci G. Covid-19: No evidence that vaccines can affect fertility, says new guidance. BMJ 2021;372. https://doi.org/10.1136/bmj.n460.

12] Martin LR, Petrie KJ. Understanding the Dimensions of Anti-Vaccination Attitudes: the Vaccination Attitudes Examination (VAX) Scale. Ann Behav

Med 2017;51:652–60. https://doi.org/10.1007/s12160-017-9888-y.

13] WHO EMRO | Palestine receives its largest COVAX shipment, funded by the Governments of Germany and Italy | News | Palestine site n.d. http://www.emro.who.int/opt/news/palestine-receives-its-largest-covax-shipment-funded-by-the-governments-of-germany-and-italy.html (accessed August 23, 2022).

14] Khubchandani J, Bustos E, Chowdhury S, Biswas N, Keller T. COVID-19 Vaccine Refusal among Nurses Worldwide: Review of Trends and Predictors. Vaccines 2022;10. https://doi.org/10.3390/vaccines10020230.

15] Rabi R, Maraqa B, Nazzal Z, Zink T. Factors affecting nurses' intention to accept the COVID-19 vaccine: A cross-sectional study. Public Health Nurs 2021;38:781–8. https://doi.org/10.1111/phn.12907.

16] Alya WA, Maraqa B, Nazzal Z, Odeh M, Makhalfa R, Nassif A, et al. COVID-19 vaccine uptake and its associated factors among Palestinian healthcare workers: Expectations beaten by reality. Vaccine 2022;40:3713–9. https://doi.org/10.1016/j.vaccine.2022.05.026.

17] Conis E. A mother's responsibility: women, medicine, and the rise of contemporary vaccine skepticism in the United States. Bull Hist Med 2013;87:407–35. https://doi.org/10.1353/bhm.2013.0047.

18] Sharma N, Chakrabarti S, Grover S. Gender differences in caregiving among family - caregivers of people with mental illnesses. World J Psychiatry 2016;6:7–17. https://doi.org/10.5498/wjp.v6.i1.7.

19] Hernandez RG, Hagen L, Walker K, O'Leary H, Lengacher C. The COVID-19 vaccine social media infodemic: healthcare providers' missed dose in addressing misinformation and vaccine hesitancy. Hum Vaccin Immunother 2021;17:2962–4. https://doi.org/10.1080/21645515.2021.1912551.

20] Diaz P, Reddy P, Ramasahayam R, Kuchakulla M, Ramasamy R. COVID-19 vaccine hesitancy linked to increased internet search queries for side effects on fertility potential in the initial rollout phase following Emergency Use Authorization. Andrologia 2021;53. https://doi.org/https://doi.org/10.1111/and.14156.

21] Diaz P, Zizzo J, Balaji NC, Reddy R, Khodamoradi K, Ory J, et al. Fear about adverse effect on fertility is a major cause of COVID-19 vaccine hesitancy in the United States. Andrologia 2022;54. https://doi.org/https://doi.org/10.1111/and.14361.

22] Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, Zigron A, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. Eur J Epidemiol 2020;35:775–9. https://doi.org/10.1007/s10654-020-00671-y.

23] Papagiannis D, Rachiotis G, Malli F, Papathanasiou I V, Kotsiou O, Fradelos EC, et al. Acceptability of COVID-19 Vaccination among Greek Health Professionals. Vaccines 2021;9. https://doi.org/10.3390/vaccines9030200.

24] Sallam M, Dababseh D, Eid H, Al-Mahzoum K, Al-Haidar A, Taim D, et al. High Rates of COVID-19 Vaccine Hesitancy and Its Association with Conspiracy Beliefs: A Study in Jordan and Kuwait among Other Arab Countries. Vaccines 2021;9. https://doi.org/10.3390/vaccines9010042.

25] Siu JY, Cao Y, Shum DHK. Perceptions of and hesitancy toward COVID-19 vaccination in older Chinese adults in Hong Kong: a qualitative study. BMC Geriatr 2022;22:288. https://doi.org/10.1186/s12877-022-03000-y.

26] Scully EP, Schumock G, Fu M, Massaccesi G, Muschelli J, Betz J, et al. Sex and Gender Differences in Testing, Hospital Admission, Clinical Presentation, and Drivers of Severe Outcomes From COVID-19. Open Forum Infect Dis 2021;8. https://doi.org/10.1093/ofid/ofab448.

27] Khubchandani J, Sharma S, Price JH,

Wiblishauser MJ, Sharma M, Webb FJ. COVID-19 Vaccination Hesitancy in the United States: A Rapid National Assessment. J Community Health 2021;46:270–7. https://doi.org/10.1007/s10900-020-00958-x.

28] Verger P, Scronias D, Dauby N, Adedzi KA, Gobert C, Bergeat M, et al. Attitudes of healthcare workers towards COVID-19 vaccination: a survey in France and French-speaking parts of Belgium and Canada, 2020. Euro Surveill Bull Eur Sur Les Mal Transm = Eur Commun Dis Bull 2021;26. https://doi.org/10.2807/1560-7917.ES.2021.26.3.2002047.

29] Eguia H, Vinciarelli F, Bosque-Prous M, Kristensen T, Saigí-Rubió F. Spain's Hesitation at the Gates of a COVID-19 Vaccine. Vaccines 2021; 9. https://doi.org/10.3390/vaccines9020170.

30] Yang Y, Dobalian A, Ward KD. COVID-19 Vaccine Hesitancy and Its Determinants Among Adults with a History of Tobacco or Marijuana Use. J Community Health 2021;46:1090–8. https://doi.org/10.1007/s10900-021-00993-2.