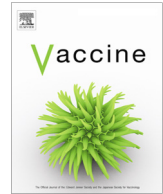




Contents lists available at ScienceDirect

Vaccine

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## COVID-19 vaccine uptake and its associated factors among Palestinian healthcare workers: Expectations beaten by reality

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### ARTICLE INFO

#### Article history:

Received 25 June 2021

Received in revised form 17 April 2022

Accepted 7 May 2022

Available online xxxx

#### Keywords:

COVID-19 vaccine  
Vaccination uptake  
Healthcare workers  
Palestine

### ABSTRACT

**Background:** In response to this extraordinary outbreak, many countries and companies rush to develop an effective vaccine, authorize, and deliver it to all people across the world. Despite these extensive efforts, curbing this pandemic relies highly upon vaccination coverage. This study aimed to determine SARS-CoV-2 vaccine uptake among Palestinian healthcare workers, the factors that influence vaccination uptake, and the motivators and barriers to vaccination.

**Methods:** A cross-sectional study was conducted using an online anonymous self-administered questionnaire during April and May 2021, after the Palestinian Ministry of Health launched the COVID-19 vaccination campaign.

The questionnaire collected socio-demographic characteristics, vaccination attitude and vaccination uptake status, and motivators and barriers towards vaccination. In addition, multivariate logistic regression was performed to identify the influencing factors of vaccination uptake.

**Results:** The study included 1018 participants from different professions, including 560 (55.0%) females. Of the participants, 677 (66.5%; 95% CI: 63.5–69.4%) received the vaccine. Higher uptake was observed among males (aOR = 1.5; 95% CI: 1.1–2.1), single HCWs (aOR = 1.3; 95% CI: 1.1–1.8), HCWs working in the non-governmental sector (aOR = 1.6; 95% CI: 1.2–2.4), higher monthly income (aOR = 1.9; 95% CI: 1.4–2.8) and smoking (aOR = 1.5; 95% CI: 1.1–3.5). The lower level of negative vaccination attitudes predicted higher intake; mistrust of vaccine belief (aOR = 1.6; 95% CI: 1.4–1.7) and worries over unforeseen future effects (aOR = 1.2; 95% CI: 1.1–1.3).

**Conclusion:** In conclusion, the COVID-19 vaccination uptake was comparable to other studies worldwide but still needs to be improved, especially in the context of this ongoing global pandemic. It is imperative to invest resources to promote vaccination uptake and target all the vaccine misconceptions and fears.

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## 1. Introduction

COVID-19 is a public health emergency of international concern. It was declared a pandemic on March 11, 2020 [1]. As of June 24, 2021, about 180 million confirmed cases of COVID-19 were reported to the WHO, with almost 3.9 million deaths [2]. In addition, there were about 342 thousand confirmed cases in Palestine during the same period, with 3823 deaths [3]. Thus, the pandemic is still ongoing and poses a serious global challenge.

Vaccines are widely recognized as an effective tool for managing public health, and as a result, preventive vaccines will be critical for long-term control of the COVID-19 pandemic [4]. Since the emergence of the diseases and following the virus's genetic sequence release in early January 2020, multiple laboratories have been working rapidly on candidate vaccines against SARS-CoV-2. As a result, several COVID-19 vaccines that have been approved by the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) are currently available [5,6].

Healthcare workers (HCW) are at the forefront of fighting epidemics, and they are at high risk of contracting the virus, and their infections reduce the number of HCWs available [7]. Therefore, it is critical to ensure the safety of HCWs to ensure continuous patient

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care and prevent virus transmission. The vaccine uptake and knowledge of HCWs may have an impact on the entire population because they serve as trusted sources of vaccine information for patients and contribute to public trust in vaccines [8]. This is supported by evidence of a low acceptance rate of the COVID-19 vaccine among Palestinians, with only 41.3 percent believing the vaccine was safe [9].

The WHO has identified HCWs as a priority group for COVID-19 vaccination. The vaccine should be available to all HCWs and not restricted to those who deal with COVID-19 positive patients only [10,11]. Resistance to vaccination among HCWs, on the other hand, is a serious issue that could jeopardize COVID-19 vaccination [12].

HCWs' vaccination uptake is low based on previous experiences with other diseases such as influenza [13,14], and also based on recent studies, HCWs' acceptance of and Intention to receive the COVID-19 vaccine is low [15–18]. For example, a study conducted in Palestine at the start of 2021 revealed that only 37.8% of HCWs intended to get the vaccine, 30.7% planned not to, and the remainder were undecided [16].

Inadequate vaccine knowledge, negative vaccine attitudes, and a flood of misinformation from traditional and social media were identified as significant contributors to COVID-19 vaccine hesitancy [19–21]. In addition, concerns about efficacy and safety were also expressed, including worries about short- and long-term side effects [22–24]. Other frequently cited reasons include health issues (e.g., chronic diseases), religious beliefs, and political concerns [23].

On May 31, 2021, the total number of vaccinated individuals in the West Bank and Gaza was 318,134, with 70% receiving two doses. Unfortunately, no definitive numbers were available for subgroups such as healthcare workers. Measuring the vaccination coverage and understanding the factors that promote vaccine uptake among HCWs may have significant policy implications for improving the HCW acceptability of COVID-19 vaccination. Therefore, the specific goal of this study is to determine SARS-COV-2 vaccine uptake among Palestinian HCWs and the factors that influence vaccination uptake, and the motivators and barriers to vaccination.

## 2. Methods

### 2.1. Study design and population

A cross-sectional study was carried out using an online self-administered questionnaire. The study was conducted between April and June 2021, after the Palestinian Ministry of Health launched the COVID-19 vaccination campaign, with HCWs as the priority group. Therefore, we targeted all Palestinian HCWs (physicians, nurses, lab technicians, radiology technicians, and occupational and physiotherapists) in the West Bank and Gaza Strip who work in primary health care centers and hospitals in both the governmental and non-governmental sectors.

### 2.2. Sample size

We calculated the sample size needed for this study using the formula for descriptive studies:  $[n = [DEFF * Np(1 - p)] / [(d^2 / Z_{1-\alpha/2}^2 * (N - 1) + p * (1 - p)]]$ , where  $Z = 1.96$  is the confidence level statistic,  $P$  is the estimated proportion of unvaccinated HCWs, and  $d$  is the accuracy [25]. Thus, the sample size needed to meet the research objectives was calculated to be 1024 HCWs, with an estimated proportion of 50%, a confidence level of 95%, and a 3% absolute precision.

### 2.3. Measures

We used an anonymous self-administered online questionnaire developed and adopted from literature reviews [22–24,26,27] and our previous studies [16,17]. The questionnaire is divided into four sections. The first section evaluated HCWs' background, professional and clinical characteristics such as age, gender, profession, marital status, income, health care setting, physical activity, smoking status, and history of chronic diseases, such as diabetes, hypertension, heart disease, and others. HCWs were considered physically active if they engaged in at least 150 min of moderate exercise per week or minimum 75 min. of vigorous exercise per week [28].

The second section assessed the HCWs' attitudes. We used the Vaccination Attitudes Examination Scale (VAX), adjusted to the COVID-19 vaccine. The VAX scale, which consists of 12 items and four subscales, is used to assess anti-vaccination attitudes [29]. It is further sub-categorized into four sub-scales: (1) mistrust of vaccine benefits, (2) worries over unforeseen future effects, (3) concerns about commercial profits, (4) preference for natural immunity. Each item is scored on a scale of 1 (strongly agree) to 5 (strongly disagree), except subscale #1, which is reversed coded from 1 (strongly disagree) to 5 (strongly agree). A higher overall score shows more negative attitudes towards vaccination with COVID-19. A high degree of internal consistency has been demonstrated in previous studies [29,30]. The authors of this study translated the VAX into Arabic, and a native English speaker verified the back-translation. It showed high internal consistency; Cronbach's  $\alpha = 0.83$ .

The third section evaluated the study's primary outcome variable, COVID-19 vaccine uptake (vaccinated vs. unvaccinated). Furthermore, it assessed variables related to the COVID-19 vaccine in terms of type, the number of doses received, side effects and perceived COVID-19 and vaccine knowledge. Finally, the fourth section assessed the factors that influenced HCWs' decision to receive (motivators) the COVID-19 vaccine and those that influenced their decision not to accept it (barriers).

After three experts reviewed the questionnaire, we created the study's online link using Google forms. We then conducted a pilot study with 30 HCWs using the online form to evaluate the questionnaire's clarity, understanding, and feasibility. The pilot study results were used to improve the quality and efficiency of the primary survey, but they were not included in the current study. In addition, those who took part in the pilot study were excluded from the larger sample.

### 2.4. Data collection

We used a convenience sampling technique to invite participants. We distributed a web link to the questionnaire via Google forms and an introductory invitation to closed institutional groups of HCWs (WhatsApp and Messenger). This takes advantage of Palestinians' high rate of internet usage.

### 2.5. Data analysis

We conducted the statistical analysis using the IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, NY, USA). We used descriptive statistics such as mean, standard deviation (SD), frequency, and percentages to summarize HCWs' background, professional and clinical characteristics, and COVID-19 vaccination attitudes. We used the Chi-square test to assess the association between vaccine uptake status and HCWs' background, professional and clinical characteristics, and the independent  $t$ -test to compare vaccine attitudes scores between the vaccinated and unvaccinated groups. We used multivariable logistic regression

to identify factors independently associated with vaccine uptake by including all variables demonstrating significance in univariable analysis. The associations between HCWs' characteristics and COVID-19 vaccine uptake were expressed as adjusted odds ratios (aOR) and 95% confidence intervals (95 %CI). We set the significance level at a P-value of <0.05.

## 2.6. Ethical considerations

The study was approved by the Institutional review board (IRB) of An-Najah national university (Ref #: Med. March. 2021/23) and the Palestinian ministry of health. HCWs were informed of the study's aim at the start of the online survey, and they were assured

**Table 1**  
Participants background and demographic characteristics (n = 1018).

Characteristic	Total n(%)	Vaccinated	Unvaccinated	P-value
<i>Sex</i>				
Male	458 (45.0%)	343 (74.9%)	115 (25.1%)	<0.001
Female	560 (55.0%)	334 (59.6%)	226 (40.4%)	
<i>Age group</i>				
Under 30 years	395 (38.8%)	260 (65.8%)	135 (34.2%)	0.780
30–39 years	337 (33.1%)	220 (65.3%)	117 (34.7%)	
40–49 years	202 (19.8%)	140 (69.3%)	62 (30.7%)	
≥50 years	84 (8.3%)	57 (67.9%)	27 (32.1%)	
<i>Profession</i>				
Physicians	438 (43.0%)	323 (73.7%)	115 (26.3%)	<0.001
Nurses	292 (28.7%)	182 (62.3%)	110 (37.7%)	
Others*	288 (28.3%)	172 (59.7%)	116 (40.3%)	
<i>Marital status</i>				
Married	685 (67.3%)	436 (63.6%)	249 (36.4%)	0.006
Single	333 (32.7%)	241 (72.4%)	92 (27.6%)	
<i>Monthly income (NIS)</i>				
<4000	544 (53.4%)	315 (57.9%)	229 (42.1%)	<0.001
4000–<6000	361 (35.5%)	271 (75.1%)	90 (24.9%)	
≥6000	113 (11.1%)	91 (80.5%)	22 (19.5%)	
<i>Health care setting</i>				
Governmental	744 (73.1%)	474 (63.7%)	270 (36.2%)	0.002
Non-Governmental	274 (26.9%)	203 (74.0%)	71 (25.9%)	
<i>Patients contact per day</i>				
<10 patients	220 (21.6%)	138 (62.7%)	82 (37.3%)	0.353
10–29 patients	330 (32.4%)	230 (69.7%)	100 (30.3%)	
30–50 patients	226 (22.2%)	152 (67.3%)	74 (32.7%)	
≥50 patients	242 (23.8%)	157 (64.9%)	85 (35.1%)	
<i>Smoking</i>				
Non-smoker	723 (71.1%)	453 (62.6%)	270 (37.3%)	<0.001
Smoker	295 (29%)	224 (75.9%)	71 (24%)	
<i>Physical activity</i>				
No	424 (41.6%)	278 (65.6%)	146 (34.4%)	0.852
Yes- irregular	529 (52.0%)	356 (67.3%)	173 (32.7%)	
Yes- regular	65 (6.4%)	43 (66.2%)	22 (33.8%)	
<i>Chronic disease</i>				
Yes	156 (15.4%)	104 (66.7%)	52 (33.3%)	0.985
No	856 (84.6%)	570 (66.6%)	286 (33.4%)	

\* Chi-squared test, <sup>®</sup>Include lab technicians, radiology technicians, and occupational and physiotherapists.

**Table 2**  
Distribution of participants responses to COVID-19 and its vaccine questions (n = 1018).

	Total	Vaccinated (n = 677)	Unvaccinated (n = 341)	P-value*
<i>Perceived vaccine knowledge</i>				
Poor to good <sup>1</sup>	594 (58.3%)	365 (61.4%)	229 (38.6%)	<0.001
Very good to Excellent	424 (41.7%)	312 (73.6%)	112 (26.4%)	
<i>Perceived COVID-19 Knowledge</i>				
Poor to good <sup>1</sup>	462 (45.3%)	289 (62.6%)	173 (37.4%)	0.015
Very good to Excellent	556 (54.6%)	388 (69.8%)	168 (30.2%)	
<i>A relative died of COVID-19</i>				
Yes	260 (25.5%)	176 (67.7%)	84 (32.3%)	0.638
No	758 (74.5%)	501 (66.1%)	257 (33.9%)	
<i>History of COVID-19 infection</i>				
Yes	397 (39.0%)	222 (55.9%)	175 (44.1%)	<0.001
No	621 (61.0%)	455 (73.3%)	166 (26.7%)	

\*Chi-squared test.

that participation was entirely voluntary. A waiver for signed consent was obtained because the study poses minimal risk to subjects and does not include any procedures that require written consent—the web-based survey method used to collect data maintained respondent anonymity. When returning the questionnaire, web-based tools (such as Google Forms) protect information confidentiality and prevent other participants from accessing it. Furthermore, there were no identifying questions in the survey. Respondents were allowed to ask questions via a mobile phone number that was explicitly designated for the study.

### 3. Results

#### 3.1. Background characteristics

A total of 1018 health care workers (739 in the West Bank and 279 in Gaza) agreed to participate in the study and completed the questionnaire. [Table 1](#) presents the demographic characteristics of HCWs. Of them, 438 (43.0%) were physicians, 292 (28.7%) were nurses, and 288 (28.3%) were other health professionals, which included lab technicians, radiology technicians, and occupational and physiotherapists. The majority (560; 55.0%) were female HCWs, 395 (38.8%) were among those aged under 30 years, and 685 (67.3%) were married. Overall, 274 (26.9%) work in the non-Governmental sector, 423 (41.5%) work in primary healthcare,

**Table 3**  
HCWs' motivations for COVID-19 immunization.

Reason	n = 677	%
As a health professional, I am more susceptible to get infected	660	97.5%
To not harm family or others	642	94.8%
I have easy access to the vaccine	556	82.1%
Most of my Colleagues are getting vaccinated	511	75.5%
I knew someone who had severe symptoms from the COVID-19 or died due to it	468	69.1%
Encouragement from loved ones	466	68.8%
To attend social activities, sports, travel, etc.	447	66.0%
Influenced by media	355	52.4%

**Table 4**  
HCWs identified barriers to COVID-19 vaccination.

Reason	n = 341	%
There are no enough studies about the vaccine	247	72.4%
I trust my natural immunity	199	58.4%
Not encouraged because I have concerns about the severe systemic reactions of the vaccine	194	56.9%
I do not have enough information about the vaccine	185	54.3%
Not encouraged because I have concerns about the severe local reactions of the vaccine	173	50.7%
I have concerns about the vaccine efficacy	150	44.0%
The vaccine can transmit the virus	120	35.2%
Not encouraged because I got infected previously	116	34.0%
I am afraid of being currently infected with the virus	100	29.3%

**Table 5**  
Attitudes of healthcare workers toward the COVID-19 vaccine.

	Total (Mean ± SD)	Vaccinated (n = 677)	Unvaccinated (n = 341)	P-value*
VAX total score	36.1 ± 6.7	34.1 ± 6.0	40.0 ± 6.5	<0.001**
Mistrust of vaccine benefits	6.7 ± 1.9	5.9 ± 1.8	8.4 ± 2.5	<0.001**
Worries over unforeseen future effects	11.6 ± 1.9	11.2 ± 1.9	12.3 ± 1.8	<0.001**
Concerns about commercial profits	7.8 ± 2.5	7.3 ± 2.5	8.5 ± 2.4	<0.001**
Preference to natural immunity	10.1 ± 2.4	9.5 ± 2.0	10.9 ± 2.3	<0.001**

\*Independent t-test.

544 (53.4%) earned <4000 NIS each month, and 468 (46%) of them have contact with more than 30 patients per day. On the other hand, more than 40% of them didn't engage in physical activity, 292 (28.7%) were smokers, and 156 (15.3%) reported having chronic diseases.

#### 3.2. COVID-19 vaccine uptake

Of the total respondents, 677 [66.5%, (95% CI: 63.5%- 69.4%)] received the COVID-19 vaccine; where 515 (76.1%) of them received 2 doses. The most common type of the received vaccines was Pfizer (23.5%) and Sputnik (21.3%); followed by AstraZeneca (8.8%), Moderna (7.0%), and Sinopharm. Of the vaccinated HCWs, 556 (82.1%) reported having side effects ranging from mild local to systemic reactions. Among the non-vaccinated group, 58.6 % HCWs indicated that vaccine type could affect their decision.

Vaccination uptake was higher among males (P-value < 0.001), physicians (P-value < 0.001), single HCWs (P-value = 0.006), those with lower monthly income (P-value < 0.001) and smokers (P-value = < 0.001) ([Table 1](#)). Additionally, we found vaccine uptake significantly higher among HCWs who perceived themselves to have very good to excellent vaccine Knowledge (73.6% vs. 61.4%; P-value < 0.001) and those who perceived themselves to have very good to excellent COVID-19 Knowledge (69.8% vs. 62.2%; P-value = 0.015). On the other hand, HCWs who had a history of COVID-19 showed less vaccine uptake compared to HCWs who were not infected (55.9% vs. 73.3%; P-value = <0.001) ([Table 2](#)). It's worth noting that 33% of HCWs who did not receive the vaccine expressed an interest in receiving it in the future.

#### 3.3. Motivators and barriers of vaccination

The motivators for vaccination are shown in [Table 3](#). The two most important reasons for vaccination, according to HCWs, are being more susceptible as a result of being a health professional (97.5%) and not causing harm to family or others. On the other hand, HCWs have identified several factors that influenced their decision against COVID-19 vaccination ([Table 4](#)). The lack of evidence about vaccination effectiveness (72.4%) and belief in one's natural immunity (58.4%) were the two most important reasons for not getting vaccinated against COVID-19.

#### 3.4. Attitudes towards COVID-19 vaccine

We used the VAX scale to assess HCWs attitudes towards COVID-19 vaccine. Unvaccinated HCWs had significantly higher levels of negative attitudes toward the vaccine in the four VAX domains: mistrust of vaccine benefits (8.4 vs 5.9; P-value = <0.001), worries over unforeseen future effects (12.3 vs 11.2; P-value = <0.001), concerns about commercial profits (8.5 vs 7.3; P-value = <0.001), preference to natural immunity (10.9 vs 9.5; P-value = <0.001) ([Table 5](#)).

### 3.5. Factor associated with COVID-19 vaccine uptake

We used multivariable analysis to determine characteristics that were independently associated with COVID-19 vaccination uptake (Table 6). Males (aOR = 1.5; 95%CI: 1.1–2.1,  $p = 0.021$ ), single HCWs (aOR = 1.3; 95%CI: 1.1–1.8,  $p = 0.040$ ), and HCWs working in the non-governmental sector (aOR = 1.6; 95%CI: 1.2–2.4,  $p = 0.009$ ) showed higher uptake compared to females, married HCWs, and HCWs working at the governmental sector, respectively. In addition, monthly income of 4000–<6000 NIS (aOR = 1.9; 95%CI: 1.4–2.8,  $p = <0.001$ ), monthly income of  $\geq 6000$  NIS (aOR = 1.9; 95%CI: 1.1–3.5,  $p = 0.035$ ), and smoking (aOR = 1.5; 95%CI: 1.1–3.5,  $p = 0.045$ ) were significantly associated with higher vaccine uptake. On the other hand, a history of COVID-19 infection was associated with lower intake (aOR = 2.4; 95%CI: 1.7–3.3,  $p = <0.001$ ). For attitudes, mistrust of vaccine belief (aOR = 1.6; 95%CI: 1.4–1.7,  $p = <0.001$ ) and worries over unforeseen future effects (aOR = 1.2; 95%CI: 1.1–1.3,  $p = 0.002$ ) were significantly associated with lower vaccine uptake.

## 4. Discussion

The mass of vaccination programs started in December 2021; the latest statistics showed that 22.4% [31] of the world population received at least one shot of the COVID-19 vaccine. In this study, we investigated the COVID-19 vaccine uptake and determinants of 1018 Palestinian HCWs. Females made up the majority of the sample, which matches the gender makeup of Palestinian HCWs, who are largely females. Additionally, governmental sector employees constitute most of the study participants, as the Ministry of Health provides the vast majority of the country's health services.

The study reveals that the vaccine uptake among HCWs was 66.5%. The increased susceptibility to infection as a healthcare worker and the fear of spreading the infection to their families were the key considerations for HCWs to accept vaccines. In a previous cross-sectional study to assess HCWs' COVID-19 vaccination intentions before starting the vaccine campaign in Palestine, only 37.8% of all HCWs (25.0% of nurses) intended to get the vaccine, while the rest were hesitant [16]. However, despite the well-known fact about the intention-behavior gap [32], the situation was different for COVID-19 vaccination, where the gap was reversed, and uptake exceeded the intention rate. This discrepancy could be explained by several factors, including fear of the disease's severe consequences, the pressure exerted by community institutions to resume everyday life and overcome the pandemic's impact on education and the economy, and the anticipated restrictions on travel and movement for unvaccinated individuals. Vaccine uptake among our HCWs is comparable to that found among HCWs western countries [33,34]. On the other hand, it far exceeds the rate recorded among HCWs in Saudi Arabia [35], where only 33.3% of HCWs enrolled to receive or had already received the vaccine. The fact that 33.5% of HCWs are still unvaccinated demonstrates the need for more measures to alleviate concerns and barriers to vaccination and strengthen motivators to increase vaccination coverage.

There was a gender difference in vaccination uptake, with male HCWs significantly more likely than females to receive the vaccine ( $P = 0.021$ ). This finding aligns with the results of other similar studies [33–35] and prior studies on HCWs' intentions to get the vaccine [16,18,30]. Males are more susceptible to infection and complications than females; a recent meta-analysis of COVID-19 patients indicated that male sex was related to a greater risk of mortality and ICU admission [36]. A possible explanation for why females got the vaccine at lower rates could be concerns about

the vaccine's influence on existing or future pregnancies. A sub analysis of our data revealed that vaccination uptake among females significantly varies with age ( $P$ -value  $< 0.05$ ), with lower uptake among younger ages (childbearing age). Even during pregnancy, research shows that older pregnant mothers are more likely to accept the COVID-19 vaccine. However, there is currently no conclusive evidence regarding the acceptance of the COVID-19 vaccine among pregnant women. In order to develop a strategy to overcome vaccine hesitancy, it is necessary to understand COVID-19 vaccine acceptance among females in-depth, addressing pregnancy-related factors [37].

In our study, smokers were 1.5 times more likely to get the vaccine compared to non-smokers. Similarly, in influenza vaccine uptake studies, smoker HCWs reported higher vaccine uptake than non- or ex-smokers [14,38]. HCWs are likely aware of the adverse effects of smoking on the course of COVID-19, which may explain why they are more likely than non-smokers to receive the vaccine. A large population-based study showed that current smoking was associated with a significantly higher likelihood of developing severe COVID-19 [39].

HCWs decision to use the COVID-19 vaccine is highly dependent on their attitudes towards vaccination. Many recent studies showed that HCWs' negative attitudes are high and negatively affected their acceptance of the COVID-19 vaccination [16,17,30]. Similarly, the findings from this study demonstrated that, although HCWs' vaccine uptake is good, they still have a high level of mistrust of vaccine benefits, worries over unforeseen future effects, and a preference for natural immunity. These levels of negative attitudes, particularly mistrust of vaccine benefit and worries over unforeseen future effects, were significantly higher among the unvaccinated HCWs and are thought to be a determinant of vaccination uptake.

This mistrust could be attributed to incredulity about the healthcare system or the rapid production of vaccines worldwide, which reduces the manufacturing and testing phases [40]. Consistent with this, the main barriers to vaccination reported by our HCWs were a lack of sufficient vaccine research, a preference for natural immunity, and concerns about the vaccine's severe systemic reactions. This highlights the importance of effectively disseminating information on vaccine effectiveness and potential side effects to all HCWs, thereby helping to build and reestablish trust.

Some individual and social characteristics have been shown to influence COVID-19 vaccination uptake [41]. For example, this survey showed that being single was more likely to get vaccinated than married HCWs. Moreover, the study showed that vaccine uptake increases in line with income. Like a previous study on HCW vaccine hesitancy, the current research found that HCWs in the government sector are less likely to get the vaccine, highlighting the significance of further investigation into this disparity to improve vaccination rates.

Our study's most significant advantage is the large sample size of HCWs surveyed. Our study population is diverse, with participants representing a wide range of professions, genders, ages, and geographic areas. However, the study has some limitations. First, the online survey distribution and nonrandom sampling method used in this study may introduce selection bias, resulting in a study population not representative of all Palestinian HCWs. Second, the cross-sectional survey method may limit the ability to draw conclusions and establish causal relationships. Additionally, it is a snapshot of the staff's attitude at a specific point in time, changing over time. Third, the use of a self-administered questionnaire may expose the study to social desirability bias, which occurs when respondents underreport socially undesirable attitudes and behaviors. Again, though, to minimize this, we anonymize the

**Table 6**  
Multivariable analysis of variables associated with COVID-19 vaccine uptake.

	SE	P-Value*	Adjusted OR (95 %CI)
<b>Sex</b>			
Male	0.167	0.021	1.5 (1.1–2.1)
Female <sup>†</sup>			
<b>Profession</b>			
Physicians	0.212	0.465	1.2 (0.8–1.8)
Nurse	0.205	0.537	1.2 (0.8–1.7)
Other HCWs <sup>†</sup>			
<b>Marital status</b>			
Married <sup>†</sup>			
Single	0.177	0.040	1.3(1.1–1.8)
<b>Monthly income (NIS)</b>			
<4000 <sup>†</sup>			
4000–<6000	0.181	<0.001	1.9 (1.4–2.8)
≥6000	0.310	0.035	1.9 (1.1–3.5)
<b>Health care setting type</b>			
Governmental <sup>†</sup>			
Non-Governmental	0.189	0.009	1.6 (1.2–2.4)
<b>Smoking</b>			
Non-smoker <sup>†</sup>			
Smoker	0.197	0.045	1.5 (1.1–3.5)
<b>Perceived vaccine Knowledge</b>			
Poor to good <sup>†</sup>			
Very good to Excellent	0.221	0.532	1.2(0.7–1.3)
<b>Perceived COVID-19 Knowledge</b>			
Poor to good <sup>†</sup>			
Very good to Excellent	0.213	0.647	1.1(0.7–1.5)
<b>History of COVID-19 infection</b>			
Yes <sup>†</sup>			
No	0.161	<0.001	2.4(1.7–3.3)
Mistrust of vaccine benefits	0.041	<0.001	1.6 (1.4–1.7)
Worries over unforeseen future effects	0.047	0.002	1.2 (1.1–1.3)
Concerns about commercial profits	0.037	0.315	1.1(0.9–1.2)
Preference to natural immunity	0.040	0.276	0.9(0.8–1.1)

\*Reference group, **OR** = Odds Ratio, **CI** = confidence interval.

responses. Despite these limitations, our study contains several novel findings that will be of particular interest to policymakers involved in developing SARS-CoV-2 vaccination programs.

## 5. Conclusion

This study provides valuable insight about the COVID 19 vaccine coverage and its determinant among the Palestinian HCWS. Vaccine uptake was similar to that of UK health workers at the time of the study, but higher than in other countries such as Saudi Arabia. It was less likely among the females, those with lower income, Non-smokers, married HCWs, and those working in the governmental sector, as well as HCWs with negative vaccination attitudes.

Being a health care professional and feeling responsible not to harm others were among the most common motivators to take the vaccine, while believing that there was insufficient research and trusting in natural immunity were among the most common barriers to vaccination. It is imperative to invest resources to promote vaccination uptake and target all the vaccine misconceptions and fears. The gap between men and women in vaccination uptake requires considerable attention to address all of the females' concerns and barriers to vaccination. Addressing the barriers among HCWs by health officials may be used to improve the level of immunization in Palestine.

## 6. Declarations

### 6.1. Ethics and consent

All subjects involved in the study were invited to participate voluntarily after the study purpose, risk, and advantage of participation were clarified. A waiver for signed consent was obtained because the study poses minimal risk to subjects and does not include any procedures that require written consent. Approval of the An-Najah National University institutional review board was obtained. Participants' privacy and confidentiality were ensured.

#### Availability of data and materials

The dataset supporting the conclusions of this article is included within the article and its additional file.

#### Funding

No funding was received for this study from any source.

#### Author contributions

ZN, BM, MA, and WA Participated in conceiving and study design, supervised data collection, data analysis, manuscript writing. RM, MO, AN, and WA performed the material preparation, data collection, and research. All authors interpreted the results. ZN and WA wrote the first draft of the manuscript, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## 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 of the healthcare workers who were involved.

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