Physicians' attitudes and acceptance regarding COVID-19 vaccines: a cross-sectional study in mid Delta region of Egypt

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Abstract

Safe and effective vaccines became an important preventive tool against novel corona virus disease infection. Physicians were prioritized for early vaccination since they are at higher risk for contagion of the infection and they might affect the general populations' uptake of the vaccine. This study aimed to examine the acceptability of COVID-19 vaccines and the underpinnings of reluctance to uptake the vaccine among working physicians in Egypt. A cross-sectional study was conducted for 3 months, recruiting 1268 physicians using a snowballing random sampling technique. A self-administered electronic questionnaire was deployed to collect related data. Of participants, 24% expressed their acceptance towards COVID-19 vaccines, 39% would wait for further review, while 36.7% did not agree to get vaccinated. Findings revealed that 22% of them were vaccinated and the significant determinants of unacceptability included age, gender, higher educational attainments, prior infection, lack of direct patients' contact, and working in rural health facilities ($p < 0.05$). The most common reasons beyond their reluctance were fear of the vaccines' adverse effects and the short duration of its clinical trials (60% and 49.5%). Physicians had a low intention to receive COVID-19 vaccines particularly between females, senior staff, and those who had a low self-perceived risk for the infection. Integrated approaches should be designed to address concerns and factors associated with vaccine unacceptability to reduce vaccination reluctance between physicians, hence the general population.

Keywords COVID-19 · Infection · Vaccines · Acceptance · Physicians · Healthcare workers (HCWs) · Egypt

Abbreviations

COVID-19	Coronavirus diseases 2019
HCWs	Healthcare workers
CVDs	Cardiovascular diseases
BMI	Body mass index
COPD	Chronic obstructive pulmonary disease
WHO	World Health Organization

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Introduction

The new SARS-CoV-2 “severe acute respiratory syndrome coronavirus-2” which causes coronavirus disease (COVID-19) started in late 2019 and because of its vast spread, the WHO in January 2020 considered it a “public health emergency of international concern”. On 11th of March 2020, the WHO declared that COVID-19 is a global pandemic (World Health Organization WHO (a)2020).

The novel coronavirus is considered a persistent universal pandemic incident, it is well known that the virus influences mainly the upper respiratory airways and the lungs. Personal factors such as smoking status; increased age and medical comorbidities particularly high blood pressure and heart diseases are recognized as hazardous factors linked to the occurrence of the infection and poor prognosis of the disease (Guatam 2020). The COVID-19 virus propagates mainly by aerosols /droplets of nasal discharge or saliva of an infected person during coughing or sneezing (World Health Organization WHO (a)2021).

By 25th June 2021, the WHO reported that the confirmed COVID-19 cases were over 179 million globally with 3,895,661 deaths, while in Egypt, 279,184 confirmed COVID-19 cases with 16,002 deaths were documented (World Health Organization (WHO) (b) 2021).

As the healthcare workers (HCWs) are at the frontlines in defending COVID-19 pandemic, they are both disease victims and disease transmitters. The risk of infection with COVID-19 arises from their frequent close direct and indirect contact with COVID-19 patients, contacts, visitors, and maybe other healthcare workers who may be infected with COVID-19 (Chou et al. 2020; Mahajan et al. 2020). This risk is aggravated by the contaminated environment, overcrowdedness, insufficient isolation facilities, shortage of protective personal equipment, and inadequate knowledge and practice of HCWs about proper infection control practices (World Health Organization WHO (b) 2020; Gan et al. 2020; Wu and McGoogan 2020).

Although not all the countries register precisely the number of COVID-19 infections and deaths among HCWs, the prevalence of infection among HCWs around the world was documented by several studies in a range of 3–19% (Alajmi et al. 2020; Ali et al. 2020; Bandyopadhyay et al. 2020; Center for Diseases Control and Prevention (CDC) 2020). According to the Egyptian Medical Syndicate on their website on 25 June 2021, the number of COVID-19 deaths among physicians was 577 (Egyptian Medical Syndicate 2021).

Lockdown was an early drastic measure against the propagation of COVID-19 infection; it included shutting off public places and enforcing travel regulations (Guatam 2020). Despite the implementation of preventive measures globally in the form of quarantine measures, physical distancing, and the obligation of wearing facemasks, the COVID-19 pandemic cannot be controlled. The only hope as a successful preventive measure is the vaccination against COVID-19 to limit infections, mitigate its propagation, and save people's lives (Fares et al. 2021).

By March 2021, there were about 83 vaccines in the clinical development stage and 184 vaccines were in the pre-clinical development stage (World Health Organization WHO (c) 2020). Globally, there were many vaccines found to be safe and effective, including Pfizer, Moderna, Oxford/AstraZeneca, Sputnik V, Janssen, Sinopharm, and Sinovac (Cohen 2021; Dal-Re et al. 2021; Jones et al. 2021).

Due to the limited amounts of COVID-19 vaccines, governments have to set the high-risk groups as a priority to be vaccinated. These high-risk groups include healthcare workers, old people, and those with chronic diseases (Kaur and Gupta 2020).

Being in a frontline position fighting against COVID-19 infection, HCWs are more knowledgeable about the effect of the disease than the general population. Meanwhile, many

HCWs were reluctant and valiant to administer the COVID-19 vaccine (Dal-Ré et al. 2021).

According to the WHO, by 24 June 2021, there were a total of 2,624,733,776 doses of COVID-19 vaccines which have been globally administered, and in Egypt, a total of 4,138,935 doses of vaccines have been administered by 23 June 2021 (World Health Organization (WHO) (b) 2021).

The Egyptian government makes great efforts to make enough amounts of COVID-19 vaccines available for the Egyptian population with the priority to healthcare workers (Fares et al. 2021). The success of any vaccination program relies on high vaccine acceptance and public willingness to get the vaccine so that it is important to build public confidence in those emergency-released vaccines (Rhodes et al. 2021).

Vaccine hesitancy, which is “the delay in acceptance or refusal of vaccination despite the availability of vaccination services” (MacDonald 2015), is a barrier to the success of immunization programs as it was declared by the WHO as one of the major 10 threats to the global health (World Health Organization WHO (d) 2020).

The availability of COVID-19 vaccines cannot usually be translated into its uptake because the vaccination is voluntary (Dal-Ré et al. 2020). Several studies found that many healthcare workers are not ready to accept vaccines of COVID-19 even after being available in their countries (Shaw et al. 2021; Verger et al. 2021). For example, an international study investigated the attitudes of HCWs towards COVID-19 vaccination in France, Belgium, and Canada detected that about 40% of them accept to uptake the vaccines if COVID-19 vaccines were made available in their countries (Verger et al. 2021).

Reasons of hesitancy towards COVID-19 vaccines may be attributed to worries about safety and possible side effects of those emergency-released vaccines as well as the speed of their development and approval (Roy et al. 2021; Wang et al. 2020 and Shekhar et al. 2021).

Healthcare workers are considered by their patients a reliable source of information and act as role models about vaccination (Deem 2018), so their acceptance, refusal, or hesitancy to take COVID-19 vaccines will strongly affect the attitude of the general population uptake of COVID-19 vaccines, as people usually depend on information and actions of their healthcare workers as a guide for their decisions (Shaw et al. 2021).

Determining the acceptance of COVID-19 vaccination between physicians and understanding their beliefs regarding the vaccines would help stakeholders to formulate proper interventions to increase their vaccine uptake and hence the general population. This study is considered to be unique relative to previous literature as it intended to enroll physicians at all the levels of healthcare: primary, secondary at the Egyptian

Ministry of health facilities, and tertiary level at Tanta University teaching hospitals.

Owing to the scarcity of information regarding the hesitancy of health professionals towards the COVID-19 vaccine in Egypt, we sought out to examine the attitudes and acceptability of COVID-19 vaccines between working physicians at different healthcare settings in the El-Gharbia governorate of Egypt, as well to address the underpinnings and their concerns of reluctance to get vaccinated against COVID-19 infection.

Subjects and methods

Study design and setting

A web-based cross-sectional study was conducted from the 1st of March to the end of May 2021, in healthcare facilities at El-Gharbia governorate, the largest one in the Middle Nile Delta region of Egypt. Currently, it has 5,306,767 populations (CAPMAS, Egypt Statistical yearbook 2020).

Study sample

The target population of this study was physicians working at various healthcare levels related to Tanta University teaching hospitals and the Egyptian Ministry of Health and Population (MOHP). Exclusion criteria included physicians who were not on duty, those on special vacation, and those at the retirement age.

The sample size was computed using CDC EPI-INFO 2002 software program. According to the Egyptian Medical Syndicate in the El-Gharbia governorate, the estimated number of actively working physicians was 8317 at the time of the study. Based on recently published literature, the assumed proportion of the expected outcome (vaccination acceptance) was 50% (Shekhar et al. 2021), with a precision of 3%, confidence level of 95%, and margin of error of 0.5%; the minimum calculated sample of 368 physicians was required. However, we then more than tripled the minimum sample size to ensure wide coverage of physicians of different specialties and job ranks, as well as to overcome any invalid questionnaires.

Participants were recruited using both convenient and snowballing sampling techniques. Physicians were contacted by the authors, where an electronic survey link using Google survey form was sent to participants' emails and cellphones. Also, the survey tool was disseminated via links posted on social media platforms of several HCWs groups, and to the administrative managers in various health facilities. Besides, the respondents were encouraged to share the questionnaire with eligible colleagues and friends in their social network

contact lists. This approach was adopted to overcome the implemented social distancing measures due to the pandemic.

By the end of the study period, 1309 questionnaires were obtained, 41 questionnaires were excluded for being invalid, and the overall sample size reached 1268.

Tools of the study

Data were collected using an anonymous self-administered electronic questionnaire which was structured based on reviewing similar literature (Grech et al. 2020; Shekhar et al. 2021). It covered three parts: (i) sociodemographic information; (ii) COVID-19 experience in the form of 3 questions related to personal/familial history of exposure to infection, self-perceived risk of getting COVID-19 infection, and the degree of contact with COVID-19 patients; and (iii) the acceptance of the COVID-19 vaccine which was assessed by 4 questions. The intention to uptake the COVID-19 vaccines was measured using the question "When the COVID-19 vaccination becomes available, would you take it?," and the responses were "No," "Wait for review," and "Yes".

The nature and aim of the work were explained in detail at the beginning of the electronic survey. Before being enrolled, it was declared that they were able to withdraw from the study at any stage. Then, the respondents were kindly asked to fulfill the questionnaire anonymously. Privacy and confidentiality were ensured throughout the survey.

For validation, the developed questionnaire was reviewed by three experts, whose notes and recommendations were taken into consideration. In the current study, the test-retest reliability was good (intra-class correlation = 0.82) and the internal consistency (Cronbach α = 0.89).

Statistical analysis

The analysis of data was conducted using SPSS (IBM) Chicago version 21. Vaccination acceptance was considered the outcome variable. Explanatory variables included demographics, nature of the work, medical comorbidities, previous COVID-19 infection, vaccination history, and self-perceived risk for infection. Descriptive statistics in the form of frequency and percentage were used to present all variables.

The studied participants were divided into three substantial groups based on their acceptance to uptake the vaccine "No," "Wait for review," and "Yes". Pearson Chi-square was deployed to examine the association between the substantial groups of vaccine acceptability and the explanatory variables. When it was not appropriate; Monte Carlo exact test was applied instead. The level of significance (p -value) was adopted at < 0.05 .

Results

Out of 1268 respondent physicians, 71.5% were aged between 31 and 40 years and 59.4% were females. The majority were married and from urban residences. The physicians who worked in urban health facilities represented 77.2%. About 56% of them worked in frontline positions and 43.5% were in a primary medical subspecialty. Most of the respondents had no medical comorbidity (65.9%) and 5.8% reported that they had chronic cardiovascular diseases (CVDs)(Table 1).

Regarding COVID-19 vaccine acceptability, Table 2 shows that 36.7% of studied physicians did not accept to uptake the vaccine when available, 39% would wait for further review, while only 24.3% accept to uptake it. Of respondents, 19.2% and 41.6% reported that they were diagnosed with COVID-19 or one family member was diagnosed with COVID-19 respectively. About one-fifth of physicians would not advise their friends and families to get vaccinated for COVID-19 (21.6%). When they were asked, “Do you think you are at risk for getting COVID-19 during the next 1 year?,” 55% of them answered they believed that they would get mild symptoms that would not require hospitalization. Findings also showed that 32.5% of enrolled physicians directly take care of COVID-19 patients.

Table 3 investigates the demographic characteristics of participated physicians as predictors for vaccine acceptance, and it was noticed that physicians of the youngest age groups, male gender, married ones, and from urban residence significantly accepted to uptake the vaccines (54%, 43.3%, 40%, 40% respectively) compared to related groups. Our findings unveiled that lower educational attainment was significantly associated with vaccination acceptance, where 77.8% of the physician with bachelor's grades accepted to get vaccinated compared to 36.7% of those with doctorate grades. The study detected that vaccine acceptance was significantly higher among physicians who worked in frontline positions and of primary surgical and surgical subspecialty (40.5%, 54.7% respectively). Likely, it was significantly higher between physicians who had someone they knew diagnosed with COVID-19 and had direct contact with COVID-19 patients (47.7%, 40.8%, $p < 0.0001$ respectively). Moreover, all the physicians who believed that they may get severe COVID-19 symptoms that may require admission to the intensive care unit accepted the idea to take the vaccine while the highest refusal rate was among physicians who think that they are immune because they already have the disease (41%). The study revealed a significantly high refusal rate between physicians who had no direct or indirect contact with COVID-19 patients (42.8%).

Table 4 demonstrates that getting the influenza vaccine last year was significantly associated with vaccine acceptability (56.1%, $p = 0.0001$). As well, absence of medical comorbidity, obesity, COPD, and non-smoking status also associated with higher vaccine acceptability (41.2%, 50.9%, 34.5%, 39.4%, $p = 0.014, 0.024, 0.019$ respectively), while high

Table 1 Sociodemographic characteristics of the studied physicians

Variables	<i>n</i> = 1268	Percentage
Age (years)		
18-30	113	8.9
31-40	907	71.5
41-50	200	15.8
51-60	48	3.8
Gender		
Male	515	40.6
Female	753	59.4
Social status		
Single	246	19.4
Married	1022	80.6
Residence		
Urban	1143	90.1
Rural	125	9.9
Healthcare facility		
Urban area	979	77.2
Suburban area	119	9.4
Rural area	170	13.4
Education		
Bachelor degree	54	4.3
Diploma degree	79	6.2
Associate degree	105	8.3
Master's degree	456	36
Doctorate's degree	574	45.3
Nature of work		
Frontline position	715	56.4
Others, no direct patient contact	553	43.6
Primary area of work		
Primary medical and medical subspecialty	551	43.5
Primary surgical and surgical subspecialty	139	11.0
Diagnostic subspecialty	306	24.1
Others	272	21.5
Income		
Not enough	320	25.2
Enough	712	56.2
Enough and saving	236	18.6
Education		
Bachelor degree	54	4.3
Diploma degree	79	6.2
Associate degree	105	8.3
Master's degree	456	36
Doctorate's degree	574	45.3
Medical condition		
No chronic morbidity	835	65.9
Cardiovascular diseases	73	5.8
COPD-lung diseases	29	2.3
Diabetes mellitus	15	1.2
Cancer	3	0.2
Immunocompromised/on immunosuppressant	27	2.1
Obesity	112	8.8
Smoking	25	2.0
Others	149	11.8

refusal rate was detected between physicians who reported having cancer or being immunocompromised (100% and 51.9% respectively).

As shown in Fig. 1, the most frequently reported reasons beyond vaccination unacceptability were fear of adverse side effects followed by the short duration of clinical trials, then safety and efficacy concerns at a rate of 60%, 49.5%, and 33.2% respectively.

Table 2 Risks of COVID-19 infection and vaccine acceptance among the studied physicians ($n=1268$)

Variables	No.	Percentage
Have you or your family member or someone you know been diagnosed with COVID-19?		
I was diagnosed with COVID-19	243	19.2
A family member was diagnosed with COVID-19	528	41.6
Someone I personally know diagnosed with COVID-19	371	29.3
No one I personally know diagnosed with COVID-19	126	9.9
When the COVID-19 vaccination becomes available, would you take it?		
No	465	36.7
Wait for review	495	39.0
Yes	308	24.3
Would you advise friends and family to get vaccinated for COVID-19?		
No	274	21.6
Not sure	496	39.1
Yes	498	39.3
COVID-19 Vaccine for health care workers should be:		
Mandated by employer	65	5.1
Mandated by the government	424	33.4
Not sure	343	27.1
Voluntary	436	34.4
Did you receive the COVID-19 Vaccine?		
No	986	77.8
Yes	282	22.2
Do you think you are at risk for getting COVID-19 during the next 1 year?		
No, I already have the disease and I am immune to it (not diagnosed by PCR).	234	18.5
No, I am sure that I won't get infected.	124	9.8
No, I have already recovered and won't re-infect (diagnosed by PCR).	28	2.1
Yes, I believe I will get mild symptoms that will not require hospitalization.	706	55.7
Yes, I believe I will get moderate symptoms that probably will need hospitalization.	160	12.6
Yes, I believe I will get severe symptoms that will probably require admission to the intensive care unit.	16	1.3
Have you directly or indirectly taken care of COVID-19 patients?		
No	475	37.5
Yes, but with no direct patients' contact	381	30.0
Yes, with patients' contact	412	32.5

Discussion

As COVID-19 vaccines became available, countries put the vaccination of healthcare workers as a priority, due to the importance of their protection. The attitudes of healthcare workers towards vaccination can strongly affect their decision of vaccine intake as well as the opinion and attitude of the general population towards vaccination (Paudel et al. 2021).

Regarding the acceptability of the COVID-19 vaccine among physicians, the present study showed that only 24.3% of the included physicians accepted to take the vaccine when available while 36.7% of them refused to take it and 39% would wait for a review before deciding to take it.

Comparable findings were reported by another study done in Egypt by Fares et al. (2021), as they found that 21% of HCWs were willing to take the COVID-19 vaccine and 28% were not willing while the largest percentage of their participants were found undecided (51%).

Nearly similar findings were found in other countries in Africa by Nzaji et al. (2020) as they found in their study in the Democratic Republic of Congo that about 28% of HCWs were willing to take the COVID-19 vaccines when available.

However, in Ghana, Agyekum et al. (2021) found that 39.3% of HCWs accepted to get the COVID-19 vaccines while more than half of them indicated non-acceptance.

Table 3 Sociodemographic characteristics studied participated physicians as predictors for vaccine acceptance

Variable	No, <i>n</i> =465	Wait for review, <i>n</i> =308	Yes, <i>n</i> =495	Test of significance <i>p</i> -values
Age (years)				
18–30	37(32.7%)	15(13.3%)	61(54%)	$\chi^2=19.2$
31–40	341(37.6%)	219(24.1%)	347(38.3%)	0.004*
41–50	66(33%)	62(31%)	72(36%)	
51–60	21(43.8%)	12(25%)	15(31.2%)	
Gender				
Male	169(32.8%)	123(23.9%)	223(43.3%)	$\chi^2=7.61$
Female	296(39.3%)	185(24.6%)	272(36.1%)	0.02*
Social status				
Single	89(36.1%)	71(28.9%)	86(35%)	$\chi^2=3.94$
Married	376(36.8%)	237(23.2%)	409(40%)	0.13
Residence				
Urban	411(36%)	274(24%)	458(40%)	$\chi^2=5.29$
Rural	54(43.2%)	34(27.2%)	37(29.6%)	0.07
Educational level				
Bachelor degree	6(11.1%)	6(11.1%)	42(77.8%)	$\chi^2=81.32$
Diploma degree	34(43.1%)	20(25.3%)	25(31.6%)	<0.0001*
Associate degree	21(20%)	15(14.3%)	69 (65.7%)	
Master's degree	172(37.7%)	135(29.6%)	149(32.7%)	
Doctorate degree	232(40.4%)	132(23%)	210(36.6%)	
Income				
Not enough	113(35.3%)	91(28.4%)	116(36.3%)	$\chi^2=9.96$
Enough	275(38.6%)	168(23.6%)	269(37.8%)	0.04
Enough and saving	77(32.6%)	49(20.8%)	110(46.6%)	
Nature of work				
Frontline position	238(33.3%)	187(26.2%)	290(40.5%)	$\chi^2=8.4$
Others, no direct patients contact	227(41%)	121(21.9%)	205(37.1%)	0.01*
Primary area of work				
Primary medical and medical subspecialty	195(35.4%)	116 (21 %)	240(43.6%)	$\chi^2=61.6$
Primary surgical and surgical subspecialty	33(23.7%)	30 (21.6%)	76(54.7%)	<0.0001*
Diagnostic subspecialty	149 (48.7%)	90 (29.4%)	67 (21.9%)	
Others	88(32.3%)	72(26.5%)	112(41.2%)	
Health care facility				
Urban area	361 (36.9%)	223 (22.8%)	395 (40.3%)	$\chi^2=12.56$
Suburban area	57 (33.5%)	69 (40.6%)	44 (25.9%)	0.014*
Rural area	47 (39.5%)	41 (34.5%)	31 (26%)	
Have you or your family member or someone you know been diagnosed with COVID-19?				
I was diagnosed with COVID-19	70(28.8%)	96(39.5%)	77(31.7%)	$\chi^2=95.13$
A family member was diagnosed with COVID-19	260(49.3%)	83(15.7%)	185 (35%)	<0.0001*
Someone I personally know diagnosed with COVID-19	93(25.1%)	101(27.2%)	177 (47.7%)	
No one I personally know diagnosed with COVID-19	42(33.3%)	28(22.3%)	56 (44.4%)	
Do you think you are at risk for getting COVID-19 during the next 1 year?				
No, I already have the disease and I am immune to it (not diagnosed by PCR).	96(41%)	55(23.5%)	83(35.5%)	MCET=60.3
No, I am sure that I won't get infected.	43(34.7%)	21(16.9%)	60(48.4%)	<0.0001*
No, I have already recovered and won't re-infect (diagnosed by PCR).	0(0%)	16(57.1%)	12(42.9%)	
Yes, I believe I will get mild symptoms that will not require hospitalization.	268(38.0%)	171(24.2%)	267(37.8%)	
Yes, I believe I will get moderate symptoms that probably will need hospitalization.	58(36.3%)	45(28.1%)	57(35.6%)	
Yes, I believe I will get severe symptoms that will probably require admission to the intensive care unit.	0(0%)	0(0%)	16(100%)	
Have you directly or indirectly taken care of COVID-19 patients?				
No	205(43.2%)	88(18.5%)	182(38.3%)	$\chi^2=24.6$
Yes, but no direct patients' contact	125(32.8%)	111(29.1%)	145(38.1%)	0.0003*
Yes, with patients' contact	135(32.7%)	109(26.5%)	186(40.8%)	

 χ^2 Chi square test, MCET Monte Carlo exact test* $P < 0.05$

In Saudi Arabia, Qattan et al. (2021) in their study found that more than half of their healthcare workers were willing to take the COVID-19 vaccine if it is provided free by their government, while 49.48% were not willing.

A lower percent of vaccine refusal was reported in the USA, as Shekhar et al. (2021) in their study reported that only 8% of HCWs refused to be vaccinated, with a higher percentage of them accepted to take the vaccine (36%) while the

Table 4 Vaccination history and some medical comorbidity of studied physicians by vaccine acceptance

Variable	No, <i>n</i> =465	Wait for review, <i>n</i> =308	Yes, <i>n</i> =495	Test of significance <i>p</i> -values
Getting influenza vaccine last year				
No(<i>n</i> =856)	380(44.4%)	212(24.8%)	264(30.8%)	$\chi^2 = 88.4$
Yes (<i>n</i> =412)	85(20.6%)	96(23.3%)	231(56.1%)	0.0001*
Children received vaccines				
No(<i>n</i> =303)	110 (36.3%)	84 (27.7%)	109 (36%)	$\chi^2 = 8.71$
Yes(<i>n</i> =763)	295 (38.7%)	169 (22.1%)	299 (39.2%)	0.06
No applicable(<i>n</i> =202)	60 (29.7%)	55(27.2%)	87(43.1%)	
Medical comorbidities				
No <i>n</i> =835	284 (34%)	207 (24.8%)	344 (41.2%)	$\chi^2 = 7.89$
Yes <i>n</i> =433	181(41.8%)	101 (23.3%)	151 (34.9%)	0.014*
Cardiovascular disease				
No (<i>n</i> =1195)	436 (36.5%)	293 (24.5%)	466 (39%)	$\chi^2 = 0.65$
Yes <i>n</i> =73	29 (39.7%)	15 (20.6%)	29 (39.7%)	0.7
Diabetes mellitus				
No (<i>n</i> =1253)	459 (36.6%)	302 (24.1%)	492 (39.3%)	$\chi^2 = 2.99$
Yes (<i>n</i> =15)	6 (40%)	6 (40%)	3 (20%)	0.2
COPD-Lung disease				
No (<i>n</i> =1239)	459 (37%)	295 (23.8%)	485 (39.2%)	MCET = 6.75
Yes (<i>n</i> =29)	6 (20.7%)	13 (44.8%)	10 (34.5%)	0.034*
Cancer				
No (<i>n</i> =1265)	462 (36.5%)	308 (24.3)	495 (39.1%)	MCET=6.03
Yes (<i>n</i> =3)	3 (100)	0	0	0.049*
Obesity BMI ≥ 30				
No (<i>n</i> =1156)	430 (37.2%)	288 (24.9%)	438 (37.8%)	$\chi^2 = 7.5$
Yes (<i>n</i> =112)	35 (31.3%)	20 (17.9%)	57 (50.9%)	0.024*
Immunocompromised /on immune-suppressants				
No (<i>n</i> =1241)	451 (36.3%)	301 (24.3%)	489 (39.4%)	$\chi^2 = 3.76$
Yes (<i>n</i> =27)	14 (51.9%)	7 (25.9%)	6 (22.2%)	0.15
Smoking				
No (<i>n</i> =1243)	458 (36.8%)	296 (23.8%)	489 (39.4%)	$\chi^2 = 7.9$
Yes (<i>n</i> =25)	7 (28%)	12 (48%)	6 (24%)	0.019*
Other Medical condition				
No (<i>n</i> =1119)	384 (34.3%)	280 (25%)	455 (40.7%)	$\chi^2 = 22.9$
Yes (<i>n</i> =149)	81 (54.4%)	28 (18.8%)	40 (26.8%)	0.0001*

χ^2 Chi square test, MCET Monte Carlo exact test

**P* < 0.05

greatest percent was the HCW who waited for a review before being vaccinated (56%). Nearly similar percent of vaccine acceptance was reported by Paudel et al. (2021), in Nepal (38.3% of their participants).

A higher percent of COVID-19 vaccines acceptance was detected in the USA as Shaw et al. (2021) found that 58% of HCWs accepted to get the vaccine if available. Also, in Canada and Belgium, the level of COVID-19 vaccine acceptance was high in 48.6% of the physicians, 23 % showed moderate acceptance, while only 28.4% showed hesitancy towards vaccination (Verger P et al.2021). A much higher rate of physicians' acceptance was recorded by a Canadian study,

as Dzieciolowska et al. (2021) found that 80.9% accepted to take the vaccine while only 19.1% refused.

According to the authors' point of view, these differences in willingness to take COVID-19 vaccines among different countries may be attributed to the high prevalence of conspiracy theories about COVID-19 as it was intentionally introduced into the world to get benefits on developing vaccines for it. Also, the spread of misinformation about the quality and safety of COVID-19 vaccines especially among developing countries affects the level of vaccine acceptance among people including physicians and other healthcare workers.

Country	Egypt
Coordinates	30.867°N 31.028°E
Capital	Tanta city
Area	1,942 km ² (750 sq mi)
Population size	5,306,767

Fig. 1 Geographical map for location of El-Gharbia governorate in Egypt (Egypt's Government Services Portal 2021)

The current study showed that 19.2% of the included physicians were diagnosed with COVID-19 and 41.6% had a family member diagnosed with COVID-19. Comparable results were reported by Qattan et al. (2021), in their study among HCWs in Saudi Arabia.

Lower percent of HCWs who were diagnosed or had family members diagnosed with COVID-19 were reported by Paudel et al. (2021) in Nepal (13.9% and 9% respectively) and by Shekhar et al. (2021) in the USA (2.6% and 13% respectively). On contrary, Fares et al. (2021), in their study in Egypt, found that more than one-third of their HCWs were previously diagnosed with COVID-19.

Regarding how the Egyptian physicians perceived the risk of acquiring COVID-19 during the next year, more than half of our included physicians believed that they may get the disease but with mild symptoms that may not require hospitalization. On the other hand, 9.8% were sure that they will not get COVID-19 and only 1.3% believed that they will get a serious disease that may require admission to the intensive care unit.

In the USA, Shekhar et al. (2021) found that the majority of their participants thought that they are at risk to get COVID-19 with a higher percentage than ours of HCWs (21%) who thought that they may be at risk of getting a serious disease that may require hospitalization with less than 8% who were confident that they will not get COVID-19. Furthermore, in

Saudi Arabia, Qattan et al. (2021) found that the majority of HCWs believed that COVID-19 poses a significant risk to the people of Saudi Arabia. These findings may explain the reported higher level of vaccine acceptance among HCWs in the USA and Saudi Arabia more than in Egypt.

Of note that physicians not taking care for COVID-19 patients relatively had a higher rejection rate to uptake the vaccine (43.2%) than those who indirectly or directly contact infected patients (32.8%, 32.7%), probably they believed that they are at lower risk for contracting the infection than their counterparts.

The current study showed that 32.5% of physicians were directly taking care of COVID-19 patients, while about half of the HCWs in the study of Shekhar et al. (2021) had taken care of COVID-19 patients directly.

As regards the sociodemographic characteristics of recruited physicians as predictors for vaccine acceptance, the current study found that the level of COVID-19 vaccine acceptance was higher among the younger physicians, males, married ones, and those who live in urban areas with statistical significance (54%, 43.3%, 40%, and 40% respectively).

In contrary to our findings, Dzieciolowska et al. (2021) found that the level of COVID-19 vaccine was higher among Canadian physicians aged more than 50 years, while they agreed with ours regarding the gender of physicians with high vaccine acceptance.

Also, Shekhar et al. (2021) in the USA reported figures that contradict our age group of physicians with high vaccine acceptance. They found that the acceptance of vaccination against COVID-19 increased with increasing age as 47% aged more than 70 years old. But they agreed with our findings as they found that male HCWs and those in urban areas had higher acceptance of the vaccine (Shekhar et al. 2021).

Also, gender was detected as a predictor of the level of COVID-19 vaccine acceptance among physicians and other healthcare workers in Saudi Arabia as Qattan et al. (2021) found that more males (72.19%) accepted to be vaccinated when available than females but at the same time they did not find any significant difference among different age groups. The same findings were reported by two similar studies conducted in Egypt and Ghana (Fares et al. 202; Agyekum et al. 2021).

The higher likelihood for male physicians to accept to take COVID-19 vaccine than females could be explained by the authors due to the increased perception of males about the risk of the disease more than females.

Regarding the place of work, the present study found that the COVID-19 vaccine acceptance was higher among front-line physicians and of primary surgical and surgical subspecialty with statistical significance (40.5%, 54.7% respectively). The same findings were found in Saudi Arabia by Qattan et al. (2021). This could be due to the perceived risk of contagion infection between frontline HCWs which is high rather than their colleagues in other departments.

In contrary to our results, Dzieciolowska et al. (2021) did not find any association between the COVID-19 vaccine acceptance and the type of workplace.

Moreover, in the present study, all physicians who thought that they will acquire severe COVID-19 symptoms that may need admission to the intensive care unit were willing to get COVID-19 vaccine while the refusal rate was highest among those who believed that they are immune as they already get the disease (41%).

On contrary, Shekhar et al. (2021) reported that only 36% of their HCWs who found themselves at risk to get severe COVID-19 that may require entrance into the intensive care unit were willing to be vaccinated while the highest percent of vaccine refusal was among HCWs who were sure that they would not get COVID-19.

Qattan et al. (2021) in Saudi Arabia found that physicians and other HCWs with low or very low concern about getting COVID-19 infection were less willing to get the vaccine.

In the present study, we found that physicians who got the influenza vaccine in the last year accepted to take the vaccine more than those who did not. As well, the absence of medical comorbidities, obesity, and smoking was associated with higher vaccine acceptability. Similar results were reported by Qattan et al. (2021) in their study, whereas nearly similar findings were found in a study done by Shekhar et al. (2021) except in the effect of smoking as they found that more than half of HCWs with smokers or non-smokers wait for a review before deciding to get COVID-19 vaccine.

Regarding the reasons for not accepting to get COVID-19 vaccine, the present study found that the most frequent reasons for vaccination unacceptability among the included Egyptian physicians were fear of adverse side effects as it was reported by more than half of physicians followed by the short duration of clinical trials performed on the vaccine; then, concerns about the vaccine safety and efficacy were reported by only one-third of physicians (Fig. 2).

Similar findings with the same order of reasons of unacceptance were reported by Qattan et al. (2021) in their study among HCWs in Saudi Arabia.

This was also in agreement with Fares et al.'s (2021) findings in Egypt, as they found that lack of enough clinical trials done on the vaccine before its use was reported as the main cause of vaccine refusal in 92.4% of their participants and fear of its unexpected side effects was in 91.4% of them. Also, the unknown level of its protection or immunity duration and the rumors about the type of available vaccines in Egypt has participated in hindering vaccination acceptance (Fares et al. 2021).

In the USA, Shekhar et al. (2021) found that the most frequent concerns were worries about the vaccine efficacy, side effects, and rapidity of its development. Moreover, some HCWs showed poor trust in the government and regulatory authorities and also in justification of prescribing the vaccine (Shekhar et al. 2021).

Concerns about vaccines' safety, effectiveness, and duration of clinical trials and testing were also reported as common reasons for vaccination hesitancy or unacceptance in other studies done in Australia and the USA (Dodd et al. 2021; Pogue et al. 2020).

All these findings suggest the importance of dissemination of true information about COVID-19 vaccines through medical agencies, governmental authorities, and professional societies, to increase vaccine acceptance and its uptake by physicians and other HCWs (Shekhar et al. 2021).

Conclusions

The level of acceptance of the COVID-19 vaccine among physicians is low; less than a quarter of them was willing to get the vaccine and the rest refused to be vaccinated or chose to wait for further review. Some of the physicians' demographic characteristics such as female gender, increasing

Fig. 2 Reasons for COVID-19 vaccine unacceptance

age, senior staff, less contact with COVID-19 patients, working in rural healthcare facilities, and experience COVID-19 infection were proved to be significant factors associated with vaccine unacceptance. Findings, also revealed that physicians with obesity and lung diseases expressed their intention to uptake the vaccine, whereas those with other medical conditions were not. The low self-perceived risk of getting COVID-19 infection was an underlying determinant for vaccine unacceptance. Fears of the COVID-19 vaccines' adverse effects were the top listed reason underneath the physicians' reluctance to uptake the vaccine.

Limitation of the study

The cross-sectional nature of the study was the first limitation, so that the causality relationship cannot be established. Second, we used a convenient snowballing sampling technique; therefore, the results of the study findings cannot be generalized to the population of healthcare professionals in Egypt. Third, the online survey may lead to a low response rate due to the invited physicians who might either have no internet access or not being motivated to participate in the study.

Recommendations

The present study provides the Egyptian health authorities with data and predictors of COVID-19 acceptance among physicians that can be modified to increase the vaccine uptake among them and in turn the general population. Thus, we could reach the optimum coverage rate of vaccination. Through the findings of this work, we strongly recommend developing awareness campaigns via the governmental health authorities to disseminate reliable and accurate information about the available vaccines, their safety, and efficacy to uncover the existed fears and concerns regarding the vaccines.

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Author contribution WM got the idea of this research, had designed the study methodology, collected the related data, and drafted the manuscript. AA had participated in data collection and writing the manuscript. MM helped in data gathering, performed the statistical analysis of recruited data, and was responsible for the publishing. The manuscript was extensively reviewed by all authors.

Data availability The datasets generated and analyzed during the current study are not publicly available due to the belongingness of these data to the local health authorities in El-Gharbia governorate. However, the

datasets are available from the corresponding author on a reasonable request.

Declarations

Ethics approval and consent to participate Ethical approval was obtained from the Research Ethics Committee at the Faculty of Medicine, Tanta University before the conduction of the study. As well, we get permission from the responsible local Ministry of Health Authorities in El-Gharbia governorate. All procedures performed in the study followed the 1964 Helsinki declaration and its later amendments. The nature and objectives of the study were explained in detail at the beginning of the electronic survey and consent for participation in the study was taken from all individual respondents before being enrolled in the study.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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