Determinants of Acceptance of Coronavirus Disease-2019 (COVID-19) Vaccine Among Lebanese Health Care Workers Using Health Belief Model

Dalal Youssef (✉ dalalyoussef.esu@gmail.com)
    Ministry of Public Health
Linda Abou Abbas
    Ministry of Public Health
Atika Berry
    Ministry of Public Health
Janet Youssef
    Al Zahraa Hospital University Medical center
Hamad Hassan
    Ministry of Public Health

Research Article

Abstract

Background: Since Health care workers (HCWs) are at high occupational risk for COVID-19, they are prioritized for immunization. This study aims to assess the acceptance rate of COVID-19 vaccine among HCWs and to identify its determinants.

Methodology: A web-based cross-sectional study was conducted over the period extending from 10 to 31 December 2020 among Lebanese HCWs. The Health Belief Model (HBM) was used as theoretical framework. Descriptive statistics were reported using frequency with percentages for categorical variables. Bivariate and multivariable logistic regression were carried out to identify the factors associated with the acceptance of COVID-19 vaccine. Adjusted odds ratio and their 95% confidence intervals were reported. The level of statistical significance was set at a p-value < 0.05.

Results: A total of 1800 HCWs have completed the survey. Around half of them were frontliners aged between (30-49) years old. About two third (67.33%) have received their influenza vaccine this year. The acceptance rate of COVID-19 vaccine among surveyed HCWs was 58%. Being a male (aOR=1.988, 95% CI (1.411-2.801)), working in the frontline (aOR=1.610, 95% CI (1.173-2.209), and having received influenza vaccination this year (aOR=1.378, 95% CI(0.990-1.916))were significantly associated with higher COVID-19 vaccine acceptance. However, living in rural area (aOR=0.606, 95%CI (0.440-0.836)), personal history of COVID-19 (aOR=0.695, 95%CI (0.470-1.029), novelty of vaccine (aOR=0.424, 95% CI (0.255-0.706)), side effects (aOR=0.413, 95%CI (0.234-0.731), reliability of manufacturer (aOR=0.434, 95% CI (0.297-0.633) and vaccine frequency (aOR=0.580, 95% CI (0.403-0.836) were negatively associated with the willingness to take it. Remarkably, limited availability (aOR=2.161, 95% CI(1.461-3.197) and accessibility (aOR=1.680, 95% CI (1.141-2.474) to the vaccine were also positively associated to its uptake. Similarly, HCWs who perceived vaccine benefits were more likely to get vaccinated (aOR=11.048, 95% CI (7.993-15.269)). With regards to cues of action, having reliable and adequate information regarding the vaccine (aOR=1.979, 95% CI (1.361-2.878)), recommendation by health authorities (aOR=1.976, 95% CI(1.343-2.908)) or health facilities (aOR=2.684, 95% CI(1.804-3.994)) were positively linked to vaccine acceptance, whilst recommendation by family members (aOR=0.479, 95% CI(0.283-0.811)) was negatively related to it.

Conclusion:

Pointing out the factors driving moderate vaccine acceptance among HCWs via targeting messages addressing key concerns would be required to reach higher vaccination rate.

Background

Coronavirus disease 2019 (COVID-19) has instigated a public health and economic calamity worldwide [1]. It continues to inflict substantial morbidity and mortality despite intervention efforts. As of 20 January 2021, there have been over 85 million cases and 1.8 million deaths reported [2]. To control the blowout of COVID-19, countries have focused their efforts on slowing the spread of the disease by adopting a variety of non-pharmaceutical interventions, including travel restriction, schools' closure, remote schooling, forced quarantine, and lockdown [3]. Despite that these measures are considered essential in the short-term, a long-lasting solution represented by vaccines is urgently needed to dramatically lessen the mortality burden and conceivably halt local transmission [4].

Considering this fact, numerous pharmaceutical companies were preemptive, as they took the initiative to started vaccine development since the early phase of the pandemic, which coincided with the publication of the first genome sequence of the Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [5]. Several prophylactic vaccines against COVID-19, including mRNA-based vaccine, DNA-based vaccines, inactivated, live attenuated, sub-unit, and replicating or no replicating viral vector-based vaccines are being developed across multiple countries [6]. Fortunately, the rapid development of many promising vaccines was crowned in the final weeks of 2020 by the first authorization and shipping of doses [7]. Correspondingly, many countries have authorized the emergency use of COVID-19 vaccines [8].

However, limited COVID-19 vaccine supply combined with the vibrant discrepancies in the transmission dynamics and seriousness of COVID-19 across groups will be extremely challenging for the first several months of the vaccination campaign[9]. Accordingly, it urges the need to establish an effective policy for COVID-19 vaccine allocation based on a deep understanding of the current epidemiological characteristics of COVID-19 [10]. This information includes key factors of group heterogeneity such as susceptibility to get COVID-19, the severity of outcomes, and contact rates. However, vaccination policy against influenza could not be used as a mirror for the ongoing COVID-19 pandemic. This can be due to the sharp variances in the epidemiology of the 2 viruses. For example, lower susceptibility to infection among children and adolescents and a substantial higher fatality rate that increases evidently with age is associated with COVID-19 [11].

Given the evidence of ongoing COVID-19 infections among HCWs and the high occupation risk encountered by them particularly those working in the frontline, the need to protect them is considered a national priority [12]. Besides, their role in providing care to patients and the negative impact resulting from their sickness if they got COVID-19 on medical services provided by health facilities, they can provoke nosocomial outbreak by spreading the virus to those they are caring for hospitalized patients and residents of health facilities [13].

Early vaccine access for HCWs is critical to ensuring their health and safety, thus protecting their patients, families, communities, and the broader health of our country. Based on the Values Framework and Population Prioritization Roadmap, issued by a World Health Organization (WHO) advisory group on immunization, countries that plan to roll out COVID-19 should prioritize health care workers (HCWs) and other at-risk populations for vaccination [14].

In Lebanon, since the early phase of vaccine development, national efforts were engrossed in securing the country's portion of the COVID-19 vaccine through negotiation conducted with Pfizer/BioNtech Company. The vaccine is intended to reach Lebanon by mid-February 2021 and the expectable supply will cover 15% of the population. The vaccine will be provided for free for the population following a voluntary process. In addition, the COVAX platform will cover 20% of the population [15]. As of March 2, 2021, there were more than 2567 confirmed COVID-19 cases and 45 deaths reported among HCWs in Lebanon [16]. Similarly, to other countries and based on the current epidemiological data, the MOPH has prioritized the COVID-19 vaccination for all HCWs. Hence, it is crucial that government start to gauge current levels of willingness to receive a potentially safe and effective COVID-19 vaccine among HCWs and to identify determinants of acceptance and refusal of the vaccine [17].

The objectives of this study were to assess the acceptance rate of the COVID-19 vaccine among HCWs and to evaluate the perceived susceptibility to COVID-19, perceived severity of COVID-19 infection, perceived benefits, barriers of COVID-19 vaccine, and appraise participants' cues to action and self-efficacy. In addition, we sought to identify the determinants of participants' intention to receive the COVID-19 vaccine.

Methods

Study tool and design:

A cross-sectional study, using an online survey, was conducted during the early phase preceding the arrival of the COVID-19 vaccine in Lebanon between 10th and 31st December 2020. As the Lebanese government recommended the public to minimalize face-to-face interaction, potential respondents were electronically invited to participate.

Questionnaire development

An extensive review of the literature was conducted to list available resources on acceptance of vaccine, as well as to identify relevant items and scales on vaccination. The Health Belief Model (HBM), used extensively in vaccination research to study vaccination behaviors and to identify participant perceptions towards disease and vaccination was adopted as a theoretical framework in this study in order to assess HCWs drives for receiving COVID-19 vaccine [18]. It comprises six key domains which impact willingness to vaccinate: perceived susceptibility to COVID-19, perceived severity of COVID-19 infection, perceived benefits of COVID-19 vaccine, perceived barriers of COVID-19 vaccine, cues to action, and self-efficacy [19].

A 72-item questionnaire was developed to assess the study objectives. A structured questionnaire was initially developed and designed by the authors to cover important aspects of COVID-19 vaccination among HCWs based upon the HBM (Supplement file 1).

A panel of experts has reviewed the developed questionnaire and assessed the clarity of the questions, interpretability, and accuracy of the domains. Then he original English draft of the questionnaire was translated and adapted to the Arabic language based on standard translation guidelines [20]. The questionnaire was pre-tested among 20 HCWs for survey flow, functionality, readability, comprehension of instructions, and clarity. Based upon feedback from the pre-test, minor modifications regarding readability and clarity were made to the questionnaire. Furthermore, the reliability of the questionnaire was checked, and the Cronbach Alpha value was 0.82. The average time for filling the survey was 8 minutes. The questionnaire was self-administered and consisted of open-ended questions. It was divided into seven domains:

1. **Baseline information of participants:** including age, gender, marital status, urbanicity, and specialty, place of work, clinical experience, health status, underlying conditions, household size, household income, religiosity, and health coverage. Participants were also asked whether they have a child at home or they live with an elderly or someone having comorbidities. Besides, they were asked if they have ever contracted COVID-19 or they have one family member or colleague previously infected with COVID-19. They were also asked if they have received the influenza vaccine and if they have refused any kind of vaccination previously.
2. **The perceived susceptibility to COVID-19 section.** It consists of 4 questions addressing HCW's views about their risk of getting COVID-19 [21].
3. **The perceived severity section** consists of 5 questions that relate to the patient's concerns about the seriousness of COVID-19.
4. **The perceived benefits section** comprises 7 questions linked to the perceived outcomes of getting vaccinated against COVID-19 to reduce their susceptibility to or severity of the illness [22].
5. **Perceived barriers** consist of 13 questions that identify patient's concerns or negative beliefs about COVID-19 vaccines. Responses to questions related to perceived susceptibility, severity, benefits, and barriers were graded on a 3-point Likert scale, an agreement scale ranging from '1' for disagree to '3' agree.

6. **The cues to action section** comprise 7 questions addressing strategies or information sources that promote the willingness to get the COVID-19 vaccine. Responses to statements related to cues of action were sorted on a 3-point Likert scale, an agreement scale ranging from '1' for No, '2' Not sure and '3' Yes.
7. **The self-motivation section** comprised 2 statements that addressed HCW's willingness to improve his health, e.g., adopting a healthy lifestyle. Responses to questions related to self-motivation were graded on a 3-point Likert scale, an agreement scale ranging from '1' for never to '3' all the time[23].
8. **Knowledge about vaccine section** consists of 8 questions assessing awareness of HCWs about COVID-19 vaccine. All the items were answered on a true/false basis and an additional "do not know" option. A correct response had a value of '1' and a "wrong" or don't know response had a value of '0'. Hence, the aggregate score for all 8 knowledge questions would range from 0 to 8 points. Participants 'overall knowledge was categorized using modified Bloom's cut-off point, as good if the score was >60% (5–8 points), and poor if the score was less than 60% (< 5 points)

Participants were also requested to indicate their intention to receive the COVID-19 vaccine and to rank the reliability of information sources.

Sample size calculation

To calculate the sample size of the study, the Raosoft sample size calculator designed specifically for population surveys was used. Assuming that between 50000 registered HCWs, 40000 of them are actively practicing at the health facilities level, a 95% confidence level was used and an absolute error was estimated to be 5%. All previous information was used to calculate the sample size for this study which yielded the least required sample size of 381 participants. The required sample size was achieved at an early stage before the closure of response acceptance (January 1st, 2021).

Data collection

An online questionnaire using a Google form was emailed to governmental run and private hospital directors. Then, designated focal persons working in Lebanese hospitals were contacted via phone call and notified about the survey and its purpose. Upon their agreement to participate, the link of the study was sent through "WhatsApp" to the designated focal person (infection control personnel) who was requested in his turn to disseminate it among other HWCs facilities. This link included a brief introduction to the background, the objective of the survey, and instructions for filling the questionnaire.

HCW is defined as: any regulated health professionals and any staff member, or other essential caregiver currently working in a health care organization, including cleaning staff, food services staff, and other administrative staff [24]. Participants were identified via the infection control personnel at the hospital. All HWCs, working in Lebanese hospitals in different provinces in Lebanon and who agreed to participate to the study, were eligible for participation.

Ethical considerations

An oral informed consent was obtained for each participant. They were reassured that their participation is voluntary and that they were free to withdraw at any time. In addition, all information were gathered anonymously and handled confidentially. The questionnaire was collected only in subjects who expressed consent for study participation. As individual participants cannot be identified based on the presented material, this study caused no plausible harm or stigma to participants. The study design assured adequate protection of study participants, and neither included clinical data about patients nor configured itself as a clinical trial. Hence, this study was exempted from ethical approval of the ministry of Public Health.

Statistical analysis

The data were analyzed using the statistical software SPSS (Statistical Package for Social Sciences), version 22.0. Descriptive statistics were reported using frequency with percentages for categorical variables. Bivariate analysis was performed to examine factors associated with the dependent variable (willingness to vaccinate) and the demographic variables in addition to the domains of HBM. The relation between nominal variables was tested using the chi-squared test. The variables in bivariate analysis with p-value < 0.2 were entered into multivariable logistic regression. Adjusted odds ratio and their 95% confidence intervals were reported. The final logistic regression model to determine the predictors of willingness to vaccinate was reached after confirming the adequacy of the data using the Hosmer and Lemeshow test. The level of statistical significance was set at a p-value < 0.05.

Results

A total of 1800 HCWs completed the survey. The majority of participants were female 1209 (67.1%) and around half of them were aged between (30-49) years old (Table 1). About two third of the HCWs were married (62.6%) and reside in urban area (61.4%). The higher

participation rate was among nurses (48.9%). They mostly had a good health status (81.4%) and were covered by a public insurance (79.60%). Only 22% of HCWs suffered from comorbidities. Approximately all the participants (91.9%) reported having a colleague infected by COVID-19 and only 20.9% of them reported being infected by COVID-19. More than half of the participants (58.10%) were frontliners in the response to COVID-19.

Only 45.4% of surveyed HCWs have received influenza vaccine in the past season whereas 67.33% of them declared that they got vaccinated against influenza during the current season. Only 18.94% of them had reported that they refused a type of vaccine other than influenza in the past. However, only 58% of surveyed HCWs said that they would get vaccinated if the COVID-19 vaccine was available (figure 1). Figure 2 showed that the intention of HCWs to receive COVID-19 vaccine increased with age. Variance in acceptance rate of COVID-19 vaccine was identified also between geographical areas where Akkar reported the lowest rate (42.6%), compared to Beirut (Capital) that ranked the top (Figure 3).

Of the total, 86.5% of participants perceived themselves susceptible to get COVID-19 due to their occupational exposure and 91.6% of them considered that healthy people can get COVID-19. Only half of them declared that they can protect themselves better than other people. More than 90% of HCWs agreed that COVID-19 makes some people ill and could be fatal and 85.6% considered that COVID-19 is more serious than influenza. Only 29.3% of them thought that they will be very ill if they contracted COVID-19, 30.7% stated that they may need hospitalization and 21.7% pondered that they might die (Table 2).

Table 3 displayed perceived benefits and barriers of COVID-19 vaccination by HCWs. Around half of them agreed that vaccination is a good idea because it makes them feeling less worried about catching COVID-19, it decreases their chance of getting COVID-19 or its complications. They reported that if they got vaccinated, they could protect their close environment (patients, family and friends) from the infection and the whole community in wider range. The major perceived barriers cited by HCWs for COVID-19 vaccine were the novelty, the side effects, the efficacy and the safety of the vaccine.

Table 4 summarized cues of action that promote willingness to get COVID-19 vaccine. The majority of HCWs (64.3%) stated that they will take the COVID-19 vaccine if they had reliable information about it and 47.7% of them will took the vaccine if it is recommended by the health authorities. Third quarter of respondents said that they frequently did things on their own to improve their health (healthy diet, physical diet…) and followed yearly physical examinations in addition to visits related to illness.

Table 5 displayed the HCWs responses to the knowledge items related to the vaccine. Approximately two quarters of them (76.8%) were found to be knowledgeable about the basic information related to COVID-19 vaccines (Figure 4).

Table 1: Baseline characteristics of the study participants (N=1800)		
	n	%
Gender		
Male	593	32.90%
Female	1209	67.10%
Age		
18-29 years	651	36.20%
30-49 years	904	50.20%
>50 years	245	13.60%
Marital status		
Single	618	34.30%
Married/Engaged	1127	62.60%
Other (Divorced or Widowed)	55	3.10%
Urbanicity		
Rural	695	38.60%
Urban	1105	61.40%
Occupation		
Physician	382	21.20%
Nurse	880	48.90%
Pharmacist	124	6.90%
Administrative	206	11.40%
Others (Midwife, Lab technician...)	208	11.6%
Health status		
Fair and Below	335	18.60%
Good and above	1465	81.40%
Presence of underlying health condition		
Yes	396	22.00%
No	1404	78.00%
Presence of child at home		
Yes	1000	55.60%
No	800	44.40%
Presence of elderly people at home		
Yes	852	47.30%
No	948	52.70%
Health insurance		
Public	1433	79.60%
Private	220	12.20%
None	147	8.20%
Working in frontline in the response to COVID-19		
Yes	1045	58.10%

No		755	41.90%
Personal history of COVID-19 diagnosis			
Yes		377	20.90%
No		1423	79.10%
Family member/friend ever diagnosed with COVID-19			
Yes		713	39.60%
No		1087	60.40%
Colleague ever diagnosed with COVID-19			
Yes		1654	91.90%
No		146	8.10%
Total		1800	100%

Figure 5 displayed the reliability of sources of information used by HCWs. International Health Websites (WHO…) and scientific articles were ranked the most reliable sources, while family and friends were listed the least trusted information sources.

Logistic Regression:

Table 6 presents the multivariable logistic regression of the factors associated with COVID-19 vaccine acceptance. Our results showed that being a male (aOR=1.988, 95% CI (1.411-2.801)), working in the frontline (aOR=1.610, 95% CI (1.173-2.209), and having received influenza vaccination in the current season (aOR=1.378, 95% CI(0.990-1.916))were significantly associated with higher COVID-19 vaccine acceptance. However, living in rural area (aOR=0.606, 95%CI (0.440-0.836)) and having personal history of COVID-19 (aOR=0.695, 95%CI (0.470-1.029) were negatively associated to the COVID-19 vaccine uptake. Similarly, the vaccine acceptance was lower in HCWs who perceived barriers such us novelty of vaccine (aOR=0.424, 95% CI (0.255-0.706)), side effects (aOR=0.413, 95%CI (0.234-0.731), reliability of manufacturer (aOR=0.434, 95% CI (0.297-0.633) and vaccine frequency (aOR=0.580, 95% CI (0.403-0.836). Remarkably, limited availability (aOR=2.161, 95% CI(1.461-3.197) and accessibility (aOR=1.680, 95% CI (1.141-2.474) to the vaccine were positively associated with high vaccine uptake. Likewise, HCWs who perceived vaccine benefits were 11 times more likely to get vaccinated (aOR=11.048, 95% CI (7.993-15.269)) than their counterparts, it is the main driver of vaccine uptake. With regards to cues of action, having reliable and adequate information regarding the vaccine (aOR=1.979, 95% CI (1.361-2.878)), recommendation by health authorities (aOR=1.976, 95% CI(1.343-2.908)) or health facilities (aOR=2.684, 95% CI(1.804-3.994)) were positively linked to vaccine acceptance, whilst recommendation by family members (aOR=0.479, 95% CI(0.283-0.811)) was negatively related to it.

Table 2: Perceived susceptibility and severity of COVID-19		Disagree	Neutral	Agree
		n(%)	n(%)	n(%)
	Perceived susceptibility to COVID-19			
S1	I am susceptible of getting infected due to my occupational exposure	46(2.6%)	197(10.9%)	1557(86.5%)
S2	There is a great chance to get infected by COVID-19 in the next coming months especially during winter	119(6.6%)	430(23.9%)	1251(69.5%)
S3	Healthy people can get COVID-19	47(2.6%)	104(5.8%)	1649(91.6%)
S4	My health status makes me more susceptible to contract COVID-19	897(49.8%)	526(29.2%)	377(20.9%)
S4	I believe that I can protect myself against COVID-19 better than other people	242(13.4%)	614(34.1%)	944(52.4%)
	Perceived severity and seriousness			
Sev1	Although for most people, COVID-19 causes mild illness, it makes some people very ill and can be fatal	24(1.3%)	140(7.8%)	1636(90.9%)
Sev2	I think COVID-19 is more serious than seasonal influenza	81(4.5%)	178(9.9%)	1541(85.6%)
Sev3	I will be very sick if I get COVID-19	345(19.2%)	927(51.5%)	528(29.3%)
Sev4	If I get COVID-19, I might require hospitalization	415(23.1%)	832(46.2%)	553(30.7%)
Sev5	If I get COVID-19, I might die	520(28.9%)	890(49.4%)	390(21.7%)

Table 3: HCW's perception of benefits and barriers of COVID-19		Disagree	Neutral	Agree
		n(%)	n(%)	n(%)
	Perceived benefits			
I1	Vaccination is a good idea because it makes me feel less worried about catching COVID-19	421(23.4%)	464(25.8%)	915(50.8%)
I2	Vaccination decreases my chance of getting COVID-19 or its complications	326(18.1%)	513(28.5%)	961(53.4%)
I3	Vaccines are considered between the most tested and safe medical products	327(18.2%)	658(36.6%)	815(45.35)
I4	When I get vaccinated, I protect my patients, family and friends from infection	330(18.3%)	540(30%)	930(51.7%)
I5	When I get vaccinated, the whole community benefits by preventing the spread of COVID-19	285(15.8%)	536(29.8%)	979(54.4%)
I6	COVID-19 vaccination is an effective way to prevent and control COVID-19	251(13.9%)	541(30.1%)	990(55%)
I7	High vaccination coverage globally is required to stop COVID-19 pandemic	225(12.5%)	571(31.7%)	1004(55.8%)
	Perceived barriers			
B1	I am concerned about the novelty of vaccine (not used before)	151(8.4%)	386(21.4%)	1263(71.1%)
B2	I am concerned about the side effects of COVID-19 vaccine	134(7.4%)	330(18.3%)	1336(74.2%)
B3	I am concerned about the efficacy of COVID-19 vaccine	193(10.7%)	342(19%)	1265(70.3%)
B4	I am concerned about the safety of COVID-19 vaccine	156(8.7%)	371(20.6%)	1273(70.7%)
B5	I am concerned about the cost of COVID-19 vaccine (willingness to pay)	429(23.8%)	539(29.9%)	832(46.2%)
B6	I am concerned about the accessibility of COVID-19 vaccines (geographical distribution of sites)	529(29.6%)	563(31.3%)	708(39.3%)
B7	I am concerned about the availability of COVID-19 vaccine in limited quantities for limited categories of the population	239(13.3%)	475(26.4%)	1086(60.3%)
B8	I am concerned whether if the COVID-19 vaccine is halal	862(47.9%)	546(30.3%)	392(21.8%)
B9	I am concerned about the reliability of the manufacturer and the source of supply	329(18.3%)	573(31.8%)	898(49.9%)
B10	I am concerned about Lebanese health system, and the strategy of distribution of the vaccines	157(8.7%)	452(25.1%)	1191(66.2%)
B11	I am concerned about vaccine mode of administration (needles use...)	709(39.4%)	518(28.8%)	573(31.8%)
B12	I am concerned about vaccine frequency (number of doses required....)	510(28.3%)	559(31.1%)	731(40.6%)
B13	I am concerned about immunity duration (how much time I will be protected)	156(8.7%)	493(27.4%)	1151(63.9%)

	Table 4: Cues of action and Health motivation			
	Cues of action	Disagree	Neutral	Agree
		n(%)	n(%)	n(%)
C1	I will only take the COVID-19 vaccine if I was given adequate and reliable information about it	326(18.1%)	317(17.6%)	1157(64.3%)
C2	I will only take the COVID-19 vaccine if the vaccine is recommended by the health facilities	515(28.6%)	445(24.7%)	840(46.7%)
C3	I will only take the COVID-19 vaccine if the vaccine was recommended by a family member (relatives...)	1146(63.7%)	460(25.6%)	194(10.8%)
C4	I will only take the COVID-19 vaccine if the vaccine is recommended by the health authorities	549(30.5%)	393(21.8%)	858(47.7%)
C5	I will take COVID-19 vaccine if the vaccine is recommended by the media	1324(73.6%)	357(19.8%)	119(6.6%)
C6	I will take the COVID-19 vaccine if the vaccine is recommended by my work	741(41.2%)	479(26.6%)	580(32.2%)
C7	I will take the COVID-19 vaccine if the vaccine is taken by many in the public	765(42.5%)	531(29.5%)	504(28%)
		Never	Occasionally	All the time
		n(%)	n(%)	n(%)
	Health motivation			
H1	I frequently do things on my own to improve my health	61(3.4%)	388(21.6%)	1351(75.1%)
H2	I have the recommended yearly physical examinations in addition to visits related to illness	86(4.8%)	339(18.8%)	1375(76.4%)

	Table 5: HCWs' responses Knowledge items			
		Correct	Incorrect	I Don't Know
		n(%)	n(%)	n(%)
	Knowledge about vaccine			
K1	Vaccines are effective in combating highly contagious diseases [c]	1307(72.6%)	97(5.4%)	396(22%)
K2	Traditionally, vaccines create immunity by introducing a weak form of an infectious agent that allows the immune system to build a memory against this agent [c]	1358(75.4%)	44(2.4%)	398(22.1%)
K3	The RNA and DNA vaccines give our bodies the genetic code it needs to allow our immune system to produce the antigen on its own [c]	972(54%)	83(4.6%)	745(41.4%)
K4	Covid-19 vaccines are being developed as quickly as possible, but they were required receive the necessary regulatory licenses [c]	740(41.1%)	157(8.7%)	903(50.2%)
K5	The flu vaccine protects against covid-19 [F]	1283(71.3%)	78(4.3%)	439(24.4%)
K6	People with chronic diseases and elderly are more likely to have the disease and its complications, so they should get the vaccine [c]	1334(74.1%)	135(7.5%)	331(18.4%)
K7	Young people are healthy and therefore do not need to follow preventive measures and to get the vaccine in order to protect themselves against Covid-19 [F]	1447(80.4%)	138(7.7%)	215(11.9%)
K8	Until the readiness and the availability of COVID-19 vaccine, we cannot do anything to tackle the disease [F]	1185(65.8%)	331(18.4%)	270(15%)

Table 6: Multivariable logistic regression of the factors associated with COVID-19 vaccine acceptance

	Acceptance of vaccine				95% CI for aOR	
No	**Yes**	**P-value**	**aOR**			
n (%)	**n (%)**				**Lower**	**Upper**
Gender			<0.001			
Female	588(48.7%)	619(51.3%)		1.00		
Male	161(27.2%)	432(72.8%)		1.988	1.411	2.801
Urbanicity			0.002			
Urban	451(40.8%)	654(59.2%)		1.00		
Rural	298(42.9%)	397(51.7%)		0.606	0.440	0.836
Working in frontline in the response to COVID-19			0.003			
No	393(37.6%)	652(62.4%)		1.00		
Yes	356(47.2%)	399(52.8%)		1.610	1.173	2.209
Personal history of COVID-19 infection			0.032			
No	571(40.1%)	852(59.9%)		1.00		
Yes	178(47.2%)	199(52.8%)		0.659	0.450	0.965
Received vaccination against influenza in the current season			0.047			
No	296(50.3%)	292(49.7%)		1.00		
Yes	453(37.4%)	759(62.6%)		1.378	0.990	1.916
Refusal of any type of vaccination in the past			0.039			
No	222(65.1%)	119(34.9%)		1.00		
Yes	527(36.1%)	932(63.9%)		0.695	0.470	1.029
Novelty of the vaccine (not used before)			0.001			
Disagree	81(15.2%)	453(84.8%)		1.00		
Agree	668(52.8%)	598(47.2%)		0.424	0.255	0.706
Side effects of COVID-19 vaccine			0.002			
Disagree	64(13.8%)	400(86.2%)		1.00		
Agree	685(51.3%)	651(48.7%)		0.413	0.234	0.731
Accessibility of COVID-19 vaccines (distribution of sites)			0.009			
Disagree	566(51.8%)	526(48.2%)		1.00		
Agree	183(25.8%)	525(74.2%)		1.680	1.141	2.474
Availability of COVID-19 vaccine in limited quantities			<0.001			
Disagree	455(63.7%)	259(36.3%)		1.00		
Agree	294(27.1%)	792(72.9%)		2.161	1.461	3.197
Reliability of the manufacturer and the source of supply			<0.001			
Disagree	253(28%)	649(72%)		1.00		
Agree	496(55.2%)	402(44.8%)		0.434	0.297	0.633
Vaccine frequency (number of doses needed...)			0.003			
Disagree	383(35.8%)	686(64.2%)		1.00		
Agree	366(50.1%)	365(49.9%)		0.580	0.403	0.836

I will take the COVID-19 vaccine if i was given adequate and reliable information about it			<0.001		
Disagree	419(65.2%)	224(34.8%)	1.00		
Agree	330(28.5%)	827(71.5%)	1.979	1.361	2.878
I will take the COVID-19 vaccine if the vaccine is recommended by the health facilities			<0.001		
Disagree	581(60.5%)	379(39.5%)	1.00		
Agree	168(20%)	672(80%)	2.684	1.804	3.994
I will take the COVID-19 vaccine if the vaccine was recommended by a family member (relatives...)			0.006		
Disagree	699(43.5%)	907(56.5%)	1.00		
Agree	50(25.8%)	144(74.2%)	0.479	0.283	0.811
I will take the COVID-19 vaccine if the vaccine is recommended by the health authorities			<0.001		
Disagree	596(63.3%)	346(36.9%)	1.00		
Agree	153(17.8%)	705(82.2%)	1.935	1.331	2.813
Perceived benefits scale			<0.001		
Non beneficial	646(77.6%)	186(22.4%)	1.00		
Beneficial	98(10.3%)	852(89.7%)	11.048	7.993	15.269
***p*-value<0.05** is considered significant, aOR: Adjusted Odds Ratio					

Discussion

As the COVID-19 continues to swiftly evolve into a full-blown pandemic, Lebanon is planning to initiate the first round of immunization within the first quarter of this year, slated HCWs and the elderly to be an early recipient of the COVID-19 vaccine. Since HCWs are at high occupational risk for COVID-19 and will be responsible to administer and recommend vaccines to their patients and the general population, hence the importance of gauging their willingness to get vaccinated and to identify the determinants of their COVID-19 vaccine acceptance. Besides, it allows us to proactively develop the appropriate interventions, particularly during the current flood of misinformation about the safety of the vaccine. To the best of our knowledge, this is the first large national study investigating both determinants of COVID-19 vaccine uptake among HCWs as well as their willingness to get the vaccine.

Our findings showed that 20.9% of surveyed HCWs reported a personal history of COVID-19 infection and 91.9% of them had a colleague infected by COVID-19. However, this infectiousness rate among Lebanese HCWs was higher than the reported rate in Qatar, where a study conducted among 16,912 HCWs revealed that10.6% of HCWs were positive for COVID-19 and an exposure to a colleague (45%) or a patient was stated [25]. In India, a study reported an 11% prevalence of COVID-19 infection among HCWs [26]. This could be due to the lack of sufficient personal protective equipment (PPEs) at facilities, their proper use and poor adherence to other infection control measures. Therefore, our results underline the need of effective HCWs protection.

More than half of our participants were working in the frontline of the response to COVID-19. Since many studies emphasized a significant amplified risk of COVID-19 infection among frontliners who are in direct contact with COVID-19 patients compared to the general community [27], there is an urgent need to improve the acceptance of COVID-19 vaccine particularly among this category.

The study's main findings are that nearly 58% of surveyed participants were willing to receive the COVID-19 vaccine. Our results were consistent with the findings displayed in a systematic review regarding acceptability of COVID-19 vaccine which found that the proportion of HCWs that intent to accept COVID-19 vaccination was 55.9% with a wide range among studies from 27.7% to 81.5%. In United States of America (USA), a recent preprint research paper reports that vaccine acceptance is low even among HCWs [28]. This willingness to get vaccinated increased with age. Our results are concordant with those of a study conducted in DR Congo among HCWs [29]. An increase of acceptance of vaccine among older HCWs may be due to the fear expressed by elderly, given the serious complications and deaths recorded amongst them. Geographical variation in vaccine acceptance was also found in our survey. Peripheral areas such as Akkar province had the lowest acceptance rate comparing to the capital (Beirut).

One noteworthy finding in the present study is that influenza vaccination coverage during the current season escalates to 67.3% comparing to the past season where only 45.4% of surveyed HCWs have received their influenza vaccine. This could be due to the fact that public health experts highlight the importance of influenza vaccine during the COVID-19 pandemic which overlapped with the influenza season. It is also indicating a generally promising perception of vaccination. However, only 18.94% of them had reported that they have previous experience of refusal of a type of vaccine other than influenza. This behavior defined as vaccine hesitancy could be related to confidence issues, complacency and convenience [30].

Concerning HCWs' perception of susceptibility, the majority of participants perceived themselves susceptible to get COVID-19 due to their occupational exposure. A risk perception assessment of COVID-19 among Portuguese HCWs showed that 54.9% perceived themselves at a high likelihood of becoming infected [31]. Another study conducted in USA showed that HCWs, particularly nurses, have a higher prevalence of SARS-CoV-2 infection than non-health care workers, according to researchers at Rutgers [32].

Notably, 91.6% of HCWs considered that healthy people can get COVID-19 infection and could need hospitalization. These findings were in line with the outcomes of a study conducted among more than 3,000 adults aged between 18 and 34 years who contracted COVID-19 and required hospitalization. Researchers reported that 21% of them ended up in intensive care, 10% were placed on a breathing machine and 2.7% died [33] On the other hand, only half of them declared that they can protect themselves better than other people. One possible explanation could be that this proportion of HCWs consider themselves more aware and knowledgeable of the latest information of COVID-19 pandemic. Their skills, received training and their adherence to basic infection prevention measures such as basic hygiene (hand and cough etiquette), the availability and adequate use of protective personal equipment make them feeling safer and more protected against infectious diseases. Indeed, HCWs were mentioned as the 'canary in the mine'.

More than 90% of HCWs agreed that COVID-19 makes some people ill and could be fatal and 85.6% considered it more serious than influenza [34]. In this regard, many health experts highlighted the large numbers of susceptible people due to the slight preexistent immunity to the virus that causes COVID-19 infection which allows it to blowout so easily and increasing rates of severe disease and deaths.

Only 29.3% of them thought that they will be very ill if they contracted COVID-19, 30.7% stated that they may need hospitalization and 21.7% pondered that they might die. Our results were consistent with the findings of a study conducted in China, which revealed that the proportion of HCWs with severe illness was high in early January 2020 then decreased reflecting more steady adoption of IPC [35]. However, severe illness among HCWs continues to be reported, suggesting that the use of currently approved infection control processes do not entirely prevent severe COVID-19 among HCWs.

Our participants mentioned that the main benefits of getting vaccinated against COVID-19 include decreasing their fears about catching COVID-19, decreasing their chance of getting infected or presenting complications, protecting their patients and family members and preventing the spread of COVID-19 at community level. This comes in consistency with the findings of a study conducted among Chinese population who perceived the same benefits [36].

The main barriers cited by HCW's that could hamper their willingness to vaccinate against COVID-19 were their concerns about novelty, side effects, efficacy, and the vaccine safety. There are vigorous testing trials in place to warrant that approved COVID-19 vaccines are both effective and safe [37]. Bearing in mind that all kind of therapies, including vaccination, has risks. Addressing the extent of those risks presents a biggest challenge in the development of the COVID-19 vaccine .

In terms of gender, our results also revealed some interesting results, males were 2 times more likely to get vaccinated compared to males. Our results were consistent with other studies that showed that men were more willing to get vaccinated compared to women. This could be explained by the high infection rate of COVID-19 among them. A study conducted among Newzeelanders showed that two-thirds of women were willing to be vaccinated compared to three-quarters of men [38].

 Besides, working in the frontline was associated positively to vaccine acceptance; this may be due to the highest risk of susceptibility faced by this category of HCWs. Our results were in line with a study conducted in USA that found that vaccine acceptance was higher among HCWs involved in direct patient care [39]. It is worth mentioning that past behavior handed over by receiving influenza vaccination in the current season was positively associated with the COVID-19 vaccine acceptance.

Having personal history of COVID-19 infection was negatively associated with the willingness to vaccinate, this could be due to the fact that the majority of previously infected people considered themselves as naturally immune, hence they refused to get vaccinated.

The majority of the HBM domains were considerably associated with the vaccine uptake. In particular, respondents who perceived the vaccine as conferring benefits, and received cues to action were significantly more likely to accept the vaccine. Our results were consistent with the outcomes of a study conducted in China [40].

Of note, we found that some keys components of HBM such us perceived susceptibility and perceived severity of infection were not associated with the vaccine acceptance. This observation could be explained by the fact that COVID-19 is perceived as a mild disease unless the infected person has underlying risk conditions. This implies the direction of promotion and education for COVID-19 vaccine should be different than other vaccines in which prevention of infection is perceived as the main purpose.

On the other hand, perceived barriers such as novelty of vaccine, possible side effects induced by the vaccine,reliability of manufacturer, trust of the source and number of doses required to get immune were negatively associated with the vaccine uptake. Our results were in line with the facts that trust in vaccination manufacturer and source contributes to explain vaccination uptake [41]. Given the massive plea of COVID 19 vaccine, a large number of new companies entered to the market [42]. However, the lack of awareness besides the large number of suppliers at once would intensify the doubt of vaccine recipients towards the validity of less recognized producers, which may in turn limit their acceptance of vaccines. In order to crack this obstacle, governments should also proactively include details about their chosen vaccine manufacturer(s). A peculiar finding that HCWs who conceived limited availability and accessibility of COVID-19 vaccine as barriers were more likely to accept vaccine. This could be explained by the facts that were usually the unreachable makes things unspeakably desirable. However, it is not universal human nature but a common learned pattern.

The main predictor of the willingness to vaccinate was the perception of benefits, HCWs who perceived the benefits were 10.771 more likely to get vaccinated than their counterparts with low perception of benefits. Our results were concordant with a study conducted in France that stresses the importance of communicating the benefits of herd immunity in reducing COVID-19 vaccine hesitancy [43].

With regards to cues of action, we found a remarkable pattern for COVID-19 vaccine. The recommendation from the health authorities and from the health facilities stood out as the most important cues. However, family members' recommendation that is associated negatively to COVID-19 vaccine associated with acceptance. A substantial discrepancy was recorded by country, with China again having the highest proportion of positive responses (83.7%) comparing to Russia that had the highest proportion of negative responses willing to accept their employer's recommendation [44].

Furthermore, having reliable, sufficient and adequate information regarding the vaccine also turn out to be an important driver of vaccine acceptance. These observations highlight evidence-based design of vaccine promotion campaigns tailored for the context of the HCWs concern.

Consistently to other studies that demonstrated the capability of the HBM constructs in predicting behaviors related to influenza vaccination [45]. Our findings suggested that the domains of HBM could be used to elucidate vaccine uptake behavior.

In summary, this study revealed a moderate acceptance rate of COVID-19 vaccine among participated HCWs and this could have broader extents. Our findings highlighted also the significance of governmental and facility recommendation on vaccine uptake, whereas knowledge, perceived susceptibility and severity to infection were not. Acceptance could be impaired by worries on novel vaccination approaches and manufacturers reliability. It will also guide us to develop the appropriate interventions to increase COVID-19 vaccination uptake.

There is a significant need for addressing concerns and increasing awareness to improve acceptance rate for COVID-19 vaccine. Otherwise, there is an additional chance of mass hesitancy among the general population when the COVID-19 vaccine becomes available.

Limitations of the study:

Several limitations of this study should be acknowledged. Firstly, this is a cross-sectional survey and we could not establish a cause-and-effect relationship between the independent factors and the outcome. They could however be used in prediction of COVID-19 vaccine acceptance. Also, this survey examined the HBM constructs among Lebanese HCWs, and the generalizability of its findings to other settings should be cautious. Secondly, our study relies on HCWs self-reported information, which may be a threat to information bias. In addition, self-reported information could be associated with recall bias about past behaviors. On other hand, participant's responses may be influenced by social desirability and then intentionally modified to meet the norms. Finally, since the online survey relies on the availability and accessibility to internet, there is a possibility of selection bias.

Conclusion

The moderate acceptance of HCWs to vaccinate against COVID-19 could impact the trust of individuals and trigger a ripple effect in the general public. Since vaccination is a complex behavior, understanding and pointing out the factors driving moderate vaccine uptake via targeting messages addressing key concerns would be required to reach higher vaccination rate.

Declarations

Ethics approval

The study design respected the participant's confidentiality and autonomy. A written informed consent was obtained from all participants. As survey studies are exempt from ethical approval in Lebanon according to national regulations [46], the Lebanese Ministry of Public Health waived the need for ethical approval.

Data availability

After publication, the survey data will be made available on reasonable request to the corresponding author. A proposal with a detailed description of study objectives and a statistical analysis plan will be needed for assessment of requests. Additional materials might also be required during the process of assessment. De-identified participant data will be provided after approval by the investigators.

Authors' contributions

DY developed the project idea. DY, JY and LAA formulated the questionnaire, organized and analyzed the survey. DY, JY, LAA, AB and HS drafted and critically reviewed the paper. All authors read and agreed on the final version.

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.

Transparency declaration

The corresponding author, as the manuscript's guarantor, affirms that the manuscript is an honest, accurate, and transparent account of the study being reported and that no important aspects of the study have been omitted.

Consent for publication

Not applicable.

Authors information

Dalal Youssef, MSc, MPH, PHD candidate, Ministry of public Health, Lebanon, Preventive medicine department, Lebanon

Janet Youssef, MD, OBGYN, ZHUMC, Lebanon

Atika Berry, MD, Ministry of Public Health, Preventive medicine department, Lebanon

Linda Abou Abbas, MPH, PHD, Ministry of Public Health, Epidemiological surveillance unit, Lebanon

Hamad Hassan, PhD, Ministry of Public Health, Lebanon

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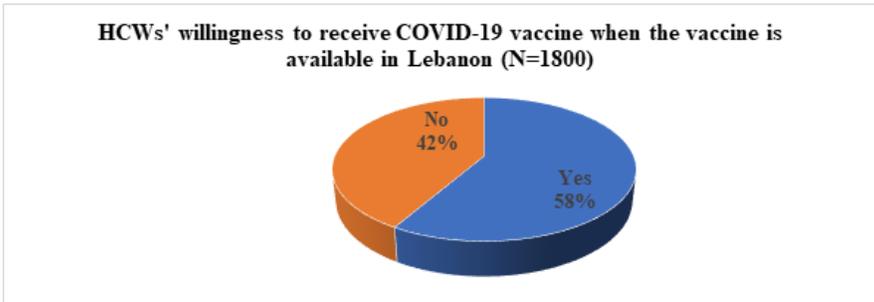
Figures

Figure 1

HCWs' willingness to receive COVID-19 vaccine when the vaccine is available in Lebanon (N=1800)
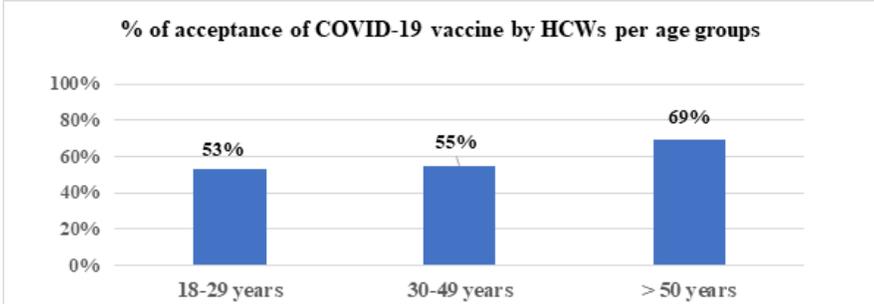

Figure 2

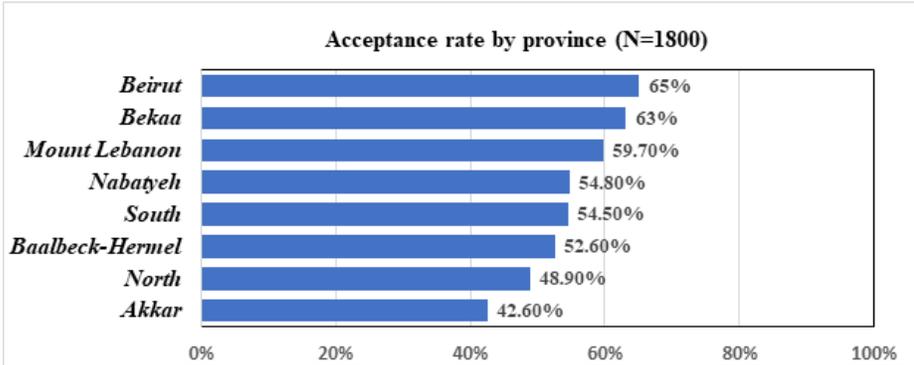HCWs' intention to receive COVID-19 vaccine per age groups

Figure 3

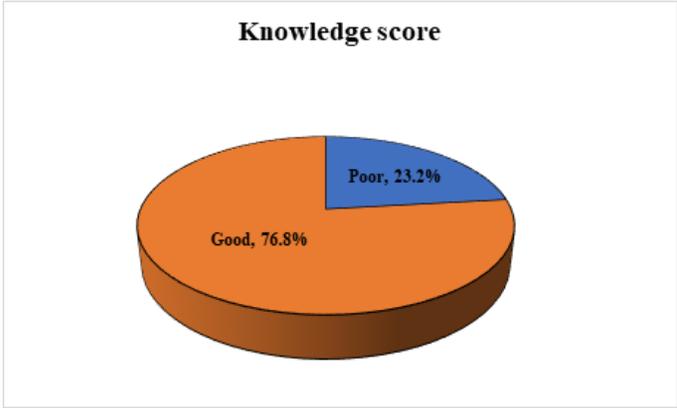HCWs' intention to receive COVID-19 vaccine per age groups
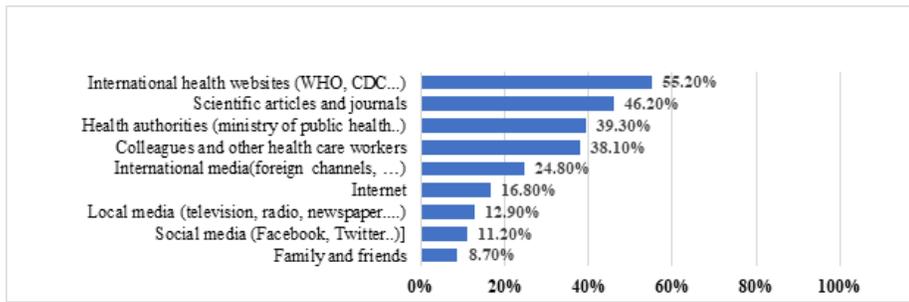

Figure 4

knowledge score

Figure 5

HCWs' ranking of the most reliable source of information

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- QuestionnaireDeterminantsofacceptanceofCOVID.docx