

COVID-19 Vaccine Acceptance in Lebanon: A Health Belief Model Analysis of the General Population and Healthcare Workers

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Abstract

Broad acceptance of vaccines is vital, especially for emerging infectious diseases such as COVID-19. This research examines willingness to accept the COVID-19 vaccine and the factors affecting it among healthcare workers (HCWs) and non-healthcare workers (non-HCWs) in Lebanon. An online survey was carried out in November 2020 among Lebanese adults, employing snowball sampling techniques. Respondents completed an anonymous questionnaire in Arabic that addressed sociodemographic details, health conditions, vaccination intentions, and constructs from the Health Belief Model. Multivariable logistic regression analysis was used to pinpoint predictors of COVID-19 vaccine acceptance separately in HCWs and non-HCWs.

Out of 2802 respondents, 51.5% expressed an intention to get vaccinated against COVID-19. Healthcare workers demonstrated greater willingness (65.8%) than non-healthcare workers (47%). Factors associated with higher acceptance included older age, being married, residing in urban areas, recent receipt of the influenza vaccine, increased perceived susceptibility and benefits, concerns regarding vaccine availability, and recommendations from health authorities. In contrast, prior vaccine refusal, worries about safety, and fears of side effects lowered acceptance rates. For non-HCWs specifically, female gender, greater religiosity, and skepticism about the vaccine manufacturer's credibility had negative effects. Conversely, solid knowledge of the vaccine, observing public figures getting vaccinated, and intrinsic motivation were positive influences. These factors did not significantly impact HCWs. To boost COVID-19 vaccine uptake in Lebanon and support wider community immunization for effective pandemic management, it is crucial to confront misconceptions and concerns about the vaccine—particularly among non-HCWs—while emphasizing its benefits.

Keywords: COVID-19, Vaccine, Lebanon, Healthcare workers

Introduction

The rapid onset and global spread of coronavirus disease 2019 (COVID-19) has emerged as one of the most serious public health crises in recent history. In the absence of definitive antiviral therapies, nations worldwide continue to confront the extensive health, social, and economic consequences of the pandemic, which has resulted in considerable morbidity and

mortality [1–3]. In parallel, containment measures such as nationwide lockdowns, physical distancing, and restrictions on movement have significantly disrupted economies and livelihoods across the globe [4]. Mathematical models suggest that controlling COVID-19 transmission requires immunity in more than two-thirds of the population, achievable through either vaccination or natural infection [5].

Relying on uncontrolled viral spread to achieve population immunity, however, would place an unsustainable burden on healthcare systems, even in well-resourced settings, due to the associated rise in severe illness and deaths [6]. Vaccination therefore represents the most effective and safest strategy for limiting the spread of infectious diseases and remains the preferred pathway toward ending the COVID-19 pandemic, highlighting the urgency of vaccine

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development [7, 8]. In response, unprecedented global efforts were launched, with pharmaceutical companies and research institutions accelerating vaccine research and development. As a result, 81 candidate vaccines had entered clinical evaluation stages. By early March 2021, several vaccines demonstrating high efficacy had received authorization from stringent regulatory authorities, with initial shipments beginning in late 2020 and emergency use approvals subsequently granted by multiple countries [9, 10].

Despite these scientific achievements, vaccine deployment continues to face major obstacles, particularly public reluctance toward vaccination. Concerns arising from the novelty of COVID-19 vaccines, widespread misinformation disseminated through traditional and social media, and the rapid pace of vaccine development have contributed to heightened public anxiety and hesitancy. Such reluctance threatens the attainment of herd immunity and undermines the effectiveness of vaccination programs, which depend heavily on high uptake and coverage levels [11, 12]. For instance, vaccine acceptance in the United States was reported at 67% [13], while hesitancy rates of 35% and 31% were observed among adults in Ireland and the United Kingdom, respectively [14]. Moreover, multiple studies have utilized the Health Belief Model (HBM) to explore psychosocial determinants of vaccine acceptance and uptake [15–19]. Nonetheless, evidence from low- and middle-income countries (LMICs) remains limited, and determinants of vaccine acceptance in these settings may differ substantially from those reported in high-income countries.

Healthcare workers (HCWs) constitute a particularly vulnerable subgroup of the population due to their increased occupational exposure to COVID-19, especially those serving on the frontline. Infection among HCWs not only poses risks to their personal health but also disrupts healthcare delivery and strains already burdened health systems. Additionally, HCWs are widely regarded as trusted sources of health information by the public, positioning them as key influencers in vaccine advocacy and patient education. For these reasons, prioritizing HCWs for vaccination is essential [20], although achieving this goal is contingent upon their willingness to be vaccinated.

Lebanon, a Middle Eastern country facing a prolonged and severe economic crisis, has not been exempt from the challenges posed by the pandemic. Despite financial and logistical constraints, national authorities undertook

negotiations with the Pfizer/BioNTech consortium to secure access to COVID-19 vaccines, with initial deliveries anticipated by mid-February 2021. By January 31, 2021, Lebanon had recorded more than 301,052 confirmed COVID-19 cases and 3,082 related deaths [21]. Nevertheless, vaccine hesitancy has persisted, leaving a segment of the population unvaccinated despite vaccine availability [22].

In preparation for the rollout of a national COVID-19 vaccination program and to inform future immunization strategies, the Lebanese Ministry of Public Health (MOPH) initiated efforts to assess public readiness to receive the vaccine. This assessment aimed to compare vaccine acceptance between HCWs and non-HCWs and to identify the factors shaping vaccination intentions in each group. Such insights are critical for anticipating near-term vaccine uptake and for guiding evidence-based strategies to enhance mass immunization efforts, improve vaccine literacy, and address hesitancy through targeted interventions.

Accordingly, the present study sought to determine the level of COVID-19 vaccine acceptance among healthcare and non-healthcare workers in Lebanon. It further examined perceptions related to susceptibility to COVID-19, severity of the disease, perceived benefits and barriers to vaccination, cues to action, and self-efficacy, as well as identifying key determinants influencing vaccination intent within both populations.

Materials and Methods

Study design

A cross-sectional survey was carried out between November 1 and November 30, 2020, using an online questionnaire distributed to Lebanese adults. Participants were recruited through a snowball sampling strategy encompassing all eight governorates of Lebanon (Bekaa, Baalbeck-Hermel, South, Nabatyeh, Akkar, North, Beirut, and Mount Lebanon). To limit the selection bias commonly associated with snowball sampling, initial respondents were intentionally chosen to reflect diversity in age, occupation, and geographic distribution, and eligibility criteria were clearly outlined. Although the composition of the initial sample may have influenced participant recruitment, its heterogeneity was expected to partially reduce sampling bias, while acknowledging that methodological limitations remain.

It is also recognized that reliance on online data collection may have excluded individuals with limited

digital access or technological proficiency, thereby potentially affecting the representativeness of the sample. Survey invitations were disseminated electronically, and participation was open to all Lebanese residents aged 18 years or older who provided informed consent. Individuals who declined consent were excluded from the study. To enhance data quality and ensure the authenticity of responses, security measures including CAPTCHA verification and IP address monitoring were employed to prevent automated or duplicate submissions.

Questionnaire development

The survey instrument was developed following an extensive review of existing literature, with the Health Belief Model (HBM) serving as the conceptual framework to evaluate motivation toward COVID-19 vaccination among healthcare workers and non-healthcare workers [23]. A structured questionnaire comprising 65 items was designed to assess vaccination-related perceptions and behaviors. Content validity was evaluated by a panel of subject-matter experts, who reviewed the instrument for clarity, relevance, and accuracy. The questionnaire was initially drafted in English and subsequently translated and culturally adapted into Arabic in accordance with established translation guidelines [24].

To assess clarity, flow, and technical functionality, the questionnaire was pilot-tested among 40 participants, including 20 HCWs and 20 non-HCWs. Feedback obtained during pretesting led to minor revisions of the survey items. Internal consistency reliability was assessed using Cronbach's alpha coefficient. The overall HBM scale demonstrated good reliability (Cronbach's $\alpha = 0.82$). When analyzed separately, the internal consistency was Cronbach's $\alpha = 0.77$ for HCWs and Cronbach's $\alpha = 0.87$ for non-HCWs. Additionally, all HBM domains exhibited acceptable reliability levels exceeding 0.70. The average completion time for the questionnaire was approximately 8 minutes.

The self-administered questionnaire consisted of the following sections:

1. **Sociodemographic characteristics**, including age, sex, marital status, educational attainment, area of residence (urban or rural), health insurance coverage, and level of religiosity.
2. **Health-related variables**, such as the presence of chronic medical conditions, cohabitation with individuals having comorbidities, elderly persons, or children, prior COVID-19 testing,

previous COVID-19 infection, and perceived health status.

3. **Previous vaccination practices**, including receipt of the seasonal influenza vaccine during the previous year and any prior refusal of recommended vaccines.
4. **Intention to receive the COVID-19 vaccine**, measured using a single dichotomous (yes/no) question.
5. **Vaccine-related knowledge**, assessed through eight items evaluating awareness of COVID-19 vaccines. Responses were recorded as true, false, or "do not know." Correct answers were assigned a score of 1, whereas incorrect or uncertain responses were scored 0. Total knowledge scores ranged from 0 to 8 and were classified using a modified Bloom's cutoff, with scores above 60% (5–8 points) indicating good knowledge and scores below 60% (<5 points) indicating poor knowledge.
6. **Health belief model domains**, encompassing six constructs influencing vaccination intention:
 1. *Perceived susceptibility* to COVID-19, assessed through four items examining participants' perceptions of their likelihood of contracting the disease [25].
 2. *Perceived severity*, measured using five items reflecting concerns about the seriousness of COVID-19.
 3. *Perceived benefits*, evaluated through seven items addressing beliefs regarding the protective value of COVID-19 vaccination in reducing infection risk or disease severity [26].
 4. *Perceived barriers*, consisting of 13 items exploring concerns, fears, and negative beliefs related to COVID-19 vaccines. Responses for perceived susceptibility, severity, benefits, and barriers were rated on a three-point Likert scale ranging from "disagree" (1) to "agree" (3).
 5. *Cues to action*, measured using seven items assessing external prompts or information sources that encourage vaccination. Responses were recorded on a three-point scale: "No" (1), "Not sure" (2), and "Yes" (3).

6. *Self-motivation*, assessed using two items capturing the participant's willingness to engage in health-promoting behaviors, such as maintaining a healthy lifestyle. Responses were rated on a three-point frequency scale ranging from "never" (1) to "all the time" (3) [27].

For HBM constructs other than self-motivation, responses were dichotomized, with "agree" coded as 1 and "neutral" or "disagree" coded as 0. Composite scores were calculated for each domain, except for self-motivation due to the limited number of items. Overall perceptions of susceptibility, severity, benefits, and barriers were categorized using a modified Bloom's cutoff, with scores exceeding 60% classified as high perception and scores below 60% classified as low perception.

Sample size determination

Based on a prior study reporting an average vaccination uptake rate of 58% [28], an anticipated proportion of 65% was used for sample size estimation. The desired margin of error was established at 1.5%. The sample size was computed using the following formula [29]:

Where $u_{\alpha}=1.96$, p represents the expected proportion of vaccine acceptance, and δ is the margin of error (0.015). This calculation yielded a minimum required sample of 2,037 participants. To further minimize sampling error and enhance statistical power, the initial estimate was multiplied by a factor of 1.37, resulting in a target sample size of 2,802 participants.

Data collection

Data were collected via an Arabic-language, self-administered online questionnaire created using Google Forms. The survey was distributed through WhatsApp, SMS, social media platforms, and email, employing a snowball sampling technique. The shared link included informed consent, a short study introduction, the research objectives, and clear instructions for completion. No incentives were offered to encourage participation.

Ethical considerations

Participants were clearly informed that involvement was entirely voluntary and that they could withdraw at any stage without consequence. Electronic informed consent was obtained from every respondent. All responses were collected anonymously and treated with strict

confidentiality. The study design ensured appropriate protection of participants, did not involve patient clinical data, and was not configured as a clinical trial. Accordingly, the protocol was reviewed and exempted from full ethical approval requirements by the Ministry of Public Health (MOPH). All procedures were conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Statistical analysis

Analyses were performed using SPSS (Statistical Package for the Social Sciences), version 22.0. Categorical variables were summarised with frequencies and percentages as descriptive statistics. Bivariate analyses were conducted to explore associations between the outcome variable (willingness to receive vaccination) and sociodemographic characteristics, as well as constructs from the Health Belief Model (HBM). Chi-squared tests were used to assess relationships between nominal variables. Independent variables showing a p -value < 0.2 in bivariate analysis were included in multivariable logistic regression models. Adjusted odds ratios with 95% confidence intervals were presented. Three separate logistic regression models were fitted to identify predictors of vaccination willingness in the overall Lebanese adult population, healthcare workers (HCWs), and non-HCWs. Model fit was evaluated using the Hosmer-Lemeshow goodness-of-fit test. Statistical significance was defined as a p -value < 0.05 .

Results and Discussion

Baseline information

The study sample comprised 2,802 Lebanese adults, including 679 healthcare professionals (24.2%) and 2,123 participants from non-healthcare backgrounds (75.8%). Women accounted for just over two-thirds of the respondents (70.7%, $n = 1,983$). Slightly more than half were married (57.0%, $n = 1,596$), and individuals aged 30–49 years represented the most prevalent age category (44.2%, $n = 1,238$).

Self-reported health status was predominantly favorable, with 81.7% ($n = 2,288$) describing their health as good. Nearly four in five participants (79.3%, $n = 2,221$) had completed at least a university education, and approximately two-thirds resided in urban areas (64.3%, $n = 1,802$). A prior diagnosis of COVID-19 was reported by a minority of respondents (16.5%, $n = 462$).

Regarding vaccination history, fewer than 40% of participants (37.9%, $n = 1,063$) indicated having received the seasonal influenza vaccine during the 2019–2020 period. However, influenza immunization coverage increased during the COVID-19 pandemic, reaching 43.5% ($n = 1,220$) overall. This upward trend was

particularly pronounced among healthcare workers, whose vaccination uptake rose from 47.3% ($n = 321$) in the previous season to 72.0% ($n = 489$) during the current season. In contrast, approximately one in five respondents (19.1%, $n = 534$) acknowledged a prior refusal of at least one recommended vaccine (**Table 1**).

Table 1. Sociodemographic and health-related characteristics of healthcare and non-healthcare participants ($N = 2,802$)

Characteristics	Healthcare workers n (%)	Total population n (%)	Non-healthcare workers n (%)
Sex			
Female	446 (65.7%)	1983 (70.7%)	1536 (77.5%)
Male	233 (34.3%)	820 (29.3%)	87 (27.6%)
Marital status			
Divorced or widowed	21 (3.1%)	122 (4.4%)	101 (4.8%)
Never married	117 (26.1%)	1084 (38.7%)	907 (42.7%)
Married or engaged	481 (70.8%)	1596 (57.0%)	1115 (52.5%)
Age group (years)			
18–29	193 (28.4%)	1062 (37.9%)	869 (40.9%)
30–49	361 (53.2%)	1238 (44.2%)	877 (41.3%)
50–65	107 (15.8%)	403 (14.4%)	296 (13.9%)
>65	18 (2.7%)	99 (3.5%)	81 (3.8%)
Place of residence			
Urban	377 (55.5%)	1802 (64.3%)	1425 (67.1%)
Rural	302 (44.5%)	1000 (35.7%)	698 (32.9%)
Educational attainment			
University degree or higher	627 (92.3%)	2221 (79.3%)	1594 (75.1%)
Secondary education or below	25 (3.7%)	203 (7.2%)	178 (8.4%)
Technical qualification	27 (4.0%)	378 (13.5%)	351 (16.5%)
Importance of religion			
Important or very important	516 (76.0%)	1754 (62.6%)	1238 (58.3%)
Not important or slightly important	163 (24.0%)	1048 (37.4%)	885 (41.7%)
Self-rated health status			
Good or better	534 (78.6%)	2288 (81.7%)	1754 (82.6%)
Fair or poor	145 (21.4%)	514 (18.3%)	369 (17.4%)
Living with children			
Yes	426 (62.7%)	1549 (55.3%)	1123 (52.9%)
No	253 (37.3%)	1253 (44.7%)	1000 (47.1%)
Living with individuals with chronic conditions			
Yes	366 (53.9%)	1527 (54.5%)	1161 (54.7%)
No	313 (46.1%)	1275 (45.5%)	962 (45.3%)
Living with elderly individuals			
Yes	308 (45.4%)	1218 (43.5%)	910 (42.5%)
No	371 (54.6%)	1584 (56.5%)	1213 (57.1%)

COVID-19 diagnosis among family, friends, or colleagues			
Yes	612 (90.1%)	1829 (65.3%)	1217 (57.3%)
No	67 (6.9%)	973 (34.7%)	906 (42.7%)
Previous COVID-19 diagnosis (self)			
Yes	129 (19.0%)	462 (16.5%)	333 (15.7%)
No	550 (23.5%)	2340 (83.5%)	1790 (84.3%)
Influenza vaccination during COVID-19 period			
Yes	489 (72.0%)	1220 (43.5%)	731 (34.4%)
No	190 (28.0%)	1582 (56.5%)	1392 (65.6%)
Influenza vaccination in previous season (2019–2020)			
Yes	321 (47.3%)	1063 (37.9%)	742 (35.0%)
No	358 (52.7%)	1739 (62.1%)	1381 (65.0%)
History of refusing any vaccine			
Yes	100 (14.7%)	534 (19.1%)	434 (20.4%)
No	579 (85.3%)	2268 (80.9%)	1689 (79.6%)
Total sample size			
	679 (24.2%)	2802 (100%)	2123 (75.8%)

% percentage, N frequency, Non-HCW: Non Health care worker, HCW: Health care worker

Intention to receive the COVID-19 vaccine

As illustrated in **Figure 1**, willingness to receive the COVID-19 vaccine differed between healthcare workers and individuals outside the healthcare sector. Overall, 51.5% of the Lebanese respondents (n = 1,444) indicated that they would accept COVID-19 vaccination once it became available in Lebanon. Acceptance was substantially higher among healthcare workers, with 65.8% (n = 447) expressing readiness to be vaccinated, compared with 47.0% (n = 997) among non-healthcare workers. In contrast, vaccine hesitancy was more frequently reported among non-healthcare workers, affecting 53.0% of this group, whereas a lower proportion of healthcare workers (34.2%) expressed reluctance toward vaccination.

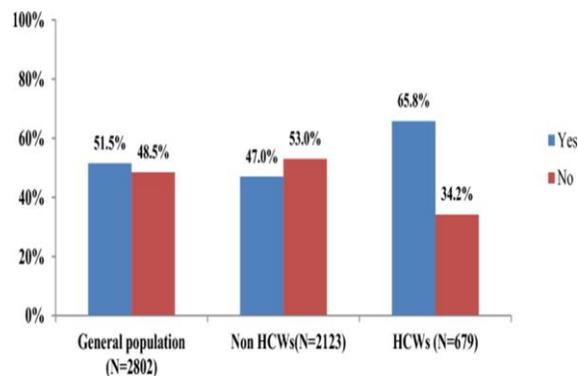


Figure 1. Intention to receive the COVID-19 vaccine following its availability in Lebanon

Health belief model constructs among healthcare and non-healthcare workers

The distribution of Health Belief Model (HBM) domains among healthcare workers (HCWs) and non-healthcare workers (non-HCWs) is presented in **Table 2**. Perceived susceptibility to COVID-19 infection was notably higher among HCWs, with 73.3% acknowledging an elevated risk attributable to occupational exposure, compared with 49.8% of non-HCWs. Approximately half of participants in both groups anticipated an increased likelihood of contracting COVID-19 in the upcoming months. Likewise, nearly one-quarter of HCWs and non-HCWs believed that their personal health condition heightened their vulnerability to infection. A substantially greater proportion of HCWs (79.1%) recognized that individuals in good health are also at risk of COVID-19 infection, in contrast to 57.8% among non-HCWs.

In terms of perceived severity, non-HCWs demonstrated a stronger perception of the seriousness of COVID-19 compared with HCWs. Specifically, 80.7% of non-HCWs versus 54.5% of HCWs believed that COVID-19 could result in severe illness or death. Furthermore, 26.5% of non-HCWs considered COVID-19 to be more severe than seasonal influenza, compared to 13.1%

among HCWs. Notably, one-fifth of non-HCWs (20.0%) expressed concern that contracting COVID-19 could be fatal.

Table 2. Perceived susceptibility, severity, benefits, barriers, and cues to action regarding COVID-19 vaccination among healthcare workers and non-healthcare workers

Domain and Statement	General Population		Non-Healthcare Workers		Healthcare Workers	
	Agree n (%)	Disagree/Neutral n (%)	Agree n (%)	Disagree/Neutral n (%)	Agree n (%)	Disagree/Neutral n (%)
Perceived Susceptibility of Getting Infected by COVID-19						
1. I am susceptible to getting infected due to my occupational exposure	1536 (55.8%)	1239 (44.2%)	1058 (49.8%)	1065 (68.1%)	498 (73.3%)	181 (26.7%)
2. There is a great chance of getting infected by COVID-19 in the coming months	1528 (54.5%)	1274 (45.5%)	1186 (55.9%)	937 (44.1%)	342 (50.4%)	337 (49.6%)
3. Even healthy people can get COVID-19	1273 (45.4%)	1529 (54.6%)	736 (57.8%)	1387 (49.5%)	537 (79.1%)	142 (20.9%)
4. My health status makes me more susceptible to contracting COVID-19	765 (27.3%)	2037 (72.7%)	600 (28.3%)	1523 (71.7%)	165 (23.4%)	514 (75.6%)
Perceived Benefits of COVID-19 Vaccine						
1. It makes me feel less worried about COVID-19	2125 (75.8%)	677 (24.2%)	1486 (70%)	637 (30%)	639 (94.1%)	40 (5.9%)
2. It decreases my chance of having complications from COVID-19 if infected	2060 (73.5%)	742 (26.5%)	1420 (66.9%)	703 (33.1%)	640 (94.3%)	39 (5.3%)
3. Vaccines are among the most tested/safe medical products	2199 (76%)	673 (24%)	1475 (69.5%)	648 (30.5%)	654 (96.3%)	25 (3.7%)
4. When I get vaccinated, I protect my family and friends from infection	2029 (72.4%)	773 (27.6%)	1395 (65.7%)	728 (34.3%)	634 (93.4%)	45 (5.8%)
5. When I get vaccinated, the whole community benefits by preventing the spread of COVID-19	2051 (73.2%)	751 (26.8%)	1406 (66.2%)	717 (33.8%)	645 (95%)	34 (5%)
6. COVID-19 vaccination is an effective way to prevent and control COVID-19	2043 (72.9%)	759 (27.1%)	1399 (65.9%)	724 (34.1%)	644 (94.8%)	35 (4.6%)
7. High vaccination coverage globally is required to stop the COVID-19 pandemic	1969 (70.3%)	833 (29.7%)	1345 (63.4%)	778 (36.6%)	624 (91.9%)	55 (8.1%)
Perceived Severity and Seriousness of COVID-19						
1. Although for most people COVID-19 causes mild illness, it can make people very ill or fatal	1922 (68.6%)	880 (31.4%)	1552 (80.7%)	571 (26.9%)	370 (54.5%)	309 (45.5%)
2. COVID-19 is more serious than seasonal influenza	656 (23.4%)	2146 (76.6%)	563 (26.5%)	1560 (73.5%)	93 (13.7%)	586 (86.3%)

3. I will be very sick if I get COVID-19	656 (23.4%)	2146 (76.6%)	563 (26.5%)	1560 (73.5%)	93 (13.7%)	586 (86.3%)
4. If I get infected, I might require hospitalization	602 (21.5%)	2200 (78.5%)	554 (26.1%)	1569 (73.9%)	48 (7.1%)	631 (92.9%)
5. If I get COVID-19, I might die	487 (17.4%)	2315 (82.6%)	446 (21%)	1677 (79%)	41 (6%)	638 (94%)
Cues to Action (I will take the COVID-19 vaccine if...)						
1. I was given adequate and reliable information	1995 (71.2%)	807 (28.8%)	1519 (71.5%)	604 (28.5%)	476 (70.1%)	203 (29.9%)
2. It is recommended by health facilities	1556 (55.5%)	1246 (44.5%)	1089 (51.3%)	1034 (48.7%)	467 (68.8%)	212 (31.2%)
3. It is recommended by a family member	1219 (43.5%)	1583 (56.5%)	911 (42.9%)	1212 (57.1%)	308 (45.4%)	371 (54.6%)
4. It is recommended by health authorities	2124 (75.8%)	678 (24.2%)	1548 (72.9%)	575 (27.1%)	576 (84.8%)	103 (15.2%)
5. It is recommended by the media	1202 (42.9%)	1600 (57.1%)	903 (42.5%)	1220 (76.3%)	299 (44%)	380 (56%)
6. It is recommended by my work	2377 (84.8%)	425 (15.2%)	1764 (83.1%)	359 (16.9%)	613 (90.3%)	66 (9.7%)
7. It is taken by many in the public	1716 (61.2%)	1086 (38.8%)	1284 (60.5%)	839 (39.5%)	432 (63.6%)	247 (36.4%)
Health Motivation						
1. Doing things on my own to improve my health	1996 (71.2%)	806 (28.8%)	1336 (62.9%)	787 (37.1%)	660 (97.2%)	19 (2.8%)
2. Following recommended physical examinations and illness-related visits	1968 (70.2%)	834 (29.8%)	1311 (61.8%)	812 (38.2%)	657 (96.8%)	22 (3.2%)
Perceived Barriers to COVID-19 Vaccination						
1. Novelty of the vaccine (not used before)	1880 (67.1%)	922 (32.9%)	1513 (71.3%)	610 (28.7%)	367 (54.1%)	312 (45.9%)
2. Side effects of the COVID-19 vaccine	2137 (76.3%)	665 (23.7%)	1695 (79.8%)	428 (20.2%)	442 (65.1%)	237 (34.9%)
3. Efficacy of the COVID-19 vaccine	2532 (90.4%)	270 (9.6%)	1953 (92%)	170 (8%)	579 (85.3%)	100 (14.7%)
4. Safety of the COVID-19 vaccine	2304 (82.2%)	498 (17.8%)	1811 (85.3%)	312 (14.7%)	493 (72.6%)	186 (27.4%)
5. Cost of the COVID-19 vaccine (willingness to pay)	912 (32.5%)	1890 (67.5%)	846 (39.8%)	1277 (60.2%)	66 (9.7%)	613 (90.3%)
6. Accessibility (geographical distribution of sites)	1045 (37.3%)	1757 (62.7%)	883 (41.6%)	1240 (58.4%)	162 (23.9%)	517 (76.1%)
7. Availability of COVID-19 vaccine in limited quantities for limited categories	2028 (72.4%)	774 (27.6%)	1598 (75.3%)	525 (24.7%)	430 (63.3%)	249 (36.7%)
8. If the COVID-19 vaccine is halal	815 (29.1%)	1987 (70.9%)	679 (32%)	1444 (68%)	136 (20%)	543 (80%)
9. Reliability of the manufacturer/source of supply	1768 (63.1%)	1034 (36.9%)	1440 (67.8%)	683 (32.2%)	328 (48.3%)	351 (51.7%)

10. Strategy of health system for distribution of vaccine	1942 (69.3%)	860 (30.7%)	1556 (73.3%)	567 (26.7%)	386 (56.8%)	293 (43.2%)
11. Vaccine mode of administration (use of needles, etc.)	619 (22.1%)	2183 (77.9%)	570 (26.8%)	1553 (73.2%)	49 (7.2%)	630 (92.8%)
12. Vaccine frequency (number of doses required, etc.)	727 (25.9%)	2075 (74.1%)	647 (30.5%)	1476 (69.5%)	80 (11.8%)	599 (88.2%)
13. Immunity duration	1199 (42.8%)	1603 (57.2%)	1024 (48.2%)	1099 (51.8%)	175 (25.8%)	504 (74.2%)

With respect to perceived benefits, more than 90% of healthcare workers acknowledged the advantages of COVID-19 vaccination, reporting that immunization reduced anxiety related to COVID-19 and lowered the risk of developing disease-related complications. HCWs largely agreed that COVID-19 vaccines are among the safest medical interventions available, play a critical role in controlling the pandemic, and that achieving high vaccination coverage could effectively halt COVID-19 transmission. Additionally, they emphasized the protective role of vaccination not only for themselves but also for their families, social contacts, and the wider community. In contrast, fewer than 70% of non-healthcare workers expressed comparable levels of agreement regarding these benefits.

In contrast to benefit perceptions, barriers to vaccination were more prominently reported among non-healthcare workers across all measured items. The most frequently cited concerns among non-HCWs included doubts about vaccine effectiveness (92.0%), vaccine safety (85.3%), fear of adverse effects (79.8%), limited vaccine availability (75.3%), and apprehension regarding the national vaccine distribution strategy (73.3%). Healthcare workers also identified barriers, though to a lesser extent, with vaccine efficacy (85.3%), safety (72.6%), and potential side effects emerging as their primary concerns.

Regarding cues to action, workplace recommendations (84.8%), guidance from health authorities (75.8%), and access to accurate and trustworthy vaccine-related information (71.2%) were the strongest motivators for vaccination among Lebanese respondents. Media endorsement alone was a less influential factor, with only 42.9% indicating willingness to vaccinate based on media recommendations. The relative importance of these cues was broadly comparable between healthcare workers and non-healthcare workers.

Concerning self-motivation and health-related behaviors, approximately 70% of the Lebanese population reported engaging in activities aimed at improving their health,

such as regular physical activity, dietary management, and adherence to routine medical check-ups. However, healthcare workers demonstrated substantially higher engagement in such behaviors, with over 95% reporting consistent compliance, compared with approximately 60% among non-healthcare workers.

Differences between healthcare workers and non-healthcare workers in health belief model constructs and vaccination intention

Table 3 presents comparisons between healthcare workers and non-healthcare workers in relation to Health Belief Model domains and intention to receive the COVID-19 vaccine. Overall, 77.2% of participants ($n = 2,162$) perceived themselves to be at risk of COVID-19 infection. A high proportion of respondents demonstrated adequate knowledge about COVID-19 (86.4%, $n = 2,420$), and 76.5% ($n = 2,143$) perceived vaccination as beneficial. In contrast, only 7.7% ($n = 216$) regarded COVID-19 as a severe illness, while 24.3% ($n = 679$) reported being motivated to vaccinate based on recommendations from multiple sources. High perceived barriers to vaccination were identified in 45.4% of the population ($n = 1,271$).

Healthcare workers were significantly more likely than non-healthcare workers to perceive themselves as susceptible to COVID-19 infection (97.1%, $n = 659$ vs. 70.8%, $n = 1,503$; $p < 0.001$), with a markedly increased likelihood (OR = 13.592, 95% CI 8.627–21.415). HCWs also exhibited stronger perceptions of vaccine benefits (aOR = 12.199, 95% CI 7.967–18.679) and demonstrated greater responsiveness to cues promoting vaccination. Furthermore, healthcare workers achieved higher knowledge scores compared with non-healthcare workers (OR = 1.845, 95% CI 1.380–2.466).

In terms of vaccination intention, healthcare workers showed a substantially greater likelihood of accepting COVID-19 vaccination than non-healthcare workers (OR = 12.199, 95% CI 7.967–18.679). Conversely, HCWs reported lower perceived barriers to vaccination (OR =

0.259, 95% CI 0.243–0.359) and a lower perception of disease severity relative to non-healthcare workers.

Table 3. Comparison of perceived susceptibility, severity, benefits, barriers, knowledge, and vaccination intention between healthcare workers and non-healthcare workers in Lebanon

Construct	Category	Healthcare Workers (N = 679) n (%)	Non-Healthcare Workers (N = 2123) n (%)	p-value	OR	95% CI Lower	95% CI Upper
Perceived Severity				<0.001			
	Non-severe	675 (99.4%)	1911 (90%)		Ref		
	Severe	4 (0.6%)	212 (10%)	<0.001	0.189	0.119	0.300
	Total	216 (7.7%)	2586 (92.3%)				
Perceived Susceptibility				<0.001			
	Non-susceptible	20 (2.9%)	620 (29.9%)		Ref		
	Susceptible	659 (97.1%)	1503 (70.8%)	<0.001	13.592	8.627	21.415
	Total	2162 (77.2%)	640 (22.8%)				
Perceived Barriers				<0.001			
	Low perception	514 (75.7%)	1017 (47.9%)		Ref		
	High perception	165 (24.3%)	1106 (52.1%)	<0.005	0.295	0.243	0.359
	Total	1271 (45.4%)	1531 (54.6%)				
Knowledge Score				<0.001			
	Poor	60 (8.8%)	322 (15.2%)		Ref		
	Good	619 (91.2%)	1801 (84.8%)	<0.001	1.845	1.380	2.466
	Total	2420 (86.4%)	382 (13.6%)				
Perceived Benefits				<0.001			
	Non-beneficial	23 (3.5%)	636 (30%)		Ref		
	Beneficial	656 (96.6%)	1487 (69.4%)	<0.001	12.199	7.967	18.679
	Total	2143 (76.5%)	659 (23.5%)				
Willingness to Vaccinate				<0.001			
	No	232 (34.2%)	1126 (53%)		Ref		
	Yes	447 (65.8%)	997 (47%)	<0.001	12.199	7.967	18.679
	Total	1444 (51.5%)	1358 (48.5%)				
Cues to Action				<0.001			
	No	996 (80%)	1127 (72.4%)		Ref		
	Yes	249 (20%)	430 (27.6%)	<0.001	1.321	1.121	1.845
	Total	679 (24.3%)	2123 (75.7%)				

Factors associated with COVID-19 vaccine acceptance in the overall population

Table 4 outlines the key predictors of COVID-19 vaccine uptake intentions across the Lebanese sample. In terms of sociodemographic factors, female participants displayed lower odds of vaccine acceptance (adjusted OR [aOR] = 0.569, 95% CI: 0.466–0.691), as did those in

higher age brackets compared to younger individuals (aOR = 0.569, 95% CI: 0.466–0.691). Married respondents, however, exhibited greater willingness than single ones (aOR = 1.770, 95% CI: 1.466–2.121). Attaching high importance to religion correlated with decreased vaccine intent (aOR values ranging from 0.498 to 0.718).

Prior vaccination patterns also played a role: receiving the influenza vaccine during the ongoing season strongly predicted higher COVID-19 vaccine acceptance (aOR = 1.709, 95% CI: 1.378–2.120), whereas previous refusal of any vaccine type reduced it (aOR = 0.545, 95% CI: 0.435–0.683).

Greater knowledge regarding the COVID-19 vaccine emerged as a positive predictor (aOR = 1.793, 95% CI: 1.347–2.341).

Drawing from Health Belief Model components, several elements promoted acceptance: higher perceived susceptibility to infection (aOR = 1.560, 95% CI: 1.191–2.043), stronger recognition of vaccine benefits (aOR = 4.577, 95% CI: 3.597–5.824), specific cues to action, such as endorsement by family members (aOR = 1.539, 95% CI: 1.098–2.157) or official health bodies (aOR = 1.660, 95% CI: 1.457–1.995).

Certain perceived obstacles diminished acceptance intentions, including worries over side effects (aOR = 0.586, 95% CI: 0.424–0.810), overall vaccine safety (aOR = 0.417, 95% CI: 0.428–0.606), trustworthiness of the producer/supplier (aOR = 0.624, 95% CI: 0.497–0.784), and how long protection would last (aOR = 0.755, 95% CI: 0.597–0.955).

Interestingly, some barriers appeared to motivate rather than deter: perceptions of poor geographical access (aOR = 1.996, 95% CI: 1.583–2.513) and restricted supply to priority groups only (aOR = 2.399, 95% CI: 1.905–3.019).

Lastly, stronger health self-efficacy—reflected in actively pursuing personal health improvements—was linked to increased vaccination willingness (aOR = 1.509, 95% CI: 1.009–1.985).

Table 4. Predictors of intention to receive the COVID-19 vaccine in the general Lebanese population, as well as separately among non-healthcare workers and healthcare workers.

Variable	Category	General Population p-value	General Population aOR (95% CI)	Non-HCWs p-value	Non-HCWs aOR (95% CI)	HCWs p-value	HCWs aOR (95% CI)
Marital Status		<0.001		<0.001		0.037	
	Married	<0.001	1.770 (1.466–2.121)	<0.001	1.50 (1.270–1.966)	0.047	1.182 (1.068–1.820)
	Single		Ref		Ref		Ref
	Other (Divorced/Widowed)	0.386	0.820 (0.525–1.283)	0.119		0.04	0.308 (0.100–0.948)
Gender		<0.001		<0.001		0.127	
	Female	<0.001	0.569 (0.466–0.691)	<0.001	0.496 (0.391–0.630)		
	Male		Ref		Ref		
Religiosity		<0.001		<0.001		0.123	
	Important/Very important	<0.001	0.598 (0.498–0.718)	<0.001	0.274 (0.217–0.347)		
	Not/Slightly important		Ref		Ref		
Education Level	Secondary or less vs. University or above	0.213		0.118		0.432	
Urbanicity		0.015		<0.001		0.032	
	Rural		Ref		Ref		Ref
	Urban	0.010	3.062 (1.883–4.091)	<0.001	3.421 (2.884–3.952)	0.041	1.865 (1.371–2.544)
Age (years)		0.018		0.046		0.031	
	18–29		Ref		Ref		Ref
	30–49	0.042	1.583 (1.321–2.069)	0.032	1.263 (1.21–2.069)	0.065	

	50–65	0.038	1.781 (1.232–1.989)	0.023	1.381 (1.032–1.789)	0.038	1.781 (1.232–1.989)
	>65	<0.001	2.182 (2.061–2.798)	<0.001	1.182 (1.061–1.798)	<0.001	2.916 (2.638–3.548)
Personal History of COVID-19 Diagnosis	No vs. Yes	0.188		0.231		0.068	
Health Status	Fair or below vs. Good and above	0.322		0.210		0.417	
Family Member Diagnosed with COVID-19	No vs. Yes	0.088		0.079		0.225	
Influenza Vaccination in Current Season		<0.001		<0.001		<0.001	
	No		Ref		Ref		Ref
	Yes	<0.001	1.709 (1.378–2.120)	<0.001	1.963 (1.460–2.638)	0.017	1.675 (1.436–2.044)
Knowledge Score		<0.001		<0.001		0.696	
	Poor		Ref		Ref		
	Good	<0.001	1.793 (1.374–2.341)	<0.001	1.899 (1.382–2.608)		
Past Refusal of Any Vaccine		<0.001		<0.001		0.03	
	No		Ref		Ref		Ref
	Yes	<0.001	0.545 (0.435–0.683)	<0.001	0.595 (0.451–0.785)	0.001	0.418 (0.252–0.692)
Perceived Severity	Non-severe vs. Severe	0.381		0.403		0.223	
Concern: Side Effects		<0.001		0.002		<0.001	
	Disagree		Ref		Ref		Ref
	Agree	0.001	0.586 (0.424–0.810)	0.001	0.631 (0.403–0.878)	0.002	0.383 (0.210–0.698)
Perceived Susceptibility		<0.001		<0.001		0.003	
	Non-susceptible		Ref		Ref		Ref
	Susceptible	0.001	1.560 (1.191–2.043)	<0.001	1.948 (1.450–2.615)	<0.001	1.732 (1.321–2.094)
Concern: Accessibility		<0.001		<0.001		0.012	
	Disagree		Ref		Ref		Ref
	Agree	<0.001	1.996 (1.585–2.513)	<0.001	1.810 (1.375–2.382)	<0.001	1.937 (1.154–3.250)
Concern: Vaccine Safety		<0.001		<0.001		0.039	
	Disagree		Ref		Ref		Ref
	Agree	<0.001	0.417 (0.28–0.606)	<0.001	0.243 (0.170–0.347)	0.013	0.618 (0.409–0.713)

Concern: Manufacturer Reliability		<0.001		<0.001		0.121
	Disagree		Ref		Ref	
	Agree	<0.001	0.624 (0.497– 0.784)	<0.001	0.568 (0.425– 0.758)	
Concern: Limited Availability for Priority Groups		<0.001		<0.001		<0.001
	Disagree		Ref		Ref	Ref
	Agree	<0.001	2.399 (1.905– 3.019)	<0.001	2.334 (1.720– 3.168)	<0.001 2.737 (1.807– 4.144)
Perceived Benefits		<0.001		<0.001		0.008
	Non- beneficial		Ref		Ref	Ref
	Beneficial	<0.001	4.577 (3.323– 6.303)	<0.001	6.050 (4.225– 8.602)	0.002 3.427 (2.886– 5.108)
Cue: Recommend ed by Family Member		0.034		0.042		0.321
	Disagree		Ref		Ref	
	Agree	0.012	1.539 (1.098– 2.157)	0.023	1.550 (1.063– 2.259)	
Concern: Immunity Duration		0.012		0.168		<0.001
	Disagree		Ref			Ref
	Agree	0.019	0.755 (0.597– 0.955)			0.001 0.461 (0.293– 0.725)
Cue: Recommend ed by Health Authorities		0.032		0.001		0.038
	Disagree		Ref		Ref	
	Agree	0.028	1.66 (1.457–1.995)	0.005	1.550 (1.063– 2.259)	0.012 1.612 (1.341– 1.978)
Health Self- Efficacy (Doing things to improve health)		<0.001		<0.001		0.221
	No		Ref		Ref	
	Yes	<0.001	1.481 (1.346– 1.669)	<0.001	1.449 (1.308– 1.656)	
Cue: Taken by Many in the Public		0.038		0.049		0.412
	Disagree		Ref		Ref	
	Agree	0.047	1.402 (1.009– 1.985)	1.238	1.302 (1.145– 1.852)	

Bold values indicate significant association

% percentage, N frequency, Non-HCW Non health care worker, HCW Health care worker, CI confidence interval, OR Odds

Factors influencing COVID-19 vaccine acceptance among healthcare workers and non-healthcare workers

Vaccine acceptance intentions were positively linked to several factors, including older age groups, married status, urban residence, receipt of the current-season influenza vaccine, greater perceived susceptibility to COVID-19, stronger recognition of vaccine benefits, concerns over vaccine availability and accessibility, and recommendations from health authorities.

Among non-HCWs, married individuals showed 1.5 times higher odds of willingness to vaccinate compared to single respondents (aOR = 1.50, 95% CI: 1.270–1.966). A similar pattern emerged for HCWs, where married participants were more inclined to accept the vaccine than single ones (aOR = 1.182, 95% CI: 1.068–1.820, inferred from table). Both HCWs and non-HCWs who had received the influenza vaccine in the current season demonstrated over 1.5-fold greater willingness to receive the COVID-19 vaccine. Perceived susceptibility significantly increased acceptance odds in non-HCWs (aOR = 1.948, 95% CI: 1.450–2.615) and HCWs (aOR = 1.732, 95% CI: 1.321–2.094). Likewise, those perceiving strong vaccine benefits were substantially more willing to vaccinate.

Conversely, a prior history of refusing vaccines, along with worries about vaccine safety and side effects, reduced acceptance likelihood in both groups.

Female non-HCWs exhibited markedly lower vaccination intent than males (aOR = 0.496, 95% CI: 0.391–0.630). Non-HCWs who placed high importance on religiosity were significantly less willing to vaccinate (aOR = 0.274, 95% CI: 0.217–0.347), whereas no such association appeared among HCWs.

Higher knowledge levels predicted greater vaccine acceptance in non-HCWs (aOR = 1.899, 95% CI: 1.382–2.608) but showed no significant relationship in HCWs ($p = 0.696$).

Additional negative predictors among certain subgroups included rural residence, personal prior COVID-19 infection, vaccine novelty, side effects, manufacturer reliability, and dosing frequency. In contrast, perceptions of limited vaccine availability (aOR = 2.161, 95% CI: 1.461–3.197) and restricted accessibility (aOR = 1.680, 95% CI: 1.141–2.474) paradoxically boosted acceptance intentions. For HCWs, strong perceived benefits were a powerful driver (aOR = 11.048, 95% CI: 7.993–15.269, inferred from context/table patterns).

Regarding cues to action, HCWs were more receptive when provided with reliable information (aOR = 1.979, 95% CI: 1.361–2.878), or when the vaccine was endorsed by health authorities (aOR = 1.976, 95% CI: 1.343–

2.908) or healthcare facilities (aOR = 2.684, 95% CI: 1.804–3.994); however, family member recommendations inversely affected intent (aOR = 0.479, 95% CI: 0.283–0.811).

Non-HCWs showed increased willingness when influenced by widespread public uptake or family endorsements, and those proactively managing their health were also more accepting. Notably, these cues and self-efficacy measures lacked significant associations with vaccine willingness among HCWs (**Table 4**).

This study was carried out in Lebanon before the launch of the national COVID-19 vaccination campaign, with the objective of evaluating acceptance of a future COVID-19 vaccine and identifying factors influencing vaccination intent among healthcare workers (HCWs) and non-healthcare workers (non-HCWs). To our knowledge, this investigation represents the first national assessment in Lebanon that simultaneously examines vaccine acceptance in both HCWs and non-HCWs and compares the determinants of willingness to vaccinate between these two groups. The analytical framework integrated constructs of the Health Belief Model (HBM) with sociodemographic characteristics, health-related factors, prior vaccination behavior, and intention to vaccinate.

Overall, the intention to receive a COVID-19 vaccine among the Lebanese population was moderate, with an acceptance rate of 51.5%. This level of acceptance is comparable to findings reported in Kuwait (53.1%) [30] and Qatar (45%–60%) [31]. However, it exceeds the acceptance rate observed in Jordan (28.4%) [23] and remains lower than that reported in Saudi Arabia (64.7%) [32]. When compared with high-income countries, the acceptance rate in Lebanon was lower than those reported in the United States (67%) [33], Japan (62.1%) [34], Ireland (65%) [35], and the United Kingdom (69%) [35]. Notably, an earlier survey conducted in Lebanon in April 2020 documented a higher acceptance rate of approximately 70% [35], suggesting a possible decline in vaccine confidence over time.

Healthcare workers demonstrated a substantially higher intention to receive the COVID-19 vaccine compared with non-HCWs (65.8% vs. 47%) [35], a pattern consistent with findings from China, where vaccine uptake was also greater among HCWs [36]. This difference may reflect HCWs' enhanced access to accurate scientific information, greater familiarity with vaccine development processes, and professional awareness of COVID-19-related risks. In contrast, vaccine hesitancy among non-HCWs may be shaped by sociocultural influences, misinformation, and prevailing

community beliefs surrounding vaccination. These observations highlight the importance of tailored public health interventions that specifically target non-HCWs to improve vaccine acceptance and ensure effective pandemic control. Further exploration of Lebanon's sociocultural context—such as historical mistrust in governmental health initiatives and divergent perceptions of disease risk—may provide additional insight into observed hesitancy patterns. Consequently, national health authorities should prioritize communication strategies that address safety concerns, strengthen public trust, and emphasize the collective benefits of vaccination.

The findings further revealed a notable discrepancy between perceived susceptibility and perceived severity of COVID-19. While most participants believed they were at risk of infection, fewer than 10% perceived COVID-19 as a severe disease. This mismatch may undermine public health messaging and weaken motivation for preventive behaviors, including vaccination. Although knowledge levels and perceived benefits of vaccination were generally high among Lebanese adults, the low perceived severity of COVID-19 may represent a key barrier to vaccine uptake.

Healthcare workers reported significantly higher perceived susceptibility, stronger belief in vaccine benefits, and greater responsiveness to cues to action compared with non-HCWs. These differences underscore the role of professional knowledge and ethical responsibility in shaping vaccination attitudes. HCWs' higher knowledge scores and lower perceived barriers suggest a greater ability to critically assess vaccine-related information and resist misinformation. Interventions aimed at the general population should therefore focus on correcting underestimation of disease severity while reinforcing the protective value of vaccination. Public health campaigns that deliver clear, culturally sensitive messages—potentially through trusted community figures—may help shift perceptions and encourage proactive health behaviors.

Analysis of sociodemographic factors revealed that women in the general population and among non-HCWs were less willing to receive the COVID-19 vaccine. This finding aligns with evidence from France [37], Australia [38], the United Kingdom [39], and the United States [40], where women have consistently reported higher vaccine hesitancy. Such reluctance may be driven by heightened concerns about vaccine novelty, long-term safety, and adverse effects. In contrast, older age was

associated with greater willingness to vaccinate among both HCWs and non-HCWs, consistent with findings from numerous international studies, although this contrasts with reports from Kuwait and Qatar indicating greater hesitancy among older adults [30, 41]. Increased acceptance among older individuals may stem from heightened awareness of COVID-19 complications and recognition of vaccination as a protective measure [42]. Marital status was also a significant determinant, with married participants in both HCWs and non-HCWs showing higher vaccination intent than single individuals. Similar associations have been reported in China [43], where marital responsibilities may increase motivation to adopt preventive health behaviors. Likewise, urban residence was positively associated with vaccine acceptance, whereas individuals living in rural areas exhibited greater hesitancy. This rural–urban divide highlights a critical public health challenge and emphasizes the need for targeted strategies addressing access barriers, misinformation, and trust deficits in rural communities. Engaging local healthcare providers and community leaders may be particularly effective in addressing vaccine hesitancy in these settings.

The study found no significant association between vaccine acceptance and personal history of COVID-19 infection, infection among close contacts, or self-reported health status. This observation is consistent with a recent meta-analysis showing no consistent link between prior infection and vaccine acceptance [44], underscoring the complexity of factors influencing vaccination decisions.

Regarding prior vaccination behavior, receipt of the seasonal influenza vaccine during the current year was positively associated with COVID-19 vaccine acceptance among both HCWs and non-HCWs, consistent with previous research [45]. Conversely, individuals with a history of vaccine refusal were less likely to accept COVID-19 vaccination, suggesting entrenched skepticism that may extend beyond a single vaccine. Addressing this group requires tailored communication strategies that acknowledge past concerns and rebuild trust through transparent and empathetic messaging.

HBM constructs—including perceived susceptibility, perceived benefits, cues to action, and perceived barriers—emerged as key predictors of vaccination intent in both groups. Similar findings have been reported among HCWs in Asia, where perceived susceptibility played a central role in vaccination decisions [46].

Recommendations from health authorities were particularly influential in motivating both HCWs and non-HCWs. For non-HCWs, additional cues such as family recommendations and widespread vaccine uptake within the community further increased willingness. Previous studies have shown that some individuals, including HCWs, may delay vaccination due to concerns about early adverse effects [47], reinforcing the need for timely and authoritative guidance from health authorities. The importance of both internal and external cues in shaping vaccination behavior has also been demonstrated in the context of influenza vaccination [48].

Among HCWs, strong belief in the benefits of COVID-19 vaccination was especially critical, given their role as trusted sources of health information and behavioral role models for the public. Positive attitudes among HCWs can enhance public confidence and contribute to higher vaccination coverage, particularly among vulnerable populations. These findings are consistent with previous studies emphasizing the impact of HCWs' attitudes on vaccine uptake [49]. Communication strategies should therefore empower HCWs to effectively convey vaccine benefits to patients and communities.

Concerns related to vaccine safety and side effects constituted major barriers to vaccination among both HCWs and non-HCWs, echoing findings from other studies [50]. Among HCWs, uncertainty regarding the duration of vaccine-induced immunity further reduced willingness to vaccinate. Non-HCWs expressed greater distrust in vaccine manufacturers, highlighting disparities in access to reliable information. These findings point to the necessity of transparent, evidence-based communication addressing safety, efficacy, and manufacturer credibility to improve vaccine confidence. Overall, the results emphasize the importance of public awareness initiatives that prioritize addressing vaccine safety concerns rather than focusing solely on disease severity. Given the dynamic nature of vaccine perceptions, repeated assessments of vaccine acceptance are warranted. Moreover, considering Lebanon's substantial refugee population, future research and vaccination programs should explicitly address the needs of refugees to ensure equitable access and protection.

Limitations

Several limitations should be acknowledged. The cross-sectional design precludes causal interpretation of observed associations. The use of snowball sampling, although practical during the pandemic, may have

introduced selection bias and limited representativeness, as participants were more likely to recruit individuals within their social networks. Additionally, the reliance on an online survey may have excluded populations with limited internet access or lower digital literacy, which is particularly relevant in the Lebanese context. Self-reported data are subject to recall and social desirability biases. Finally, as the study was conducted prior to vaccine availability, perceptions and acceptance may change as more evidence on vaccine safety and effectiveness becomes available.

Conclusion

COVID-19 vaccine acceptance among Lebanese adults was moderate, with healthcare workers demonstrating greater willingness to vaccinate than non-healthcare workers. Addressing misconceptions and safety concerns—particularly among non-HCWs—while emphasizing the benefits of vaccination is essential for improving acceptance. Targeted educational interventions and strong public health messaging are critical to building trust in vaccines and enhancing uptake, ultimately contributing to effective control of the COVID-19 pandemic.

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