COVID-19 Vaccine Hesitancy in Lebanon

Mariam Mando, Aseel Al Khansa, Yousef Zaitoun, Mariam Chokor, Bilal Elchehimi, Riham Dweik, Batoul Jaafar, Rayan Al Haj, Rim Nahme, Ismaeil Bazzi, Hayssam Chebli

Faculty of Science, Lebanese University, Beirut, Lebanon
Email: mariammando09@gmail.com

Abstract

COVID-19 vaccine has become the topic of concern for the world population, and hesitation to vaccinate is among the top 10 global health by the World Health Organization (WHO). Questions about vaccine hesitancy are investigated in a sample (n = 2642) of Lebanese people through an online survey distributed in January 2022. The survey was made up of closed-ended questions that aim to study the relations between sociodemographic factors, general knowledge and attitudes about the COVID-19 vaccine, and vaccine hesitancy using bivariate analysis, and logistic regression models. R language is used to test the proposed relationships, the hypotheses are supported, the proposed models in logistic regression are proven to be fit and the implications are discussed. 70.4% of the participants are vaccinated, and 83.3% among them are willing to take the extra dose of the vaccine. 29.6% are not vaccinated, and among them, only 23.66% are willing to take the vaccine. Vaccination was significantly associated with more odds of being aged more than 50 (OR = 2.62) compared to participants aged less than 50. And of lower odds of being infected with coronavirus (OR = 0.69) compared to non-infected people and of more odds of gaining insights about COVID-19 vaccine from Health workers and scientific publications (OR = 3.94) compared to other sources of information. In a sub-group of 1860 vaccinated participants, the willingness of taking the next dose of the vaccine was significantly associated with lower odds of Medical field workers (OR = 0.36), knowing people who died of coronavirus infection (OR = 0.55), suffering from severe symptoms due to the vaccine (OR = 0.4) and taking another vaccine than AstraZeneca and Pfizer (OR = 0.45), and having taken already two doses of the vaccine (OR = 0.33) compared with their reference modalities.

Subject Areas

Drugs & Devices, Epidemiology, Infectious Diseases, Public Health, Statistics

Keywords

COVID-19, Vaccine, Logistic Regression, Hesitancy

1. Introduction

The new coronavirus outbreak, since it erupted in Wuhan, China, in December 2019 got quickly spread across China, causing varying degrees of disease. Then it has spread worldwide, where millions of people throughout the world have been ill and hundreds of thousands have died [1] [2]. COVID-19 causes symptoms such as cough, fever, breathing difficulty, and invasive lesions in the patient's lungs [3]. It may spread to the lower respiratory system, where in severe cases, patients suffer from dyspnea and respiratory distress syndrome [4]. In Lebanon, there have been 978,125 confirmed cases of COVID-19 with 9730 deaths, between January 2020 and February 2022, reported to WHO. As of February 2022, a total of 5,247,401 vaccine doses have been administered [5], and the major goal was to achieve population immunity. The immunity of the population is reached when a percentage of a population becomes immune to previous infection/vaccination. It has been proven that more than 95% of people who recovered from COVID-19 had a lasting memory of the virus up to eight months after infection [6].

As of Feb 10, 2022, the percentage of people fully vaccinated in Lebanon is 51.87% [7]. With people receiving the "COVID-19" vaccination, questions have started to arise about the reasons that drive the world to get vaccinated, and the Lebanese population has been divided between those who are with and those who are against the vaccine [8], which leads to hesitation. Learning about the factors associated with willingness or refusal to vaccinate can inform our awareness and dedicated efforts to increase the uptake of the COVID-19 vaccine and maximize adoption. Therefore, the purpose of the study is to evaluate the intention to receive the COVID-19 vaccine in Lebanese people and the factors associated with vaccine rejection. The objective of the study was written on top of the questionnaire, as well as the respondent anonymity assurance.

2. Materials and Methods

2.1. Study Design and Data Collection

We conducted this study in January 2022, where half of the Lebanese population was vaccinated. We used the simple random sampling technique to create our sample, where every person in Lebanon has an even chance of being selected in our sample. All methods were carried out according to the relevant guidelines and regulations.

Data were collected via an online survey distributed randomly among Lebanese people aged above 18. The questions were easy to be understood, written in Arabic (the native language of Lebanon) to avoid any conflict, covering socio-demographic features and attitudes of people towards COVID-19 outbreaks and vaccination.

2.2. Statistical Analysis

R language was used for the data analysis, and a p-value ≤ 0.05 was considered to be statistically significant.

The data were collected via a link, so there are no missing values as all the questions were required.

We described the demographic characteristics of the participants, including age, gender, profession, suffering from chronic diseases, and smoking.

For the comparison of categorical variables, we used the chi-square test.

We employed two multivariate logistic regressions to identify the factors affecting the intention of getting vaccinated, taking the dependent variable as getting vaccinated or not for the first regression model, and as the willingness to take the extra dose of the vaccine among the vaccinated respondents for the second regression model, and independent variables as all the variables having a p-value less than 0.2, In the literature, a cut-off value of 0.2 is supported [9], [10].

3. Results

3.1. Univariate Analysis

The sociodemographic and other characteristics of the participants are shown in Table 1.

Overall, 2642 participants enrolled in the study, with 73.13% (1932) aged between 18 and 35 and 83.7% (2212) of them are females. As for profession, 45.04% (1190) are teachers and students, 30.66% (810) are jobless, and the rest are divided into different categories. The majority of the participants don't suffer from chronic diseases (88.38%; 2335) and don't smoke (57.99%; 1532), almost half of them got infected with coronavirus (45.61%; 1205) and the symptoms were divided between mild and moderate symptoms (82.82%; 998), severe symptoms (11.45%; 138), and no symptoms (5.73%; 69).

70.4% (1860) of the participants are vaccinated, the most used vaccine is Pfizer (80.32%; 1494), then AstraZeneca (15.81%; 294). Among the vaccinated participants 16.5% (307) had one dose of the vaccine, 76.67% (1426) had two doses while only 6.83% (127) had three doses, and 83.82% (1559) are willing to take the extra dose of the vaccine. Among the non-vaccinated participants (782) only 23.66% (185) are willing to take the vaccine.

By direct question about the reasons that prevent people from getting vaccinated, we see that mistrust in the effectiveness of the vaccine comes in the first place with a proportion of 0.28 followed by the worry about the side effects with a proportion of 0.21 (Figure 1).

Among the vaccinated people, the main reasons for taking the vaccine were "Reliving symptoms in case of infection" and "contributing to preventing outbreaks" with an equal proportion of 0.4 (Figure 2), and a small proportion of participants (0.14) were forced to vaccinate due to travel or work. On the other hand, we asked these vaccinated participants who are not willing to take the next dose of the vaccine about the reason behind this decision to end up with a proportion of 0.52 of them being worried about side effects and 0.25 of them consider it as useless (Figure 3).

Table 1. Characteristics of participants on COVID-19 vaccine hesitancy survey.

Variable	Frequency (N)	Percentage
Gender		
Male	430	16.3%
Female	2212	83.7%
Age		
18 - 22	818	30.96%
23 - 35	1114	42.17%
36 - 50	561	21.23%
More than 50	149	5.64%
Profession		
Jobless	810	30.66%
Student	715	27.06%
Teacher	475	17.98%
Self-employment	316	11.96%
Medical Field	162	6.13%
Other	164	6.21%
Chronic Disease		
Yes	307	11.62%
No	2335	88.38%
Smoking		
Yes	1110	42.01%
No	1532	57.99%
Infected		
Yes	1205	45.61%
No	1437	54.39%
Infection Symptoms		
No Symptoms	69	5.73%
Mild/Moderate	998	82.82%
Severe Symptoms	138	11.45%
Source of information about the vaccine		
Social media	1466	31.83%
TV, Magazines, and chats	884	19.19%
Scientific Publications	1222	26.53%
Health Workers	1043	22.45%
Vaccinated		
Yes	1860	70.4%
No	782	29.6%

Continued

Willingness to take the vaccine		
Yes	185	23.66%
No	597	76.34%
Vaccine Symptoms		
No Symptoms	486	26.13%
Mild/Moderate	1297	69.73%
Severe Symptoms	77	4.14%
Vaccine type		
Pfizer	1494	80.32%
AstraZeneca	294	15.81%
Other	72	3.87%
Number of doses		
One dose	307	16.5%
Two doses	1426	76.67%
Three doses	127	6.83%
Willingness to take next dose		
Yes	1559	83.82%
No	301	16.18%
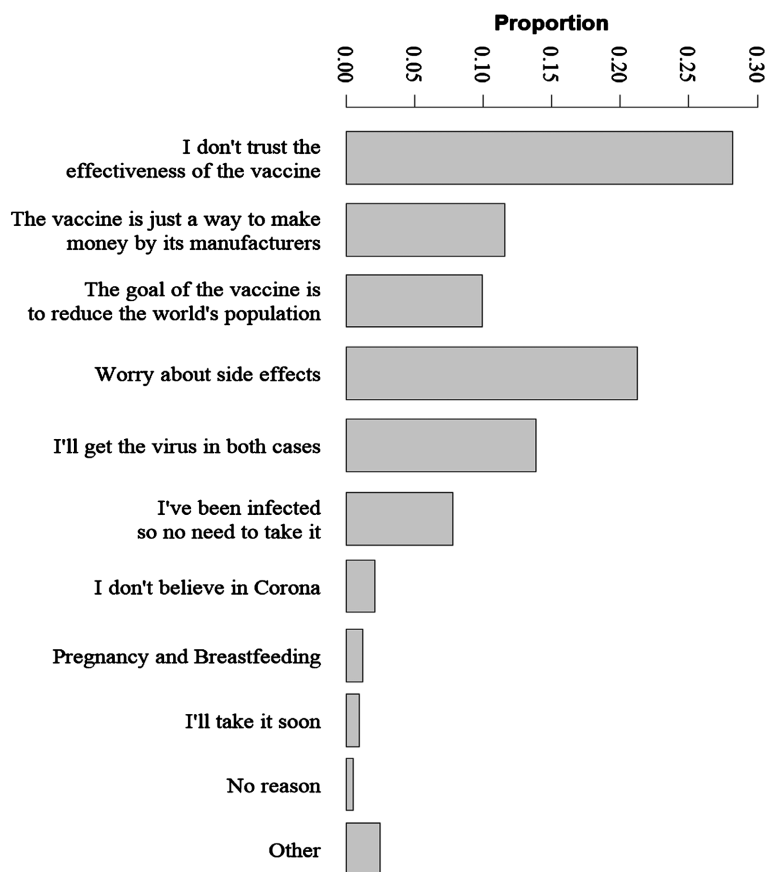
Figure 1. Reasons that prevent people from getting vaccinated.
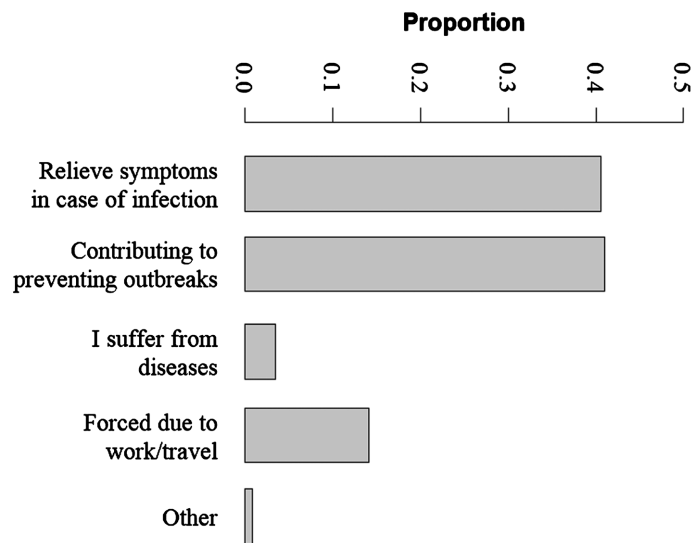
Figure 2. Reasons that prompted people to take the COVID-19 vaccine.
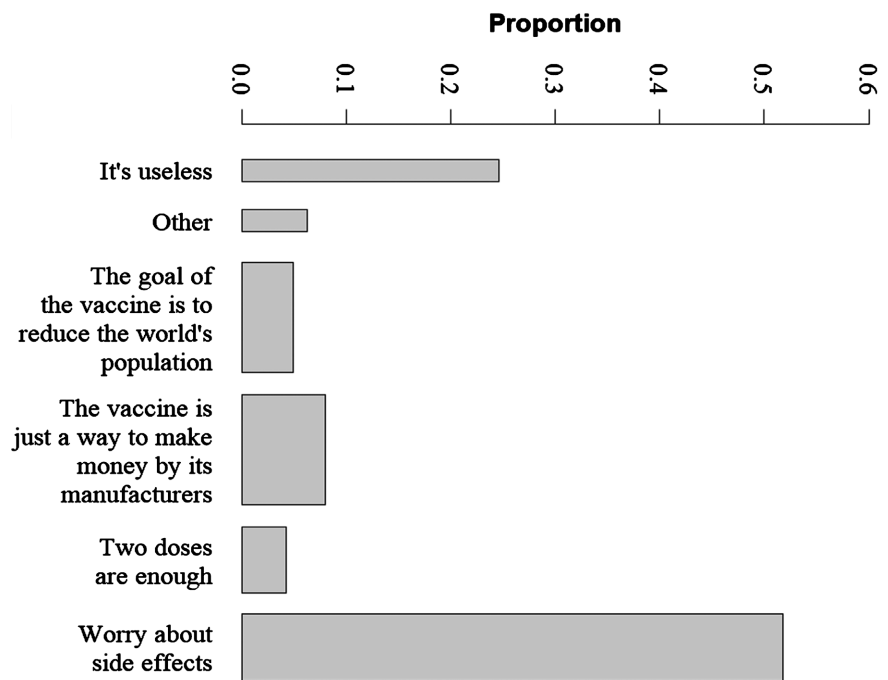
Figure 3. Reasons that prevent people from taking the next dose of the vaccine.

3.2. Bivariate Analysis

A significant relationship was shown between getting infected with coronavirus and getting vaccinated, the percentage of infection among non-vaccinated people (51%) was significantly higher in comparison with the vaccinated participants (43%). AstraZeneca showed a significantly higher percentage of Mild/Moderate and Severe symptoms in comparison with the other vaccines. And the percentage of not willing to take the extra dose of the vaccine is significantly higher for the participants who suffered from severe symptoms due to the previous doses than those who faced mild, moderate, or no symptoms. Age is significantly asso-

ciated with both coronavirus infection and getting vaccinated, as participants aged more than 50 years old showed a smaller percentage of getting infected, and a higher percentage of getting vaccinated concerning participants aged less than 50. The percentage of vaccinated people among Medical field workers is significantly higher than in the other fields. Also, we detect an association between getting vaccinated and having chronic diseases, knowing people who died due to the vaccine, or who died due to coronavirus, or who died because of infection while they were not vaccinated (Table 2).

3.3. Multivariate Analysis

Multivariable Logistic Regression

All the variables in Table 3 were used as independent variables except those that have a p-value > 0.2.

Table 2. Bivariate Analysis between categorical variables, chi-square test, p-value < 0.05.

Pearson's Chi-squared test	X-squared	df	P-value	Result
H_0: No relationship between vaccination and coronavirus infection				
	16.061	1	6.134e−05	Reject H_0
H_0: No relationship between the type of vaccine and vaccine symptoms				
	14.075	4	0.007058	Reject H_0
H_0: No relationship between the willingness of taking the next dose of vaccine and vaccine symptoms				
	11.255	2	0.003597	Reject H_0
H_0: No relationship between age and coronavirus infection				
	15.57	3	0.001389	Reject H_0
H_0: No relationship between age and vaccination				
	24.199	3	$2.27e^{-05}$	Reject H_0
H_0: No relationship between profession and vaccination				
	31.334	5	$8.045e^{-06}$	Reject H_0
H_0: No relationship between having chronic diseases and vaccination				
	6.6349	1	0.01	Reject H_0
H_0: No relationship between knowing people who died due to the vaccine and vaccination				
	19.379	1	$1.072e^{-05}$	Reject H_0
H_0: No relationship between knowing people who died due to coronavirus and vaccination				
	42.249	1	$8.037e^{-11}$	Reject H_0
H_0: No relationship between knowing non-vaccinated people who died due to coronavirus and vaccination				
	5.0583	1	0.02451	Reject H_0

Table 3. Chi-square tests between dependent variable and independent variables. p-value < 0.2.

Dependent Variable	Independent Variables	Chi-square p-value
Model 1: Getting Vaccinated (Yes/No*)	Gender	0.05278
	Age	$2.27e^{-05}$
	Profession	$8.045e^{-06}$
	Chronic Disease	0.01
	Smoking	0.4922
	Coronavirus infection	$6.134e^{-05}$
	Knowing people who died due to the vaccine	$1.072e^{-05}$
	Knowing people who died due to coronavirus infection	$8.037e^{-11}$
	Knowing people (non-vaccinated) who died due to the coronavirus infection	0.02451
	Source of information	$1.796e^{-14}$
Model 2: Willingness to take the next dose (Yes/No*)	Gender	0.1214
	Age	0.01236
	Profession	0.0008124
	Chronic Disease	0.3749
	Smoking	0.01317
	Coronavirus infection	0.5353
	Knowing people who died due to the vaccine	0.1753
	Knowing people who died due to coronavirus infection	0.0008995
	Knowing people (non-vaccinated) who died due to the coronavirus infection	0.03298
	Source of information	0.9193
	Vaccine Symptoms	0.003597
	Vaccine Type	0.006502
	Number of doses taken	$1.985e{-07}$

Table 4 represents the logistic regression results for getting vaccinated (model 1) after splitting the data randomly into 80% training set and 20% test set, and after performing a backward stepwise selection and cleaning the data from influential points. The Hosmer and Leme goodness-of-fit showed a good fitting degree of the model (χ^2 = 2.8545, p-value = 0.9432). Odds reporting COVID-19 vaccination are significantly associated with age, profession, having chronic diseases, knowing people who died due to the vaccine or due to coronavirus, and the source of information about the vaccine. People aged more than 50 are 2.26 times more likely to get vaccinated in comparison with people below 22. Medical field workers had 2.39 greater odds of getting vaccinated compared to jobless

Table 4. Model 1: Multivariable regression taking the COVID-19 vaccination.

Coefficients	Estimate	OR	Std. Error	z value	Pr (>|z|)
(Intercept)	0.59144	1.81	0.18220	3.246	0.001170 **
Age					
18 - 22 (ref)	-	-	-	-	-
23 - 35	0.05752	1.06	0.14667	0.392	0.694927
36 - 50	0.30062	1.35	0.17868	1.682	0.092482.
more than 50	0.96273	2.62	0.31528	3.054	0.002261 **
Profession					
Jobless (ref)	-	-	-	-	-
Medical Field	0.87254	2.39	0.28275	3.086	0.002029 **
Other	0.69621	2.006	0.24925	2.793	0.005218 **
Self-employment	−0.03462	0.97	0.16682	−0.208	0.835615
Student	0.13717	1.15	0.16509	0.831	0.406042
Teacher	0.29493	1.34	0.15352	1.921	1.921
Chronic disease					
No (ref)	-	-	-	-	-
Yes	0.32642	1.39	0.17836	1.830	0.067226.
Coronavirus infection					
No (ref)	-	-	-	-	-
Yes	−0.37415	0.69	0.10217	−3.662	0.000250 ***
Know people who died due to the vaccine					
No (ref)	-	-	-	-	-
Yes	-0.30593	0.74	0.11026	-2.775	0.005527 **
Know people who died due to the coronavirus infection					
No (ref)	-	-	-	-	-
Yes	0.63879	1.89	0.11015	−5.799	6.66e−09 ***
Source of information about the vaccine					
a (ref)	-	-	-	-	-
a; b	0.07480	1.08	0.20495	0.365	0.715130
a; b; c	0.61257	1.85	0.30112	2.034	0.041920 *
a; b; c; d	0.79871	2.22	0.18906	4.225	2.39e−05 ***
a; b; d	0.93191	2.54	0.36360	2.563	0.010378 *
a; c	0.22696	1.25	0.29434	0.771	0.440659
a; c; d	0.47173	1.6	0.30179	1.563	0.118024
a; d	0.56713	1.76	0.29565	1.918	0.055081.

Continued

b	0.15823	1.17	0.19547	0.809	0.418244
b; c	−0.04856	0.95	0.42634	−0.114	0.909309
b; c; d	1.53268	4.63	0.77373	1.981	0.047604 *
c	0.91731	2.5	0.16746	5.478	4.31e−08 ***
c; d	1.37199	3.94	0.24914	5.507	3.65e−08 ***
d	0.71731	2.05	0.18976	3.780	0.000157 ***

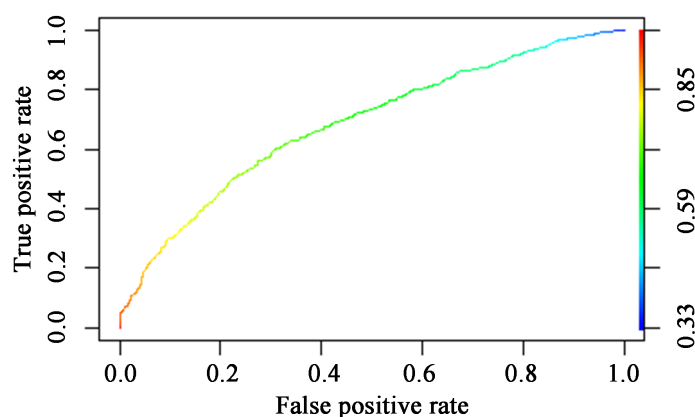Significance codes: 0 "***"; 0.001 "**"; 0.01 "*"; 0.05 "."; 0.1 "".

Figure 4. Model 1 ROC curve.

respondents. Those who were infected with coronavirus were 30% less likely to get vaccinated compared to non-infected people. And those who know people who died because of the vaccine were less likely to get vaccinated by 26% in comparison with the others, while those who know people who died because of coronavirus infection were more likely to get vaccinated by 89% compared to the others, and for the source of information about COVID-19 vaccine we notice that those who take their information from scientific publications and health workers are almost 2 times more likely to get vaccinated than those who just follow social media news. As for a prediction, the model showed an accuracy of 0.67 and the Roc curve gave an AUC (Area under Curve) of 0.68 (Figure 4).

Among the vaccinated participants (1860, 70.4%), another multivariate logistic regression was performed to find the factors that affect the willingness of taking the next dose of the vaccine, with the Hosmer and Leme goodness of fit test (χ^2 = 4.1207, p-value = 0.8461) we can assume that the model fits well the data. Medical field workers (OR = 0.36), knowing people who died of coronavirus infection (OR = 0.55), suffering from severe symptoms due to the vaccine (OR = 0.4) and taking another vaccine than AstraZeneca and Pfizer (OR = 0.45), and having taken already two doses of the vaccine (OR = 0.33) were all less likely to get the next dose of the vaccine in comparison with their reference modalities, while only those who know non-vaccinated people who died of coronavirus infection were more likely to take the next dose by 82% in comparison with those

who don't know such people Table 5. The accuracy of this model in predicting the willingness of taking the next dose was 0.83, and the area under the roc curve AUC was equal to 0.68

4. Discussion

As the hesitancy of getting vaccinated is still available in the Lebanese population

Table 5. Model 2: Multivariable regression taking the willingness to do the next dose of the COVID-19 vaccine.

Coefficients	Estimate	OR	Std. Error	z value	Pr (>|z|)
(Intercept)	2.6800692	14.59	0.3515040	7.625	2.45e−14***
Profession					
Jobless (ref)	−	−	−	−	−
Medical Field	−1.0185882	0.36	0.2672527	−3.811	0.000138***
Self-employment	−0.2773079	0.76	0.2421540	0.2421540	−1.145
Student	0.2894546	1.34	0.2058474	1.406	0.159676
Teacher	0.4006265	1.49	0.2322956	1.725	0.084592.
Other	0.0009538	1.001	0.3155272	0.003	0.997588
Know people who died due to coronavirus infection					
No (ref)	−	−	−	−	−
Yes	−0.5680057	0.55	0.1548519	−3.668	0.000244***
Know non-vaccinated people who died due to coronavirus infection					
No (ref)	−	−	−	−	−
Yes	0.5976610	1.82	0.1636652	3.652	0.000260***
Vaccine symptoms					
Mild/Moderate (ref)	−	−	−	−	−
Severe symptoms	−0.9212450	0.4	0.2867735	−3.212	0.001316**
No symptoms	0.1873125	1.21	0.1776683	1.054	0.291754
Vaccine type					
AstraZeneca (ref)	−	−	−	−	−
Pfizer	−0.4035657	0.67	0.2216221	−1.821	0.068612.
Other	−0.7885602	0.45	0.3899705	−2.022	0.043166*
Number of doses taken					
One dose (ref)	−	−	−	−	−
Two doses	−1.1159057	0.33	0.2577644	−4.329	1.50e−05***
Three doses	0.0276651	1.028	0.4260750	0.065	0.948230

Significance codes: 0 "***" 0.001 "**" 0.01 "*" 0.05 "." 0.1 "".

even after half of it got vaccinated, we conducted this study to know the reasons behind this hesitancy. In our study about a quarter of Lebanese participants are not vaccinated yet, and more than a third-quarter of them are not willing to get vaccinated. Acceptance of COVID-19 vaccine in Lebanon got increased by 7% between February 2021 (63.4%) [11] and January 2022 (70.4%) as shown in our study, while this percentage was only 21.4% in November 2020 few months before the introduction of the vaccine in Lebanon [8]. we have seen that vaccine hesitancy was related to several factors including age, chronic diseases, trust, source of information about vaccine, taking into consideration the previous negative experiences of friends and relatives regarding vaccination, which significantly increased their hesitancy, while in Portugal the factors were quite similar, such as being younger, loss of income during the pandemic, no intention of taking the flu vaccine, low confidence in the COVID-19 vaccine and the health service response during the pandemic, worse perception of government measures, perception of the information provided as inconsistent and contradictory [12].

Hesitancy of getting vaccinated was also related to injection fears, where blood-injection-injury fears may explain approximately 10% of cases of COVID-19 vaccine hesitancy [13], on the other hand health-related fears and anxiety related to COVID-19 were associated with higher vaccine acceptance [14].

COVID-19 affected negatively the life expectancy, as women from 15 countries and men from 10 countries ended up having a lower birth expectancy in 2020 than in 2015 [15]. Chronic diseases and coronavirus infection are significantly associated, and it was shown in another study that people with liver disease, diabetes, high blood pressure, and obesity are more likely to be infected with COVID-19 [16].

5. Conclusions

Overall, our findings revealed that a high percentage of people (70.4%) were already vaccinated, which means that people are more likely tending to accept the COVID-19 vaccine. As long as the acceptance is increasing the hesitancy of getting vaccinated is decreasing simultaneously.

The factors that most affected the vaccine hesitancy in our study were knowing people having bad experiences with the COVID-19 vaccine, also the source of information about the vaccine, as social media platforms offer all kinds of news about the vaccine no matter if they are correct or not. And the willingness of taking the next dose of the vaccine was related to the number of doses taken and the vaccine type.

Our future goal is to keep looking for the factors that most affect people's decisions regarding COVID-19 vaccination, aiming to reach the end of this pandemic.

These findings underscore the importance of public education measures to reduce vaccine safety and efficacy concerns. Also, health education and choosing

trusted sources to get to know more about the vaccine are important to increase acceptance of vaccination.

Governments can take further steps to increase this acceptance by doing educational webinars about the importance of vaccination.

Acknowledgments

Ethical Statement

Informed consent was obtained from all participants at the start of the survey.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Schumaker, E. (2020) Timeline: How Coronavirus Got Started. ABC News. https://abcnews.go.com/Health/timeline-coronavirus-started/story?id=69435165

[2] Guan, W.-J. (2020) Clinical Characteristics of Coronavirus Disease 2019 in China. *The New England Journal of Medicine*, **6**, 531-543.

[3] Song, F.X., *et al.* (2020) Emerging 2019 Novel Coronavirus (2019-nCoV) Pneumonia. *Radiology*, **295**, 210-217.

[4] Gibson, P.G., Qin, L. and Puah, S.H. (2020) COVID-19 Acute Respiratory Distress Syndrome (ARDS): Clinical Features and Differences from Typical Pre-COVID-19 ARDS. Wiley Public Health Emergency Collection.

[5] WHO Health Emergency Dashboard. https://covid19.who.int/region/emro/country/lb

[6] National Institutes of Health (2021) Lasting Immunity Found after Recovery from COVID-19. https://www.nih.gov/news-events/nih-research-matters/lasting-immunity-found-after-recovery-covid-19

[7] The Gardner News. Lebanon County, PA COVID-19 Vaccine Tracker. https://data.thegardnernews.com/covid-19-vaccine-tracker/pennsylvania/lebanon-county/42075/

[8] Al Halabi, C.K., Obeid, S., Sacre, H., Akel, M., Hallit, R., Salameh, P. and Hallit, S. (2021) Attitudes of Lebanese Adults Regarding COVID-19 Vaccination. *BMC Public Health*, **21**, Article No. 998. https://doi.org/10.1186/s12889-021-10902-w

[9] Bendel, R.B. and Afifi, A.A. (1977) Comparison of Stopping Rules in Forward "Stepwise" Regression. *Journal of the American Statistical Association*, **72**, 46-53. https://doi.org/10.2307/2286904

[10] Mickey, R.M. and Greenland, S. (1989) The Impact of Confounder Selection Criteria on Effect Estimation. *American Journal of Epidemiology*, **129**, 125-137. https://doi.org/10.1093/oxfordjournals.aje.a115409

[11] Hanna, P., Issa, A., Noujeim, Z., Hleyhel, M. and Saleh, N. (2022) Assessment of COVID-19 Vaccines Acceptance in the Lebanese Population: A National Cross-Sectional Study. *Journal of Pharmaceutical Policy and Practice*, **15**, Article No. 5. https://doi.org/10.1186/s40545-021-00403-x

[12] Soares, P. and Rocha, J.V. (2021) Factors Associated with COVID-19 Vaccine Hesitancy. *Vaccines* (*Basel*), **9**, Article No. 300. https://doi.org/10.3390/vaccines9030300

[13] Freeman, D., Lambe, S., Yu, L.-M., *et al.* (2021) Injection Fears and COVID-19 Vaccine Hesitancy. *Psychological Medicine*, 1-11. https://doi.org/10.1017/S0033291721002609

[14] Bendau, A., Plag, J., Petzold, M.B. and Strohle, A. (2021) COVID-19 Vaccine Hesitancy and Related Fears and Anxiety. *International Immunopharmacology*, **97**, Article ID: 107724. https://doi.org/10.1016/j.intimp.2021.107724

[15] Aburto, J.M., *et al.* (2021) Quantifying Impacts of the COVID-19 Pandemic through Life-Expectancy Losses: A Population-Level Study of 29 Countries. OUP Public Health Emergency Collection. https://doi.org/10.1101/2021.03.02.21252772

[16] Hamed, A.M. (2020) An Overview on COVID-19: Reality and Expectation. *Bulletin of the National*, **44**, Article No. 86. https://doi.org/10.1186/s42269-020-00341-9