COVID-19 Vaccine Hesitancy in Lebanon

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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 sociodemographic 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%)

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**Figure 1.** Reasons that prevent people from getting vaccinated.
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 |
|----------------------------|-----------|----|---------|--------|
| H₀: No relationship between vaccination and coronavirus infection | 16.061 | 1 | 6.134e-05 | Reject H₀ |
| H₀: No relationship between the type of vaccine and vaccine symptoms | 14.075 | 4 | 0.007058 | Reject H₀ |
| H₀: No relationship between the willingness of taking the next dose of vaccine and vaccine symptoms | 11.255 | 2 | 0.003597 | Reject H₀ |
| H₀: No relationship between age and coronavirus infection | 15.57 | 3 | 0.001389 | Reject H₀ |
| H₀: No relationship between age and vaccination | 24.199 | 3 | 2.27e-05 | Reject H₀ |
| H₀: No relationship between profession and vaccination | 31.334 | 5 | 8.045e-06 | Reject H₀ |
| H₀: No relationship between having chronic diseases and vaccination | 6.6349 | 1 | 0.01 | Reject H₀ |
| H₀: No relationship between knowing people who died due to the vaccine and vaccination | 19.379 | 1 | 1.072e-05 | Reject H₀ |
| H₀: No relationship between knowing people who died due to coronavirus and vaccination | 42.249 | 1 | 8.037e-11 | Reject H₀ |
| H₀: No relationship between knowing non-vaccinated people who died due to coronavirus and vaccination | 5.0583 | 1 | 0.02451 | Reject H₀ |
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  | Gender                                                     | 0.05278            |
| (Yes/No*)                         | 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 coronavirus infection | 0.02451          |
|                                   | Source of information                                      | 1.796e−14          |
| **Model 2:** Willingness to take | Gender                                                     | 0.1214             |
| the next dose                     | Age                                                        | 0.01236            |
| (Yes/No*)                         | 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 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 ($\chi^2 = 2.8545$, 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 | b; c | b; c; d | c | c; d | d |
|---|---|------|---------|---|------|---|
|   | 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 ($\chi^2 = 4.1207$, 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.

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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.

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