COVID-19 Vaccine Hesitancy among University Students in Lebanon

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Abstract

Background

Lebanon has one of the lowest reported COVID-19 vaccine acceptance rates (21%). Little is known about the decision-making process of college students in Lebanon regarding obtaining a COVID-19 vaccination. Therefore, the aim of this study was to identify factors that predicted the behavioral intentions of students enrolled at the American University of Beirut (AUB), Lebanon to obtain a COVID-19 vaccine.

Methods

The study was a randomized, non-experimental, and cross-sectional study of undergraduate and graduate students. A valid and reliable survey was developed. A total of 3,805 students were randomly selected to participate from all academic units. A total of 800 students responded (21% return rate).

Results

We generated three groups based on students' intentions to be vaccinated: 1) vaccine accepting (those who are willing to take or already took the vaccine); 2) vaccine hesitant (those who are hesitant to take the vaccine); and 3) vaccine resistant (those who decided not to take the vaccine). The majority were Lebanese (85%), undergraduate students (75%), females (57%) with a mean age of 21 ± 0.14 years. Overall, students were vaccine accepting. Specifically, they were vaccine accepting (87%), vaccine hesitant (10%), and vaccine resistant (3%). Vaccine hesitancy was significantly associated with nationality, residency status and university rank (p value < 0.05). Moreover, there was a significant association between hesitancy and agreement with conspiracies. A significant factor for hesitancy was disagreement with the statement that symptomatic cases are the only carriers of COVID-19 (OR = 5; 95% CI = 1.67–14.29; p value = 0.004). Students believed that that the vaccine was safe (OR = 0.01; 95% CI = 0.002–0.08; p value = 0.000); in agreement with their personal views (OR = 0.1; 95% CI = 0.02–0.51; p value = 0.004) and were less likely to be hesitant than the vaccine accepting group (reference group).

Conclusion

The factors identified that explain and/or predict each of the three vaccine intention groups can be used as core content for health communication and social marketing campaigns to increase the rate of COVID-19 vaccination.

Background

On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic (1, 2). SARS-CoV-2, the causative agent of COVID-19 is a respiratory virus transmitted from person-to-person via

droplets. With the lack of antiviral treatment and vaccines, non-pharmaceutical interventions (NPIs) were implemented to slow the spread of the virus. These NPIs included closure of international borders and points of entry/exit, screening of travelers, implementation of strict lockdown measures, isolation of positive cases, use of hand hygiene, face coverings, and other personal protective equipment (3–5). Despite the implementation of these measures, the number of COVID-19 cases is still increasing worldwide (6). Therefore, vaccines remain the most effective way to prevent the spread of COVID-19 (6, 7).

Since the emergence of SARS-CoV-2, several vaccines were developed in an 11-month period, a record time (5, 6). Currently, there are 9 vaccines in early or limited use with 8 vaccines approved for full use (6, 8). Several platforms for the vaccines are currently in use; two companies developed mRNA-based vaccines: Pfizer/BioNtech and Moderna. These vaccines encode the spike glycoprotein of SARS-CoV-2 and offer an efficacy of 95% and 94.1%, respectively (9). The Johnson & Johnson's Janssen COVID-19 vaccine and the AstraZeneca/Oxford (ChAdOx1) vaccines are based on a recombinant, replication-incompetent human adenovirus serotype 26 vector and chimpanzee adenovirus (ChAdOx1) vector encoding the spike glycoprotein of SARS-CoV-2 (8–13). Inactivated virus as well as protein-based vaccines have also been developed and many are in use. The record time of development of these vaccines generated a global hesitancy among many and is currently affecting the roll-out of vaccines to control the spread of the SARS-CoV-2 (5).

Vaccine hesitancy, defined as the "delay in acceptance or refusal of vaccines despite availability of vaccine services," has been an ongoing challenge (5, 14). Vaccine hesitancy is caused by multiple factors and varies with time, place and vaccines (14, 15). These factors include complacency (individual perceptions of the risks versus the need for vaccination), convenience (availability, affordability and accessibility to vaccines), and confidence (trust in the safety and effectiveness of the vaccine and the delivering healthcare system, and in the decisions of policymakers) (14). The "3Cs" are helpful in understanding factors that contribute to vaccine hesitancy (14, 16). These include *contextual influences* (e.g. historic, socio-cultural, environmental, health system/ institutional, economic or political factors), individual and group influences (personal perception of the vaccine including knowledge, awareness, conspiracy beliefs, attitudes, or a personal experience with a vaccinated family member/friend), as well as vaccination influences (costs, mode of delivery, mode of administration, strength and knowledge of healthcare workers, risks, or benefits).

Various countries have conducted studies on COVID-19 vaccine hesitancy. The highest COVID-19 vaccine acceptance rates were reported in Ecuador (97%) (17), Malaysia (94%) (18), Indonesia (93%) (19) and China (91%) (20). High trust in government among these Asian countries is posited as to why these acceptance rates are so high (21). In the US, vaccine acceptance rates were reported among adults (between 57.5% and 68.5%) (21), medical students (75.5%) (22), dental students (56%) (23), and the general population (78%) (24). Unfortunately, COVID-19 vaccine acceptance rates in the Middle Eastern populations have been among the lowest worldwide: Lebanon (21%) (25), Jordan (28.4–37.4%) (16, 26,

27), followed by Qatar (43%) (28), Iraq (62%) (7), Saudi Arabia (65%) (29), Turkey (66%) (30), and Israel (75%) (31).

University and college students form an important part of every society. Students are considered insightful, influential, open-minded, educated, and responsive to public health issues (32). To investigate COVID-19 vaccine hesitancy among this important population, various studies were conducted in this region of the world among medical students (5) and university students in general (33, 34). However, to our knowledge, this is the first study to assess COVID-19 vaccine hesitancy among university students in Lebanon and no studies in the past have used a theoretical approach to elucidate their decision-making process. Therefore, the purpose of this study was to identify the readiness, behavioral intentions, and predictors of obtaining the COVID-19 vaccine among university students at the American University of Beirut.

Methods

Study Design, Participants and Sample Size

The study was a randomized, non-experimental, and cross-sectional study. It was approved by the institutional review board (IRB) at the American University of Beirut (AUB). Participants were both undergraduate and graduate students enrolled at AUB. At the time of the study, there were approximately 9,495 students enrolled at the university: 7,794 undergraduates and 1,701 graduates. A sample size estimate indicated that 367 completed surveys from undergraduate students and 314 completed surveys from graduate students were needed to achieve external validity (95% confidence interval; 5% margin of error, and a 50% response distribution). We estimated a maximum of a 20% response rate. Therefore, we invited 3,805 undergraduate and graduate students who were 18 years old and older to participate.

Survey Instrument

The survey instrument was built using LimeSurvey. Survey questions were developed based on previously published literature on attitudes and behaviors about vaccination (5, 22, 34). The survey included questions based on the Integrated Behavioral Model (IBM) (to assess attitude, perception and behavioral intentions) (35), Precaution Adoption Process Model (PAPM) (to assess readiness to get vaccinated) (36), and the Extended Parallel Processing Model (EPPM) (to assess cognition and emotional reactions) (37). The survey was divided into sections with a total of 35 questions.

The first section asked questions related to the PAPM stage of readiness, history of COVID-19 infection and behavioral intentions towards getting the vaccine once available to students. The second section consisted of questions entailing participant's salience, instrumental and experiential attitudes, and knowledge about COVID-19 vaccine. Salience was assessed using three-questions to determine the importance of getting vaccinated among students (4-point scale ranging from "not important at all" to "very important."). Instrumental and experiential attitudes were assessed using seven questions to determine the level of favorability among students towards the COVID-19 vaccine (5-point scale with 5

being the most favorable). Knowledge about COVID-19 infection and the vaccine was assessed using eight true/false questions. The third section of the online survey included eight questions that assessed students' level of confidence to perform actions related to getting a COVID-19 vaccine (4-point scale questions from "not confident at all" to "very confident"). The fourth section included questions related to environmental constraints and perceived behavioral control towards vaccination. Environmental constraints were assessed using 12 questions related to the effect of specific environmental conditions on getting or not getting the vaccine (a 5-point scale from "very easy" to "very difficult" and a 4-point scale from "significant impact" to "no impact'). Perceived control of getting the COVID-19 vaccine was assessed in a 5-point scaled question (from "not under my control" to "completely under my control").

The fifth section of the survey assessed students' perceived social norms (descriptive and subjective norms). Descriptive norms were assessed using eight questions related to the likelihood of individuals in the student's social network to get the COVID-19 vaccine (5-point scale ranging from "very unlikely" to "very likely" in addition to "not applicable"). Subjective norms were measured using 8-questions related to the perceived influence of others regarding obtaining the vaccine (4-point scale ranged from "not influential at all" to "very influential," in addition to "not applicable").

Finally, section six of the survey targeted conspiracy beliefs regarding the importance, safety, and efficacy of the vaccine in addition to financial aspects of the vaccine. These included beliefs related to the media as driver of unnecessary fear about COVID-19, the potential harm from the vaccine versus COVID-19 disease, the more severe impact of flu compared to COVID-19, the hidden information by pharmaceutical companies regarding vaccination health outcomes, and the vaccine as an attempt to control people and take away personal freedom. The last section addressed socio-demographic characteristics of students (age, gender, program of study, rank, nationality), health status (flu vaccination habit, history of chronic diseases), and sources of knowledge about COVID-19 (social media, friends, family, healthcare workers, YouTube, TV, medical journals, government websites, and medical websites).

Data Collection

Data collection started on May 11, 2021 and ceased on June 18, 2021- the date marking the start of the vaccination campaign at AUB. Invitations and reminders (n = 4) were sent anonymously to potential participants via standardized mass emails or through official university platforms on social media (Facebook Inc, Twitter, Instagram and Whatsapp Messenger).

Statistical Analysis

Data analysis was performed using STATA SE 13.0. Descriptive statistics (frequencies, percentages, and means) were reported. We generated three groups to categorize vaccine willingness: 1) vaccine accepting (those who are willing to take or already took the vaccine), 2) vaccine hesitant (those who are hesitant to take the vaccine), and 3) vaccine resistant (those who decided not to take the vaccine). Chi-square test of proportions was used to compare categorical variables across the vaccine willingness groups (accepting, hesitant and resistant). Backward stepwise regression and multiple logistic regression models were used to assess the association between the vaccine hesitancy or resistant groups and their knowledge about

COVID-19 and its vaccine, environmental constraints, self-efficacy, perceived control, instrumental and experiential attitudes, salience, response cost and efficacy, and descriptive and subjective norms. We simultaneously estimated the ODDs ratios (OR) with its corresponding 95% confidence intervals (CI) to determine the associations between the variables retained from the stepwise regression (p value < 0.05) and the hesitancy group (comparison group) versus vaccine acceptance group (reference group). Similarly, we estimated the OR and its 95% CI to determine the associations between the retained variables and the vaccine resistant group (comparison group) versus its reference group (hesitancy and acceptance groups). We adjusted for control variables (views regarding impact of COVID-19 on Lebanon, views regarding getting vaccinated against COVID-19, conspiracy thinking, flu vaccination habit, and health behaviors) in both multivariable logistic regression models. A p value < 0.05 was considered statistically significant.

Results

Demographic Characteristics of Study Participants

Of the 3,805 students who were invited to participate, 800 participants (21%) from seven academic units at the American University of Beirut completed the survey. The mean age was 21 ± 0.14 years with the majority being Lebanese (85%), undergraduate students (75%), and females (57%) (Table 1). The acceptance, hesitant and resistant groups represented 87%, 10%, and 3% of students enrolled in the study, respectively. Our data show that residency area, nationality and university rank differed significantly among the three groups (Table 1).

Table 1
Demographic characteristics of study participants and COVID-19 vaccine intentions.

	Respondents N (%)	**Accepting (%)**	**Hesitant (%)**	**Resistant (%)**	***p value***
Age (N = 727)					
≤ 20 years	416 (57)	358 (86)	45 (11)	13 (3)	
21–30 years	280 (39)	247 (88)	26 (9.5)	7 (2.5)	
31–40 years	28 (4)	24 (86)	3 (11)	1 (3)	
					0.944
Gender (N = 762)					
Female	433 (57)	372 (86)	49 (11)	12 (3)	
Male	325 (43)	285 (88)	30 (9)	10 (3)	
					0.901
Nationality (N = 760)					
Lebanese	646 (85)	571 (88)	58 (9)	17 (3)	
Syrian	23 (3)	18 (78)	4 (17.5)	1 (4.5)	
Palestinian	25 (3.5)	23 (92)	1 (4)	1 (4)	
Other	63 (8.5)	46 (73)	14 (22)	3 (5)	
					0.02
University Rank (N = 764)					
Freshmen	27 (4)	20 (74)	6 (22)	1 (4)	
Sophomore	175 (23)	140 (80)	26 (15)	9 (5)	
Junior	180 (23.5)	157 (87)	19 (10.5)	4 (2.5)	
Senior	186 (24.5)	173 (93)	11 (6)	2 (1)	
Graduate Student	191 (25)	169 (88.5)	16 (8.5)	6 (3)	
					0.012
Residency Status (N = 754)					
Local Students	669 (89)	589 (88)	62 (9)	18 (3)	
International Students	85 (11)	64 (75)	17 (20)	4 (5)	
					0.005

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
Living Status (N = 763)					
Alone	46 (6)	36 (78)	8 (17.5)	2 (4.5)	
With others	717 (94)	623 (87)	71 (10)	20 (3)	
					0.216
Age of People sharing same Housing (N = 763)					
< 18 years	272 (36)	236 (87)	28 (10)	8 (3)	0.953
19–40 years	390 (51)	338 (87)	40 (10)	12 (3)	0.839
41–65 years	602 (79)	527 (87)	58 (10)	17 (3)	0.814
≥ 66 years	133 (17)	120 (90)	10 (8)	3 (2)	0.521
Area of Residence (N = 797)					
Beirut	369 (46)	325 (88)	37 (10)	7 (2)	0.363
Beqaa	24 (3)	20 (83)	2 (8.5)	2 (8.5)	0.237
Mount Lebanon	291 (36)	256 (88)	29 (10)	6 (2)	0.632
Nabatiyeh	17 (2)	15 (88)	1 (6)	1 (6)	0.629
North Lebanon	38 (5)	29 (76)	6 (16)	3 (8)	0.064
South Lebanon	48 (6)	41 (85.5)	4 (8.5)	3 (6)	0.299

Health Behaviors, Perceptions and COVID-19 Vaccines

We assessed the variation of health status and health behaviors among the vaccine groups: accepting, hesitant, and resistant groups. Our data show that previous history of COVID-19 infection and testing positive for COVID-19 did not differ among the three vaccine willingness categories (Table 2). However, the three groups differed significantly on several variables including adherence to non-pharmaceutical interventions (wearing a facemask, social distancing, hand hygiene, avoiding in-door spaces and going out) as well as flu vaccination history whereby the hesitant and the resistant groups (Table 2). It was clear that almost all respondents who received the flu vaccine during the past 3 years were accepting of the COVID-19 vaccine. Similarly, these groups significantly differed when we inquired about agreement with conspiracy beliefs and perceptions about COVID-19 infection and vaccine (Table 3). Pharmaceutical companies, manipulation by higher power, the vaccine taking away personal freedom and governmental control were mainly where the 3 groups differed.

Table 2
Health behaviors and acceptability of COVID-19 vaccine among study participants.

	Respondents N (%)	**Accepting (%)**	**Hesitant (%)**	**Resistant (%)**	***p value***
COVID-19 Infection History (N = 730)					
Yes	200 (27)	171 (85.5)	22 (11)	7 (3.5)	
No	530 (73)	470 (89)	47 (9)	13 (2)	
					0.2
Tested for COVID-19 (N = 792)					
Yes	533 (67)	467 (88)	52 (10)	13 (2)	
No	259 (33)	221 (85.5)	29 (11)	9 (3.5)	
					0.864
Tested Positive for COVID-19 (N = 685)					
Yes	200 (29)	171 (85.5)	22 (11)	7 (3.5)	
No	485 (71)	427 (88)	44 (9)	13 (3)	
					0.886
COVID-19 Infection History among people in same social circle (N = 788)					
Yes	776 (98)	679 (88)	75 (10)	21 (2)	
No	12 (2)	7 (58)	4 (33)	1 (9)	
					0.039
Hospitalization due to COVID-19 among people in same social circle (N = 755)					
Yes	587 (78)	522 (88.93)	50 (8.52)	15 (2.56)	
No	167 (22)	137 (82.04)	23 (13.77)	7 (4.19)	
					0.019
Death due to COVID-19 among people in same social circle (N = 763)					
Yes	495 (65)	438 (89)	42 (8)	14 (3)	
No	268 (35)	229 (85)	32 (12)	7 (3)	
					0.085
Flu vaccination history in the past years (N = 712)					
3 times	91 (13)	87 (96)	2 (2)	2 (2)	

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
1 time	62 (9)	56 (90)	5 (8)	1 (2)	
None	353 (49)	299 (85)	34 (10)	18 (5)	
Unsure/ Don't remember	206 (29)	167 (81.5)	37 (18.)	1 (0.5)	
					0.000
Health Behavior during the past month					
Face Mask (N = 742)					
All or most of the time	638 (86)	569 (89)	54 (9)	14 (2)	
Some of the time	92 (12)	67 (73)	19 (21)	6 (6)	
Never	12 (2)	9 (75)	1 (8)	2 (17)	
					0.000
Social Distancing of minimum 6 ft (N = 752)					
All or most of the time	322 (43)	287 (89)	25 (8)	9 (3)	
Some of the time	350 (46.5)	304 (87)	37 (10)	9 (3)	
Hardly ever	64 (8.5)	50 (79)	12 (19)	1 (2)	
Never	16 (2)	9 (60)	3 (20)	3 (20)	
					0.001
Washing Hands (N = 746)					
All or most of the time	618 (83)	549 (89)	54 (9)	15 (2)	
Some of the time	114 (15)	88 (77)	20 (17.5)	6 (5.5)	
Hardly ever	14 (2)	10 (71.5)	3 (21.5)	1 (7)	
					0.025
Avoiding indoor spaces (N = 747)					
All or most of the time	357 (48)	320 (90)	27 (7)	10 (3)	
Some of the time	306 (41)	264 (86.5)	38 (12.5)	4 (1)	
Hardly ever	66 (88)	52 (79)	9 (14)	5 (7)	
Never	18 (3)	12 (67)	3 (17)	3 (16)	

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
					0.001
Avoiding close contact with COVID-19 positive cases (N = 724)					
All or most of the time	665 (92)	585 (88)	62 (9)	18 (3)	
Some of the time	59 (8)	45 (76)	10 (17)	4 (7)	
					0.02
Intentionally not going out (N = 708)					
All or most of the time	488 (69)	441 (90)	39 (8)	8 (2)	
Some of the time	195 (27.5)	159 (81.5)	28 (14.5)	8 (4)	
Never	25 (3.5)	17 (68)	3 (12)	5 (20)	
					0.000
Physical health status (N = 757)					
Excellent/ Good	363 (48)	319 (88)	34 (9)	10 (3)	
Fair	17 (2)	15 (88)	1 (6)	1 (6)	
Poor	377 (50)	323 (86)	43 (11)	11 (3)	
					0.202
Mental health status (N = 757)					
Excellent/ Good	378 (50)	331 (88)	38 (10)	9 (2)	
Fair	102 (13.5)	91 (89)	9 (9)	2 (2)	
Poor	277 (36.5)	235 (85)	31 (11)	11 (4)	
					0.312
Needed a health care provider in the past 12 months for physical health (N = 754)					
Yes	359 (48)	315 (88)	34 (9)	10 (3)	
No	344 (46)	298 (87)	37 (11)	9 (2)	
Unsure	51 (6)	40 (78)	8 (16)	3 (6)	
					0.433
Needed a health care provider in the past 12 months for mental health (N = 754)					
Yes	136 (18)	122 (90)	11 (8)	3 (2)	

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
No	580 (77)	502 (86)	62 (11)	16 (3)	
Unsure	38 (5)	29 (76)	6 (16)	3 (8)	
					0.205

Table 3
Conspiracies and perceptions about COVID-19 infections and vaccines among study participants.

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
Impact of COVID-19 on Lebanon (N = 790)					
Behind us	360 (46)	324 (90)	28 (8)	8 (2)	
Happening currently	221 (28)	189 (85)	24 (11)	8 (4)	
Still to come (in the future)	209 (26)	175 (84)	28 (13)	6 (3)	
					0.204
Views regarding COVID-19 vaccination (N = 757)					
Personal Choice	103 (14)	61 (59)	27 (26)	15 (15)	
Everyone's responsibility	363 (48)	349 (96)	13 (3.5)	1 (0.5)	
Both	291 (38)	256 (88)	30 (10)	5 (2)	
					0.000
Mainstream media creating unnecessary fear about COVID-19 (N = 757)					
Disagree	156 (20.5)	142 (91)	10 (7)	3 (2)	
Agree	401 (53)	345 (86)	43 (11)	13 (3)	
Neither	200 (26.5)	166 (83)	26 (13)	6 (3)	
					0.011
COVID-19 vaccine is not needed (N = 755)					
Disagree	639 (85)	579 (91)	52 (8)	5 (1)	
Agree	34 (14)	19 (56)	6 (18)	9 (26)	
Neither	82 (11)	53 (65)	21 (25)	8 (10)	
					0.000
Potential harm of COVID-19 infection is exaggerated (N = 753)					
Disagree	437 (58)	402 (92)	26 (6)	6 (2)	
Agree	136 (18)	103 (76)	21 (15)	12 (9)	
Neither	180 (24)	145 (80)	32 (18)	3 (2)	
					0.000
Death/year from flu are millions more than that of COVID-19 (N = 749)					

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
Disagree	189 (25)	167 (88)	13 (7)	9 (5)	
Agree	230 (31)	189 (83)	32 (14)	7 (3)	
Neither	330 (44)	290 (89)	34 (10)	5 (1)	
					0.003
COVID-19 vaccine is more dangerous than the disease itself (N = 752)					
Disagree	595 (79)	551 (93)	36 (6)	5 (1)	
Agree	35 (5)	20 (57)	6 (17)	9 (26)	
Neither	122 (16)	77 (63)	37 (30)	8 (7)	
					0.000
Pharmaceutical companies have hidden information about the vaccine's bad health outcomes (N = 752)					
Disagree	414 (55)	388 (94)	22 (5)	3 (1)	
Agree	76 (10)	46 (61)	17 (23)	12 (16)	
Neither	262 (35)	214 (82)	40 (15)	7 (3)	
					0.000
No sense to get the vaccine, higher power manipulates health outcomes (N = 750)					
Disagree	587 (78)	538 (92)	39 (7)	7 (1)	
Agree	39 (5)	22 (56)	7 (18)	10 (26)	
Neither	124 (17)	88 (71)	32 (26)	4 (3)	
					0.000
COVID-19 vaccine is an attempt to take away personal freedom (N = 749)					
Disagree	610 (81)	553 (91)	50 (8)	4 (1)	
Agree	43 (6)	23 (53)	8 (19)	12 (28)	
Neither	96 (13)	72 (75)	19 (20)	5 (5)	
					0.000
Government is using the vaccine to control population (N = 751)					
Disagree	564 (75)	517 (92)	39 (7)	5 (1)	

	Respondents N (%)	Accepting (%)	Hesitant (%)	Resistant (%)	*p value*
Agree	58 (8)	35 (60)	12 (21)	11 (19)	
Neither	129 (17)	97 (75)	27 (21)	5 (4)	
					0.027

Table 4
Factors associated with hesitancy towards COVID-19 vaccine among AUB students.

A. Hesitant Group	OR	95% CI	*p value*
Importance of getting the COVID-19 vaccine			
Not important	Ref		
Important	1 (omitted)		
Importance of decreasing odds of dying from COVID-19			
Not important	Ref		
Important	0.1	0.03–0.69	**0.015**
Feelings towards getting the vaccine: Opposed to views vs. in agreement with views			
Opposed to views	Ref		
In agreement with views	0.1	0.02–0.51	**0.004**
Only symptomatic cases spread COVID-19			
True	Ref		
FALSE	5	1.67–14.29	**0.004**
Vaccine safety wasn't adequately tested by Pharmaceutical companies			
True	Ref		
FALSE	0.5	0.19–1.43	0.21
Confidence about paying the cost of vaccines			
Not Confident	Ref		
Confident	2	0.44–6.59	0.439
Confidence about getting one or more vaccine shots as recommended by health professionals			
Not Confident	Ref		
Confident	0.01	0.002–0.08	**0.000**
Difficulty of taking a time off from school/ work on the getting the vaccine			
Difficult	Ref		
Easy	2	0.53–7.95	0.297
Difficulty of hearing/reading things from others that discourage people from getting the vaccine on getting the vaccine			

A. Hesitant Group	**OR**	**95% CI**	***p value***
Difficult	Ref		
Easy	0.1	0.01–0.57	**0.01**
Model statistics: Adjusted R^2 = 0.285, F (9,584) = 50.68), p < 0.001			
B. **Resistant Group**	OR	95% CI	*p* value
Likelihood that immediate family members already received or will receive the COVID-19 vaccine			
Unlikely	Ref		
Likely	2	0.12–39.58	0.585
Vaccine safety wasn't adequately tested by Pharmaceutical companies			
True	Ref		
FALSE	0.04	0.001–1.16	0.062
Vaccines use a new technology that changes the DNA of cells			
True	Ref		
FALSE	14	0.29-678.09	0.181
Model statistics: Adjusted R^2 = 0.077, $F_{(3, 716)}$ = 21.13, p < 0.001			

Factors associated with Vaccine Hesitancy among AUB Students

To determine the factors that predicted vaccine hesitancy, we performed a backward stepwise regression and a multivariate logistic regression using the IBM construct variables while adjusting for confounders. The IBM variables include knowledge (outside the model) descriptive norm, subjective norm, environmental constraints (outside the model), self-efficacy, perceived control, salience (outside the model), response cost and efficacy, and instrumental and experiential attitudes. The confounders included variables related to conspiracy theories, getting the flu vaccine, views towards getting the vaccine, views towards the status of the pandemic in Lebanon, and personal health behaviors related to COVID-19 prevention.

Disagreement with the statement that symptomatic cases are the only carriers of COVID-19 was a statistically significant predictor of hesitancy (OR = 5; 95% CI = 1.67–14.29; p value = 0.004). However, participants who felt that the vaccine was safe (OR = 0.01; 95% CI = 0.002–0.08; p value = 0.000) and was in agreement with their personal views (OR = 0.1; 95% CI = 0.02–0.51; p value = 0.004) despite the discouraging stories about the vaccine (OR = 0.1; 95% CI = 0.01–0.57; p value = 0.01) were less likely to be hesitant (Table 4A).

Following adjustment for confounders while retaining the variables from the backward stepwise regression with p value < 0.05, our data showed that none of these variables were significantly associated with vaccine resistance as compared to control groups (accepting and hesitant groups) (Table 4B).

Discussion

The World Health Organization (WHO) listed vaccine hesitancy as a top ten threat to the control of vaccine-preventable diseases (38). Vaccine hesitancy is usually linked to ideological beliefs as well as conspiracy ideations (39, 40). University students are a core part of society and a critical demographic to vaccination decision-making. During the college years is when most young adults become independent and responsible for their own health decision-making. University students are also leaders and play a critical role in spreading positive and informed facts about vaccines, thus influencing future generations (34). Consequently, identifying the willingness of university students to take the COVID-19 vaccine and the factors that predict vaccine hesitancy are important endeavors.

Few studies reported vaccine acceptability among university students in this region of the world. Our main findings show that the COVID-19 vaccine acceptance was high (87%) among students enrolled at the American University of Beirut and much higher than university students in Jordan (35%) (34), university students and staff in Qatar (62.5%) (33), and medical students in Egypt (35%) (5). However, our results were similar to those reported among university students in Italy in terms of willingness to take the vaccine (86%) (32) and higher than those reported in France (41).

It was interesting to note that our findings showed that males had higher intentions to obtain the COVID-19 vaccine than did females. This result was corroborated by previous studies conducted among adults in Lebanon (25) and among university students in Jordan (34). Moreover, Lebanese students had higher intentions to get the vaccine compared to other nationalities. Interestingly, a study of university students in Jordan reported that non-Jordanians had higher intentions to get vaccinated (34). Further research is needed to shed more light on this apparent difference by nationality.

The impact of receiving a past influenza vaccine was also influential. Our results showed that vaccine willingness/acceptability differed significantly by students' 'flu vaccination habits of the recent past. Those who did not take the flu vaccine in the past three years were more vaccine hesitant than those who did. Our results were corroborated by the results of previous studies that showed that those who did not take the flu vaccine in 2019 were also less likely to take the COVID-19 vaccine (42–44).

Numerous conspiracy theories regarding SARS-CoV-2 infection, the pandemic, and COVID-19 vaccines have been and continue to be widely spread on social media. It is important to keep in mind that this is the first pandemic the world has experienced with social media. Thus, not only do we have a pandemic, we have an *infodemic* (45). Misinformation and conspiracy theories are spread quickly among those who do not know how to evaluate the veracity of information. The current infodemic points to a need for a comprehensive, global approach to creating valid, reliable, and trustworthy health information (45). These conspiracy theories have included that the virus was man-made, was caused by 5G cell phone towers,

that the vaccine injects microchips to manipulate humans, changes human DNA, and causes infertility among females (5, 16, 46). Our findings show the significant impact of conspiracy beliefs among the vaccine willingness groups. However, our results were contradictory to a previous study reporting an independent correlation between hesitancy and conspiracy beliefs among university students in Jordan (34). Previous studies reported that the lack of accurate information about vaccine safety, effectiveness, and side effects in addition to misinformation from social media played a major role in hesitancy (5, 28).

In its recent report, the WHO advanced three strategies to increase COVID-19 vaccine acceptance: harnessing social influences, increasing motivation through transparent risk communication strategies and creating an enabling environment through making vaccination accessible and affordable (47). Each of these strategies can be used by countries in our region of the world. Our results also show that higher salience and positive instrumental (cognitive beliefs about outcomes of vaccines) and experiential attitudes (emotional responses to the vaccination) in relation to vaccine safety, efficacy and personal views towards vaccination resulted in lower odds of vaccine hesitancy. Moreover, higher self-efficacy except for those being confident about paying the cost of vaccines were associated with lower odds of vaccine hesitancy. Furthermore, high level of knowledge about COVID-19 disease and vaccine resulted in lower odds of vaccine resistance among AUB students. However, higher descriptive norms were associated with higher odds of vaccine resistance.

The results of our study should be cautiously interpreted. Our study enrolled students from one university in Lebanon. While AUB hosts a diverse student body from the region, our results cannot be generalized. Moreover, this study was carried-out just before the vaccination campaign at AUB and opinions might have changed because of that campaign.

Conclusion

The widespread prevalence of COVID-19 and its variants, and the fact that most of the world is not yet vaccinated, strongly suggests that evidence-based communication campaigns promoting vaccine acceptability should be designed and disseminated. Building vaccination trust among university students through the spread of clear messages is key to the success to vaccinating many.

Abbreviations

WHO: World Health Organization; AUB: American University of Beirut; NPIs: non-pharmaceutical interventions; IRB: Institutional Review Board; IBM: Integrated Behavioral Model; PAPM: Precaution Adoption Process Model; EPPM: Extended Parallel Processing Model.

Declarations

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interest

The authors declare that they have no competing interests.

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Author Contributions

M.B.H. participated in recruitment, data acquisition, analysis, and writing the first draft of the manuscript. S.S., M.P. and T.J. designed the study, prepared the analysis plan. T.J. critically reviewed the manuscript. N.M.M. revised and critically analyzed data and finalized the write-up of the manuscript. All authors reviewed and approved the manuscript.

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