COVID-19 Vaccine Hesitancy, Protective Behaviors, and Risk Perception among University Students in Alexandria

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Abstract

Background: Quick vaccine rollouts and compliance with preventive strategies are crucial for a country recovery from COVID-19, but vaccine hesitancy could prolong the pandemic and the need for physical distancing and lockdowns. **Aim of the study:** was to assess the levels of COVID-19 vaccine hesitancy, protective behaviors and risk perception among university students in Alexandria. **Study design:** An online cross-sectional exploratory survey research design was used in this study. **Setting:** This study was conducted in all faculties affiliated to Alexandria University. **Subjects:** Convenient sample of 1000 university students were selected by equal allocation method. **Tools of data collection:** Three tools were used for data collection. The first tool was "Vaccine Hesitancy Scale" to assess the students' hesitancy toward COVID-19 vaccines. The second tool was "The Protective behavior against COVID-19 Scale" to measure the protective behaviors against COVID-19. While, the third tool was "Risk Perception Scale" to measure the public risk perception for public health emergencies. **Results:** The results of this study showed that more than one quarter of them had a high level of vaccine hesitancy, while less than half of them had a good level of protective behaviors against COVID 19. On the other hand, less than one quarter of the studied students had high level of risk perception. **Conclusion:** The study concluded that university students, are among the population at risk of being infected with COVID-19 and transmitting the infection to others owing to the sense of invulnerability and their poor compliance with protective behaviors, including administration of vaccination against Covid-19. **Recommendations:** It is essential to raise awareness among university students about Covid-19 to change negative vaccine attitudes and increase the acceptance and uptake of Covid-19 vaccines.

Keywords: Vaccine Hesitancy, Protective Behaviors, Risk Perception, University Students, COVID-19

Introduction

The pandemic of COVID-19 is considered a global challenge for all countries worldwide to contain its spread. Most countries have implemented containment and mitigation strategies, including people alteration of people life styles and adoption of certain behaviors such as practicing social distance, hygienic practices and proper ways of wearing facemask regularly **(Al Hanawi et al., 2020; Alwi et al., 2021)**.

Currently, no curative treatment exists for COVID-19 infection. Therefore, a safe and effective prophylactic vaccine is urgently needed to contain the pandemic, which has had devastating medical, economic, and social repercussions. To date, several vaccines have been developed and approved for emergency immunization. This has given a glimpse of hope for preventing the spread of COVID-19 infection.

Countries and governments worldwide have spent billions of dollars in preparing to immunize the population of their countries **(Wang et al., 2020; Krause P & Gruber M., 2020).**

According to the World Health Organization , around 33% of the world population has received at least one dose of a COVID-19 vaccine, 5.13 billion doses have been administered globally, and 36.21 million are now administered each day. Only 1.6% of people in low-income countries have received at least one dose. In Egypt, as of 16 August 2021, a total of 6,477,535 vaccine doses have been administered **(WHO., 2021& WHO EMRO., 2021)**.

Vaccination programs can lead to herd immunity without requiring a substantial proportion of the community to be infected. However, such immunity requires a sufficient proportion of the population to be vaccinated. So, its effectiveness depends on the population's

willingness to be vaccinated and their compliance with some protective measures such as physical distancing, avoidance of crowds, cleaning hands and wearing masks (**Li et al., 2020; Ludecke & Von Dem., 2020).**

As the vaccine development process progresses, it is crucial to boost the acceptance of the new vaccines and reduce the vaccine hesitancy, which means to delay accepting or refusing vaccination although the vaccination services are made available. It is characterized by the lack of confidence in or the fear of vaccines (**Schwarzinger et al., 2021**).

Developing effective COVID-19 prevention and management strategies necessitate a proper understanding of the factors that would impact the decision of vaccination and adherence to protective behaviors as these factors may change for individuals who accept and be determined to comply to such strategies from those who do not (**Xiao & Wong 2020**).

Several studies have investigated the willingness to take a potential COVID-19 vaccine in high and middle-income countries and found that the average acceptance rate is 80.3%, ranging between 66.5% and 96.6% (**Solis Arce et al., 2021; Lazarus et al., 2020; Dror et al., 2020**).

Moreover, many factors have been identified that influence the acceptance of the COVID-19 vaccine and compliance with protective behaviors against Covid-19. These include risk perception of the disease, perception of vaccine safety and efficacy, general vaccination attitudes, vaccination costs, vaccination convenience and socio-demographic characteristics (**Ludecke & Von Dem., 2020; Reiter et al., 2020; Kreps et al., 2020**).

Risk perceptions are precursors to health-related behaviors; it is defined as the beliefs about possible harm or loss. In other words, it is the subjective judgment that people express about the severity and criteria of risks, such as injury, illness, disease, and death. Moreover, risk perception motivates people to change their behavior and make their decision to either deal with risks or prevent them. COVID-19 risk perception is a key determinant of adopting protective behaviors to reduce potential risks, and designing strategic interventions for behavior change (**Ning et al., 2020; Liu et al., 2020).**

Significance of the study

Quick vaccine rollouts and compliance with preventive strategies are crucial for a country recovery from Covid-19, but vaccine hesitancy could prolong the pandemic and the need for physical distancing and lockdowns (**Schwarzinger et al., 2021**).

Risk perception is known to be important determinant of the public's willingness to cooperate with and adopt health-protective behaviors during pandemics. Risk perception plays a major role in estimating the extent of community awareness regarding the seriousness of this pandemic and the extent of the willingness to cooperate in the implementation of health preventive measures, at the individual, local, and international levels (**Kreps et al., 2020**).

A research gap exists regarding the extent of risk perception in response to health pandemics among various communities, especially Arabian communities. Additionally, most of the studies were conducted among healthcare providers or the general population, and limited literature has examined these factors in other risky groups of COVID-19. Young adults, specifically university students, are at risk of being infected with COVID-19 and transmitting the infection to others owing to the sense of invulnerability. So, the identification of the intentions and abilities to apply health protective measures including vaccination against the COVID-19 pandemic, represent baseline levels of information to determine how best to optimize community health.

Aims of the study

The aims of the study are to:
1. Assess the levels of COVID-19 vaccine hesitancy, protective behaviors and risk perception among university students in Alexandria.
2. Identify the relationship between COVID-19 vaccine hesitancy, protective behaviors and risk perception among university students in Alexandria.

Research questions:
1. What are the levels of COVID-19 vaccine hesitancy, protective behaviors and risk perception among university students in Alexandria?

2. What is the relationship between COVID-19 vaccine hesitancy, protective behaviors and risk perception among university students in Alexandria?

Materials and Method
Materials:
Research design:

An online cross-sectional exploratory survey research design was adopted to carry out this study.

Setting:

The study settings were selected using a multistage random sampling technique. Accordingly, the study was carried out in all faculties affiliated to Alexandria University representing the two main academic sectors namely; Health (4 faculties) including Faculty of Nursing, Faculty of Medicine, Faculty of Pharmacy and Faculty of Dentistry.   While Non-Health (16 faculties) including Faculty of Science, Faculty of Engineering , Faculty of Agriculture , Faculty of Agriculture (Saba Basha), Faculty of Veterinary Medicine, Faculty of Arts, Faculty of Commerce, Faculty of Education, Faculty of Fine Arts, Faculty of Kindergarten, Faculty of Law, Faculty of Physical Education for Men, Faculty of Physical Education for Girls, Faculty of Specific Education, Faculty of Tourism and Hotels and Faculty of Economic Studies and Political science (Alexandria University, 2021).

Subjects:

One thousand university students from the previously mentioned settings were selected. The study respondents were selected according to the following inclusion criteria; Egyptian residents, with the access to the internet, accepted to participate in the study and with minimum age of 18 years old.

Sampling technique:

- Using the equal allocation method, a convenient sample of 50 students was selected from each of the previously mentioned settings. The total sample size was 1000 students.
- Online convenient sample was used because of the difficulty to collect the required number of the respondents due to social distance precautions during data collection duration.

Sample size:

- The sample size was estimate using Epi info 7 statistical program using the following parameters; total population (all students enrolled in the previously mentioned faculties in the academic year 2020-2021) 189.510 students, prevalence of problem 50%, confidence level 95%, margin of error 5% and with effect size 1.5. The minimum sample size estimated to be 576 students. The final sample size was 1000 students for possible non-response.

Tools of the study: In order to collect the necessary data for the study, three tools were used:

Tool (I): The Vaccine Hesitancy Scale:

It is a self-reporting instrument developed by **(Shapiro et al., 2017)** to assess the vaccine hesitancy. It comprises 9 items rated on a 5-point Likert scale; 1 (Strongly disagree), 2 (Disagree), 3 (Neither agree or disagree), 4 (Agree), and 5 (Strongly agree) with two items reverse score. The total score is determined by summing up the scores of the 9 items. The vaccine hesitancy level was classified as low level is scored from 36 to 45, moderate level is scored from 27 to 35 and high level is ranged from 9 to 26. The reliability coefficient of the Vaccine Hesitancy Scale was 0.854 **(Shapiro et al., 2017)**.

Tool (II): The Protective behavior against COVID 19 Scale:

It is developed by the researchers based on recent relevant literatures **(Kwok et al., 2020; Zhong et al., 2020)**. It enclosed 18 items to evaluate protective behaviors against COVID 19 as hand hygiene, respiratory etiquette, physical distancing, and healthful life style. The items are rated on 5 points Likert scale, ranging from 0 (never) to 4 (always). The total score ranges from 0 to 72, and it was categorized into three levels; poor behavior (score from 0 to 35), fair behavior (score from 36 to 53) and good behavior (score from 54 to 72).

Tool (III): The Risk Perception Scale:

It is a self-reporting instrument developed by **(Ya-Jun D., 2018)** to measure the public risk perception for public health emergencies. The scale has good reliability (Cronbach's $\alpha = 0.750$). The Risk Perception Scale has 9 items encompass the following subscales; Susceptibility (3 items),

Severity (4 items), and Controllability (2 items). The items are rated on 5 points Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 9 to 45, A summed score for each subscale was calculated and classified into low-risk perception (score from 9 to 26), moderate risk perception (score from 27 to 35) and high-risk perception (score from 36 to 45) **(Ya-Jun D., 2018)**.

In addition to questions about the students' personal and socio-demographic data such as age, sex, faculty, educational grade, place of residence, marital status, health problems and previous infection with COVID 19. Furthermore, an open-ended question was added about the students' perceived barriers and motivators regarding COVID 19 vaccination.

Methods

− An online semi-structured questionnaire was developed by using Google forms.

− Before sending the online form, the validity of the tools was assessed. Five experts in the filed in community health nursing were asked to review the tools regarding its relevancy and content validation related to aim of the study.

− A pilot study was carried out on 50 students to test the extent of the clarity, feasibility, applicability and average time required needed to be completed by each respondent. The necessary modifications were done. These responses were excluded from the total study subjects.

− Reliability of the tools was asserted by using Cronbach's Alpha coefficient test. The internal consistency reliability result was 0.883 for tool I, 0.775 for tool II, and 0.934 for tool III.

− A standardized general startup note was sent for each participant to describe the title, purpose, inclusion criteria of the research study and acceptance of completing the survey and ensuring the anonymity and privacy of the data in the beginning of the online form and also was noted with the link.

− The link of the questionnaire was sent through different social network, media and platform especially (e- mails, Facebook, twitter, LinkedIn, WhatsApp and Instagram) which used in disseminating the survey to for reaching out large number of the students as possible.

− Respondents who gave consent to willingly contribute in the online survey follow the 'next' button and would then be directed to complete the self-administered questionnaire. After submission there were thanks message sent to each respondent.

− The study respondents were encouraged to distribute the questionnaire link to as many students as possible. Thus, the link was furthered to other students away from the first respondents of contact and so on.

− All responses were sent to researcher Gmail and collected through Google form responses.

− Data was collected by the researchers during the period from May 2021 till the end of June 2021.

Statistical analysis:

After data were collected, they were coded and transferred into specially designed formats so as to be suitable for computer feeding. Following data entry, checking and verification processes were carried out to avoid any errors during data entry, frequency analysis, cross tabulation and manual revision were all used to detect any errors. The statistical package for social sciences (SPSS version 25) was utilized for both data presentation and statistical analysis of the results. The level of significance selected for this study was P equal to or less than 0.05.

Ethical considerations:

Written online consent after complete description of the research purpose was included at the start-up statement at the beginning of the online form. Respondents who gave consent follow the 'next' button and would then be directed to complete the self-administered questionnaire. Confidentiality and anonymity of participant's response was ensured by statement in the startup page of the online tool, and a code number was used instead of the names as well. Participation was maintained on a voluntary basis.

Results:

Table (1): shows that, the age of the students ranged from 18 to 26 years with a mean of 20.56±1.643. Furthermore, more than two fifths (44.6%) of the students were males while the rest (55.4%) were females. In addition, one fifth (20.0%) of the students were enrolled in medical faculties and the majority (80.0%) of the students were enrolled in non-medical faculties. Less than one quarter (21.0%) of the students were enrolled in the first year, while 8.5% of them were in the fifth year. Moreover, the vast majority of the students were not married while the rest were married. Furthermore, 73.5% of them were urban dwellers. The table also portrays that less than half (49.2%) of the students stated that they had enough family income. Concerning the students' health status, the tables shows that less than three quarters of the students had no chronic diseases, while those who had previous history of COVID 19 infection constituted 27.4% and less than half (47.3%) of them reported a family history of COVID 19 infection. On the other hand, all (100.0%) students had information about COVID 19, mainly through media (87.3%), internet (53.4%) and academic courses as mentioned by around one quarter (24.9%) of the students.

Table (2) reveals the distribution of the students according to the type of faculty in relation the levels and mean scores of COVID 19 risk perception, protective behaviors and vaccine hesitancy. Concerning the perception of susceptibility, the table shows that the students from medical faculties had higher mean score than those of non- medical faculties (12.40±2.074 and 11.22±2.030 respectively) with a statistically significant difference between them (t= 53.95, p= 0.000). Moreover, less than three quarters (72.0%) of the medical students compared to 46.5% of the non-medical students had high level of susceptibility, with a statistically significant difference between them (X^2= 41.86, P= 0.000).

Regarding the perception of severity, it was noticed that the students from medical faculties had higher mean score than those of non- medical faculties (16.68±2.591 and 15.47±2.518 respectively) with a statistically significant difference between them (t= 36.60,

p= 0.000). Additionally, more than three quarters (75.5%) of the medical students compared to around half (49.1%) of the non-medical students had high level of severity perception, with a statistically significant difference between them (X^2= 44.87, P= 0.000).

The same was noticed in relation to the perception of controllability, where a statistically significant difference was found (t= 91.28, p= 0.000) between medical and non-medical students (6.500±2.514 and 5.060±1.711 respectively). Furthermore, less than half (43.5%) of the medical students and around one tenth (10.5%) of the non-medical students had high level of controllability perception, with a statistically significant difference between them (X^2= 126.21, P= 0.000).

With respect to the students' total COVID 19 risk perception, the table also reveals a statistically significant difference between medical (35.58±6.028) and non-medical students (31.75±4.579) in relation to their risk perception mean score (t= 97.59, p= 0.000). Additionally, less than half (48.5%) of medical students and more than one tenth (14.1%) of non-medical students had a high level of risk perception towards COVID 19 (X^2= 114.11, P= 0.000).

It was noticed that more than half (56.0%) of medical students compared to more than two fifths (44.5%) of the non-medical students had a good level of protective behaviors against COVID 19, with a statistically significant difference between them (X^2= 16.245, P= 0.000). The same picture was portrayed in their mean score, where, medical students had a higher mean score (54.93±9.817) in comparison to the non-medical students (48.34±12.71) with a statistically significant difference between them (t= 6.839, p= 0.000).

Finally, the table reveals that the mean total score of vaccine hesitancy was (30.39±5.599) among medical students and (28.22±5.088) among the non-medical students with a statistically significant difference between them (t= 27.71, p= 0.000). Moreover, more than one quarter (29.6%) of the non-medical students compared to more than one fifth (21.5%) of the medical students had a high

level of vaccine hesitancy with a statistically significant difference between them (X^2= 53.52, p= 0.000).

Figure (1): presents the distribution of the studied students according to their perspectives about the barriers against receiving COVID 19 vaccines. The first barrier was fear of long-term genetic effects of the vaccines as stated by 92.9% of the students, followed by fear of unknown side effects (92.3%). Also, the majority of the students mentioned doubt in vaccine safety (87.9%), insufficient information about the vaccines (86.5%). On the other hand, 81.4% of the students declared that their doubt about the vaccine effectiveness is the main barrier against vaccination.

Figure (2): Illustrates the distribution of the studied students according to their perspectives about the motivators of receiving COVID 19 vaccines. Fear of cross infection to other family members especially parents was the first motive to receive COVID 19 vaccine as mentioned by 87.6% of the students, followed by availability of free vaccines (85.5%), fear of infection (81.8%) and finally, belief in the effectiveness and safety of the vaccines as reported by 68.7% of the students.

Table (3): portrays the correlation matrix between COVID 19 risk perception, vaccine hesitancy and protective behaviors. A statistically significant relations were found between COVID 19 risk perception and protective behaviors and vaccine hesitancy (r= 0.143, p= 0.000, and r= 0.166, p= 0.000). Additionally, a statistically significant relation was found between protective behaviors and vaccine hesitancy (r= 0.756, p= 0.000).

Table (4): illustrates the association between risk perception and characteristics of the studied students. It was explored using logistic regression analysis (Enter method) with high-risk perception as the dependent variable. The R^2 value is 0.402 which means that only 40.2% of the variability in the outcome is explained by the studied characteristic in the model .The table reveals that nine variables were found to predictors of high risk perception namely type of faculty (P = 0.000), age (P = 0.000), academic year (P = 0.026), marital status (P = 0.027), presence of chronic diseases (P = 0.000), previous infection with COVID 19 (P = 0.008), family infection with COVID 19 (P = 0.021), protective behaviors (P = 0.005), and vaccine hesitancy (P = 0.000).

Table (5): shows the association between protective behaviors and characteristics of the studied students through using logistic regression analysis (Enter method) with good protective behaviors as the dependent variable. The R^2 value is 0.630 which means that only 63.0% of the variability in the outcome is explained by the studied characteristic in the model .The table reveals that type of faculty was a predictor of good protective behaviors (P = 0.000), as well as , age (P = 0.045), academic year (P = 0.012), family income (P = 0.001), presence of chronic diseases (P = 0.013), previous infection with COVID 19 (P = 0.014), family infection with COVID 19 (P = 0.000), risk perception (P = 0.012), and vaccine hesitancy (P = 0.000).

Table (6): portrays the association between vaccine hesitancy and characteristics of the studied students. It was done through using logistic regression analysis (Enter method) with high vaccine hesitancy as the dependent variable. The R^2 value is 0.771 which means that only 77.1% of the variability in the outcome is explained by the studied characteristic in the model .The table shows that type of faculty was a predictor of high vaccine hesitancy (P = 0.000), in addition to , age (P = 0.013), academic year (P = 0.003), place of residence (P = 0.051), presence of chronic diseases (P = 0.025), previous infection with COVID 19 (P = 0.037), family infection with COVID 19 (P = 0.003), risk perception (P = 0.024), and protective behaviors (P = 0.000).

Table (1) Distribution of the studied students according to their demographic and basic data

Items		Total (n=1000)	
		No.	%
Age (years)	18-	286	28.6
	20-	434	43.4
	22-	242	24.2
	24-26	38	3.8
	(Mean ± SD)	20.56±1.643	
Sex	Male	446	44.6
	Female	554	55.4
Faculties	Medical	200	20.0
	Non-medical	800	80.0
Academic year	First	210	21.0
	Second	251	25.1
	Third	236	23.6
	Fourth	218	21.8
	Fifth	85	8.5
Marital status	Not married	984	98.4
	Married	16	1.6
Place of residence	Urban	735	73.5
	Rural	231	23.1
	Squatter	34	3.4
Family income	Not enough	508	50.8
	Enough	492	49.2
Presence of chronic diseases	No	742	74.2
	Yes	258	25.8
Previous COVID 19 infections	No	726	72.6
	Yes	274	27.4
Family history COVID 19 infections	No	527	52.7
	Yes	473	47.3
Have knowledge about COVID 19	No	0	0.0
	Yes	1000	100.0
Sources of knowledge about COVID 19 #	Academic course	249	24.9
	Internet	534	53.4
	Media	873	87.3

Table (2): Distribution of the studied students according to their levels and mean scores of COVID_19 risk perception, vaccine hesitancy and protective behaviors in relation to their type of faculty:

Items	Medical (N= 200)		Non-Medical (N=800)		Total (N= 1000)		Test of Significance	
	No.	%	No.	%	No.	%		
Risk Perception								
Low	18	9.0	108	13.5	126	12.6	X^2= 114.11	P= 0.000*
Moderate	85	42.5	579	72.4	664	66.4		
High	97	48.5	113	14.1	210	21.0		
Mean ±SD	35.58±6.028		31.75±4.579		32.51±5.134		t= 97.59	P= 0.000*
▪ **Susceptibility**								
Low	10	5.0	64	8.0	74	7.4	X^2= 41.86	P= 0.000*
Moderate	46	23.0	364	45.5	410	41.0		
High	144	72.0	372	46.5	516	51.6		
Mean ±SD	12.40±2.074		11.22±2.030		11.45±2.092		t= 53.95	P= 0.000*
▪ **Severity**								
Low	2	1.0	16	2.0	18	1.8	X^2= 44.87	P= 0.000*
Moderate	47	23.5	391	48.9	438	43.8		
High	151	75.5	393	49.1	544	54.4		
Mean ±SD	16.68±2.591		15.47±2.518		15.71±2.577		t= 36.60	P= 0.000*
▪ **Controllability**								
Low	68	34.0	502	62.8	570	57.0	X^2= 126.21	P= 0.000*
Moderate	45	22.5	214	26.8	259	25.9		
High	87	43.5	84	10.5	171	17.1		

Items	Medical (N= 200)		Non-Medical (N=800)		Total (N= 1000)		Test of Significance	
	No.	%	No.	%	No.	%		
Mean ±SD	6.500±2.514		5.060±1.711		5.350±1.982		t= 91.28	P= 0.000*
Protective behaviors								
Poor	16	8.0	153	19.1	169	16.9	X^2= 16.245	P= 0.000*
Fair	72	36.0	291	36.4	363	36.3		
Good	112	56.0	356	44.5	468	46.8		
Mean ±SD	54.93±9.817		48.34±12.71		45.66±13.31		t= 6.839	P= 0.000*
Vaccine Hesitancy								
Low	37	18.5	32	4.0	69	6.9	X^2= 53.52	P= 0.000*
Moderate	120	60.0	531	66.4	651	65.1		
High	43	21.5	237	29.6	280	28.0		
Mean ±SD	30.39±5.599		28.22±5.088		28.66±5.263		t= 27.71	P= 0.000*

X^2= Chi Square test   t = Paired t test   * Significant at p ≤0.05

Figure (1): Distribution of the studied students according to their perspectives about the barriers against COVID 19 vaccination:
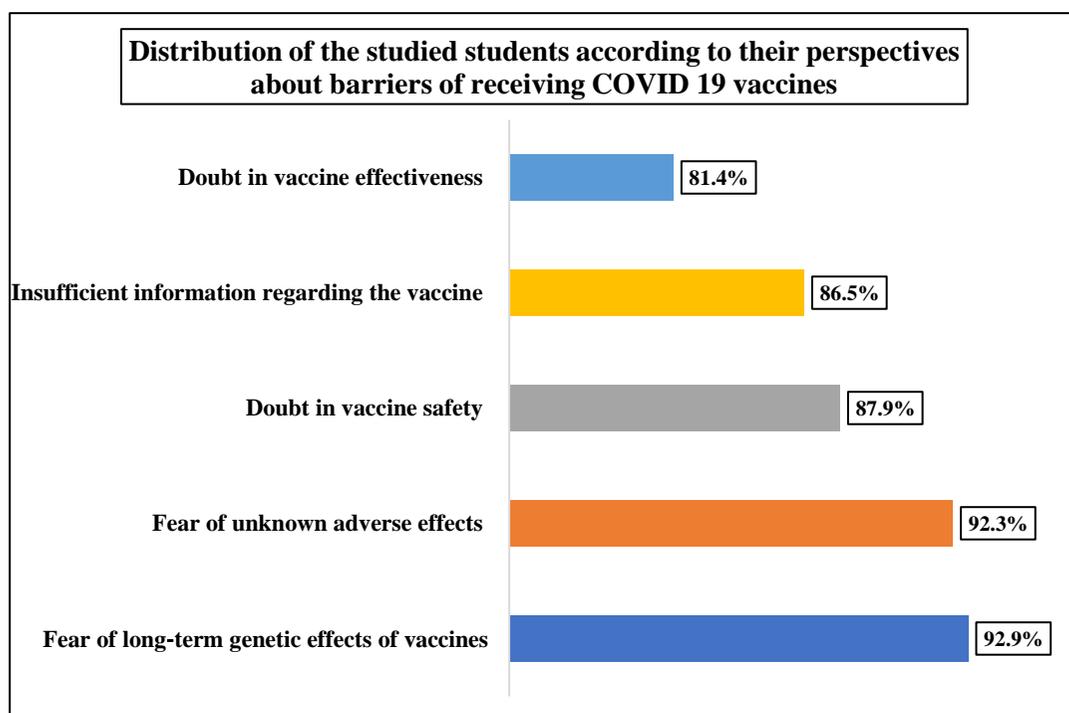
Figure (2): Distribution of the studied students according to their perspectives about the motivators about COVID 19 vaccination:

Distribution of the studied students according to their perspectives about motivators of receiving COVID 19 vaccines

- Belief in the effectiveness and safety of the vaccine: 68.7%
- Fear of being infected with COVID-19: 81.8%
- Availability of free vaccines: 85.5%
- Fear of infecting my family with COVID-19, especially my parents: 87.6%
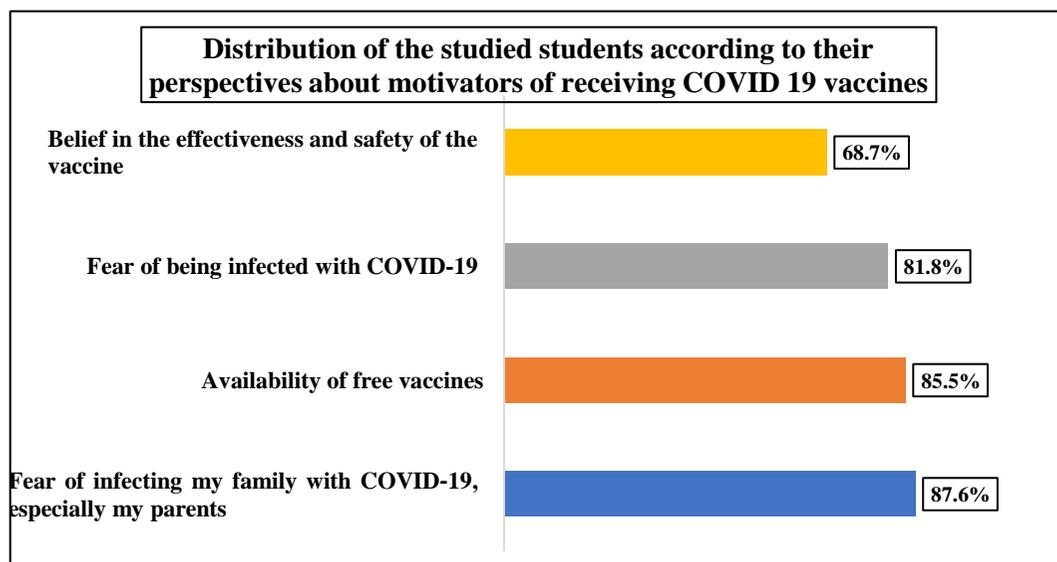
Table (3): Correlation matrix between COVID 19 risk perception, vaccine hesitancy and protective behaviors:

Items		Risk perception	Protective behaviors	Vaccine hesitancy
Risk perception	r			
	P			
Protective behaviors	r	0.143		
	P	0.000*		
Vaccine hesitancy	r	-0.166	0.756	
	P	0.000*	0.000*	

r = Correlation coefficient   * Significant at p ≤0.05

Table (4): Predictors of COVID 19 risk perception among the study students using logistic regression analysis (Enter method):

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.402	0.257		13.212	0.000
Type of faculty	0.471	0.076	0.329	6.198	**0.000***
Age	0.123	0.031	0.177	3.993	**0.000***
Sex	0.043	0.036	0.037	1.193	0.233
Academic year	0.450	0.020	0.098	2.233	**0.026***
Marital status	0.316	0.143	0.069	2.211	**0.027***
Place of residence	0.041	0.052	0.038	0.784	0.433
Family income	0.011	0.037	0.010	0.306	0.760
Presence of chronic diseases	3.909	0.667	0.305	5.860	**0.000***
Previous infection with COVID 19	1.044	0.103	0.134	2.429	**0.008***
Family infection with COVID 19	1.520	0.656	0.183	2.318	**0.021***
Protective behavior	0.598	0.211	0.092	2.830	**0.005***
Vaccine hesitancy	-1.055	0.271	-0.169	-3.890	**0.000***

Model F = 9.075, P =0.000 R^2 = 0.402   *Significant at P≤ 0.05

Table (5): Predictors of protective behaviors against COVID 19 among the study students using logistic regression analysis (Enter method):

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.791	0.369		2.147	0.032
Type of faculty	0.830	0.099	0.420	8.376	**0.000***
Age	0.983	0.041	0.186	2.008	**0.045***
Sex	0.077	0.048	0.049	1.624	0.105
Academic year	0.941	0.027	0.065	2.551	**0.012***
Marital status	0.040	0.189	0.006	0.211	0.833
Place of residence	0.001	0.069	0.001	0.015	0.988
Family income	0.168	0.049	0.106	3.414	**0.001***
Presence of chronic diseases	1.082	0.055	0.045	2.490	**0.013***
Previous infection with COVID 19	2.204	0.236	0.115	3.498	**0.014***
Family infection with COVID 19	4.712	0.443	0.110	2.931	**0.000***
Risk perception	2.066	0.242	0.048	1.558	**0.012***
Vaccine hesitancy	-0.170	0.043	0.119	3.952	**0.000***

Model F = 16.312, P =0.000 R^2 = 0.630   *Significant at P≤ 0.05

Table (6): Predictors of COVID 19 Vaccine hesitancy among the study students using logistic regression analysis (Enter method):

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	38.43	2.590		14.842	0.000
Type of faculty	3.906	0.717	0.297	5.444	**0.000***
Age	0.840	0.337	0.079	2.489	**0.013***
Sex	0.532	0.291	0.083	1.826	0.068
Academic year	0.554	0.187	0.132	2.957	**0.003***
Marital status	0.487	1.344	0.012	0.362	0.717
Place of residence	1.252	0.889	0.021	2.649	**0.051***
Family income	0.480	0.351	0.046	1.369	0.171
Presence of chronic diseases	1.100	0.491	0.110	2.241	**0.025***
Previous infection with COVID 19	2.009	0.963	0.170	2.085	**0.037***
Family infection with COVID 19	1.747	0.636	0.109	1.383	**0.003***
Risk perception	0.508	0.225	0.076	2.261	**0.024***
Protective behavior	1.788	0.621	0.121	4.096	**0.000***

Model F = 5.081, P =0.000 R^2 = 0.771   *Significant at P≤ 0.05

Discussion

COVID-19 is a serious and growing health problem all over the world. It is considered one of the most contagious diseases that have a large adverse and underappreciated social, political and economic impact which may touch the future of the young generation and hinder the communities and societies in general. Moreover, COVID-19 is one of communicable diseases that hamper the health and well-being of people and have negative consequences on quality of life particularly young people **(Thunstrom et al., 2021)**.

So, there is an urgent need for prevention and control of this pandemic disease. Vaccination and compliance with preventive measures identified by the health authorities are the primary prevention activities for halting the progression of

the disease and protection of people from getting infection with corona virus **(Kelly et al., 2021)**.

Since the emergence of COVID-19, most individuals strictly follow the protective practices and take preventive precautionary measures such as wearing a face mask, washing hand, avoiding crowded places, physical distancing to avoid infection. However, some individuals do not take such behavior carefully, harming not only their own lives but also others. The present study revealed that less than half of the studied university students have good protective behaviors, these findings may be derived by the knowledge about COVID-19 among those students that may attributes to their acceptable level of performance of protective behaviors, as the results of the current study indicate that all studied university students declared that they had

sufficient information about COVID-19 and enumerated different sources of knowledge about it mainly media, internet and academic courses. These findings were supported by the results of **(Abd-El Aziz & Hamdi., 2021)** in their study about the knowledge, misconception and preventive practices of COVID-19 among university students, who found that less than two thirds of the students complied with COVID-19 preventive practices.

In addition, the current study finding reveals that good protective behaviors were more prevalent among students from medical faculties. This finding may be attributed to the background knowledge of the students from medical faculties from the academic courses about the disease process, the infection cycle and the importance of adopting such preventive measures for protecting themselves and preventing transmission to other people.

This finding was supported by the result of **(Khasaeneh et al., 2020; Prasad et al., 2020)** in their studies about the precautionary practices regarding COVID-19, who found that more than half of medical students adhere to preventive measures.

Until now, many countries were and are still struggling with the COVID-19 emergency. Despite efforts to limit the viral transmission, this contagious virus has many strains and characterized by a highly mutation and variation in its genotypes. As new strains are identified every now and then, the need for different types of protective vaccines is increased **(Panda et al., 2021)**.

The fight against COVID-19 rests on widespread immunization. So far, vaccine rollouts in many parts of the world have been beset by supply constraints and limited vaccine availability. Yet, even when these issues are resolved, insufficient vaccine demand could still pose a serious challenge. Vaccine hesitancy and refusal could mean that not enough people in a community are immunized above levels required for herd immunity. Failure to reach herd immunity would halt progress against COVID-19 and place the whole world at risk **(Paul et al., 2021)**. The current study reveals that more than one quarter of the studied university students had a high level of vaccine hesitancy. This result was in congruent with **(Mant et al., 2021)** who

indicated that around one quarter of their participants were unwilling to uptake the vaccine.

Furthermore, the current study finding indicates that high level of vaccine hesitancy was less encountered among the students from medical faculties, which could be attributed to their knowledge about the vaccine effectiveness in the process of prevention and control of COVID-19 as the importance of vaccines is highlighted during the course of their education. As well as, their senses of collective responsibility as future members of the health care team toward their own health and the whole community health. In the same line, a study done by **(Sadaqat et al., 2021)** about determinants of vaccine hesitancy among university students reported that non-medical students had higher rate of vaccine hesitancy against the COVID-19 vaccine, as compared to medical students. However, **(Barello et al., 2020)** in a study about vaccine hesitancy among college students in Italy, found no difference between medical and non-medical students in relation to uptake of vaccines.

In this context, it is crucial to understand what drives vaccine hesitancy, and how it could shape pandemic dynamics. A growing body of researches indicated that the reasons for low vaccine uptake are typically centered on concerns about their safety, potential side effects and efficacy, frequently fueled by misinformation or lack of trust in government and health systems **(Barello et al., 2020)**. The current study findings reveal that the majority of the university students mentioned that fear of adverse side effects and doubt about vaccine safety as well as lack of information about the vaccines was the barriers against COVID-19 vaccine uptake, which contributed to the emergence of vaccine hesitancy among the university students. These findings shed the light on the need of supporting COVID-19 vaccination through public messages and mass community awareness campaigns in order to listen to vaccines concerns, answer questions, and counter misinformation and increase public confidence in vaccines' sources and effectiveness. Similar findings were reported by **(Wang et al., 2021; Said et al., 2021)** in their studies about vaccine hesitancy, which found that there were a lot of factors affecting COVID-19 vaccines' uptake mainly lack of information about the vaccines and concerns about its effectiveness.

On the other hand, the current study reveals that fear of infection to self and to other family members, trust of vaccines effectiveness, and the presence of free vaccines were the motivators of COVID-19 vaccination mentioned by the studied students. In the same line the findings of (**Wang et al., 2021; Said et al., 2021**).

Up till now COVID-19 became a part of everyday life and can be easily transmitted directly or indirectly from one person to another. Virulence of this communicable disease depends on how people perceive its severity and their susceptibility to infection or risk perception. COVID-19 risk perception includes the cognitive perception of the risk of falling ill with COVID-19, focuses on the infection probability and severity of the disease and the affective risk perception, focuses on affective states, such as worries, fear and anxiety about being infected or getting sick. So, risk perception means how much people know and understand risks, and how they feel about them (**Paul et al., 2021**). In the current study, the university students declared that they have sufficient information about COVID-19 and they had worries about being infected and transmitted infection to other family members as well as they had concerns about the vaccines' sources and effectiveness and efficacy, which all contribute to the current finding that less than one quarter of the studied university students had a high level of risk perception. Similar findings were reported by (**Hussein et al., 2021**) in a study about the risk perception of COVID-19 that found that around one third of the medical students had a high level of risk perception.

Moreover, the present study demonstrated a considerable variability in the level of COVID-19 risk perception between the studied students of medical and nonmedical faculties as medical students had higher level of risk perception. This may be due to; their educational background that imposes on them knowledge and awareness of such infectious diseases as well as the nature of their study that makes them more in close interaction with high-risk personnel and patients than nonmedical in turn increase their perception of risk than other personnel. In the same line, the findings of (**Elhadi et al., 2020**) in a study about knowledge, preventive behaviors and risk perception among university students, that found type of the faculty was a determinant factor for risk perception.

It is widely accepted that perceived risk is fundamental for triggering behavioral changes. Those who downplay the potential harm of a risk event are less likely to take targeted actions to prevent the event. This could explain the results of the current study where significant associations were found between risk perception, protective behaviors and vaccine hesitancy among the studied university students. Similar findings were reported by Hussein R et al (2021) who reported positive significant relationship between risk perception and protective behaviors against COVID-19, where those with higher perception of the severity of COVID-19, had a higher willingness to implement preventative measures including vaccination.

There is ample evidence that perceived susceptibility to severe disease outcomes is an important predictor of preventive behavior. In accordance with theories on health behavior decisions, engagement on preventive behavior is shaped by the awareness and risk perception, particularly among those who are more vulnerable to severe outcomes (**Elhadi et al., 2020**). The result of the present study indicated that presence of chronic diseases, previous personal or family history of COVID-19 infection were among the factors affecting the studied university students' protective behaviors, vaccine hesitancy and risk perception. These findings are consistent with the results of (**Wang et al., 2021; Hussein et al., 2021**) who found significant association between chronic diseases such as respiratory, cardiovascular, and renal diseases and risk perception and protective behaviors including vaccines' uptake.

Conclusion

Based on the current study findings, it can be concluded that the more than one quarter of them had a high level of vaccine hesitancy, while less than half of them had a good level of protective behaviors against COVID-19. On the other hand, less than one quarter of the studied students had high level of risk perception. Moreover, the students of medical faculties had higher levels of risk perception and protective behaviors and lower level of vaccine hesitancy compared to those students of non-medical faculties.

It's highlighted by the present study that several factors were significant associated with

COVID-19 vaccine hesitancy, protective behaviors and risk perception among the studied students such as the type of faculty, age, academic year, presence of chronic diseases, previous infection with COVID-19, and family infection with COVID-19.

Recommendations

In the light of the findings of the present study, the following recommendations are proposed:

− Conduct community mobilization campaigns to boost the community awareness about COVID-19 to change negative vaccine attitudes and increase the acceptance and uptake of vaccines.

− Establish a university-based health education program about COVID-19 and protective behaviors and vaccines to keep a vigilant eye to fight misinformation.

− Focus should be on promoting official sources of information to counter apprehension generated through social media use.

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