

Knowledge and Attitude of Medical Students Regarding COVID-19 Vaccines

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ABSTRACT

Background: COVID-19 pandemic has caused great socioeconomic impacts worldwide. However, its vaccines have been found to be effective in reducing its occurrence, complication, and mortality. Egypt has launched its vaccination campaign and provided various types to reach herd immunity. To reach a satisfactory vaccination coverage rate, medical students must have satisfactory knowledge and a good attitude towards COVID-19 vaccination. **Objectives:** The aim of the current study was to assess the level of knowledge and the attitude of medical students regarding COVID-19 vaccines. **Subjects and methods:** A cross-sectional study was conducted on 239 undergraduate medical students, using a semi-structured questionnaire. **Results:** About 80% of the students had a satisfactory general knowledge level, while only 8.4% had a satisfactory specific knowledge level, and 31% had a satisfactory total knowledge level. Most of the students had a positive attitude towards COVID-19 vaccination. The measured three knowledge scores were affected by several factors such as age, gender, nationality, college year, COVID-19 vaccination status of the participants, number of received vaccine doses, vaccination status of their family members, preferring some COVID-19 vaccines (Moderna, Pfizer/BioNTech, Oxford/AstraZeneca, Sinopharm, and Janssen vaccines), in addition to not-preferring specific COVID-19 vaccine. **Conclusions:** Medical Students had a satisfactory general knowledge level and positive attitude towards COVID-19 vaccination. However, they had a defect in their specific knowledge level, and hence total knowledge level regarding COVID-19 vaccines. Raising their awareness about COVID-19 vaccines is vital to raise vaccination coverage rates.

Keywords: COVID, COVID-19, Vaccine, Knowledge, Attitude, Medical Students.

INTRODUCTION

The pandemic of COVID-19 has caused a severe disturbance in ordinary socioeconomic life all over the world. Its burden on the healthcare system is expected to last in most countries ⁽¹⁾. The SARS-CoV-2 virus caused more than 534 million cases and more than 6.3 million deaths all over the world ⁽²⁾. Moreover, According to WHO, the number of reported confirmed cases of COVID-19 in Egypt, from 3 January 2020 to 27 May 2022, is 513,916 cases with 24,704 deaths ⁽³⁾. The World Health Organization (WHO) and several researchers all over the world have led prevention, early diagnosis, and medical management efforts and campaigns ⁽⁴⁾.

One of these efforts was the safe and effective vaccination globally. Vaccination has played a key role in reducing the number of cases and complications. So, governments have encouraged the efforts of the scientific community and the pharmaceutical industry to achieve safe and effective vaccination for COVID-19 ⁽⁵⁾. In Egypt, the Chinese Sinopharm vaccine was the first COVID-19 vaccine approved by The Egyptian Drug Authority (EDA). And, In January 2021, Egypt launched its vaccination campaign and started with vaccinating the quarantine hospitals' medical teams as one of the high-priority categories for the vaccination then the rest of the medical teams and established a website for the public to register for the vaccination targeting to vaccinate the high-risk groups firstly ⁽⁴⁾. There are nine vaccines approved for use in Egypt including Moderna, Pfizer/BioNTech, Gamaleya (Sputnik Light), Gamaleya (Sputnik V), Janssen (Johnson & Johnson), Oxford/AstraZeneca, Serum Institute of India Covishield (Oxford/ AstraZeneca formulation), Sinopharm (Beijing), and Sinovac ⁽⁶⁾.

Medical students are considered an essential part of the healthcare system. Their contact with the public such as their families, neighbors, and friends expose them to questions about the hot medical issues of public concern as the novel COVID-19 pandemic. Furthermore, they are the future healthcare providers who must be aware of the importance of the role of COVID-19 vaccination. They must have accurate information about the different types of COVID-19 vaccines. Their knowledge and attitude regarding COVID-19 Vaccination are important to increase the public acceptance towards COVID-19 vaccination and reach a satisfactory COVID-19 vaccination coverage rate. The aim of the current study was to assess the level of knowledge and the attitude of medical students regarding COVID-19 vaccines.

SUBJECTS AND METHODS

A cross-sectional study was carried out on 239 undergraduate students at the Faculty of Medicine, Zagazig University in the academic year 2022-2023. None of the students were excluded. The sample was chosen by Stratified Random technique with proportional allocation. The students were stratified into two strata: the academic phase and the clinical phase. The required number for the sample was taken according to the number of students in each stratum. All subjects included in the study were interviewed and a questionnaire sheet was filled out for each of them. A pre-designed semi-structured questionnaire was used to collect the following data:

The First Part included questions about socio-demographic characteristics (Gender, Age (years), Nationality, Place of Residence, and College Years) ^(7,8).

The Second Part included questions about the history of COVID-19 infection and vaccination (History of previous COVID-19 infection, the course of the disease, History of COVID-19 vaccination, the type, and doses of received COVID-19 vaccine, and the vaccination status of their family members) ⁽⁹⁾.

The Third Part assessed the student's knowledge and attitude towards the COVID-19 vaccination ^(7,8,10,11) as follows: (1) Availability of COVID-19 vaccination for the whole population. (2) Presence of different types of COVID-19 vaccines in Egypt. (3) Possibility of infection due to vaccination. (4) Protection of COVID-19 vaccines against certain strains. (5) Importance of the high number of vaccinated people for herd immunity. (6) Need the vaccinated person for a COVID test (if symptomatic). (7) The ability of vaccines to reduce COVID symptoms. (8) Allowance of vaccinated people to skip other preventive measures. (9) Recommending the participants of COVID vaccination to others. (10) Sources of their information about COVID vaccines. (11) People's eligibility to receive COVID-19 vaccines.

The Fourth Part assessed the student's knowledge and attitude towards different types of COVID-19 vaccines ⁽¹²⁾ as follows (the manufacturing country, component, efficacy, recommended age, the schedule of the approved COVID-19 vaccines in Egypt, the preferred type of COVID-19 vaccine, and the reason for their preference).

Ethical Consideration:

This study was approved by the Department of Public Health and Community Medicine at the Faculty of Medicine, Zagazig University, in addition to the official approval from the Institutional Review Board (IRB) of the Faculty of Medicine, Zagazig University (Approval Number 9579/8-6-2022). The study group was informed about the nature and the purpose of the study. The confidentiality of information was assured, and informed consent was taken before filling out the questionnaire. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical analysis:

The collected data were coded, entered, presented, and analyzed by computer using a database software program, the Jamovi program version 2.3.21.0. Qualitative data were represented as frequencies and percentages. Quantitative data were expressed as mean and standard deviation (SD). Chi-square (χ^2), and Chi-square for linear trend were used to detect the relation between different qualitative variables. The results were considered statistically significant and highly statistically significant when the significant probability (P-value) was <0.05* and <0.01** respectively.

RESULTS

This study was conducted on 239 students whose mean age was 20.3 (SD 1.55). Nearly two-thirds of the participants were males. About 60% of the participants were urban residents. The Egyptian students represented most of the participants (80.3%). The participants were nearly equal from all the college years. A high percentage of the study participants (56.6%) had no history of COVID-19 infection. Mild symptoms were the most common presentation (27.2%) among participants with a history of COVID-19 infection (Table 1).

Table (1): Socio-demographic characteristics and History of COVID-19 infection among the participants.

Variable	No. (239)	%
Age		
• 17-20	128	53.6%
• 21-25	111	46.4%
• Mean \pm SD (Range)	20.3 \pm 1.55 (17-25)	
Gender		
• Male	158	66.1%
• Female	81	33.9%
Residence		
• Rural Area	96	40.2%
• Urban Area	143	59.8%
Nationality		
• Egyptian	192	80.3%
• Palestinian	27	11.3%
• Sudanese	14	5.9%
• Others	6	2.5%
College Year		
• 1 st year	45	18.8%
• 2 nd year	49	20.5%
• 3 rd year	47	19.7%
• 4 th year	49	20.5%
• 5 th year	49	20.5%
Previous COVID-19 Infection and its Course		
• Asymptomatic COVID-19 infection	20	8.4 %
• COVID-19 infection (Mild symptoms)	65	27.2 %
• COVID-19 infection (Moderate symptoms)	15	6.3 %
• COVID-19 infection (Severe symptoms)	4	1.7 %
• No History of Infection	135	56.5 %

Most of the study participants (220 students, 92.1% of the participants) were COVID-19 vaccinated. While regarding the unvaccinated group (19 students, 7.9% of the participants), Most of them were within the age group (17-20 years) (78.9%), males (63.2%), living in a rural area (52.6%), Egyptian (94.7%), in the 1st college year (73.7%), and had no history of COVID-19 infection (52.6%) (Figure 1).

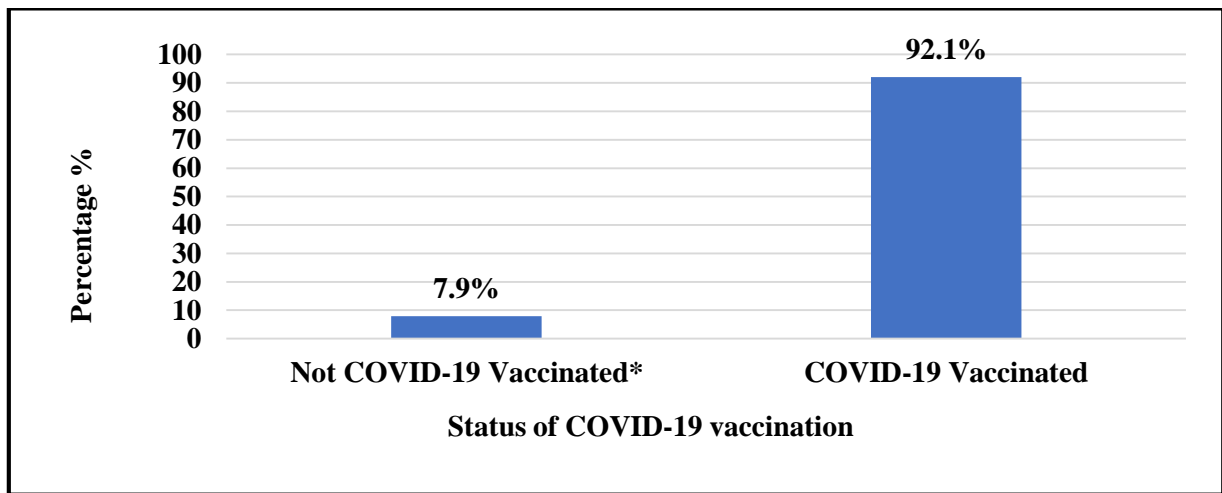


Figure (1): Frequency distribution of the participants regarding the status of COVID-19 vaccination.

The majority of the participants derived their information about COVID-19 vaccines from social media, followed by Television/Radio and then Professionals (78.2%, 44.4% and 38.5%, respectively) (Figure 2).

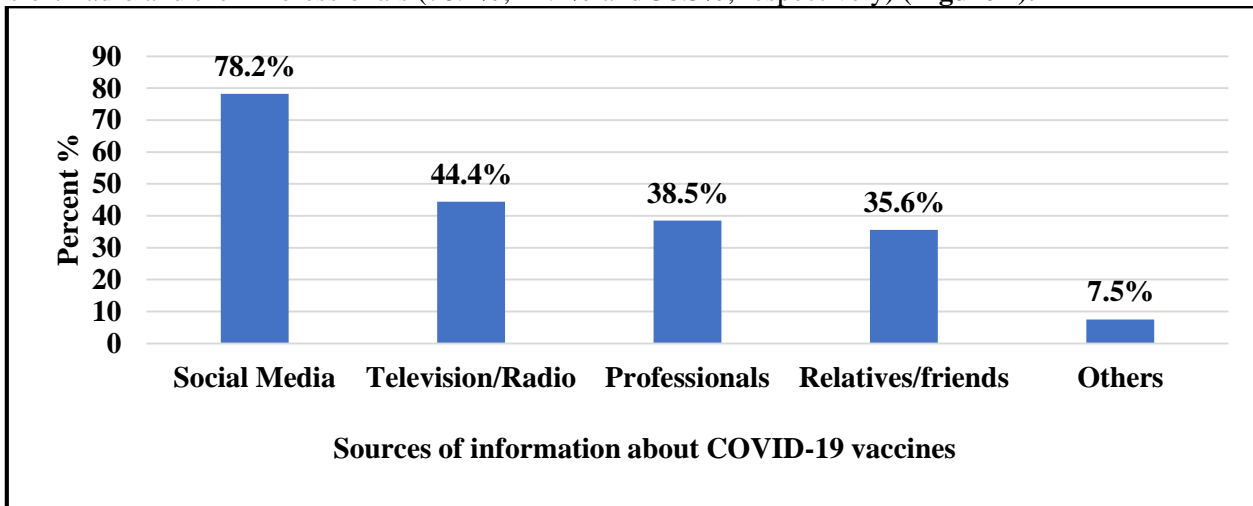


Figure (2): Sources of information about COVID-19 vaccines among participants.

Most of the participants didn't prefer a specific type of COVID-19 vaccine (53.6%). For the rest of the participants, Pfizer/BioNTech vaccine was the highest preferred vaccine (25.1%), followed by Oxford/AstraZeneca vaccine, and Janssen vaccines (12.6% and 12.1% respectively) (Figure 3).

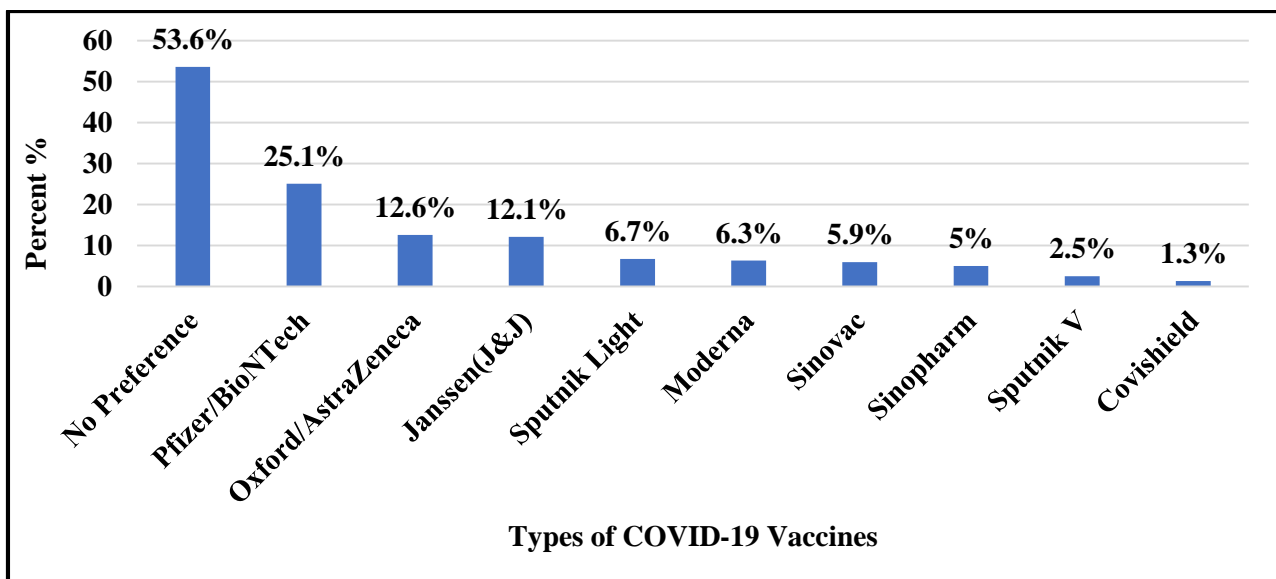


Figure (3): Frequency distribution of the participants' attitudes regarding their preferred type of COVID-19 vaccine.

Table 2 showed that there was a significant association between the satisfactory level and unsatisfactory level of the total knowledge score and the following factors (Age, Gender, Nationality, College year, the status of COVID-19 vaccination of the participants, their families, the number of COVID-19 vaccine doses received by the participants, preferring the following COVID-19 vaccines (Moderna, Pfizer/BioNTech, Oxford/AstraZeneca, Sinopharm, and Janssen) in addition to non-preferring specific COVID-19 vaccine).

Table (2): Relation between the Total knowledge score and the sociodemographic characteristics of the participants, history of COVID-19 infection and vaccination, and Preferred type of COVID-19 vaccine.

Criteria	Total Knowledge Score		χ^2 Value	p-value
	Satisfactory Level 74 (31%)	Unsatisfactory Level 165 (69%)		
Age				
• 17-20	22 (29.7 %)	106 (64.2 %)	24.5	< .001*
• 21-25	52 (70.3 %)	59 (35.8 %)		
Gender				
• Male	58 (78.4%)	100 (60.6%)	7.2	0.007*
• Female	16 (21.6%)	65 (39.4%)		
Residence				
• Rural	23 (31.1%)	73 (44.2%)	3.68	0.055
• Urban	51 (68.9 %)	92 (55.8 %)		
Nationality				
• Egyptian	61 (82.4 %)	131 (79.4 %)	9.21	0.027*
• Palestinian	12 (16.2 %)	15 (9.1 %)		
• Sudanese	0 (0.0 %)	14 (8.5 %)		
• Others	1 (1.4%)	5 (3 %)		
College Year				
• 1 st year	3 (4.1 %)	42 (25.5 %)	41.5	< .001*
• 2 nd year	11 (14.9 %)	38 (23.0 %)		
• 3 rd year	10 (13.5 %)	37 (22.4 %)		
• 4 th year	31 (41.9 %)	18 (10.9 %)		
• 5 th year	19 (25.7 %)	30 (18.2 %)		
Previous COVID-19 Infection				
• No	40 (54.1 %)	95 (57.6 %)	0.258	0.612
• Yes	34 (45.9%)	70 (42.4 %)		
Course of COVID-19 Disease (n=104):				
• Asymptomatic	5 (14.7 %)	15 (21.4 %)	0.360♦	0.548
• Mild symptoms	22 (64.7%)	43 (61.4 %)		
• Moderate symptoms	6 (17.6%)	9 (12.9%)		
• Severe symptoms	1 (2.9%)	3 (4.3%)		
COVID-19 Vaccination of the participants:				
• No	0 (0.0 %)	19 (11.5 %)	9.26	0.002*
• Yes	74 (100 %)	146 (88.5 %)		
Status of family members regarding COVID-19 vaccination:				
• No	1 (1.4 %)	31 (18.8 %)	13.4	< .001*
• Yes	73 (98.6 %)	134 (81.2 %)		
Number of COVID vaccine doses received by the participants:				
• No dose	0 (0.0 %)	19 (11.5 %)	10.1♦	0.001#
• Not Sure	2 (2.7%)	11 (6.7%)		
• One dose	8 (10.8%)	20 (12.1%)		
• Two doses	57 (77%)	104 (63%)		
• Three doses	7 (9.5%)	11 (6.7%)		

Criteria	Total Knowledge Score		χ^2 Value	p-value
	Satisfactory Level 74 (31%)	Unsatisfactory Level 165 (69%)		
Preferring Moderna vaccine ➤ Yes ➤ No	9 (12.2%) 65 (87.8%)	6 (3.6%) 159 (96.4%)	6.31	0.012*
Preferring Pfizer/BioNTech vaccine ➤ Yes ➤ No	37 (50%) 37 (50%)	23 (13.9%) 142 (86.1%)	35.3	<.001*
Preferring Oxford/AstraZeneca vaccine ➤ Yes ➤ No	18 (24.3%) 56 (75.7%)	12 (7.3%) 153 (92.7%)	13.5	<.001*
Preferring Sinovac vaccine ➤ Yes ➤ No	4 (5.4%) 70 (94.6%)	10 (6.1%) 155 (93.9%)	0.0398	0.842
Preferring Sinopharm vaccine ➤ Yes ➤ No	7 (9.5%) 67 (90.5%)	5 (3%) 160 (97%)	4.43	0.035*
Preferring Sputnik Light vaccine ➤ Yes ➤ No	8 (10.8%) 66 (89.2%)	8 (4.8%) 157 (95.2%)	2.91	0.088
Preferring Sputnik V vaccine ➤ Yes ➤ No	3 (4.1%) 71 (95.9%)	3 (1.8%) 162 (98.2%)	1.04	0.307
Preferring Janssen (J&J) vaccine ➤ Yes ➤ No	22 (29.7%) 52 (70.3%)	7 (4.2%) 158 (95.8%)	31.1	<.001*
Preferring Covishield vaccine ➤ Yes ➤ No	2 (2.7%) 72 (97.3%)	1 (0.6%) 164 (99.4%)	1.81	0.178
No preference ➤ Yes ➤ No (preferring certain vaccines)	10 (13.5%) 64 (86.5%)	118 (71.5%) 47 (28.5%)	69.1	<.001*

◆ Chi-square for linear trend (Extended Mantel-Haenszel) test.

* Significant using the Chi-square test.

Significant using the Chi-square for linear trend test.

Regarding the general knowledge score, there was a significant association between the satisfactory level and unsatisfactory level and the following factors (Nationality, College year, the status of COVID-19 vaccination of the participants, their families, the number of COVID-19 vaccine doses received by the participants, and non-preferring specific COVID-19 vaccine) (**Table 3**).

Table (3): Relation between the General knowledge score and the sociodemographic characteristics of the participants, history of COVID-19 infection and vaccination, and preferred type of COVID-19 vaccine.

Criteria	General Knowledge Score Categories		χ^2 Value	P-value
	Satisfactory Level 190 (79.5%)	Unsatisfactory Level 49 (20.5%)		
Age				
• 17-20	98 (51.6 %)	30 (61.2 %)	1.46	0.227
• 21-25	92 (48.4 %)	19 (38.8 %)		
Gender				
• Male	128 (67.4%)	30 (61.2%)	0.656	0.418
• Female	62 (32.6%)	19 (38.8%)		
Residence				
• Rural	72 (37.9%)	24 (49%)	1.99	0.158
• Urban	118 (62.1%)	25 (51 %)		
Nationality				
• Egyptian	152 (80 %)	40 (81.6 %)	9.59	0.022*
• Palestinian	26 (13.7 %)	1 (2%)		
• Sudanese	8 (4.2 %)	6 (12.2 %)		
• Others	4 (2.1%)	2 (4.1 %)		
College Year				
• 1 st year	29 (15.3 %)	16 (32.7 %)	12.2	0.016*
• 2 nd year	39 (20.5 %)	10 (20.4 %)		
• 3 rd year	40 (21.1 %)	7 (14.3 %)		
• 4 th year	45 (23.7 %)	4 (8.2 %)		
• 5 th year	37 (19.5 %)	12 (24.5 %)		
Previous COVID-19 Infection				
• No	111 (58.4 %)	24 (49 %)	1.41	0.235
• Yes	79 (41.6%)	25 (51 %)		
Course of COVID-19 Disease (n=104)				
• Asymptomatic	15 (19 %)	5 (20 %)	0.360♦	0.814
• Mild symptoms	48 (60.8%)	17 (68 %)		
• Moderate symptoms	14 (17.7%)	1 (4%)		
• Severe symptoms	2 (2.5%)	2 (8%)		
COVID-19 Vaccination of the participants				
• No	10 (5.3 %)	9 (18.4 %)	9.14	0.002*
• Yes	180 (94.7 %)	40 (81.6 %)		
Status of family members regarding COVID-19 vaccination				
• No	15 (7.9 %)	17 (34.7 %)	24.1	<.001*
• Yes	175 (92.1 %)	32 (65.3 %)		
Number of COVID vaccine doses received by the participants				
• No dose	10 (5.3 %)	9 (18.4 %)	22.3♦	<.001#
• Not Sure	4 (2.1%)	9 (18.4%)		
• One dose	22 (11.6%)	6 (12.2%)		
• Two doses	138 (72.6%)	23 (46.9%)		
• Three doses	16 (8.4%)	2 (4.1%)		
Preferring Moderna vaccine				
➤ Yes	13 (6.8 %)	2 (4.1 %)	0.505	0.477
➤ No	177 (93.2 %)	47 (95.9 %)		
Preferring Pfizer/BioNTech vaccine				
➤ Yes	53 (27.9%)	7 (14.3%)	3.84	0.05
	137 (72.1%)	42 (85.7%)		

Criteria	General Knowledge Score Categories		χ^2 Value	P-value
	Satisfactory Level 190 (79.5%)	Unsatisfactory Level 49 (20.5%)		
➤ No				
Preferring Oxford/AstraZeneca vaccine				
➤ Yes	26 (13.7%)	4 (8.2%)	1.08	0.298
➤ No	164 (86.3%)	45 (91.8%)		
Preferring Sinovac vaccine				
➤ Yes	9 (4.7%)	5 (10.2%)	2.11	0.146
➤ No	181 (95.3%)	44 (89.8%)		
Preferring Sinopharm vaccine				
➤ Yes	8 (4.2%)	4 (8.2%)	1.28	0.259
➤ No	182 (95.8%)	45 (91.8%)		
1. Preferring Sputnik Light vaccine				
➤ Yes	14 (7.4%)	2 (4.1%)	0.674	0.412
➤ No	176 (92.6%)	47 (95.9%)		
Preferring Sputnik V vaccine				
➤ Yes	5 (2.6%)	1 (2%)	0.0555	0.814
➤ No	185 (97.4%)	48 (98%)		
Preferring Janssen (J&J) vaccine				
➤ Yes	27 (14.2%)	2 (4.1%)	3.75	0.053
➤ No	163 (85.8%)	47 (95.9%)		
Preferring Covishield vaccine				
➤ Yes	2 (1.1%)	1 (2%)	0.307	0.58
➤ No	188 (98.9%)	48 (98%)		
No preference				
➤ Yes			6.21	0.013*
➤ No (Preferring certain vaccines)	94 (49.5%) 96 (50.5%)	34 (69.4%) 15 (30.6%)		

◆Chi-square for linear trend (Extended Mantel-Haenszel) test.

* Significant using the Chi-square test.

Significant using the Chi-square for linear trend test.

While concerning the specific knowledge score, there was a significant association between the satisfactory level and unsatisfactory level and the following factors Age, Gender, College year, preferring the following COVID-19 vaccines (Pfizer/BioNTech, and Janssen), in addition to non-preferring specific COVID-19 vaccine (**Table 4**).

Table (4): Relation between the Specific knowledge score and the sociodemographic characteristics of the participants, history of COVID-19 infection and vaccination, and preferred type of COVID-19 vaccine.

Criteria	Specific Knowledge Score Categories		χ^2 Value	P-value
	Satisfactory Level 20 (8.4%)	Unsatisfactory Level 219 (91.6%)		
Age				
• 17-20	1 (5%)	127 (58%)	20.7	<.001*
• 21-25	19 (95%)	92 (42%)		
Gender				
• Male	1 (5%)	80 (36.5%)	8.13	0.004*
• Female	19 (95%)	139 (63.5%)		
Residence				
• Rural	6 (30%)	90 (41.1%)	0.939	0.333
• Urban	14 (70%)	129 (58.9%)		
Nationality				
• Egyptian	16 (80%)	176 (80.4%)	3.29	0.349
• Palestinian	4 (20%)	23 (10.5%)		
• Sudanese	0 (0%)	14 (6.4%)		
• Others	0 (0%)	6 (2.7%)		
College Year				
• 1 st year	0 (0%)	45 (20.5%)	33	<.001*
• 2 nd year	1 (5%)	48 (21.9%)		
• 3 rd year	0 (0%)	47 (21.5%)		
• 4 th year	13 (65%)	36 (16.4%)		
• 5 th year	6 (30%)	43 (19.6%)		
Previous COVID-19 Infection				
• No	8 (40%)	127 (58%)	2.41	0.120
• Yes	12 (60%)	92 (42%)		
Course of COVID-19 Disease (n=104)				
• Asymptomatic	1 (8.3%)	19 (20.7%)	0.52♦	0.470
• Mild symptoms	9 (75%)	56 (60.9%)		
• Moderate symptoms	1 (8.3%)	14 (15.2%)		
• Severe symptoms	1 (8.3%)	3 (3.3%)		
COVID-19 Vaccination of the participants				
• No	0 (0%)	19 (8.7%)	1.89	0.170
• Yes	20 (100%)	200 (91.3%)		
Status of family members regarding COVID-19 vaccination				
• No	1 (5%)	31 (14.2%)	1.32	0.250
• Yes	19 (95%)	188 (85.8%)		
Number of COVID vaccine doses received by the participants				
• No dose	0 (0%)	19 (8.7%)	1.09♦	0.296
• Not Sure	1 (5%)	12 (5.5%)		
• One dose	2 (10%)	26 (11.9%)		
• Two doses	14 (70%)	147 (67.1%)		
• Three doses	3 (15%)	15 (6.8%)		
Preferring Moderna vaccine				
➤ Yes	3 (15%)	12 (5.5%)	2.82	0.093
➤ No	17 (85%)	207 (94.5%)		

Criteria	Specific Knowledge Score Categories		χ^2 Value	P-value
	Satisfactory Level 20 (8.4%)	Unsatisfactory Level 219 (91.6%)		
Preferring Pfizer/BioNTech vaccine ➤ Yes ➤ No	10 (50%) 10 (50%)	50 (22.8%) 169 (77.2%)	7.19	0.007*
Preferring Oxford/AstraZeneca vaccine ➤ Yes ➤ No	3 (15%) 17 (85%)	27 (12.3%) 192 (87.7%)	0.119	0.730
Preferring Sinovac vaccine ➤ Yes ➤ No	1 (5%) 19 (95%)	13 (5.9%) 206 (94.1%)	0.0291	0.865
Preferring Sinopharm vaccine ➤ Yes ➤ No	0 (0%) 20 (100%)	12 (5.5%) 207 (94.5%)	1.15	0.283
Preferring Sputnik Light vaccine ➤ Yes ➤ No	2 (10%) 18 (90%)	14 (6.4%) 205 (93.6%)	0.382	0.537
Preferring Sputnik V vaccine ➤ Yes ➤ No	1 (5%) 19 (95%)	5 (2.3%) 214 (97.7%)	0.553	0.457
Preferring Janssen (J&J) vaccine ➤ Yes ➤ No	6 (30%) 14 (70%)	23 (10.5%) 196 (89.5%)	6.53	0.011*
Preferring Covishield vaccine ➤ Yes ➤ No	0 (0%) 20 (100%)	3 (1.4%) 216 (98.6%)	0.277	0.598
No preference ➤ Yes ➤ No (preferring certain vaccines)	4 (20%) 16 (80%)	124 (56.6%) 95 (43.4%)	9.88	0.002*

◆Chi-square for linear trend (Extended Mantel-Haenszel) test.

* Significant using the Chi-square test.

DISCUSSION

The COVID-19 pandemic has urged medical students to continuously update their information concerning the daily published guidelines⁽¹³⁾. This study was carried out in this context to identify the level of knowledge and attitude of medical students regarding COVID-19 vaccines.

Regarding Age and Residence, this study came in line with a study conducted by **Abdou et al.**⁽¹⁴⁾ which evaluated the levels of COVID-19 vaccine hesitancy, protective behaviors, and risk perception among university students in Alexandria. In that study, the participants' age ranged from **18 to 26** years old with mean **20.56 (SD 1.643)** years and most of them were urban residents. **As for gender**, the current study agreed with a study carried out by **Habib et al.**⁽¹⁵⁾ which assessed the knowledge and attitude of medical students towards the COVID-19 vaccine in Saudi Arabia, with most participants being male. A large proportion of the current study's students (56.6%) had no previous history of COVID-19 infection. This result coincided with the results of **Habib et al.**⁽¹⁵⁾ who found that most of their study's participants in Saudi Arabia (79.6%) had no history of COVID-19 infection.

However, this result unexpectedly disagreed with the results of the study conducted by **Ruby**⁽¹⁶⁾ which included 108 medical students (53 from the 6th medical year, and 55 from the 4th medical year) at Ain Shams University. This study found that most of the participants (76.4% of the fourth-year students and 71.7% of the sixth-year students) had previously been COVID-19 infected. This discrepancy may be explained by the fact that COVID-19 has non-specific symptoms that may be confused with other diseases, which may make it difficult for the students to determine whether they have been infected or not. In addition, in the study conducted by **Ruby**⁽¹⁶⁾, most of the students had an adequate knowledge level of the symptoms, to determine whether they were COVID-19 infected or not.

This study revealed that **social media** was the most used source among the participants to gain information about COVID-19 vaccines. This finding was similar to the results of the study conducted among medical students in **Tanta** and **Kafrelsheikh** Universities which showed that social media, scientific websites, and healthcare providers were used primarily among the participants as sources of information about COVID-19⁽⁴⁾. Similarly, the study conducted by **Orok et al.**⁽¹⁷⁾ among medical students in Nigeria has shown that social media was the most used source by the participants (60%) to gain information about COVID-19 and its vaccines followed by health professionals, medical journals, international and health organizations, friends and colleagues, and print/electronic media (30%, 3.4%, 3.2%, 2.4%, and 0.8% respectively). While Television/Radio was ranked as the first source of information for the participants (48%) followed by social media (37%) among medical

students in Ethiopia, in the study conducted by **Mose et al.**⁽¹⁸⁾. Shifting to online education due to the COVID-19 epidemic has considerably affected medical students in Egypt⁽¹⁹⁾. Using online platforms for medical education may make it easier for medical students to use social media as a source of information compared to other sources. However, relying on social media for information about vaccines leads to the spread of fake news, misinformation, and the development of COVID vaccine hesitancy⁽⁴⁾.

Concerning vaccine preference, our results were consistent with the finding of the study conducted among Egyptian medical students in **Tanta** and **Kafrelsheikh** Universities which found that most of the participants (65.6%) didn't know the difference between COVID-19 vaccines with no special preference, while the Pfizer/BioNTech vaccine was the most chosen as the preferred type among the rest of the participants⁽⁴⁾. Also, in the study conducted by **Mose et al.**⁽¹⁸⁾ among medical students in Ethiopia reported that most of their study's respondents preferred the Pfizer-BioNTech vaccine (49.8%), AstraZeneca vaccine (32.8%), Moderna vaccine (8.5%), and Janssen vaccine (2%). While only 6.5% of the respondents had no special preference. In addition, the study by **Ngai et al.**⁽²⁰⁾ among medical students in Hong Kong reported that the participants preferred the Pfizer-BioNTech vaccine as it has higher vaccine efficacy against COVID-19 (87.4%).

Regarding the three knowledge scores, our results were similar to the results of the study of **Jiang et al.**⁽⁷⁾ who studied the attitudes, knowledge, and willingness of Chinese nursing students to receive the COVID-19 vaccine. They found that there was a statistically significant difference between the participants' knowledge by the following factors: gender, age, grade, educational level, academic background in high school, political affiliation, and COVID vaccination status of their family members. They also found a statistically significant difference in the participants' attitudes by the following factors: age, grade, academic background in high school, and COVID vaccination status of their family members. Also, the study by **Hossain et al.**⁽²¹⁾ among public university students in Bangladesh found that there was a statistically significant association between the knowledge of the participants, residence, category (undergraduate and postgraduate), and previous COVID infection. Regarding attitude, there was a statistically significant difference by age, category (undergraduate and postgraduate), and previous COVID infection. However, our findings contrasted with the study of **Orok et al.**⁽¹⁷⁾ which assessed the knowledge, attitude, and perception of medical students on COVID vaccines in Nigeria and reported that there was no significant difference between the knowledge score, and both the gender ($P=0.405$) and the study level of the participants ($P=0.089$).

CONCLUSION

From the previous results, we concluded that most of the Zagazig Medical Students had a satisfactory general knowledge level and positive attitude towards COVID-19 vaccination. However, they had a defect in their specific knowledge level, and hence total knowledge level regarding COVID-19 vaccines. Raising their awareness about COVID-19 vaccines is vital to raise vaccination coverage rates.

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