



Awareness, Practice, and Acceptance of COVID-19 Vaccination among Medical Students from Mansoura University, Egypt: A Cross-sectional Survey

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Abstract

Background and aims: The coronavirus disease 2019 (COVID-19) is an emerging transmissible infection that can be prevented by proper hygiene measures and vaccination. With the rise and rapid spread of the Omicron variant, vaccines are currently the best protective measure. This cross-sectional study aimed to assess knowledge, practice, and attitude towards COVID-19 virus and vaccines, particularly Sinopharm, among medical students in Mansoura University, Egypt, from July to September 2021.

Methods: A cross-sectional study was conducted using a 35-item questionnaire covering demographic data. COVID-19 knowledge/practice and knowledge/attitude towards vaccines were distributed on medical students' university Facebook group. A score was calculated for knowledge (KS), practice (PS), and attitude (AS). A 60% cutoff was considered satisfactory, and the statistical analysis was carried out using one-way ANOVA, linear regression, and Pearson's coefficient.

Results: A total of 837 students participated in this study. The majority (73.12%) of participants showed satisfactory COVID-19 KS and Sinopharm AS (54.77%) but unsatisfactory PS (68.99%) and Sinopharm KS (62.75%). Knowledge had a significant effect on Sinopharm vaccine acceptance. Moreover, females indicated higher COVID-19 KS and PS, whilst males showed higher Sinopharm KS and AS. Gender and year group had a strong correlation with PS. Furthermore, the majority (92.4%) accepted vaccination and believed it should be mandatory (80.41%). The selected vaccines were Pfizer (44.84%) > AstraZeneca (33.86%) > Sinopharm (15.56%) > others. Efficacy, safety, and country of production were the main predictors of vaccine choice. More than half (59.48%) stated that the country in which the vaccine is produced is important when choosing their intended vaccine, and 20.87% stated that their decision is based on vaccine efficacy.

Conclusions: COVID-19 was a challenging pandemic; there are several available COVID-19 vaccines, but the most available in Egypt is the Sinopharm vaccine. The results of this study will provide a basis regarding the knowledge and attitude of medical students who play a crucial part in the cycle of infection. These results will help outline the main causes of misunderstandings that can be solved by providing educational needed interventions, implementing protective measures, and distributing scientifically correct data.

Keywords: Attitude, COVID-19, Knowledge, Practice, Vaccines

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Introduction

The first coronavirus disease 2019 (COVID-19) reported case was on December 31st, 2019 in Wuhan, China. It is believed that cases appeared as early as November 17th, 2019.¹ It rapidly spread causing a global shutdown on 31st of January 2020.² COVID-19 has affected more than 200 countries and caused the death of 5.3 million people from 15th December as stated by the World Health Organization

(WHO). The rapid spread may be contributed to its high reproduction number and ability to remain on surfaces for up to 72 hours.³ When the genetic sequence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was discovered, pharmaceutical companies raced to produce vaccines.⁴

SARS-CoV-2 works on angiotensin-converting enzyme 2 (ACE2) receptors in the human body. The receptor plays

an important role in modulating antigen-presenting cells to interact with T cells to produce an immune response.⁵ Amongst the glycosylated surface proteins are the S1 and S2 subunits of the Spike protein. The S1 is responsible for ACE2 receptor binding, while S2 is responsible for membrane fusion. Pharmaceutical companies aimed to create a vaccine that would prevent the S1 subunit from binding to ACE2 receptors, therefore, preventing infection.^{6,7}

There are several vaccines, including Pfizer-BioNTech, AstraZeneca, and Sinopharm, available to the public.⁶ They differ in type, use of an adjuvant, and possible side effects⁸. Some companies have used nanotechnology in the development of their vaccines,⁸ and this has caused people to speculate that microchips will be placed in their bodies. The research was carried out on all vaccines, but the availability of data and research results vary from one to another.

There is a significant number of asymptomatic COVID-19 patients who are difficult to screen and play a role in the transmission of infection.⁹ The WHO recommended precautions to minimize the spread of infection include wearing a mask, maintaining social distance, washing hands thoroughly, regular physical activity¹⁰, and the like. In addition, healthcare professionals are recommended to wear a cloth mask over a surgical mask, tightly fitted masks, and personal protective equipment.¹¹

Sinopharm (BBIBP-CorV) vaccine is an inactivated virus that induces an antibody-mediated reaction¹², with an efficacy of 79% against both symptomatic infection and hospitalization as stated by the WHO. It was amongst the first vaccines to obtain emergency approval from the WHO¹³ and one of the top three effective vaccines in patients under 60 years.¹³ There are mild to moderate side effects to the vaccine which are well tolerated, the most common of which is fever.¹⁴ BBIBP-CorV vaccine is a non-replicating vaccine which has been approved for cancer patients¹⁵, and the WHO announced that it can be given to HIV patients who have been recommended vaccination. No clinical trials have been conducted on immunocompromised patients, but studies have indicated that inactivated virus vaccines are safe and exhibited promising results in immunocompromised patients. [_ENREF_18](#)¹⁶

Since the vaccines are a crucial part of immunity and are proven successful, this study was conducted on medical students as they are exposed to a large number of patients every day in university hospitals as part of their training. Being exposed to large numbers of people carries the risk of spreading infection onto further patients. For this reason, medical students alongside medical and paramedical staff are an important part of the cycle, and vaccinated students will help break the cycle of infection.

Similar studies have been conducted on medical professionals and medical students across different countries including Dubai¹⁷, Jordan¹⁸, India¹⁹, and Italy²⁰. Some studies have also been conducted on the general

public such as in Saudi Arabia²¹ and Egypt²². The study conducted in Egypt consisted of in-depth questions regarding COVID-19 vaccine knowledge and the attitude of the public towards vaccination.²² These studies focused on the overall acceptance of the COVID-19 vaccines and the overall knowledge regarding vaccines.

This study aimed to investigate the knowledge, practice, and attitude of medical students from Mansoura University, Egypt, regarding SARS-CoV-2, vaccines, and specifically Sinopharm as it is the most available vaccine in Egypt. Moreover, the study intended to find out whether participants have enough knowledge to make an informed decision to get vaccinated or not and what is the vaccine of choice over the period from July to September 2021. The study was designed to outline any misunderstandings or prejudice toward the Sinopharm vaccine and the reasons behind them. Furthermore, the correlation between gender or year of study and the studied parameters was investigated.

Methods

Ethics Statement

This study was approved by the Research Ethics Committee, Faculty of Medicine, Tanta University (no# 34701/5/21). All participants were informed of the purpose and benefits of the study and their right to refuse participation or withdraw at any time. A confidentiality disclosure and informed consent were included at the beginning of the questionnaire.

Target Group

The target group included medical students from Mansoura University including first to last-year students and interns (year 7). The questionnaire was distributed on the medical university students' Facebook and WhatsApp groups from July to September 2021.

Sample Size Calculation

The required sample size ($n = 364.9$) was calculated using²³

$$n = Z^2 p(1-p) / d^2$$

where

"Z" = standard normal variant corresponding to 95% confidence level

"p" = proportion of estimated population (50%)

"d" = margin of error (5%)

Online Questionnaire Design

The questionnaire was designed in English, using Google Forms (i.e., Google LLC, Mountain View, California, and United States). It has 6 sections: (1) demographic data, (2) COVID-19 knowledge (9 Questions), (3) COVID-19 practice (5 Questions), (4) Sinopharm knowledge (9 Questions), (5) COVID-19 vaccines knowledge (6 Questions), and (6) Sinopharm attitude (4 Questions). An overall score was given to knowledge (KS), practice (PS), and attitude (AS), and a cutoff point of 60% was chosen as

satisfactory as illustrated in Table S1.

Statistical Analysis

Descriptive statistics including frequency, percentage, and means \pm standard deviation were calculated using IBM SPSS 23.0. (SPSS Inc., Chicago, Illinois, USA). An independent samples t-test was used to assess the differences in scales between males and females, while one-way ANOVA was employed to determine the difference in mean KS, PS, or AS between year groups. Further, post-hoc test was used to assess the difference between groups. Linear regression was used to assess the association between gender or year group and KS, PS, or AS. Moreover, Pearson's coefficient was used to assess the correlation between KS or PS and AS. All statistical analyses were conducted at $P < 0.05$.

Results

A total of 837 participants (i.e., >double the required sample size) completed the survey to obtain more reliable and representative data with females ($n = 507$) constituting 60.57% while males ($n = 330$) constituting 39.34%. As Table S1 presents, the highest response ($n = 268$) was obtained from Year 5 students (32.02%), while the lowest response was from Year 1 (3.35%). It should be noted that those who answered Q26 with "No" were excluded from the rest of the survey.

Regarding COVID-19 KS, 72.12% of participants ($n = 612$) got a satisfactory score while 31.01% of participants got a satisfactory PS. Regarding Sinopharm KS, 37.25% of participants ($n = 285$) got a satisfactory score, while 54.77% ($n = 419$) got a satisfactory AS according to Table S1.

Relationship between Gender and KS, PS, or AS

There was a significant difference between male and female participants in COVID-19 KS and PS ($P < 0.001$) with females scoring higher than males. Males scored higher in Sinopharm KS compared to females, but this difference was not statistically significant ($P = 0.134$). Likewise, males showed significantly ($P < 0.010$) higher Sinopharm AS than females as depicted in Table 1.

Relationship Between Year Group and KS, PS, or AS

Table 2 represents descriptive statistics regarding the effect of year group on COVID-19 KS, PS, and AS. One-way ANOVA indicates that the year group has no significant effect on COVID-19 KS ($P = 0.772$), but it has a significant effect on COVID-19 PS ($P < 0.01$), Sinopharm

KS ($P < 0.01$), and Sinopharm AS ($P = 0.21$).

Comparing the Effect of Gender and Year Group on KS, PS, or AS

A linear regression analysis exhibited that gender has a significant effect on COVID-19 KS/PS ($P < 0.001$) and Sinopharm AS ($P = 0.026$) but not on Sinopharm KS. On the other hand, the year group has a strong correlation with COVID-19 PS ($P = 0.029$) and Sinopharm AS ($P < 0.001$).

Correlation Between KS and PS or AS

There is a positive weak (Pearson correlation = 0.096) significant (P -value < 0.006) correlation between COVID-19 KS and PS. Likewise, there is a moderate (Pearson correlation = 0.242) significant (P -value < 0.001) positive correlation between Sinopharm KS and AS.

Vaccine of Choice

As observed, 343 participants (44.84%) chose Pfizer, 259 participants (33.86%) chose AstraZeneca, and 119 participants (15.56%) chose Sinopharm. Only 8.60% of participants did not accept vaccination. Further, the choice of Pfizer was mainly based on its efficacy (23%), high recommendation (20%), or personal belief (13%), while choosing AstraZeneca was mainly based on its efficacy (24%), high recommendation (22%), and presence of clinical trial results (12%). In addition, choosing Sinopharm was based on its fewer side effect (19%), high recommendation (17%), or all given reasons (23%) as depicted in Figure 1.

Discussion

The WHO first declared the occurrence of the COVID-19 virus on 31st December 2019, reporting multiple cases of pneumonia in Wuhan, China. The genetic coding of COVID-19 was announced by China on 12th January 2020. Before this date, there were no cases outside China, while the first case outside China was reported in Thailand on 13th January 2020. A global pandemic was announced on 31st January 2020. COVID-19 is induced by the SARS-CoV-2 virus. The SARS virus was first reported on November 2002 in China²⁵, and similar to other viruses, it underwent genetic mutation with time as viruses are prone to changes which that alter their properties including the rate of transmission.

Over time, vaccines have been proven to be an established method of controlling the transmission of virus infection. With the rise of new more rapidly spreading COVID-19 variants, Omicron being the latest, vaccines are currently

Table 1. COVID-19 KS/PS and Sinopharm KS/AS for Males ($n = 330$) and Females (507 for COVID-19 KS and PS but 435 for Sinopharm KS and AS)

Gender		COVID-19 KS	COVID-19 PS	Sinopharm KS	Sinopharm AS
Male	Mean \pm SD	5.97 \pm 1.6	2.33 \pm 1.06	6.64 \pm 1.99	1.69 \pm 0.97
Female	Mean \pm SD	6.40 \pm 1.39	2.67 \pm 1.019	6.40 \pm 2.26	1.52 \pm 1.00
P-value		<.001	<.001	0.134	0.026

Note. COVID-19: Coronavirus disease 2019; KS: Knowledge score; PS: Practice score; AS: Attitude score; SD: Standard deviation.

Table 2. Descriptive Statistics for the Effect of Year Group on COVID-19 KS/PS and Sinopharm KS/AS

Year Group		COVID-19 KS	COVID-19 PS	Sinopharm KS	Sinopharm AS
1.00	Mean±SD	6.14±1.72	2.56±1.01	4.85±2.47	1.71±1.12
2.00	Mean±SD	6.02±1.72	2.46±1.02	5.12±2.55	1.57±1.03
3.00	Mean±SD	6.27±1.59	2.98±1.02	5.95±2.14	1.59±1.05
4.00	Mean±SD	6.18±1.57	2.68±1.18	6.19±2.08	1.53±1.01
5.00	Mean±SD	6.23±1.44	2.35±1.00	6.56±2.04	1.44±0.97
6.00	Mean±SD	6.23±1.53	2.30±.97	7.25±1.83	1.76±0.92
7.00	Mean±SD	6.43±1.21	2.56±.92	7.62±1.77	1.82±0.93
P-value		0.772	<0.001	<0.001	0.021

Note. COVID-19: Coronavirus disease 2019; KS: Knowledge score; PS: Practice score; AS: Attitude score; SD: Standard deviation.

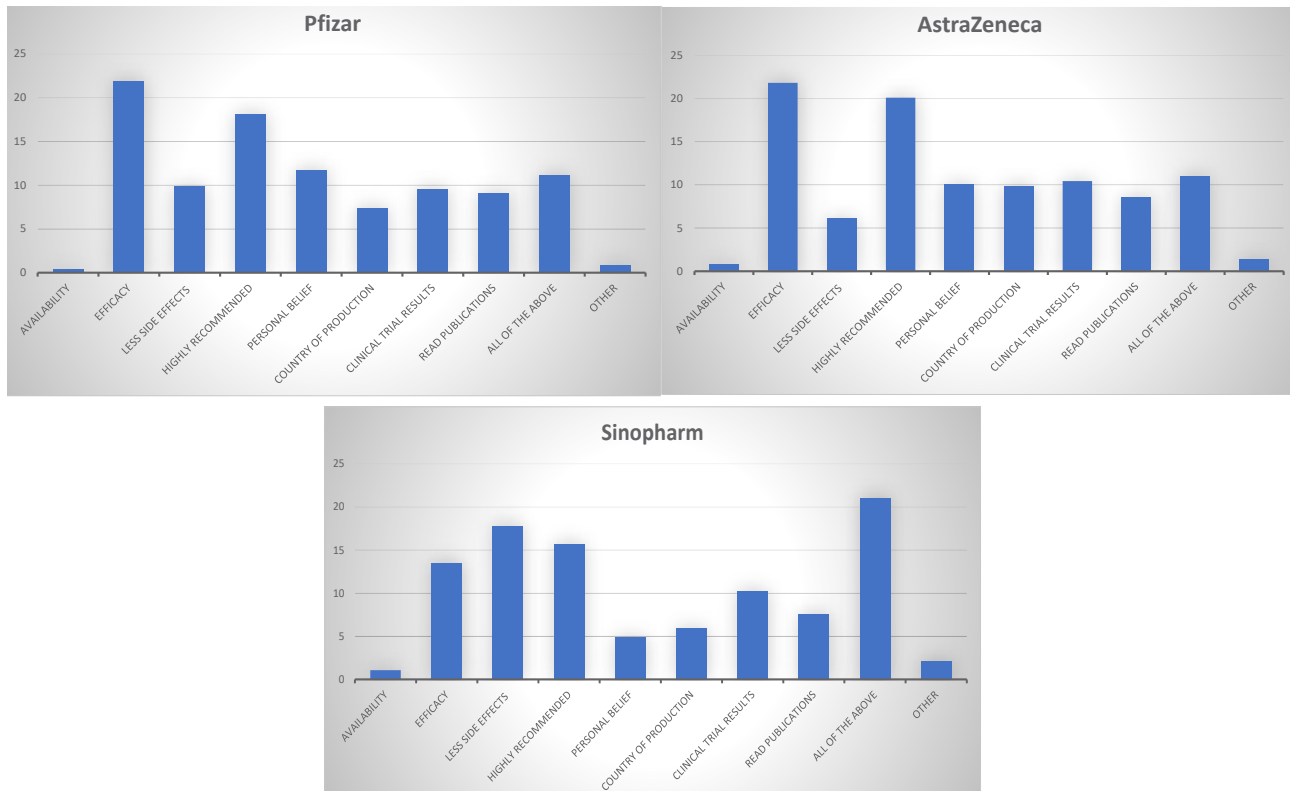


Figure 1. Bar Chart Showing Different Reasons for Choosing Pfizer, AstraZeneca, and Sinopharm Vaccines

the best protective measure. There are different types of vaccines including inactivated virus, live attenuated virus, viral vector, DNA, RNA, and protein-based vaccines. Pfizer and Moderna are both RNA virus vaccines, while ²⁶ Novavax is a protein-based vaccine²⁷, and Sinopharm and Sinovac are both inactivated virus vaccines. ²⁸

Inactivated virus vaccines are made from virus particles grown in a culture which are later destroyed to prevent infection. They form a weaker immune response compared to live vaccines; however, they are more stable and safer, are less reactive, can be used in immune-compromised patients ¹⁶, and have a lower risk of infection as the virus particles have already been destroyed. ²⁹ Inactivated virus vaccines induce antibody production by the immune system which provides protection against the virus. ¹²

Sinopharm is the most available COVID-19 vaccine in Egypt; therefore, any prejudice toward Sinopharm

should be tackled to ensure public acceptance of the vaccine. It is also important to provide information regarding the mechanism and efficacy of vaccines and tackle misunderstandings to better improve Sinopharm acceptance. This study aimed to assess the knowledge, practice, and attitude of medical students towards COVID-19 and vaccines. Medical students receive training in university hospitals and are in contact with a large number of patients every day. This makes them a vital part of the cycle of infection as they are more prone to being infected and spreading infection. Improving their acceptance is a crucial step in breaking the infection cycle. Medical students alongside medical staff can also influence the public's perception of vaccination which may improve vaccination acceptance. The questions included in the questionnaire were based on available published research and data provided by both the WHO

and the Center for Disease Control. The questionnaire was designed in English and revised by different team members to ensure that it is easily understandable by students of different ages. The validity and reliability of the questionnaire were tested on different levels. It was firstly reviewed by three independent expert reviewers and adjusted according to each reviewer's comments. It was then reviewed by a panel of experts included in the ethical committee board and adjusted according to the received feedback.¹⁸

According to the results of this study, 73.12% of the tested population, particularly females, had satisfactory COVID-19 KS; however, this was not reflected in their practice, and a weak correlation was found between KS and PS. Unfortunately, there was weak practice amongst Egyptians in general since there are weak regulations regarding WHO recommended practices. Accordingly, reinforcements of precautionary COVID-19 measures require careful consideration to reduce the incidence of COVID-19 and other infections (e.g., pneumonia, Mycobacterium tuberculosis, and influenza).³⁰ It should be highlighted that vaccines alone aren't 100% effective against infection and that recommended practices should be maintained and followed.

Assessing participants' acceptance of COVID-19 vaccination was considered. Regarding vaccination, a positive attitude (90.4% got vaccinated and 80.41% believed that vaccination should be mandatory) was observed. The main predictor of acceptance of the COVID-19 vaccine was its efficacy. In addition, the majority chose Pfizer or AstraZeneca followed by Sinopharm, which can also be explained by 59.48% of participants who admitted that the country of vaccine production affects their decision. Many believed that the Pfizer and AstraZeneca vaccines are better as they are produced in the United States and the United Kingdom, respectively.

There is controversy regarding the Sinopharm vaccine (produced in China) efficacy^{13, 31} even though it was granted emergency use in several countries including China and UAE.⁸ Low acceptance of Sinopharm vaccine may be attributed to the fact that it was produced where the COVID-19 virus originated; therefore, some countries did not regard it as a reliable vaccine; accordingly, they refuse those vaccinated with Sinopharm to travel into their country. Furthermore, compared to other vaccines, research data are scarce regarding the Sinopharm vaccine.

Conclusion

The majority of participants demonstrated satisfactory COVID-19 KS but unsatisfactory PS. Regardless of the weak correlation between COVID-19 KS and PS, females showed high COVID-19 KS and PS. Moreover, 91.4% of participants took COVID-19 vaccine, and their preference followed this order: Pfizer > AstraZeneca > Sinopharm. In addition, the efficacy, safety, and country of production were the main predictors of the vaccine's acceptance. The

majority exhibited satisfactory Sinopharm AS but not satisfactory KS with males scored higher than females. Further, gender had a significant effect on COVID-19 KS/PS and Sinopharm AS, while the year group had a strong correlation with COVID-19 PS and Sinopharm KS.

Recommendations

Improving students' practice in terms of precautionary measures against COVID-19 and knowledge about vaccines is highly required.

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Authors' Contributions

EAN and BEK formulated the research idea with objectives, designed the survey, and performed statistical data analysis and scientific writing. BEK performed data collection, coding, and scoring. Other authors contributed to data collection and coding.

Conflict of Interests

The authors declare no conflict of interests.

Ethics Statement

This study was approved by the Research Ethics Committee, Faculty of Medicine, Tanta University (no=34701/5/21) on 25th May 2021.

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Supplementary files

Supplementary file 1 contains Table S1.

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