



## Assessing University Students Knowledge and Awareness about COVID-19 Infection Symptoms and Preventive Measures in, Saudi Arabia

Bader Alhafi Alotaibi<sup>1</sup>, Muhammad Muddassir<sup>2</sup>, Moodhi Raid<sup>3</sup>, Muhammad Imran Azeem<sup>4</sup> and AbdulMalek Alsanhani<sup>5</sup>

<sup>1,2,4,5</sup>Department of Agricultural Extension and Rural Society, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia

<sup>3</sup>Faculty of Business Studies, Arab Open University, Riyadh 11681, Saudi Arabia

\*Corresponding author: balhafi@ksu.edu.sa

### ABSTRACT

The COVID-19 pandemic has significantly affected the normal functioning of different institutions of any given society globally. The continuous smooth functioning of educational and research institutions is indispensable for every nation owing to their role in the provision of skilled human resources and technological innovations. Understanding students' knowledge about symptoms of the COVID-19 infection and their awareness regarding preventive measures for curtailing its spread plays an important role in the design and implementation of effective educational interventions for pandemic management at educational institutions. Therefore, a study was undertaken to assess university student's knowledge about COVID-19 infection symptoms and its preventive measures. Data were collected from the students enrolled at King Saud University using a convenience sampling approach with the help of a pre-tested paper-based questionnaire. The findings revealed that majority of the respondents were below 25 years of age, enrolled in undergraduate programs, males, citizens, and residing in their homes. Most of them had moderate to low level of knowledge about COVID-19 infection symptoms. However, they possessed a higher level of awareness regarding preventive measures. Education level was a significant predictor of the students' knowledge about COVID-19 infection symptoms. Based on the findings, we conclude that the measures implemented by the university administration as well as by the Ministry of Health has proved effective and should continue with the same force when the situation gets worse due to a rise in COVID-19 cases. Moreover, we suggest regular update of the mobile applications and online platforms that have been specifically designed for preventing the spread of the COVID-19 in the Kingdom.

**Keywords:** Awareness, COVID-19, Knowledge, King Saud University, Students, Saudi Arabia

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### INTRODUCTION

The first identification of Corona Virus (CoV) occurred in the 1960s and showed mild influenza-like symptoms, but the real-time existence of CoV is still unidentified. It has been revealed that various vertebrates including birds, snakes, bats, camels, and several other animals could be infected by the CoV (Weiss and Navas-Martin, 2005). Every few years, new strains of the corona viruses cause deadly epidemics and pandemics globally (Yang et al., 2020). In 2003, The outbreak of Severe Acute Respiratory Syndrome (SARS) first time occurred in China. According to the World Health Organization (WHO), about 8,098 cases of SARS were recorded in multiple countries (Ryu, 2017). After that, another outbreak of Middle East Respiratory Syndrome (MERS) occurred in 2012 by a new strain of corona virus (MERS-CoV). Health officials first reported that MARS's first case occurred in Saudi Arabia in September, 2012 (Zaki et al., 2012).

In December 2019, a new strain of corona virus emerged in Wuhan, China. It is believed by the scientific community that this new strain of corona virus (SARs-CoV-2) originated in Wuhan, China at the Huanan Wholesale Seafood Market (Worobey et al., 2022). The new disease that the virus causes was named as Coronavirus Disease (COVID-19). The World Health Organization officially announced the COVID-19 outbreak as a global pandemic in March 2020 when cases outside of China started to rapidly rise and declared a Public Health Emergency of International Concern (Cucinotta and Vanelli, 2020). The COVID-19 pandemic has affected millions of people across the globe, causing massive damage. According to the World Health Organization's estimates, there are about 761.4 million confirmed cases of the COVID-19 globally as of 31 March, 2023 and around 6.88 million people died as a result of the coronavirus disease since the start of the pandemic (WHO, 2019). In Saudi Arabia, the first case of COVID-19 was reported in March, 2020 (Alahdal et al.,

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2020). Since then, the number of cases gradually rose. As of March, 2023, there were around 0.832 million confirmed cases of COVID-19 in the Kingdom (WHO, nd).

The COVID-19 has significantly changed the normal functioning of societies across the world. Countries in their varying capacities have employed both complete lockdowns and partial closure of different economic, social, educational, and recreational activities in their jurisdictions in order to prevent the spread of the COVID-19 to the masses (Verma and Prakash, 2020). However, as a result of these stringent measures, the provision of goods and services is considerably affected, leading to chaos in any given society. Educational and research institutions were also seriously affected due to the wide-spread occurrence of the COVID-19. The large educational and research institutions with sufficient financial and technical resources have designed and implemented online learning management systems while others are struggling to establish such systems for delivering their educational services (Stracke et al., 2022).

Whenever there is the fear of a new wave of the COVID-19, the governments in their first preference try to restrict people from moving beyond their residential buildings. Closing educational and research institutions may have serious implications for a society. Such institutions can even work under critical circumstances when there is a fear of COVID-19 if the people who are working as well as those who are attending these institutions are aware of the recommended practices that prevent the spread of COVID-19 to other people. Understanding students' awareness regarding symptoms of the COVID-19 infection as well as preventive measures for preventing its spread to the population will assist the administration of the institution in the design of awareness and educational programs and may pave the way towards the progression of educational activities. Keeping in view this context, a study was designed to identify student's knowledge about symptoms of the COVID-19 infection and their awareness regarding precautionary measures for preventing the spread of the COVID-19. The research was conducted with the following objectives:

1. To identify students' knowledge about symptoms of the COVID-19 infection
2. To identify students' awareness about precautionary measures if a person is infected with the COVID-19
3. To identify students' awareness about general preventive measures for preventing the spread of COVID-19
4. To determine any relationship between student's demographic characteristics and their knowledge about symptoms of the COVID-19 infection, and awareness regarding COVID-19 preventive measures.

## MATERIALS & METHODS

### Research Design and Population

The study was conducted using a cross-sectional survey approach. All the students who were enrolled in various degree programs at the King Saud University were the population of the study. The names of the colleges from which students were selected are: College of Science, College of Food and Agriculture Sciences, College of Computer and Information Sciences, College of Architecture and Planning, College of Business and Administration, College of Engineering, College of Pharmacy, College of Nursing, College of Dentistry, and Medical College. The respondents were selected from these colleges based on their willingness to participate in the study using a convenience sampling technique. Data were collected with the help of a paper-based structured

questionnaire. The questionnaire was distributed to the students in their native Arabic language. The informed consent of the students was obtained verbally. They were explained about the purpose of the study and were ensured that collected data will only be utilized for academic purposes. They were also informed that their participation in the study is not mandatory. The study was approved by the Research Ethics Committee at King Saud University (KSU-HE-22-750). Initially, 210 students were conveniently selected who expressed willingness to complete the survey questionnaire. Out of them, 168 students returned the completed questionnaire that was used for final data analysis. Data collection was completed in three months: February-April 2022.

### Research Instrument

The research questionnaire was divided into four different sections. The first section contained questions related to the personal demographics of the students. It included age, gender, education level, nationality, residence, and college of study. The second section consisted of questions about symptoms of the COVID-19 infection. In the third section, there were questions related to preventive measures if a person is infected with COVID-19. Questions in the second and third section were measured using a nominal scale (0 = No; 1 = Yes). The fourth section included questions about general preventive measures for avoiding COVID-19 infection. The student's awareness regarding general preventive measures to avoid COVID-19 infection was measured using a 5-point Likert scale (1 = Never; 2 = Rarely; 3 = Sometimes; 4 = In many cases; 5 = Always). The survey questions about symptoms of COVID-19 infection, preventive measures in case of a person gets infected with COVID-19, and general preventive measures for avoiding COVID-19 infection were adapted from Center for Disease Control and Prevention (CDC), USA. A group of researchers at the King Saud University reviewed and validated the questionnaire in terms of its face and content validity. A pilot study was also conducted in order to test the reliability of the questionnaire. Data were collected from 30 students and Cronbach Alpha was run to determine the reliability of the Likert Scale. The value of the Alpha was estimated to be 0.72.

### Data Analysis

Both descriptive and inferential statistics were used for summarizing and analyzing the collected data. The personal demographics of the students were summarized using frequency and percentages. The students' knowledge about symptoms of the COVID-19 infection was computed as a new ordinal variable (1 = low; 2 = moderate; 3 = high) using their raw scores. The respondents with overall score of 4 or below were classified as having low level of knowledge, whereas respondents with overall score of 5—8 were classified as having moderate knowledge. The respondents with an overall score of more than 8 were classified as having high level of knowledge about COVID-19 infection symptoms. In a similar fashion, students' awareness about preventive measures if a person gets infected with COVID-19 and their awareness about general preventive measures for avoiding the spread of COVID-19 were computed as new ordinal variables using their raw scores for respective variables. To determine differences in students' awareness about COVID-19 symptoms and preventive measures due to their personal demographics, non-parametric statistics were used. For nominal variables with two categories (gender, education level, nationality, college of study, and residence), the Mann Whitney test was used. For ordinal variable (age), we used Kruskal-

Wallis test to identify differences in students' knowledge about COVID-19 infection symptoms and their awareness about its preventive measures. Statistical Package for Social Sciences (SPSS 27v) was used for running data analysis.

## RESULTS

### Demographic Characteristics of the Students

Table 1 shows the results of personal demographics of the students at King Saud University. About 77% of the respondents were below 25 years of age; around 20% fall within the age range of 26-30 years. The majority of the respondents (79%) were enrolled in undergraduate degree programs. About 46% of the respondents were students at medical colleges while 54% of the students were pursuing their studies at other colleges of the university. About four-fifth of the students were male. The majority of the study participants (77%) were citizens; around 23% of them were residents. Nearly three-fifth (59%) of the students resided in their homes; about 41% were living in the student housing of the university.

### Knowledge about Symptoms of the COVID-19 Infection

Table 2 shows the results of the students' knowledge about symptoms of the COVID-19 infection. The Majority of the students (more than 80%) indicated that fever or chills, cough, and shortness of breath or difficult breathing are the symptoms of the COVID-19 infection. Around 61% expressed that headache is also a symptom of the COVID-19 infection. Sore throat and congestion or runny nose were also indicated as infection symptoms by around 56% and 66% of the students, respectively. Although about 46% of the students indicated that new loss of taste or smell is an infection symptom; however, more (54%) students expressed that it is not a COVID infection symptom. About 70% perceived that muscle or body aches are not the COVID-19 infection symptoms. Most of the students (77%) indicated that nausea or vomiting is also not a symptom of COVID-19 infection. Diarrhea is also perceived as not a symptom of the COVID-19 infection by around 70% of the students.

### Awareness about Precautionary Measures if a Person is Infected with COVID-19

Table 3 depicts the results of the students' awareness about precautionary measures if a person gets infected with the COVID-19. A vast majority (99%) of the students indicated that a person who is infected with COVID-19 should stay at home. The infected person should also stay in a specific room in the house as much as possible (89%). The majority of the students (more than 80%) also indicated that infected persons should stay in touch with a doctor and monitor their symptoms. Most of the students also expressed that wearing

a face mask (86%), covering one's coughs and sneezes (90%), washing hands frequently (86%), avoiding sharing personal items (87%), cleaning high-tough surfaces daily (85%) were also required as precautionary measures to prevent the spread of COVID-19.

**Table 1:** Demographic characteristics of the students

Variable	Frequency (n = 168)	Percent
Age		
Below 20 years	27	16.1
21—25 years	102	60.7
26—30 years	33	19.6
Above 30 years	6	3.6
Education Level		
Undergraduate	132	78.6
Post-graduate	36	21.4
College of Study		
Medical colleges	77	45.8
Other colleges	91	54.2
Gender		
Male	133	79.2
Female	35	20.8
Nationality		
Citizen	130	77.4
Resident	38	22.6
Residence		
Home	99	58.9
Student housing	69	41.1

**Table 1:** Knowledge about symptoms of COVID-19 infection

COVID-19 Symptoms	No (%)	Yes (%)
Fever or chills	18.5	81.5
Cough	11.3	88.7
Shortness of breath or difficult breathing	10.1	89.9
Fatigue	56.5	43.5
Muscle or body aches	69.6	30.4
Headache	39.3	60.7
New loss of taste or smell	53.6	46.4
Sore throat	44.0	56.0
Congestion or runny nose	33.9	66.1
Nausea or vomiting	77.4	22.6
Diarrhea	70.2	29.8

### Awareness about General Preventive Measures for Controlling the Spread of COVID-19

Table 4 shows the findings of the student's awareness about general preventive measures for controlling the spread of COVID-19 infection. About 39% of the students indicated that it is always required to know how COVID-19 spreads. The majority of the students (80%) believed that the best way to prevent illness is to avoid being exposed to the virus. Washing hands frequently with soap also helps

**Table 2:** Awareness about precautionary measures if a person is infected with COVID-19

Precautionary Measures	No (%)	Yes (%)
Stay at home	1.2	98.8
Stay in a specific room in the house as much as possible	10.7	89.3
Stay in touch with a doctor	14.3	85.7
Monitor the symptoms	10.1	89.9
Wear a face mask	13.7	86.3
Cover your coughs and sneezes	10.1	89.9
Wash hands often	13.7	86.3
Avoid sharing personal household items	13.1	86.9
Clean all high-touch surfaces daily	15.5	84.5
If a caregiver or other person needs to clean and disinfect a sick person's bedroom or bathroom, they should do so on an as-needed basis	18.5	81.5

**Table 3:** Awareness about general preventive measures for controlling the spread of COVID-19

General Preventive Measures	Never	Rarely	Sometimes	In Many	Always	Mean	Standard
	(%)	(%)	(%)	Cases (%)	(%)		Deviation
Know how COVID-19 spreads	20.8	6.5	15.5	18.5	38.7	3.48	1.55
The best way to prevent illness is to avoid being exposed to the virus	1.2	-	19.0	39.3	40.5	4.18	0.82
Wash hands frequently with a soap	2.4	1.2	14.9	33.9	47.6	4.23	0.91
Use a hand sanitizer that contains at least 60% alcohol	1.8	4.2	17.9	22.6	53.6	4.22	1.00
Avoid close contact with people who are sick, even inside your house	2.4	2.4	12.5	18.5	64.3	4.40	0.96
Stay at least 6 feet away from other people at public places	2.4	3.0	19.0	28.0	47.6	4.15	0.99
Do not gather in groups	2.4	6.5	20.2	25.6	45.2	4.05	1.06
Wear a face mask when going outside of a house	1.2	0.6	11.9	36.9	49.4	4.33	0.80
Do not use a face mask meant for healthcare workers	7.1	4.2	20.2	35.1	33.3	3.83	1.15
Throw used tissues in the trash	1.8	9.5	3.6	5.4	79.8	4.52	1.055

**Table 4:** Mann Whitney and Kruskal-Wallis tests for differences in students' knowledge and awareness

Variables	Knowledge about symptoms of COVID-19 infection			Awareness about precautionary measures if a person is infected			Awareness about general preventive measures		
	Mean Rank	Mann Whitney U	p-value	Mean Rank	Mann Whitney U	p-value	Mean Rank	Mann Whitney U	p-value
Education Level									
Undergraduate studies (n = 132)	79.36	1697.50	0.004*	80.83	1892.00	0.026*	83.78	2280.50	0.661
Postgraduate studies (n = 36)	103.3	5	Cohen's d = 0.551	97.94		Cohen's d = 0.419	87.15		
College of Education									
Medical colleges (n = 77)	84.96	3468.00	0.900	74.21	2711.00	0.063	79.10	3087.50	0.115
Other colleges (n = 91)	84.11			83.21			89.07		
Gender									
Female (n = 35)	77.50	2082.50	0.289	80.71	2195.00	0.539	76.23	2038.00	0.179
Male (n = 133)	86.34			85.50			86.68		
Nationality									
Resident (n = 38)	104.3	1714.00	0.001*	94.53	2089.00	0.086	83.03	2414.00	0.801
Citizen (n = 130)	78.68		Cohen's d = 0.596	81.57			84.93		
Residence									
Home (n = 99)	80.56	3025.50	0.163	84.13	3378.50	0.887	76.11	2836.50	0.026*
Student housing (n = 69)	90.15			85.04			90.35		Cohen's d = 0.339
Kruskal-Wallis Test									
Variable	Mean Rank	Chi-Square	p-value	Mean Rank	Chi-Square	p-value	Mean Rank	Chi-Square	p-value
Age									
Below 20 years (n = 27)	66.81	7.125	0.068	78.20	0.800	0.849	74.87	3.138	0.371
21—25 years (n = 102)	87.27			85.39			88.69		
26—30 years (n = 33)	85.44			86.14			81.24		
Above 30 years (n = 6)	111.7			88.67			74.50		

\*Significant at 0.05 level.

prevent the COVID-19 infection (82%). Around 77% were convinced that using a hand sanitizer is effective in controlling the spread of COVID-19. Avoiding close contact with sick people, even inside the house helps prevent the spread of COVID-19 (83%). About 76% believed that staying at least 6 people away from other people at public places also helps to minimize the spread of COVID-19. About 71% believed that avoiding large gatherings can also reduce COVID-19 spread. Wearing a face mask when going outside of the house can also help reduce the spread of COVID-19 (87%). About 80% believed that throwing used tissues in the trash is always helpful in controlling the spread of COVID-19.

Based on their raw scores about symptoms of the COVID-19 infection, precautionary measures in case of infection, and general preventive measures to reduce the spread of COVID-19, students were classified into three broad groups: low, moderate, and high awareness level. About 54% of the students had moderate awareness about the symptoms of COVID-19 infection. About 28% had low awareness whereas below one-fifth (18%) of the students showed a high awareness level about COVID-19 infection symptoms. In terms of precautionary measures if a person is sick with COVID-19, about 62% showed a high level of awareness. Similarly, most of the students (64%) had also high level of awareness regarding general preventive

measures for controlling the spread of COVID-19 to the population.

#### Differences in Students' Knowledge about Symptoms, Precautionary Measures, and General Preventive Measures of COVID-19 Infection According to their Demographic Characteristics

Table 5 shows the results of Mann Whitney and Kruskal-Wallis tests that were run in order to find differences in students' knowledge about symptoms, precautionary measures in case of a COVID-19 infection, and general preventive measures for controlling the spread of COVID-19. The results of the Mann Whitney test revealed that there were no significant differences in the students' knowledge of COVID-19 symptoms based on their college of education ( $U = 3468.00$ ,  $p = 0.900$ ), gender ( $U = 2082.50$ ,  $p = 0.289$ ), and place of residence ( $U = 3025.50$ ,  $p = 0.163$ ). However, the test revealed significant differences in students' knowledge about COVID-19 infection symptoms based on their level of education ( $U = 1697.50$ ,  $p = 0.004$ ), and nationality ( $U = 1714.00$ ,  $p = 0.001$ ). In order to measure the strength of relationship, effect size was computed using Cohen's  $d$  [28,29]. The postgraduate students showed significantly higher knowledge of the symptoms of the COVID-19 infection than undergraduate students (Cohen's  $d = 0.551$ ). The residents had also shown significantly higher knowledge about COVID-19 symptoms than Saudi citizens (Cohen's  $d = 0.596$ ). The results of the Kruskal-Wallis test showed that age was not significantly related to the student's awareness about symptoms of COVID-19 infection ( $\chi^2 = 7.125$ ,  $p = 0.068$ ).

Regarding students' awareness about precautionary measures if a person is infected with COVID-19, the results of the Mann Whitney test did not show any significant differences based on their college of education ( $U = 2711.00$ ,  $p = 0.063$ ) gender ( $U = 2195.00$ ,  $p = 0.539$ ), nationality ( $U = 2089.00$ ,  $p = 0.086$ ), and residence ( $U = 3378.50$ ,  $p = 0.887$ ). However, educational level ( $U = 1892.00$ ,  $p = 0.026$ ) was significantly related to their awareness about precautionary measures if a person is infected with COVID-19. The postgraduate students had significantly higher awareness than undergraduate students (Cohen's  $d = 0.419$ ). Age was not significantly related with the students' awareness about precautionary measures if a person is sick with COVID-19 ( $\chi^2 = 0.800$ ,  $p = 0.849$ ).

The results of the Mann Whitney test revealed that students' education level ( $U = 2280.50$ ,  $p = 0.661$ ), college of education ( $U = 3087.50$ ,  $p = 0.115$ ), gender ( $U = 2038.00$ ,  $p = 0.179$ ), and nationality ( $U = 2414.00$ ,  $p = 0.801$ ) were not significantly related to their awareness regarding general preventive measures for controlling the spread of COVID-19. However, the test showed that place of residence ( $U = 2836.50$ ,  $p = 0.026$ ) was significantly related to the students' awareness of general preventive measures for controlling the spread of COVID-19. The students who were living in the student housing had higher awareness than those who were residing at their homes (Cohen's  $d = 0.339$ ). The results of the Kruskal Wallis revealed that age was not significantly related to the student's awareness about general preventive measures for controlling the spread of COVID-19 ( $\chi^2 = 3.138$ ,  $p = 0.371$ ).

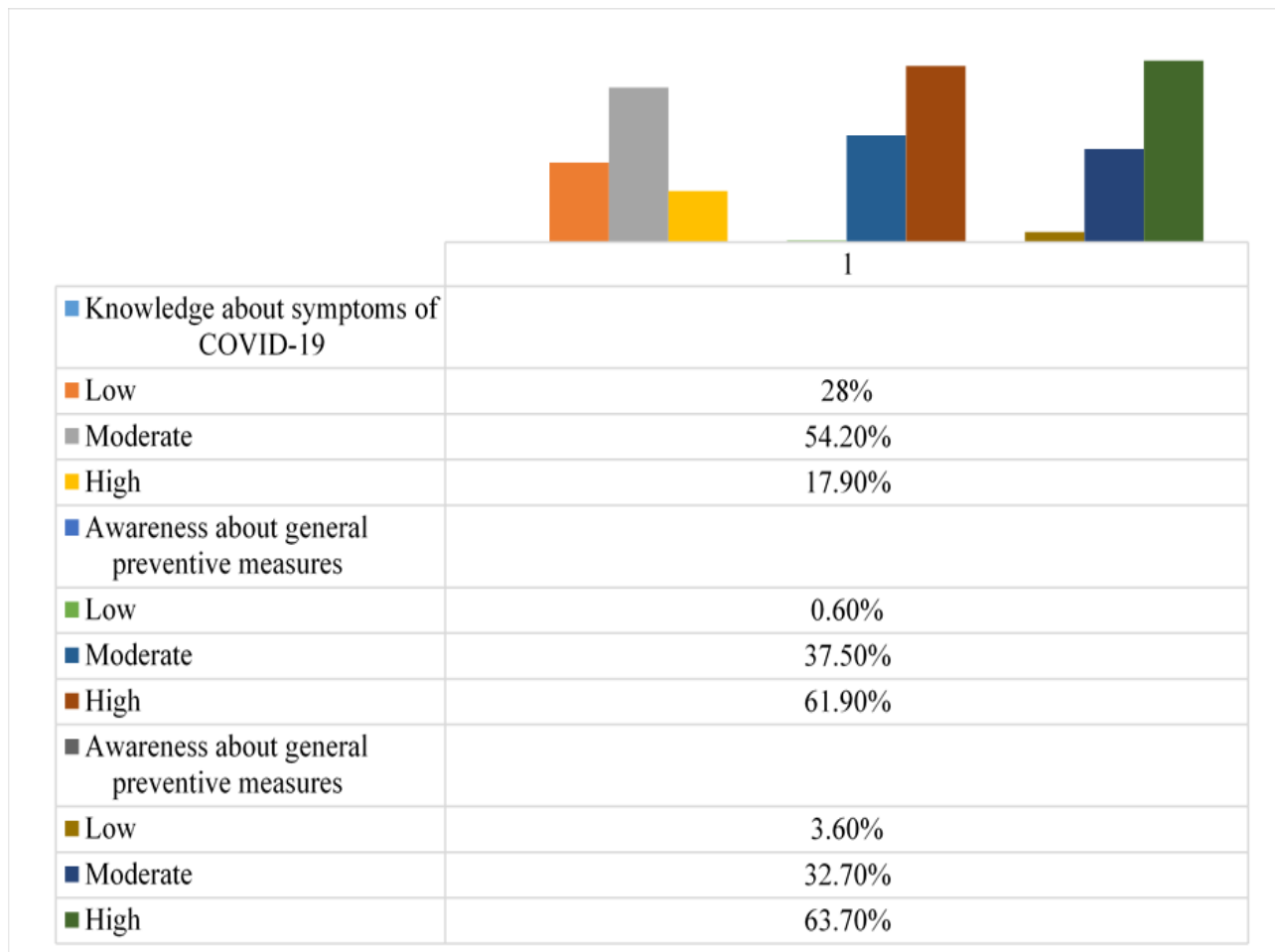


Fig. 1: Students' knowledge about symptoms and preventive measures of COVID-19 infection.

## DISCUSSION

The present study aims to explore the students' knowledge of the symptoms of COVID-19 infection and their awareness about preventive measures for controlling the spread of COVID-19. The analysis of the respondents reveal that the majority of the respondents believe that difficult breathing, cough, fever, and runny nose are the symptoms of the COVID-19 infection. Overall, they possess moderate to low levels of knowledge of the COVID-19 infection symptoms. The analysis of medical literature suggests that there are several symptoms that are associated with the COVID-19 infection, and they may also vary from one person to another. The most common symptoms of the COVID-19 infection include fever, cough, fatigue and weakness, headache, taste and smell disorder, diarrhea, and sputum (Alimohamadi et al., 2020). Fever and loss of smell and taste are generally considered as the potential predictors of the COVID-19 infection as these symptoms were frequently found in the individuals who were tested positive for COVID-19 (Huang et al., 2020). It suggests that people who experience these symptoms should self-isolate in their first preference to prevent the spread of the COVID-19 to other neighboring individuals. Moreover, elderly people are more likely to experience severe symptoms of the infection than young patients of the COVID-19 (Dadras et al., 2022). However, some studies have also reported that certain individuals infected with the COVID-19 could be asymptomatic or have slight symptoms (Guan et al., 2020). Such individuals can only be confirmed with the help of a RT-PCR test (Aruleba et al., 2022). Lack of specific clinical symptoms poses challenges for the proper diagnosis of the COVID-19 and erroneous diagnosis may facilitate infection transmission by infected asymptomatic individuals due to their negligence (Wang et al., 2020).

Regarding student's awareness about preventive measures for controlling the spread of COVID-19, the analysis of the findings shows that most of the students possess a high level of awareness about preventive measures. They seem convinced that wearing a face mask, washing hands frequently with a soap, using a hand sanitizer, and avoiding mass gatherings and close contact with suspected individuals are effective strategies for preventing the spread of the COVID-19. Similar findings were reported in several past studies (Siddiqui et al., 2020); however, these studies did not specifically target university students. Another study that particularly targeted nursing students from multiple universities in the Kingdom demonstrated that nursing students were having higher level of knowledge regarding COVID-19 and its preventive measures (Albaqawi et al., 2020). Similar results were reported by other studies that targeted pharmacy students (Jan et al., 2022). Certain preventive measures have been designed in order to prevent the spread of the COVID-19. The most common preventive measures include wearing a face mask and its proper disposal, washing hands frequently, using sanitizer, social distancing, and restricting public and community gatherings in small and large groups. The risk of getting COVID-19 infection is higher in crowded and poorly ventilated places (Bokhari and Shahzad, 2022). Most independent nations vigorously implemented such preventive measures on a wide-scale using all possible means for curtailing the spread of the COVID-19 to the masses. The Kingdom of Saudi Arabia adopted a proactive approach for counteracting the COVID-19 in an effective manner. Since the identification of first COVID-19 case in the Kingdom in March 2020, the government implemented stringent measures by suspending air travel and local

transportation facilities, closing mosques, including two holy mosques in the cities of Makkah and Madinah, for prayers, and closing all educational institution from grassroot level to universities. The government has also designed an effective network for monitoring the violations; violators are heavily fined that acts as a massive deterrence for the potential violators. Consequently, these measures proved successful in reducing the transmission of the COVID-19 and were gradually lifted by the government when the circumstances were in control (Nurunnabi, 2021).

High level of awareness regarding preventive measures for curtailing the spread of the COVID-19 among students may be attributed to strict measures implemented by the government, especially the Ministry of Health, Saudi Arabia (MOH) and the administration of the university. In order to enhance public awareness about preventive measures and about relevant regulatory measures of the government and ministry, the MOH has designed special mobile applications and online platforms, from where individuals can get accurate information and can also post their useful feedback to further improve the service. One such mobile application, locally named as Tawakkalna, was declared as the winner of United Nations Public Service Award 2022. This award was delivered to Saudi Arabia under the category of "Institutional resilience and responses to the COVID-19 pandemic" (SPA, 2022). Additionally, the King Saud University has designed some other mobile applications for its students and staff that tend to reinforce the mission of the MOH for controlling the pandemic in the Kingdom. If any of the university staff member or student is tested COVID-19 positive, the affiliated medical college of the university immediately informs the relevant department and college. Such a person is not permitted to attend the classes or deliver a lecture until he or she undergoes a quarantine of at least 7 days. Sanitizers have been placed by the administration at key entry points in different colleges and substantial sanitation and hygiene measures are also in place to ensure a clean and healthy on-campus environment.

Inferential analysis reveals that some demographic factors have significant influence on the respondents' knowledge of COVID-19 infection symptoms and their awareness about preventive measures. Education level shows a significant relationship with the students' knowledge about symptoms of the COVID-19 infection. Postgraduate students demonstrate a higher level of knowledge than the students of undergraduate programs. In addition to their relatively higher academic level, it may also be due to their early access to on-campus activities. Due to their research work, postgraduate students at the university were permitted earlier to attend on-campus educational work than undergraduate students when COVID-19 restrictions were officially abandoned during 2022. Their level of awareness about precautionary measures if a person gets infected with COVID-19 is also significantly higher than undergraduate students. Some past studies reported that education level has a significant relationship with knowledge about COVID-19. People with higher education level possess more knowledge about COVID-19 than people whose level of education is relatively lower (Alghamdi et al., 2021). The resident students at the university also have higher knowledge about COVID-19 infection symptoms. Students who are not citizens might be more concerned about their health than local students owing to their isolation from their family members. Secondly, almost all of the resident students live in student housing, where additional awareness programs are also offered for the hostel residents and preventive measures are also more strictly implemented with proper monitoring.

This may also explain significantly higher awareness about preventive measures of the students who live in the student housing than their peers who live in their homes.

### Conclusion

Overall, the university students demonstrated a relatively lower level of knowledge about symptoms of the COVID-19 infection and a higher level of awareness regarding preventive measures for curtailing the spread of the COVID-19. It suggests that the students need to be properly educated about symptoms of the infection. Potential educational programs that are designed to accomplish this aim should consider that a variety of clinical symptoms can be found in patients suffering from COVID-19. Moreover, there is also the likelihood of lack of any apparent symptoms in individuals being tested positive for the COVID-19. Under this scenario, people should be vigilant as their neglect and careless attitude to follow preventive measures may help in the transmission of the infection to other individuals in their close proximity and may pose a health risk for others. The student's higher level of awareness regarding the protection measures suggests effectiveness of the prevailing strategies implemented both by the Ministry of Health and the university administration. Such measures can also be employed by other educational institutions to combat potential pandemics or reemergence of the COVID-19. Regular update of the custom-designed mobile applications and online platforms would be highly beneficial to serve a large number of students using minimum public resources. Students' high level of awareness and adherence to the recommended protection measures for controlling the spread of the COVID-19 could facilitate the educational and health policymakers in their decisions to keep educational institutions operational during critical times like COVID-19.

### Conflicts of Interest

The authors declare no conflict of interest

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