

Adherence to Preventive Measures during the COVID-19 Pandemic among University Students in Sudan

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Abstract

Background: Coronavirus disease 2019, otherwise known as COVID-19, emerged in December of 2019. COVID-19 spreads through an airborne transmission route. Preventive measures were described to help decrease the spread of COVID-19 worldwide. There were a number of preventive measures that were globally adopted: social distance of at least 1 meter, mask wearing, washing hands for 20 seconds, and covering the mouth and nose if the person sneezes or coughs. **Methods:** A descriptive cross-sectional study among 362 students from the International University of Africa, Sudan, was carried out between August 2021 and September 2022. Statistical Package for Social Sciences version 26 was used for data analysis; frequency and percentage were used to describe the qualitative variables. A chi-square test was used for association analysis; a P -value ≤ 0.05 was considered statistically significant. **Results:** Among study participants, the females were 70.9%; most were 20 - 23 years old (73.6%). 54.2% were vaccinated against COVID-19; 83.6% had good knowledge regarding the mode of transmission, and 76.1% stayed in during quarantine. 80.6% of participants understood social distancing correctly. 76.1% of males and 45.1% of females started or completed vaccination ($P \leq 0.05$). 51.4% of males and 81.3% of females adhered to preventive measures ($P \leq 0.05$). **Conclusions:** It is important to target health education campaigns and interven-

tions to improve adherence to preventive measures among university students. Although the pandemic is coming to an end, a lesson should be learned from it, and future preparation should be employed.

Keywords

Sudan, COVID-19, Preventive, Measures, Adherence

1. Introduction

In December of 2019, a new global health issue was raised: the pandemic of a respiratory disease that carries the name Coronavirus Disease 2019 (COVID-19) [1]. COVID-19 is caused by an enveloped, positive single-stranded ribonucleic acid (RNA) virus microorganism. This virus can affect both humans and animals. It was first discovered in 1966 and has four subfamilies: alpha, beta, gamma, and delta [2].

In 2020, the World Health Organization (WHO) revealed that droplets are a route of transmission for COVID-19. Other possibilities were listed, such as inhalation of the virus and direct contact with the virus [3].

There is an assumption that the general population has high compliance with public health prevention measures [4]. This could misrepresent the actual implementation of health behaviors such as social isolation.

Preventive measurements were described to help decrease the spread of COVID-19 worldwide. There were a number of preventive measures that were globally adopted, including a social distance of 2 meters, mask wearing, washing hands for 20 seconds, and covering the mouth and nose if the person sneezes or coughs [5].

A life-altering challenge tested the world due to the COVID-19 pandemic [6], and many countries adapted to a new normal, which is social distancing. Since the first vaccines against the virus were approved at the end of 2020, vaccination preparedness has been the second most crucial factor in preventing the spread of COVID-19. Similar to adherence, when health concerns are more severe, views regarding vaccination are more positive [7]. People are more likely to get vaccinated when they think they are at risk for a disease and think immunization has a major role in providing protection [8].

Self-preservation is the primary driving force behind vaccination, but altruistic motives are equally significant. This is particularly true for people who have a low chance of experiencing a serious illness as a result of the infection [9], like the majority of young people who have the COVID-19 infection.

There is still no cure for this global medical condition, which makes prevention the key solution to decreasing the number of infected cases. The most effective preventive tool approved by the world against COVID-19 is social distance. However, the extent of adherence to social distance measures remains understu-

died in Sudan, considering that social distancing is the best prevention measure available in a low- to middle-income country (LMIC) due to monetary costs.

University students represent a specific demographic group that is important to study in relation to adherence to preventive measures during the COVID-19 pandemic. University students are often young adults who may have different attitudes, behaviors, and knowledge compared to other age groups. University students are often considered a high-risk group due to their close proximity to dormitories or shared living spaces, as well as their social interactions on campus. Studying university students allows for insights into the effectiveness of preventive measures within an educational setting, where students may have different living situations and levels of exposure to the virus, which can inform future interventions and public health strategies targeting this population.

Understanding the experiences of university students during the COVID-19 pandemic is crucial for developing effective strategies and interventions to support their mental health and well-being [10].

2. Methods and Material

2.1. Objective

The aim of this paper is to explore the adherence of university students to social distancing measures during the COVID-19 pandemic, specifically to determine the prevalence of vaccination among students, their level of knowledge, and their adherence to social distance measures.

2.2. Design and Population

We conducted a descriptive cross-sectional university-based study at the International University of Africa, which is located in Khartoum State, Sudan.

The study was carried out between August 2021 and September 2022.

The study included students from the Faculty of Medicine; the exclusion criteria were remote education. The sample size was determined using the Yamane sample size equation [11], and the participants were selected using a simple random method (a sample calculation is available in **Appendix**).

A well-structured questionnaire was designed based on previous literature [12] [13] and adjusted to meet the objectives of the study. A sample of 20 questionnaires was filled out and analyzed.

2.3. Data Collection Tools

2.3.1. Questionnaire: [12] [13]

The questionnaire consisted of three parts (questionnaire available in **Appendix**).

- 1) Characteristics of study participants included: sex, age group, year of university, living situation, and vaccination status against COVID-19.
- 2) Knowledge regarding mode of transmission [11].
- 3) Adherence to preventive measures [12].

2.3.2. Measurements

Five items were used to assess COVID-19 knowledge. The sources of COVID-19, routes of transmission, symptoms, methods of prevention and control, perceptions of COVID-19 deaths, and sources of information on COVID-19 were among the items on the list. The correct replies to these items were added to determine respondents' understanding of COVID-19.

The maximum score was 5. Scores 1 and 2 were considered poor knowledge; score 3 was considered average knowledge; and scores 4 and 5 were considered good knowledge. To assess adherence to preventive measures during the COVID-19 pandemic, a scoring system can be used. Each affirmative response to the following measures is assigned 1 point:

- 1) Keeping a physical distance of at least one meter.
- 2) Going out with a face mask on.
- 3) Hand wash on a regular basis.
- 4) When coughing or sneezing, cover the mouth and nose.
- 5) Avoiding facial contact.
- 6) No travel in the past seven days.
- 7) Cleaning the phone when arriving home.
- 8) Using hand sanitizer containing alcohol if coughed or sneezed.
- 9) Wash or disinfect their hands.
- 10) Remaining at home when suffering from flu-like symptoms.

By adding up the points, you can determine the individual's adherence to these preventive measures. A higher score indicates a higher level of adherence to the measures. The maximum score was 10. Scores 1 - 6 were considered non-adherence; scores 7 - 10 were adherence.

2.4. Data Processing

2.4.1. Data Collection

To decrease the risk to the participating students, all precautions regarding COVID-19 were considered (wearing masks, social distancing, and hand washing), and they were asked to fill out the questionnaire during their free time.

2.4.2. Data Analysis

The Statistical Package for Social Sciences (SPSS) version 26.0, SPSS Inc., Chicago, IL, was used for data entry and statistical analysis. Tables and figures were used to present the data. The frequency distributions for independent and dependent variables were created. The chi-square test was used to compare proportions between two groups. A *P*-value of 0.05 was declared statistically significant, with a 95% level of confidence.

2.5. Ethical Considerations

The authorization was granted by the Sudanese Ministry of Higher Education and Scientific Research. Approval was obtained from the university's administration before starting data collection.

The protocol, aims, and benefits of the study were clarified to all the participants, and written, informed consent was obtained from each. Participants were informed before starting the survey that all data collected would not be identifiable and would only be used for research purposes. Any participant had his or

her own right to withdraw at any stage without penalty.

3. Results

The study included students from Africa International University, 257 (70.9%) were females, most were 20 - 23 years old 267 (73.6%), in their fourth year 148 (40.8%), lived with family 247 (68.2%) (**Table 1**). Most had stayed in during quarantine 276 (76.1%), and were vaccinated against COVID-19 196 (54.2%) (**Table 1**).

Figure 1 showed the understanding of preventive measures; the figure shows that 291 (80.6%) of participants understood that social distance was all precautions: wearing a mask, keeping a minimum of 1 meter apart and using alcohol for hand sanitization, 29 (7.9%) keeping approximately 1/2 to 2 (1.86) meters apart, 33 (8.9%) wearing a mask, using alcohol for hand sanitization 2 (0.50%), while 7 (2.1%) understood known.

Figure 2 showed the reasons, if any for breaking lockdown (Quarantine/Isolation); of the participants 147 (55.7%) didn't leave their homes, 39 (14.9%) of

Table 1. Distribution of characteristics of participants ($N=362$).

Characteristic	Number	Percentage
Sex		
Female	257	70.9
Male	105	29.1
Age group		
17 - 20	68	18.9
20 - 23 years	267	73.6
23 - 26 years	27	7.5
Year of university		
First	25	7
Second	70	19.4
Third	88	24.4
Fourth	148	40.8
Fifth	31	8.4
Living situation		
Alone	22	6
Family	247	68.2
Dormitory	90	24.9
Other	3	1
Vaccination against COVID-19		
Yes	196	54.2
No	166	45.8

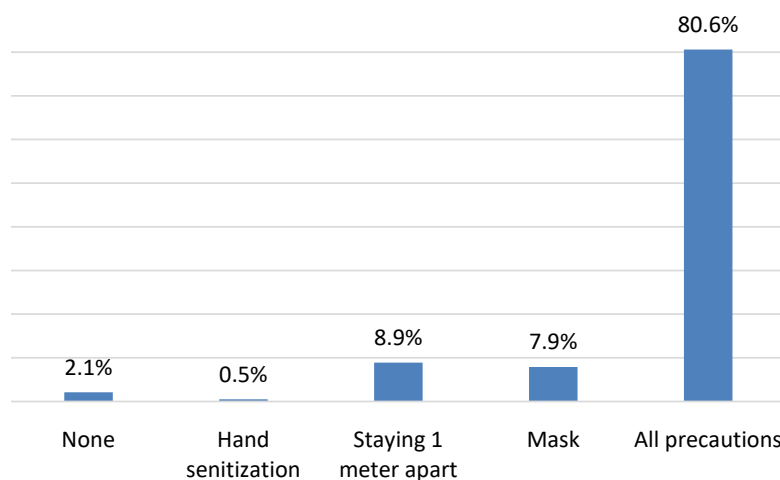


Figure 1. Understanding of preventive measures.

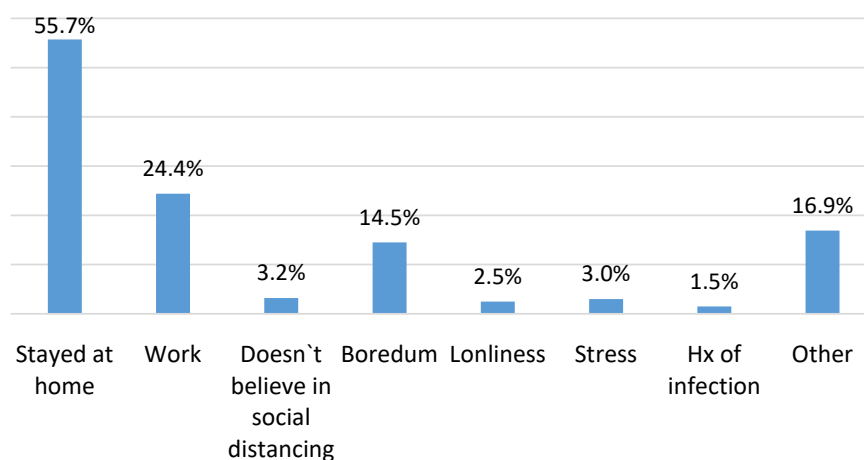


Figure 2. Reasons, if any for breaking quarantine.

participants left for work, 12 (4.5%) left because of boredom, 7 (3%) of them left because of increased stress, 6 (2.5%) because they felt alone, 3 (1.5%) because they already got infected, and 2 (1%) left because they didn't believe it would help, while the remaining 44 (16.9%) left because of other reasons.

Figure 3 showed that 302 (83.6%) of participants had good knowledge about COVID-19.

Figure 4 showed that 263 (72.2%) of the participants adhered to social distancing measures.

A statistically significant association was observed between vaccination and sex; 80 (76.1%) of males and 116 (45.1%) females started/completed vaccination ($P = 0.039$). A statistically significant association was observed between adherence to preventive measures and sex; 54 (51.4%) males and 209 (81.3%) females adhere to preventive measures ($P = 0.046$). A statistically significant association was observed between adherence to preventive measures and university year; 33 (12.5%), 66 (25.1%), 131 (49.9%), and 33 (12.5%), in Second, Third, Fourth, and Fifth year students respectively ($P = 0.024$) (**Table 2**).

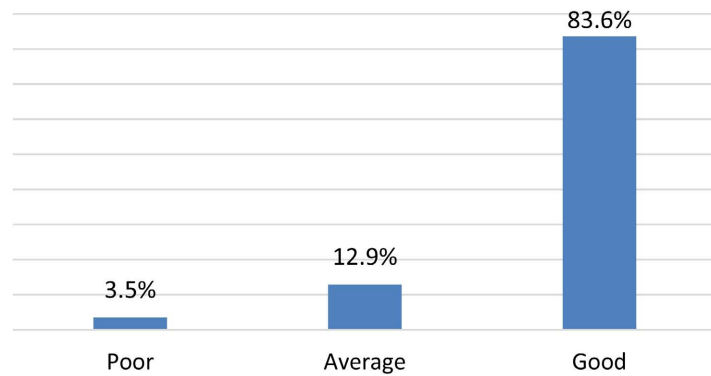


Figure 3. Knowledge of COVID-19.

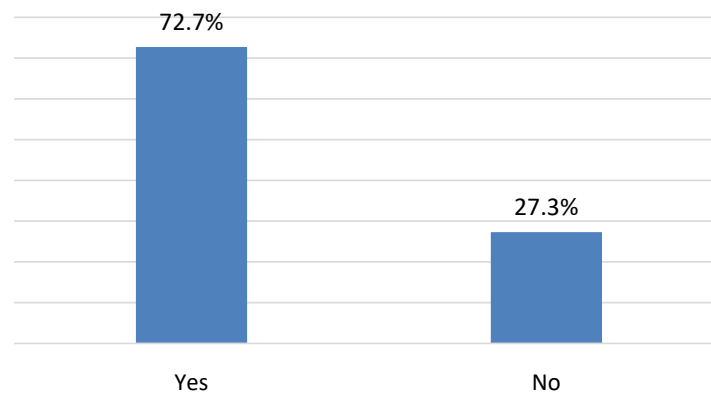


Figure 4. Adherence to social distancing measures.

Table 2. Distribution of mental health assessment according to participants’ characteristics (*N* = 221).

	Vaccinated		Adherence to preventive measures	
	Number (%)	<i>P. Value</i>	Number (%)	<i>P. Value</i>
Sex				
Male	80 (76.1)	0.039*	54 (51.4)	0.046*
Female	116 (45.1)		209 (81.3)	
Age groups (years)				
17 - 20	26 (13.2)	0.921	64 (24.4)	0.740
20 - 23	156 (79.6)		179 (67.8)	
23 - 26	14 (7.2)		20 (7.8)	
University year				
First	5 (2.4)	0.051	0	0.024*
Second	42 (21.4)		33 (12.5)	
Third	42 (21.4)		66 (25.1)	
Fourth	84 (42.9)		131 (49.9)	
Fifth	23 (11.9)		33 (12.5)	

*Statistically significant association.

4. Discussion

COVID-19 is a highly contagious illness that is easily passed from person to person. Preventive measures (such as mask use, social distancing, hand sanitization, etc.) have been shown to be successful in slowing the rapid spread of the virus in the absence of appropriate medical care and vaccines. In this study, we explore many aspects regarding COVID-19 and university students.

4.1. Prevalence of Vaccination

In our study, we found that the prevalence of COVID-19 vaccination among university students was relatively low, with only 54.2% of participants having received the vaccine. This finding is consistent with previous research that highlights a lower willingness to receive the vaccine among younger adults [14].

The males were the predominant group receiving the COVID-19 vaccine. This disagrees with previous research [15].

It is important to understand the sociodemographic characteristics associated with COVID-19 vaccination uptake in order to improve global immunization programs and better prepare for future pandemics [16].

Historically, sociodemographic variables, religious and political convictions, risk perceptions, and trust have all influenced vaccine uptake [17] [18] [19] [20]. Apprehensions about COVID-19 and associated vaccinations have surfaced, resulting in an increase in studies on vaccine hesitancy connected to COVID-19 vaccines [21]. Fear of side effects, skepticism in the quick development process, disinformation, and questions about vaccine efficacy all contribute to this reticence. To improve vaccination uptake and effectively prevent the transmission of the virus, public health officials must address these concerns, give correct information, and foster trust in the healthcare system [18] [21] [22] [23].

Being male ($P \leq 0.05$) was found to be the characteristic most strongly associated with higher vaccination rates. This aligns with existing evidence that suggests a difference in vaccine hesitancy between males and females. Studies have consistently shown that women tend to exhibit more vaccine hesitancy compared to men [24] [25] [26] [27] [28]. However, there are also studies that have found no significant differences in vaccine hesitancy based on sex [19] [29]. Among the studies that examined vaccine willingness and biological sex, some have reported that men are more willing to receive a COVID-19 vaccination compared to women [19] [30] [31] [32] [33], while others have indicated that women are more willing [34]. It is important to note that findings may vary across different studies, underlining the complex and context-specific nature of vaccine hesitancy and willingness.

Understanding the factors that influence vaccine acceptance and uptake among university students is crucial to developing targeted health education campaigns.

4.2. Knowledge of COVID-19

Our study found a high level of knowledge regarding COVID-19, with 83.6% of

participants demonstrating a good understanding. This is consistent with existing literature, which reports that individuals, such as professionals and students in the medical field, and the population, generally possess a high level of knowledge regarding pandemic-related information. Previous studies have indicated knowledge levels ranging from 69% to 91% [35]-[43]. These findings suggest that there is a widespread and strong understanding of COVID-19 and related information among these groups.

It is promising to observe that almost 90% of respondents recognize COVID-19 as a significant illness. This suggests strong awareness and comprehension among the public regarding the gravity of the virus. However, there are still some misunderstandings and knowledge gaps, as demonstrated by a relatively lower perception of mask usage as an effective preventive measure compared to other strategies [44].

Consistent with our findings, other studies conducted among healthcare students in Jordan have also reported a high level of knowledge regarding COVID-19. Specifically, university students displayed good knowledge, with an overall score of 80.1%. However, knowledge levels varied depending on the students' college of study and educational level. Notably, medical sciences and postgraduate students exhibited the highest levels of knowledge. These results indicate that the level of knowledge about COVID-19 can be influenced by factors such as the specific field of study and the level of education [45].

Another study also showed a good level of knowledge in the majority of the sample, with differences between students attending life sciences degree courses and those attending other courses [46].

From our findings and the available literature, the importance of implementing health education programs about viral infections and infectious diseases for university students to enhance their knowledge and engagement in protective health measures is very important, despite their good level of knowledge.

In line with our study, another research also found a good level of knowledge among the majority of participants. However, there were differences observed between students enrolled in life sciences degree courses and those in other courses [46]. Based on our findings and the available literature, it is clear that implementing health education programs covering viral infections and infectious diseases is highly important for university students. These programs aim to further enhance their knowledge and promote their active engagement in adopting protective health measures, despite their already good level of knowledge.

4.3. Preventive Measures

In our study, 72.2% of the participants adhered to social distancing measures, and compliance with the quarantine was 76.1%.

The adherence to preventive measures in our study was also associated with being in the fourth year ($P \leq 0.05$), agreeing with previous findings [46] [47], where higher-level undergraduate and graduate participants had higher adhe-

rence levels when it came to the preventive measures than the younger students. This might be a result of age or education disparities.

Adherence to preventive measures was associated with being female ($P \leq 0.05$). Preventive measure adherence among females is consistent among studies [13] [48] [49] [50] and has a higher perception of risk compared to males [50]; these trends were also seen among studies conducted in university settings [47] [51]. Consistent with these observations, males have also been reported to practice riskier behaviors when compared to females [52].

Furthermore, another paper observed that males with higher levels of education were more concerned about COVID-19 than those with lower levels of education [53]. Age and using preventive measures have been linked to several additional studies. For instance, in 2021, Luo *et al.* stated that older generations are more likely than younger generations to take preventive steps [54].

In our study, the reasons for breaking quarantine were work, feeling lonely, and stress. Enhancing and encouraging adherence to quarantine is an essential part of any infectious disease outbreak. Ensuring information about an infectious disease outbreak and quarantine protocol is clear is key to achieving this [55].

4.4. Limitations

The primary weakness of this study is its cross-sectional design, which limits the capacity to prove causality and makes determining the time sequence of events or establishing cause-and-effect correlations difficult. In this study, the design restricts the capacity to postulate conclusions about the directionality of the observed relations between variables.

Another limitation of the study is its focus on a specific population, namely medical specialties in a single university. This restricts the generalizability of the findings to a broader population. Therefore, caution should be exercised when applying the findings to different populations or contexts.

It is important to consider these limitations when interpreting the results of the study. Future research utilizing longitudinal designs and including diverse populations would be beneficial in providing a more comprehensive understanding of the relationships between variables and establishing causal links.

5. Conclusions [55] [56]

In this study, the prevalence of vaccination was 54.2%, the knowledge regarding COVID-19 was very good at 83.6%, 72.2% of the participants adhered to social distancing measures, and compliance with the quarantine was 76.1%.

The males were more open to vaccination, while the females were better at adhering to preventive measures. The findings highlight the importance of targeted health education campaigns and interventions to improve adherence to preventive measures among university students. Although the pandemic is coming to an end, a lesson should be learned from it, and future preparation should be

employed.

6. Recommendations

Based on the findings, we recommend:

1) Targeted health education campaigns: Implementing health education programs for students in universities is crucial to enhance their knowledge and engagement in protective health measures. Despite their good level of knowledge, there are still some misunderstandings and knowledge gaps that need to be addressed.

2) Individual-level methods: Future interventions to promote compliance with social distancing precautions must concentrate on personal approaches that address the study's identified primary impediments to social distancing.

3) Institutional measures: Effective institutional measures should be implemented to support and enforce adherence to preventive measures among university students. This could involve providing clear guidelines and protocols, ensuring access to necessary resources (such as masks and hand sanitizers), and promoting a culture of adherence to preventive measures on campus.

4) Public health interventions: Public health interventions should be developed and implemented to raise awareness about the importance of adherence to preventive measures among university students. This could involve campaigns, workshops, and other educational initiatives that emphasize the role of students in preventing the spread of infectious diseases.

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Ethics Approval

Ethical approval was obtained from all appropriate parties.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data and Material

Data and material are available upon request.

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Abbreviations and Symbols

COVID-19: Coronavirus Disease 2019

World Health Organization: WHO

Statistical Package for Social Sciences: SPSS

Appendix

Sample size calculation:

Yamane Formula

N = Population of study, K = Constant (1), e = degree of error expected, n = sample size

$$n = N/K + N(e)^2$$

$$1490/1 + 1490(0.05)^2$$

$$1490/1 + 1490(0.0025000000000000005)$$

$$1490/1 + 3.7250000000000005$$

$$1490/4.7250000000000005$$

$$n = 315.3439153439153$$

+15% were added in case of dropout or incomplete questionnaire.

Total sample size = 362

Questionnaire

1) Sex:

- a) Male
- b) Female

2) Age: _____ (years)

3) Year of university:

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

4) Living situation:

- a) Alone
- b) Family
- c) Dormitory
- d) Other

5) Covid-19 vaccination status:

- a) Yes (started at least one dose)
- b) No

6) Please choose all that apply. What do we mean by preventive measures?

- a) Hand sanitization
- b) Staying at least 1 meter apart from others
- c) Wearing a mask
- d) I do not know/none of the mentioned

7) If you broke quarantine, state the reason?

- a) Work
- b) Do not believe quarantine works
- c) Boredom
- d) Loneliness
- e) Stress

Knowledge of COVID-19: (May choose more than one)

- 8) To the best of your knowledge, the novel Coronavirus is:
- a) A biological weapon designed by the government of China
 - b) A virus designed by pharmaceutical industry to sell their drugs
 - c) An exaggeration by news media to cause fear and panic
 - d) A severe illness transmitted to people from wild animals
 - e) A plague caused by sins and unbelief of human being
 - f) Designed to reduce or control the population
 - g) A biological weapon designed by the USA government
- 9) The Coronavirus is typically spread (*i.e.*, passed from person-to-person) by which means?
- a) Contact with airborne droplets via breathing, sneezing, or coughing,
 - b) Kissing, hugging, sex or other sexual contact
 - c) Eating of contaminated water or food
 - d) Touching contaminated objects or surfaces
 - e) Through 5G phone network or masts
 - f) Using the test-kits or vaccine
 - g) Living a sinful life
- 10) Coronavirus can be prevented by
- a) The hot weather of Africa
 - b) Regular hand washing and social distancing
 - c) Taking chloroquinne capsules and antibiotics
 - d) Fumigation and spraying bus stops and other public places
 - e) Consuming gins, garlic, ginger, herbal mixtures and traditional food and soup
 - f) Closing schools and cancelling mass gathering events
 - g) Disinfecting contaminated surfaces
 - h) Anointing oil and prayers
- 11) The most important symptoms of COVID19/Coronavirus are:
- a) Cough
 - b) Fever
 - c) Fatigue
 - d) Sneezing
 - e) Sore throat
 - f) Muscle pain
 - g) Shortness of breath
 - h) I do not know any symptoms of COVID19/Coronavirus
- 12) Do you think it is possible to die from the Coronavirus?

- a) Yes
- b) No
- c) I do not know

13) Which of the following sources have you received new information about the Coronavirus?

- a) The mass media (television, newspapers, radio, etc.)
- b) The internet (Google, Wikipedia, etc.)
- c) Health workers (doctors, nurses, pharmacist, NCDC, etc.)
- d) Government officials (governors, ministers, commissioners, etc.)
- e) Friends and family members
- f) Social media (Whatsapp, Facebook, Instagram, Twitter, etc.)
- g) Other

Adherence to preventive measures:

1) Observing 1.5 - 2 m physical distance rule

- a) Yes (started at least one dose)
- b) No

2) Wearing a face mask when going out

- a) Yes
- b) No

3) Washing hands regularly

- a) Yes
- b) No

4) When I cough/sneeze, I cover my mouth and nose

- a) Yes
- b) No

5) Avoid touching my face (eyes, nose, mouth)

- a) Yes
- b) No

6) Did you travel within the last 7 days

- a) Yes
- b) No

7) Disinfecting phone when getting home

- a) Yes
- b) No

8) Using alcohol-based hand sanitizer during the day

- a) Yes
- b) No

9) Hands washing/disinfecting right after coughing or sneezing

- a) Yes
- b) No

10) Staying at home when having flu-like symptoms

- a) Yes
- b) No