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Public knowledge, attitudes, and practices towards COVID-19 in Pakistan: A cross-sectional study

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\textbf{Abstract}

In response to the recent COVID-19 pandemic, each country has adopted different measures for its control, for instance, complete lockdown, smart lockdown based on hotspot analysis, and/or strict movement control on their residents. The effectiveness of such controls depends largely on public knowledge, attitude, and practices towards this novel virus. The prime objective of this study is to examine the knowledge, attitudes, and practices of university students and graduates in Pakistan regarding COVID-19. For this purpose, cross-sectional data is collected from 1789 participants through an online survey conducted between July 12 and August 10. The survey instrument consists of demographic characteristics, 13 items on knowledge, 6 items on attitudes, and 3 items on practices, modified from a previously published questionnaire on COVID-19. Our statistical analyses are based on descriptive statistics, chi-square tests, and analysis of variance (ANOVA). The overall correct response rate of the knowledge section is 73\%, which is comparatively lower than similar studies in the region. The majority of participants are optimistic about the successful control of COVID-19 in Pakistan, and following the instructions issued by the government of Pakistan. However, a bulk of participants showed skepticism and no trust in the health facilities of hospitals in Pakistan, which could be the potential explanation of falling confirmed cases in Pakistan. In addition, a low knowledge score is found to be significantly associated with low confidence in successful control of COVID-19, and socially undesirable practices. The results suggest an urgent need for health education programs to hold optimistic attitudes and rebuilding of trust of the general public in health facilities in local hospitals to avoid the possible next wave of COVID-19 in Pakistan.

1. Introduction

The novel coronavirus disease (COVID-19) originated from Wuhan, Hubei, China (Zhong et al., 2020). It is caused by a virus named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (Dos Santos, 2020). World Health Organization (WHO) issued its highest level of international public health emergency on January 30, 2020 (Jahangir et al., 2020). Later, WHO declared it a pandemic on March 12, 2020 and called for global efforts to prevent its further spread. Statistical data highlights that the COVID-19 pandemic spread quickly across the globe (Farooq et al., 2020). At present, it has affected 218 countries and territories with total confirmed cases of more than 59.2 million and caused more than 1.4 million confirmed deaths across the globe (WHO, 2020). The presence of COVID-19 in Pakistan was confirmed on February 27, 2020 by public officials, and the source of the virus was linked to Iran (Gul, 2020; Jahangir et al., 2020). Currently, there are more than 380 thousand confirmed COVID-19 cases in Pakistan, with 7744 confirmed deaths (Government of Pakistan, 2020).

In response to this pandemic, each country has adopted different measures for its control, for instance, complete lockdown, smart lockdown based on hotspot analysis, and/or strict movement control on their residents (Azlan et al., 2020). The government of Pakistan has also taken numerous effective measures to control the spread of COVID-19 transmission (Munawar & Choudhry, 2020). Those measures include the initial closing of public spaces, educational institutions, business organizations, and tourism. A distinctive policy measure adopted by the current government is smart lockdown which has been appreciated by the WHO officials (Farooq et al., 2020). Although the official statistics show that the increase in the number of COVID-19 cases and deaths has been controlled, many are suspicious and concerned about the low

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testing and gross under-reporting of COVID-19 cases in Pakistan (Hashim, 2020). As the COVID-19 still remains one of the most significant challenges faced by the countries across the globe with many combating the second wave of COVID-19, it would be hard to conclude about the success of Pakistan’s policy on COVID-19 solely based on the statistics (Bhatti, 2020).

The success of any strategy to combat COVID-19 relies heavily on the adherence of the general public to the guidelines issued by the relevant authority (Roy et al., 2020). Therefore, it is important to know about the information, attitudes, and practices of people to analyze and ensure the success of Government policy to battle this pandemic (Geldsetzer, 2020). Otherwise, the decreasing statistics on new COVID-19 cases could be the result of many possible reasons. Therefore, without ensuring the propagation of knowledge and best practices to control its spread, the resurgence of the next wave of COVID-19 in the country is possible given the recent experience of many countries across the globe (Jahangir et al., 2020; Dos Santos, 2020; Wang et al., 2020).

This research is an attempt to understand the underlying mechanism that is essential to predict the success of the COVID-19 outbreak management policy in Pakistan. Firstly, this study investigates the level of knowledge and awareness regarding COVID-19 disease, i.e. its causes, effects, and prevention measures, among university students and graduates in Pakistan. Secondly, we examine the attitudes and confidence of these educated people regarding the success of the COVID-19 pandemic management policy in Pakistan. Thirdly, it also summarizes the practices of participants in this regard. Moreover, it also tries to find out the reasons for the accomplishment of the COVID-19 management policy of the Government of Pakistan that is reflected in recent statistics (Hashim, 2020). Finally, based on the above results, we attempt to predict the realization of the COVID-19 outbreak management policy of Pakistan in the future.

Recently, three important studies have been conducted in this regard. First, Zhong et al. (2020) examine the knowledge, attitudes, and practices of the general public towards COVID-19 in China. They measure the knowledge score of each participant regarding COVID-19 on the basis of 12 questions. Their findings suggest that financially stable participants, especially women, have a high knowledge score, appropriate practices, and optimistic attitudes towards the successful control of COVID-19. Second, Azlan et al. (2020) also examine the knowledge, attitudes, and practices of the general public towards COVID-19 in the context of Malaysia using the same questionnaire developed by Zhong et al. (2020). They find a high knowledge score among the participants, a moderate level of appropriate practices, and high confidence among participants about the successful control of COVID-19. Both these studies use authors’ networks and online convenient sampling technique. Finally, Roy et al. (2020) also assess the perceptions and behavioral changes among the population due to COVID-19 in India. In past, during the swine flu outbreak in the United Kingdom, a similar kind of study is conducted by Rubin et al. (2009).

In the context of Pakistan, Salman et al. (2020) conduct a study with similar objectives but with a different questionnaire and limited sample. They collect data from February 22, 2020 to March 12, 2020 while the first case of COVID-19 is confirmed by the officials on February 27, 2020 (Gul, 2020). Also, the scope of their study is limited geographically to a certain part of Lahore city in Pakistan. The objective of the study in hand is to expand the scale of sample size geographically, and to assess the knowledge, perceptions, and practices of the educated public towards COVID-19 in relevance of higher infection rates in Pakistan. The findings of this study would be significant in policy formulation to combat COVID-19, given the recent resurgence or second wave of COVID-19 in many countries (Bhatti, 2020).

The remaining part of this study is arranged as follows. Research method, sampling technique, and data collection are discussed in section 2. Descriptive Statistics and results are summarized in section 3. Discussion on results and limitations of the study are presented in section 4. Conclusion and policy recommendations are provided in section 5.

2. Research method

A quantitative approach based on cross-sectional analysis is employed to analyze the knowledge, attitudes, and practices of the educated population in Pakistan. An online survey is recognized as the most appropriate and convenient tool to collect information from a geographically diverse large sample (Zhong et al. 2020, Azlan et al. 2020). Therefore, data for this study is collected online, from July 12, 2020 to August 10, 2020 by using Google Forms online application. Participants are communicated on social media to voluntarily participate in this research by using authors’ personal and professional networks, and endorsement by many public and private employees, student leaders, and teachers of higher education institutes from all provinces in Pakistan. Participants who have Pakistani nationality, age 18 or more, enrolled or graduated from any University in Pakistan, and willing to contribute to this study are asked to fill the survey by clicking on the online survey link. Two social media platforms, i.e. Facebook and WhatsApp are largely used to broadcast the call for participation in this research (Azlan et al. 2020). Unlike Salman et al. (2020), participants from all four provinces, capital territory, and other administrative regions of Pakistan are approached to participate.

The survey questionnaire used in this study is taken from Zhong et al. (2020), which is earlier used in the context of Malaysia as well by Azlan et al. (2020). This is done to ensure the consistency of results and comparative analysis with earlier studies. The questionnaire is designed in the English Language because the medium of instruction in higher education institutions of Pakistan is English. Ethical consideration is also the reason that we use the questionnaire developed by Zhong et al. (2020) for a similar research objective. Participants are asked about their willingness to complete the survey by using a simple “Yes or No Question”. The questionnaire, protocol of the study, and research procedures are approved by the Ethics Committee of Wuhan Mental Health Center and Ethics Committee of Universiti Kebangsaan Malaysia (Zhong et al. 2020, Azlan et al. 2020).

The data is collected across cross-sections because, given the nature of the recent COVID-19 outbreak, it is difficult to analyze the effect of time across the cross-sections. The survey for this study is conducted between July 12, 2020 and August 10, 2020. According to the UNESCO Institute for Statistics (2020), 8.6 percent of the population in Pakistan, aged 25 and above, has either an undergraduate or higher degree in Pakistan as of 2017. The total population in Pakistan was 212.2 million as of 2018 (World Bank, 2020). Therefore, the desired sample size is 1067, using the statistics above regarding the target population of university enrolled or graduated students in Pakistan. This is the smallest acceptable sample size to ensure a confidence level of 95 percent and +3 confidence interval. Finally, 1789 people submitted their responses to this research.

2.1. Study measures

As mentioned earlier, the survey used in this study is borrowed from Azlan et al. (2020), originally used by (Zhong et al. 2020), for consistency and comparability. This survey consists of four key sections. The first section covers demographic information like gender, age, educational attainment, region, and employment status. The second section of the survey consists of 13 questions regarding the knowledge about COVID-19 disease. These questions are related to clinical symptoms, transmission mechanism, and prevention and control methods of COVID-19 disease. Three options, i.e. true, false, and not sure, are provided for each of these knowledge questions. The response is then converted into a binary variable where 1 indicates the correct response and 0 as an indicator of either false or not sure response. The maximum
possible knowledge score is 13, which indicates perfect knowledge, and the minimum possible score is 0, which indicates no knowledge regarding COVID-19. In the third section, questions regarding the attitudes and beliefs of participants about COVID-19, and the effectiveness of policies to control this disease in the future are asked. For each of these questions except one, three options i.e. Agree, Disagree, and Not sure, are provided to participants. A question is also added to examine the trust of participants in the health infrastructure and hospitals of Pakistan for the treatment of COVID-19 disease. Finally, the last section consists of questions on general practices of participants related to prevention measures to combat COVID-19 disease.

2.2. Statistical analysis

Google Forms online platform is used for the collection of data. For the statistical analysis, we used STATA version 15. Descriptive analysis of the data is based largely on frequency-based histograms, and percentages. In addition, chi-square tests, independent samples t/F-tests, and Analysis Of Variance (ANOVA) methods are used to test the differences between groups based on various demographic characteristics. The 5% level of significance is used for these tests. Internal consistency of the knowledge measures is confirmed using a reliability test where the “Cronbach alpha coefficient” helped in evaluating the reliability of the variables. Cronbach’s alpha coefficient of the knowledge questionnaire is 0.6778 in our sample, indicating acceptable internal consistency.²

3. Results

3.1. Demographic characteristics

A total of 1789 well-educated individuals from different universities in Pakistan participated in this research. The majority of the respondents are female (53.05%), having domicile of Punjab (69.5%), single (69.9%), students by occupation (44%), enrolled in University (60%) and having personal income below PKR 20,000 per month (55.9%). The average age of the respondents is 23.4 years (S.D. = 8.23). Detailed demographic characteristics are presented in Table 1.

3.2. Knowledge score

In order to evaluate the COVID-19 knowledge score of university students and graduates in Pakistan, a total of 13 questions are asked (Azlan et al. 2020). The correct answer rate of the knowledge questionnaire is 46.0–93.5% (see Table 2). The average knowledge score for respondents is 9.60 with a standard deviation of 2.33 and ranges from 0 to 13, suggesting an overall 73.65% (9.60 = 13 * 100) correct rate in this survey. Almost 62% of the total number of respondents receive a knowledge score of more than 10 which represents a satisfactory knowledge on COVID-19. The majority of the respondents believe that to prevent the infection with the COVID-19, individuals should avoid going to crowded places such as markets, social events, and to avoid commuting via public transportation (93.5%). Also, to most respondents, an effective way to reduce the spread of COVID-19 is isolation and treatment of COVID-19 infected people (93.4%). However, respondents are confused about the transmission mechanisms of the COVID-19 virus. Just 28.7% of respondents answer correctly when asked a question about the airborne transmission of the virus, and only 45.9% answer correctly when asked about the transmission of the virus through touching and eating animals (see Table 2). Knowledge scores of respondents according to demographic characteristics are compared by using one-way analysis of variance (ANOVA) and independent-sample t-tests as applicable. Findings suggest that knowledge score is significantly different across income categories, employment status, university enrollment, education level, marital status, domicile, age, and gender. COVID-19 knowledge score is highest among female respondents, with the age of above 40, and residents of Sindh province. Moreover, ANOVA results reveal that the knowledge score of Ph.D. respondents is significantly higher than those of Bachelor of Science (BS) and Master of Science (MS) students and graduates. Additionally, graduates from Sindh based Universities have higher knowledge about the COVID-19 virus as compared to students from the universities based in other provinces or administrative areas. As far as employment status is concerned, public employees have the highest knowledge score among the occupation groups. Similarly, respondents with personal income between PKR 40001- PKR 80,000 per month have the highest knowledge score among other income categories (see Table 3).

3.3. Attitude evaluation

The respondents are asked 6 questions in order to evaluate their attitudes and beliefs about the COVID-19. First, whether or not they agree that the COVID-19 is a result of an international conspiracy. Second, whether they agreed; that COVID-19 will successfully be controlled in the world. Third, whether or not they have confidence that Pakistan can win the battle against COVID-19. Fourth, whether wearing a mask and use of hand sanitizers are effective in controlling the spread of this virus. Fifth, whether they thought that the government of

² According to Van Griethuysen et al. (2015) "the range of the Cronbach alpha within 0.6 to 0.7 is considered reliable and adequate.

Table 1

| Characteristic          | Type     | Frequency | Percentage (%) |
|------------------------|----------|-----------|----------------|
| Gender                 | Female   | 949       | 53.05          |
|                        | Male     | 840       | 46.95          |
| Age (Years)            | 18-25    | 886       | 49.52          |
|                        | 26-30    | 483       | 27.00          |
|                        | 31-40    | 340       | 19.01          |
|                        | Above 40 | 80        | 4.47           |
| Domicile               | Punjab   | 1243      | 69.48          |
|                        | Khyber Pakhtunkhwa | 166 | 9.28          |
|                        | Sindh    | 114       | 6.37           |
|                        | Islamabad Capital Territory | 102 | 5.70          |
|                        | Gilgit Baltistan | 101 | 5.65          |
|                        | Azad Jammu and Kashmir | 35 | 1.96          |
|                        | Balochistan | 28 | 1.57          |
| Marital Status         | Single   | 1250      | 69.87          |
|                        | Married  | 529       | 29.57          |
|                        | Divorced | 10        | 0.56           |
| University Enrollment  | Yes      | 1073      | 59.98          |
|                        | No       | 716       | 40.02          |
| Education Level        | BS Graduated or Enrolled | 974 | 54.44         |
|                        | MS Graduated or Enrolled | 561 | 31.36         |
|                        | Ph.D. Graduated or Enrolled | 254 | 14.20         |
|                        | Enrolled | 1073      | 59.98          |
| University Location    | Punjab   | 978       | 55.17          |
|                        | Sindh    | 106       | 5.93           |
|                        | Khyber Pakhtunkhwa | 99 | 5.53          |
|                        | Gilgit Baltistan | 33 | 1.84          |
|                        | Balochistan | 12 | 0.67          |
|                        | Azad Jammu and Kashmir | 11 | 0.61          |
| Employment Status      | Students Only | 787 | 43.99         |
|                        | Public Employee | 356 | 19.90         |
|                        | Private Employee | 311 | 17.38         |
|                        | Unemployed | 238       | 13.30          |
|                        | Self-employed or Businessman | 97 | 5.42          |
| Personal Income        | Below PKR 20000/month | 999 | 55.84         |
|                        | PKR 20001-PKR 40000/ month | 280 | 15.65         |
|                        | PKR 40001-PKR 80000/ month | 294 | 16.43         |
|                        | Above PKR 80000/month | 216 | 12.07         |
Table 2
Participant knowledge of COVID-19 (N = 1789).

| Question                                                                 | True      | False     | I'm Not Sure |
|--------------------------------------------------------------------------|-----------|-----------|--------------|
| The most common clinical initial symptoms of COVID-19 are fever, fatigue, dry cough, and myalgia (muscle pain). | 1481 (82.78%) | 54 (3.02%) | 254 (14.20%) |
| Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus. | 898 (50.20%) | 307 (17.16%) | 584 (32.64%) |
| There is currently no effective cure for COVID-2019, but early symptomatic and supportive treatment can help most patients to recover from the infection. | 1554 (86.86%) | 62 (3.47%) | 173 (9.67%) |
| Not all persons with COVID-19 will develop into severe cases. Only those COVID-19 infected people, who are elderly, obese (fat), and have chronic (long term) illnesses are more likely to be severe cases. | 1341 (74.96%) | 184 (10.29%) | 264 (14.76%) |
| Eating or contacting wild animals would result in infection with the COVID-19 virus. | 378 (21.13%) | 822 (45.95%) | 589 (32.92%) |
| Persons with COVID-2019 cannot infect others with the virus when they do not have a fever. | 207 (11.57%) | 1219 (68.14%) | 363 (20.29%) |
| The COVID-19 virus spreads through respiratory droplets of COVID-19 infected individuals. | 1445 (80.77%) | 97 (5.42%) | 247 (13.81%) |
| People can wear general medical masks to prevent infection with the COVID-19 virus. | 1497 (83.68%) | 141 (7.88%) | 151 (8.44%) |
| It is not necessary for children and young adults to take measures to prevent the infection with the COVID-19 virus. | 291 (16.27%) | 1398 (78.14%) | 100 (5.59%) |
| To prevent the infection with the COVID-19, individuals should avoid going to crowded places such as markets, social events, and avoid taking public transportations. | 1673 (93.52%) | 97 (5.42%) | 67 (3.75%) |
| Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus. | 1670 (93.35%) | 39 (2.18%) | 80 (4.47%) |
| People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place. In general, the observation period is 14 days. | 1641 (91.73%) | 53 (2.96%) | 95 (5.31%) |
| The COVID-19 virus can be transmitted through the air over time and distance. | 851 (47.57%) | 513 (28.68%) | 425 (23.76%) |

Table 3
Demographic characteristics of participants and knowledge score (N = 1789).

| Characteristic        | Type                | Frequency | Knowledge score (SD) | t / F   | P-Value |
|-----------------------|---------------------|-----------|----------------------|---------|---------|
| Gender                | Female              | 949 (53.05%) | 9.71 (2.21)          | 5.45    | <0.001  |
|                       | Male                | 840 (46.95%) | 9.45 (2.45)          |         |         |
| Age (Years)           | 18–25               | 886 (49.52%) | 9.22 (2.46)          | 15.41   | <0.001  |
|                       | 26–30               | 483 (27.00%) | 9.88 (2.05)          |         |         |
|                       | 31–40               | 340 (19.01%) | 9.93 (2.27)          |         |         |
|                       | Above 40            | 80 (4.47%)   | 10.33 (1.88)         |         |         |
| Domicile              | Punjab              | 1243 (69.48%) | 9.57 (2.37)          | 2.15    | <0.001  |
|                       | Khyber Pakhtunkhwa  | 166 (9.28%)  | 9.69 (1.96)          |         |         |
|                       | Sindh               | 114 (6.37%)  | 10.1 (2.15)          |         |         |
|                       | Islamabad Capital Territory | 102 (5.70%) | 9.088 (2.67)        |         |         |
|                       | Gilgit Baltistan    | 101 (5.65%)  | 9.69 (1.78)          |         |         |
|                       | Azad Jammu and Kashmir | 35 (1.96%) | 9.51 (2.55)         |         |         |
|                       | Balochistan         | 28 (1.57%)   | 8.96 (2.51)          |         |         |
| Marital Status        | Single              | 1250 (69.87%) | 9.47 (2.34)          | 9.90    | <0.001  |
|                       | Married             | 529 (29.57%) | 9.91 (2.25)          |         |         |
|                       | Divorced            | 10 (0.56%)   | 7.8 (1.68)           |         |         |
| University Enrollment | Yes                 | 1073 (59.98%) | 9.43 (2.38)          | 11.12   | <0.001  |
|                       | No                  | 716 (40.02%) | 9.81 (2.22)          |         |         |
| Education Level       | BS Graduated or Enrolled | 974 (54.44%) | 9.27 (2.47)          | 20.26   | <0.001  |
|                       | MS Graduated or Enrolled | 561 (31.36%) | 9.94 (2.12)          |         |         |
|                       | PhD Graduated or Enrolled | 254 (14.20%) | 10.01 (1.94)        |         |         |
| University Location   | Punjab              | 978 (55.17%) | 9.47 (2.39)          | 2.51    | <0.001  |
|                       | Islamabad Capital Territory | 541 (30.24%) | 9.73 (2.28)       |         |         |
|                       | Sindh               | 106 (5.93%)  | 10.22 (1.75)         |         |         |
|                       | Khyber Pakhtunkhwa  | 99 (5.53%)   | 9.46 (2.21)          |         |         |
|                       | Gilgit Baltistan    | 33 (1.84%)   | 9.42 (1.82)          |         |         |
|                       | Balochistan         | 12 (0.67%)   | 8.67 (3.05)          |         |         |
| Employment Status     | Students Only       | 787 (43.99%) | 9.26 (2.42)          | 6.85    | <0.001  |
|                       | Public Employee     | 356 (19.90%) | 9.89 (2.30)          |         |         |
|                       | Private Employee    | 311 (17.38%) | 9.88 (2.05)          |         |         |
|                       | Unemployed          | 238 (13.30%) | 9.75 (2.25)          |         |         |
| Personal Income       | Self-employed or Businessman | 97 (5.42%) | 9.74 (2.26)         |         |         |
|                       | Below PKR 2000/0/month | 999 (55.84%) | 9.39 (2.35)        | 6.60    | <0.001  |
|                       | PKR 20001-PKR 4000/month | 280 (15.65%) | 9.65 (2.28)       |         |         |
|                       | PKR 40001-PKR 8000/month | 294 (16.43%) | 10.00 (2.82)       |         |         |
|                       | Above PKR 8000/0/month | 216 (12.07%) | 9.87 (2.20)        |         |         |
Pakistan is taking effective measures to control the spread of COVID-19. Finally, whether they prefer to go to the hospital or to stay at home, if they experienced the symptoms of COVID-19, in the current situation of Pakistan (see Fig. 1).

Optimism among participants about successful control of COVID-19 is significantly associated with the age group, domicile category, and university location of participants. Knowledge score is significantly lower for the participants who are unsure about the successful control of COVID-19 in the world. Similarly, the confidence of participants about the successful management of the COVID-19 pandemic in Pakistan is significantly associated with the gender, domicile category, marital status, university enrollment status, and location of the university. Knowledge score is significantly lower for the participants who are unsure about the confidence that Pakistan would be able to successfully manage this pandemic. Moreover, the belief of participants that the government of Pakistan is taking effective measures to manage the COVID-19 health crisis is significantly associated with the gender, age, domicile, marital status, location of the university, and personal income of participants. The knowledge score is significantly lower for the participants who are uncertain about the success of measures taken by the Pakistan government (see Table 4).

In response to the question, asking the opinion of respondents whether COVID-19 is an international conspiracy, respondents show mixed opinions (33.8% agreed, 34.2% disagreed, and 32% were unsure). The majority of the respondents (58.3%) believe that the COVID-19 will successfully be controlled in the world, while (71.8%) also have confidence that Pakistan would be able to win the war against this pandemic.

In another question, where participants are asked that whether wearing a mask and using sanitizers are not effective measures to control the spread of this virus, a large share of respondents (72.8%) show disagreement with the non-usefulness statement which implies that they believe in their effectiveness to combat COVID-19 pandemic. In addition, more than half of the sample population (51%) agree with the strategy and policies of the government of Pakistan to curb COVID-19, while 15.5% are uncertain about the government role. Finally, an alarming majority of the sample (53.1%) respond that they prefer home quarantine without medical advice over asking for medical advice and visiting hospitals.

3.4. Practices evaluation

In order to evaluate the practices towards COVID-19, 3 different questions are asked from the respondents. First, respondents are asked whether they avoid crowded places like weddings or funerals in recent weeks. Second, they are asked about the use of masks in daily life. Third, they are asked about the use of hand sanitizer in daily life. In response to the first question, the majority of the respondents (74.5%) report that they avoid crowded places while the remaining 25.5% do not avoid social events in recent weeks when confirmed COVID-19 cases are at their peak in Pakistan. Almost 68.8% of respondents report that they always wear a face mask when leaving their homes, while 27% do not wear a face mask, and the remaining respondents report the occasional use of masks. Finally, (71%) of respondents report that they always wash their hands with hand sanitizers, while 26.2% report the occasional use of hand sanitizer in recent weeks (see Fig. 2).

Table 5 reports that females, age 26–30, single, living in Sindh province, enrolled in the university, Ph.D. student or graduate, with university-based in Islamabad, unemployed, and having income below PKR 20,000 per month show a significantly higher percentage of wearing the face mask while leaving the house. This result seems inconsistent; however, it could be because this category contains most of the students without jobs. It is mandatory to wear masks in the educational institutions, and therefore although students have not paid serious attention to learn about COVID-19 as reflected in overall knowledge score but still they have to wear masks in their educational institutions and most of them are following this rule naturally. In the same way, female, people with age above 40, living in Azad Kashmir, not enrolled in university, MS degree student or graduate, with a university located in Sindh, unemployed, and having income below PKR 20,000 per month show a higher percentage to practice hand hygiene by using hand sanitizers and frequently washing hands.

In order to analyze the differences between demographic groups, we find strong shreds of evidence that the avoidance of crowded places (i.e. wedding or funeral) is significantly associated with the gender group, domicile category, university location category, employment status, and personal income category. Table 5 also reveals a significant difference in knowledge scores between the participants who do not avoid and those who avoid crowded spaces. Likewise, wearing a mask while going outside is significantly associated with the gender, age group, domicile category, university enrollment status, educational level, location of the university, employment status, and personal income category. Most importantly, people with higher knowledge score is more likely to wear the face mask while leaving the house. Finally, proper hand hygiene by using hand sanitizers, and frequently washing hands is significantly correlated with gender, domicile, university enrollment status, location of the university, employment status, and personal income category. Besides, people with higher knowledge scores are more likely to practice proper hand hygiene by using hand sanitizers and frequently washing hands (see Table 5).

4. Discussion

The significance of this study is based on a large sample size of students from all across Pakistan studied during critical times when the daily confirmed cases are at their peak. However, the results mentioned above should be considered by keeping in view the associated limitations. Although, independence of observations across the geographically diverse sample is a reasonable assumption for this study, but there is the possibility of some bias due to the use of a convenient sampling method, based on social and professional networks of authors. The sample is quite balanced in terms of gender and age distribution. However, it is important to highlight the over-representation of Punjab province. Hence, the findings may suffer from geographic biasedness. As mentioned above, the participants of this study are university students or graduates with internet access therefore, the knowledge score findings should be viewed as the upper bound for the general public. Also, due to self-reported data, the answers of participants may represent socially desirable responses which also enforce the fact that the knowledge score and desirable outcome statistics should be treated as the upper bound for the general population of Pakistan. However, the internal consistency of the knowledge measures is confirmed using a reliability test where the “Cronbach alpha coefficient” helped in evaluating the reliability of the variables. Cronbach’s alpha coefficient of the knowledge questionnaire is 0.6778 in our sample, indicating acceptable internal consistency. Finally, due to the nature of the COVID-19 pandemic, only a few aspects of knowledge, attitudes, and practices are examined among the sample. Due to limited internet access and virtual health information sources, vulnerable populations of Pakistan under the COVID-19 epidemic like rural families and older adults at the grass-root level have a higher probability of having negative attitudes, poor knowledge, and unsuitable defensive practices towards this pandemic. For further analysis, aspects of literacy and risk preferences regarding health may also be explored for Pakistan and other developing countries (Britt and Hatten 2013, Duong et al. 2017).
Fig. 1. Attitudes of participants on COVID-19 (N = 1789).
Table 4
Demographic characteristics and attitudes toward COVID-19 (N = 1789).

| Characteristic                          | Type                          | Do you agree that COVID-19 will be successfully controlled in the world? | Do you have confidence that Pakistan can win the battle against the COVID-19 virus? | The government of Pakistan is taking effective measures to manage the COVID-19 health crisis? |
|----------------------------------------|-------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Gender                                  |                               | Agree 543 (57.2%) Disagree 499 (52.8%) I'm not sure 270 (29.1%) | Agree 656 (69.1%) Disagree 628 (95.3%) I'm not sure 235 (81.2%) | Agree 454 (47.8%) Disagree 437 (52.4%) I'm not sure 175 (64.7%) |
| Age (Years)                             |                               | Male 510 (57.6%) 256 (29.5%) | Male 625 (70.9%) 265 (31.3%) | Male 430 (48.5%) 256 (30.6%) |
|                                        |                               | 18–25 256 (61.3%) 106 (24.3%) | 26–30 265 (75.6%) 106 (31.3%) | 26–30 256 (75.6%) 106 (31.3%) |
|                                        |                               | 31–40 183 (53.8%) 67 (28.2%) | 31–40 235 (69.1%) 64 (28.2%) | 31–40 235 (69.1%) 64 (28.2%) |
|                                        |                               | Above 40 53 (66.3%) 9 (11.3%) | Above 40 59 (73.8%) 9 (11.3%) | Above 40 59 (73.8%) 9 (11.3%) |
| Domicile                               |                               | Punjab 702 (56.2%) 229 (17.2%) | Punjab 904 (72.6%) 203 (17.2%) | Punjab 654 (52.6%) 217 (17.2%) |
|                                        |                               | Khyber Pakhtunkhwa 125 (57.3%) 25 (17.2%) | Khyber Pakhtunkhwa 131 (78.9%) 23 (17.2%) | Khyber Pakhtunkhwa 89 (53.6%) 217 (17.2%) |
|                                        |                               | Sindh 66 (59.7%) 29 (25.7%) | Sindh 74 (64.9%) 19 (16.7%) | Sindh 50 (43.9%) 21 (16.7%) |
|                                        |                               | Islamabad Capital Territory 56 (54.9%) 29 (28.4%) | Islamabad Capital Territory 66 (64.7%) 23 (22.6%) | Islamabad Capital Territory 40 (39.2%) 20 (19.6%) |
|                                        |                               | Gilgit Baltistan 57 (56.4%) 29 (28.7%) | Gilgit Baltistan 62 (61.4%) 23 (22.6%) | Gilgit Baltistan 48 (47.6%) 25 (24.5%) |
|                                        |                               | Azad Jammu and Kashmir 20 (57.1%) 9 (25.7%) | Azad Jammu and Kashmir 28 (80.0%) 4 (11.4%) | Azad Jammu and Kashmir 20 (57.1%) 9 (25.7%) |
|                                        |                               | Balochistan 16 (57.1%) 7 (25.0%) | Balochistan 19 (67.9%) 6 (21.4%) | Balochistan 10 (35.7%) 5 (18.5%) |
| Marital Status                          |                               | Single 740 (59.2%) 297 (23.8%) | Single 906 (72.5%) 214 (17.1%) | Single 616 (49.3%) 220 (17.6%) |
|                                        |                               | Married 297 (56.1%) 132 (24.9%) | Married 374 (70.8%) 90 (17.0%) | Married 291 (50.0%) 55 (10.4%) |
|                                        |                               | Divorced 5 (50.0%) 2 (20.0%) | Divorced 4 (40.0%) 2 (20.0%) | Divorced 4 (40.0%) 2 (20.0%) |
|                                        |                               | University Enrollment Yes 641 (59.7%) 258 (24.0%) | University Enrollment Yes 780 (72.2%) 258 (24.0%) | University Enrollment Yes 547 (50.0%) 55 (10.4%) |
|                                        |                               | No 401 (56.0%) 142 (19.8%) | No 504 (70.4%) 116 (16.2%) | No 364 (50.8%) 116 (16.2%) |
| Education Level                         |                               | BS Graduated or Enrolled 546 (56.1%) 247 (25.4%) | BS Graduated or Enrolled 694 (77.1%) 165 (16.0%) | BS Graduated or Enrolled 481 (49.4%) 179 (18.4%) |
|                                        |                               | MSc Graduated or Enrolled 336 (59.9%) 128 (22.9%) | MSc Graduated or Enrolled 408 (72.7%) 95 (16.9%) | MSc Graduated or Enrolled 292 (52.1%) 69 (12.3%) |
|                                        |                               | PhD Graduated or Enrolled 160 (62.9%) 56 (22.1%) | PhD Graduated or Enrolled 182 (71.6%) 46 (18.1%) | PhD Graduated or Enrolled 138 (54.3%) 28 (11.0%) |
| University Location                    |                               | Punjab 559 (56.6%) 227 (23.0%) | Punjab 723 (73.3%) 155 (15.7%) | Punjab 538 (56.5%) 142 (14.4%) |
|                                        |                               | Sindh 58 (54.7%) 30 (28.3%) | Sindh 69 (65.1%) 17 (16.0%) | Sindh 47 (44.3%) 18 (16.9%) |
|                                        |                               | Islamabad Capital Territory 319 (58.9%) 146 (26.9%) | Islamabad Capital Territory 377 (69.7%) 108 (19.9%) | Islamabad Capital Territory 261 (48.2%) 96 (17.7%) |
|                                        |                               | Gilgit Baltistan 58 (54.7%) 30 (28.3%) | Gilgit Baltistan 69 (65.1%) 17 (16.0%) | Gilgit Baltistan 47 (44.3%) 18 (16.9%) |
|                                        |                               | Khyber Pakhtunkhwa 75 (78.5%) 13 (13.1%) | Khyber Pakhtunkhwa 77 (77.8%) 14 (14.1%) | Khyber Pakhtunkhwa 55 (55.6%) 12 (12.1%) |
|                                        |                               | Sindh 21 (66.7%) 8 (24.2%) | Sindh 25 (75.8%) 15 (52.5%) | Sindh 18 (54.6%) 5 (15.2%) |
|                                        |                               | Balochistan 4 (33.3%) 3 (25.0%) | Balochistan 5 (41.7%) 4 (33.3%) | Balochistan 4 (33.3%) 3 (25.0%) |
|                                        |                               | Azad Jammu and Kashmir 6 (54.5%) 4 (33.3%) | Azad Jammu and Kashmir 8 (72.7%) 2 (18.2%) | Azad Jammu and Kashmir 4 (33.3%) 3 (25.0%) |
| Employment Status                      | Students Only                  | 456 (57.9%) 194 (24.7%) | 563 (71.3%) 140 (17.8%) | 399 (50.8%) 135 (17.2%) |
|                                        | Public Employee               | 208 (58.4%) 90 (25.3%) | 258 (72.9%) 64 (17.9%) | 191 (53.7%) 43 (12.1%) |
|                                        | Private Employee              | 180 (59.7%) 73 (23.9%) | 210 (67.3%) 57 (18.3%) | 151 (49.2%) 43 (12.1%) |
|                                        | Unemployed                    | 146 (61.3%) 49 (20.6%) | 177 (74.4%) 36 (15.1%) | 120 (50.4%) 34 (14.3%) |
|                                        | Self-employed                 | 52 (53.6%) 25 (25.8%) | 76 (78.4%) 9 (9.3%) | 48 (50.7%) 16 (16.5%) |
|                                        | Below PKR 20000/month         | 590 (59.1%) 243 (24.3%) | 718 (71.9%) 176 (17.9%) | 493 (49.4%) 165 (16.5%) |
|                                        | PKR 20001–PKR 40000/month     | 160 (57.1%) 68 (24.3%) | 210 (75.0%) 32 (11.4%) | 160 (57.1%) 45 (16.1%) |
|                                        | PKR 40001–PKR 80000/month     | 161 (54.8%) 54 (20.3%) | 204 (69.4%) 44 (14.8%) | 150 (50.0%) 36 (12.1%) |
| Knowledge Score                        | Above PKR 80000/month         | 9.90 (1.99) 9.27 (2.78) | 9.90 (1.99) 9.27 (2.78) | 9.90 (1.99) 9.27 (2.78) |
The participants of this study are university students or graduates with information access via the internet however, still, the average knowledge score among the sample is 9.50 out of a maximum possible score of 13. This reflects the unpromising situation of knowledge about COVID-19 among the general public, particularly poverty-stricken and uneducated, in Pakistan. This is even more alarming because this study is conducted when the daily cases are at their peak, and after more than four months since the first confirmed case of COVID-19 in Pakistan (Government of Pakistan 2020).

Despite the government’s efforts to create awareness about COVID-19 via different official and media channels, actively learning efforts are still required from the general public.

An overwhelming majority of respondents are found to be optimistic about the successful control of COVID-19 and the effectiveness of Government policies in this regard. This optimistic response from respondents could be the result of unprecedented relaxation in the nationwide lock-down, and a gradual shift towards strict smart lockdown in Pakistan (Hashim, 2020). In addition, it could be because of low COVID-19 deaths in Pakistan as compared to the western world. Finally, our results indicate the statistically significant association between low knowledge score and pessimism about the successful control of COVID-19 in Pakistan.

As mentioned earlier, the knowledge of COVID-19 is highest among respondents from Sindh province even higher than the Punjab province and the Capital territory. This finding looks counterintuitive as Sindh is a relatively less educated province compared to Punjab and the Capital. One possible explanation for such a result could be the time factor. Sindh was the first province to go into lockdown, it was the epicenter of COVID-19 in its early stages during March and early April 2020 in Pakistan. Moreover, the Sindh Government went into complete lockdown while Governments of other provinces were reluctant to such drastic measures. Hence, it is plausible that such drastic measures and press conferences by public officials may have induced more fear and hence more attention from the people of Sindh towards COVID-19.

Our results also suggest certain inappropriate practices and beliefs among the sample of university students and graduates in Pakistan. Firstly, 33% of participants believe that COVID-19 is an international conspiracy. Moreover, alarmingly 65% of participants prefer staying at home or just using masks and hand sanitizer rather than visiting the hospital for tests and treatment in case they feel the symptoms of COVID-19. This observation reflects the serious mistrust of educated people on public health institutions and infrastructure. This could be a possible explanation for the apparent mysterious decline in COVID-19 cases in Pakistan despite a lack of knowledge and wrong practices (Bhatti, 2020). Approximately, 30% of the sample indicate the use of masks and hand sanitizers either never or sometimes. Also, a similar proportion of participants attend a social event during the study period. The true percentage of people who are not doing the right thing, given the socially desirable response factor, is expected to be significantly higher. After the end of the study period, the Eid-al-Adha festival was celebrated in Pakistan with minimal lockdown restrictions. Recently, the Muharram, the first month in Islamic Calendar, has also been observed in August 2020 in Pakistan. Moreover, a recent flood across Karachi, the biggest city in Pakistan with a population of around 16 million, could probably be the next hot spot for COVID-19 in Pakistan in light of the results of this study (Hashim, 2020).
| Characteristic Type | In recent weeks, have you gone to any social event like a wedding or funeral, or any other get-together? | In day-to-day life, do you wear a face mask when going outside? | In day-to-day life, do you practice proper hand hygiene by using hand sanitizers and frequently washing your hands? |
|---------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Gender Female | Yes 163 (17.2%) | No 786 (82.8%) | Always 730 (76.9%) Never 34 (3.6%) Sometimes 185 (19.5%) |
| Male | Yes 293 (34.9%) | No 547 (61.5%) | Always 501 (59.6%) Never 28 (3.3%) Sometimes 311 (37.0%) |
| Age (Years) 18–25 | Yes 228 (25.7%) | No 656 (74.3%) | Always 595 (67.2%) Never 43 (4.9%) Sometimes 248 (27.9%) |
| 26–30 | Yes 120 (24.8%) | No 363 (75.2%) | Always 341 (70.6%) Never 7 (1.45%) Sometimes 135 (27.9%) |
| 31–40 | Yes 89 (26.2%) | No 251 (73.8%) | Always 230 (67.7%) Never 9 (2.65%) Sometimes 101 (29.7%) |
| Above 40 | Yes 19 (23.8%) | No 61 (76.3%) | Always 65 (81.3%) Never 3 (3.7%) Sometimes 12 (15.0%) |
| Domicile Punjab | Yes 298 (23.9%) | No 945 (76.0%) | Always 889 (71.3%) Never 43 (3.5%) Sometimes 311 (25.0%) |
| Khyber Pakhtunkhwa | Yes 61 (36.8%) | No 105 (63.2%) | Always 85 (51.2%) Never 5 (3.01%) Sometimes 76 (45.8%) |
| Sindh | Yes 24 (21.1%) | No 90 (78.9%) | Always 86 (71.5%) Never 6 (5.3%) Sometimes 135 (27.9%) |
| Islamabad Capital Territory | Yes 28 (27.5%) | No 74 (72.2%) | Always 67 (65.7%) Never 4 (3.9%) Sometimes 31 (30.4%) |
| Gilgit Baltistan | Yes 28 (27.7%) | No 73 (72.3%) | Always 67 (66.3%) Never 3 (2.9%) Sometimes 31 (30.4%) |
| Azad Jammu and Kashmir | Yes 8 (22.9%) | No 77 (77.1%) | Always 27 (71.1%) Never 0 (0%) Sometimes 130 (26.9%) |
| Balochistan | Yes 19 (23.8%) | No 61 (76.3%) | Always 65 (81.3%) Never 3 (3.7%) Sometimes 12 (15.0%) |
| Marital Status Single | Yes 314 (25.1%) | No 936 (74.9%) | Always 846 (67.2%) Never 49 (3.9%) Sometimes 355 (28.4%) |
| Married | Yes 139 (26.3%) | No 390 (73.7%) | Always 377 (71.3%) Never 1 (1.0%) Sometimes 1 (1.0%) |
| University Enrollment Yes | Yes 268 (24.9%) | No 805 (75.1%) | Always 721 (67.2%) Never 48 (4.5%) Sometimes 304 (28.3%) |
| No | Yes 188 (26.3%) | No 528 (73.7%) | Always 510 (71.2%) Never 14 (1.9%) Sometimes 192 (26.8%) |
| Education Level BS Graduated or Enrolled | Yes 253 (25.9%) | No 721 (74.0%) | Always 667 (68.5%) Never 41 (4.2%) Sometimes 266 (27.3%) |
| MS Graduated or Enrolled | Yes 141 (25.1%) | No 420 (74.9%) | Always 384 (68.5%) Never 9 (1.6%) Sometimes 168 (29.9%) |
| PhD Graduated or Enrolled | Yes 62 (24.4%) | No 192 (75.6%) | Always 180 (70.9%) Never 12 (4.7%) Sometimes 62 (24.4%) |
| University Location Punjab | Yes 240 (24.3%) | No 747 (75.7%) | Always 719 (72.9%) Never 29 (2.9%) Sometimes 239 (24.2%) |
| Khyber Pakhtunkhwa | Yes 8 (22.9%) | No 77 (77.1%) | Always 27 (71.1%) Never 0 (0%) Sometimes 130 (26.9%) |
| Sindh | Yes 28 (30.0%) | No 70 (70.0%) | Always 27 (71.1%) Never 1 (1.0%) Sometimes 1 (1.0%) |
| Islamabad Capital Territory | Yes 28 (30.0%) | No 70 (70.0%) | Always 27 (71.1%) Never 1 (1.0%) Sometimes 1 (1.0%) |
| Gilgit Baltistan | Yes 28 (30.0%) | No 70 (70.0%) | Always 27 (71.1%) Never 1 (1.0%) Sometimes 1 (1.0%) |
| Azad Jammu and Kashmir | Yes 28 (30.0%) | No 70 (70.0%) | Always 27 (71.1%) Never 1 (1.0%) Sometimes 1 (1.0%) |
| Balochistan | Yes 28 (30.0%) | No 70 (70.0%) | Always 27 (71.1%) Never 1 (1.0%) Sometimes 1 (1.0%) |
| Knowledge Score | Yes 9.59 (2.47) | No 9.70 (2.26) | Always 7.44 (7.84) Never 19 (2.0%) Sometimes 186 (19.6%) **
5. Conclusion

Every country in the world is facing serious health, social, and economic challenges during the recent COVID-19 pandemic. Lack of health knowledge about COVID-19 among the population, and not following the Standard Operating Procedures (SOPs) and instructions issued by the Government could inhibit the effectiveness of successful control of this pandemic. This study is an attempt to analyze the knowledge, attitudes, and practices of educated people regarding COVID-19 in Pakistan. Among the sample of university students and graduates, we find the correct response rate of 73% for questions related to COVID-19. In comparison to similar studies for China and Malaysia, this is quite a low correction rate, implying a low level of awareness regarding COVID-19 among the general public in Pakistan. Therefore, the government of Pakistan should intensify their campaign to raise awareness about the causes, symptoms, and control measures for COVID-19 among the general public.

Participants are mostly satisfied with government policies and optimistic about the successful control of this virus. The majority of the people responses with practices (i.e. social distancing) are consistent with the instructions of the government. Also, about 30% of participants are not doing the right thing. In addition, more than 60% of participants show skepticism or no trust in the treatment facilities available in hospitals. This skepticism could be because of the stigma attached to the COVID-19 virus. Nonetheless, this could be a possible explanation for the unusual fast decline in confirmed cases of COVID-19 in Pakistan. The characteristics of knowledge score, attitudes, and practices towards COVID-19 in Pakistan are also examined in the context of demographic factors of participants. Low knowledge score is found to be significantly associated with socially unacceptable practices, and the pessimism of participants regarding successful control of COVID-19 in Pakistan. Fortunately, Pakistan has remained largely unaffected during this pandemic but our findings suggest that much is needed to be done. The government of Pakistan and the people of Pakistan are required to put together efforts for spreading adequate awareness about doing the right thing through health education programs targeted at COVID-19. Most importantly, the government should also rebuild the trust of people in local hospitals and their treatment facilities. Likewise, it should intensify its efforts to eliminate the social stigma attached to the virus. In case of failure to address these issues, there exist a reasonable probability of a new wave of COVID-19 in Pakistan, as it happened across the globe.

6. Compliance with ethical standards

Funding: The authors received no funding for this study.

Authors Contribution: Both authors contributed equally to the conception and design of the study.

Availability of Data and Material: The data and material that support the findings of this study are available from the corresponding author upon reasonable request.

CRediT authorship contribution statement

Muhammad Arslan Iqbal: Conceptualization, Questionnaire Development, Writing of Discussion Section. Muhammad Zeeshan Younas: Data Curation, Methodology, Software, Writing of Methodology and Results Sections.

Declaration of Competing Interest

The authors declared that there is no conflict of interest.

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