Unpacking Misinformation Amid the COVID-19 Pandemic: A Mixed Methods Study

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Misinformation knows no bounds, but its impacts are particularly prominent in low-income countries, such as Pakistan, where social media usage is widespread, and health and media literacy levels are too low to navigate pitfalls when consuming COVID-19-related misinformation. This mixed methods study deploys a researcher-administered survey $(N = 380)$ and semistructured interviews $(N = 30)$ to assess how exposure to social media affects people's perceptions of the COVID-19 pandemic in Pakistan against the backdrop of sociocultural nuances and an "infodemic" of COVID-19 misinformation. In addition, we show that the triad of social media usage, COVID-19 misinformation, and sociocultural aspects affect sociodemographic groups differentially. Nearly 80% of the total respondents were social media users. The survey results indicate that belief in COVID-19-related misinformation was higher among low-income and poorly educated respondents in comparison to respondents from relatively high-income and educated backgrounds, whereas the interviewees were increasingly susceptible to political-, scientific-, and religious-sounding misinformation about COVID-19.

From conspiracy theories of COVID-19 being a biological weapon to rumors that the uptake of COVID-19 vaccines can kill people in two years, the pandemic has shown the world that with increasing social media usage, public exposure to misinformation has increased multifold. Access to a plethora of information leads to the rapid proliferation of accurate and inaccurate information, which may be particularly challenging for users to identify. Amid the pandemic, the World Health Organization (WHO) has repeatedly warned against the rise of false and deceptive COVID-19 content—calling it an "infodemic" (i.e., an epidemic of misinformation)—which requires sustained action at a global level to be solved.[1] Factual information, based on evidence from relevant experts, may alleviate the ongoing public health crisis, whereas misinformation may exacerbate it and even put lives at risk when a misinformation-driven incorrect medical decision is taken. Many governments, health authorities, and big tech companies are striving to limit the generation and dissemination of COVID-19 misinformation, but their efforts are hampered due to the speed and ease at which social media platforms facilitate the spread of misinformation.[2]

Although the proliferation of COVID-19 misinformation via social media is commonplace worldwide, research endeavors have focused on only a few geographical areas. By way of example, misinformation is prevalent in South Asian countries, but has received less attention from researchers.[3] Moreover, there is a dearth of mixed methods assessment of how exposure to social media usage in South Asia, in addition to how various sociocultural factors, such as strong religious belief and lack of trust in government and scientists, can exacerbate misleading perceptions of COVID-19, thereby, obstructing vaccination drives and other government interventions to curb the spread of the virus.

To fill this gap, we deployed a mixed methods research design, entailing a researcher-administered survey and semistructured interviews, to examine COVID-19-related misinformation in connection to social media usage and sociocultural aspects fomenting its dissemination in Pakistan. Against the backdrop of the worrying trend of COVID-19 misinformation, we attempt to answer the following research questions.

RQ-1: *What are the primary sources of COVID-19-related (mis)information?*

RQ-2: *How do sociodemographic differentials (e.g., income and education) impact people's awareness about COVID-19-related misinformation?*

RQ-3: *Which types of COVID-19 misinformation garner support, and what are the sociocultural aspects undergirding their support?*

Our findings are interpreted in the light of the rising COVID-19 cases amid the fourth wave in 2021, as people became increasingly infected with the Delta variant in Pakistan. At the time of writing, nearly 2000 new infections are reported on average each day.[4]

In questioning the respondents about beliefs in COVID-19-related information and what information sources they rely on, we observed that social media usage was high among the survey and interview respondents, and conspiracy theories, as well as misinformation of political and religious nature, garnered immense support. By shedding light on how social media usage impacts people's understanding of COVID-19 and investigating how it differentially affects sociodemographic groups and the sociocultural aspects that undergird COVID-19 misinformation proliferation, we hope that our study can motivate contextual interventions to reduce the impact of COVID-19 misinformation on health outcomes and increase the effectiveness of public health communication.

BACKGROUND

The term misinformation gained widespread popularity in connection with the 2016 U.S. Presidential elections for alleged swaying of voter preferences.[5] However, there exist earlier studies that analyzed the spread and impact of misinformation, particularly in the healthcare domain, as systematically reviewed in Wang *et al.*'s work.[6] In this study, Wang *et al.* highlighted the need for more research on the identification of susceptible populations, and on the understanding of sociodemographic and ideological asymmetries in the intention to spread misinformation.

Social media usage plays a critical role in people's lives as it alters their perceptions of "disease exposure, resultant decision making, and risk behaviors."[7] With the content on social media being filtered by automated recommender systems, polarization becomes much more likely since echo chambers and filter bubbles result in users only being exposed to like-minded opinions and beliefs, which may limit people's exposure to diverse perspectives and foster misinformation spreading.[8]

In the wake of the COVID-19 pandemic, evidence suggests that exposure to misinformation about the virus might be more prevalent than often deduced.[9] For instance, a study by Li *et al.* [10] found that over 25% of the top YouTube videos about COVID-19 contained misleading information and had received 62 million views globally. With its real-life implications on people's willingness to comply with public health guidance, the spread of misinformation has prompted researchers to inquire why people fall for false information about COVID-19. While some researchers posit that lower trust in science is positively correlated with higher susceptibility to misinformation,[11,12] others have noted that mainstream media[13] and government [14] may foment the misinformation phenomenon.

In Pakistan's context, studies have mainly focused on the types of social media platforms that facilitate the spread of COVID-19-related misinformation. Javed *et al.*,[15] for instance, found that WhatsApp is a popular social media platform accelerating the spread of COVID-19 misinformation in Pakistan. Similarly, Ittefaq *et al.*[16] focused on how messages disseminated across social media, particularly WhatsApp, as well as the government's weak response to the pandemic, has aggravated the misinformation problem in the country. Besides analyzing which types of social media platforms prompt COVID-19 misinformation proliferation, studies exploring sociocultural aspects that may inform people's perceptions toward COVID-19 and their propensity to fall for misinformation in Pakistan are lacking. Our study is unique in this sense, as it provides contextual data and empirically grounded information on how sociocultural factors may promote misinformation propagation, specifically in Pakistan's case.

Therefore, while it is evident that misinformation regarding COVID-19 exists, it is worth understanding which groups are more susceptible to misinformation and why that is the case. To reiterate, the extent to which people are susceptible to COVID-19 misinformation may vary according to religious and political affiliation, social media usage, vaccination intent, education levels, and government regulations to curb the pandemic.[9,17] For example, religious beliefs have been known to stifle vaccination drives in the past, whereby

misinformation regarding un-Islamic ingredients in the polio vaccine contributed to the struggles of the polio eradication campaign in Pakistan.[18] As a result, to tackle health misinformation and diminish its adverse impacts in the ongoing health crisis in Pakistan, further research probing into the trends and sociocultural factors undergirding the prevalence of COVID-19 misinformation is required to understand why people's perceptions and responses take the forms they do.

METHODOLOGY

Research Design

We used the convergence variant of the concurrent triangulation design—an approach to mixed methods research—that involves combining quantitative and qualitative research components. The convergence variant of triangulation allowed us to conduct quantitative and qualitative data collection in parallel with minimal exposure to COVID-19. Moreover, a single-phased data collection scheme, where equal importance is given to quantitative and qualitative data, was apt for our diverse team of statisticians, computer scientists, and anthropologists.

Ethical Considerations

Before beginning data collection, we obtained approval from the institutional review board (protocols October 16, 2019) at the Lahore University of Management Sciences (LUMS). We recruited undergraduate students from LUMS who received adequate training to administer the survey in person, whereas the authors themselves conducted the interviews. Only those fully vaccinated against COVID-19 collected the data while following preventative measures.

Sampling and Data Collection

We obtained data using surveys and interviews in Lahore, Pakistan, between mid-July and early September 2021. This time frame captured a snapshot of Pakistan's fourth wave of COVID-19 when the country witnessed a spike in Delta variant cases, imposition of lockdown policies, and state-driven mandatory vaccination.[4] We chose malls and bazaars as our field site due to a large diversity of people from different sociodemographics, ranging from customers to janitorial staff members, present there. Also, malls and bazaars were among the few venues open amid the fourth wave and were relatively safer compared to enclosed, compact spaces that would increase the risk of contracting COVID-19. Moreover, it is important to note that the sample's demographics are more representative of Lahore's population than the population of the

entire country. For example, 33% of the survey respondents were undergraduate students, which is unsurprising, as the number of undergraduate students in Lahore is generally a lot higher than that in other places in Pakistan. Lahore is famously known as the "city of colleges" for having more than 43% of all universities in the province of Punjab (which has 237 cities in total), whereas Punjab has the largest share (35%) of universities across all five provinces.[19]

We collected 380 survey responses (214 men, 165 women, and one of them preferred not to state their gender) and conducted 30 interviews (14 men and 16 women) using convenience sampling in three of Lahore's busiest shopping hubs. We tried reducing bias by maintaining a gender balance among the respondents and ensuring that they belonged to different age groups and had varying education and income levels.

Phase 1: Quantitative Study

The surveyors were trained to ensure the quality and accuracy of the responses. They would carry printed copies of the survey to the field site, explain the research scope to interested respondents, obtain informed consent, explain the questions and options in either English or a local language to respondents who may have had little to no schooling, and then ensure that the respondents answer all the questions. The average time taken to complete the survey was 20–25 min. Table 1 depicts details regarding the demographic characteristics of the survey respondents.

Survey
The survey comprised a total of 53 questions and was divided into the following six sections.

1) *Sociodemographic characteristics:* We asked the respondents to indicate their gender, age, education level, employment status, occupation, and monthly household income.
2) *Awareness regarding COVID-19-related information:* The respondents were asked whether they agreed, disagreed, or were unsure about the 17 statements related to COVID-19. Out of the 17 statements, 12 were false and five were factual. The statements were divided into the following categories: religious rhetoric (Five statements), incomplete scientific knowledge (Five statements), rumors about COVID-19 vaccines (three statements), and popular conspiracy theories (four statements). The statements for this section were meticulously extracted from websites of credible

TABLE 1. Demographic characteristics of respondents in the quantitative study (*N* = 380).

Gender	*N*	%
Male	214	56.32
Female	165	43.42
Prefer not to say	1	0.26
Age		
18-29	142	37.37
30-39	103	27.11
40-49	71	18.68
50-59	45	11.84
60-69	18	4.74
70 or older	1	0.26
Education		
Undergraduate degree (BA/BSc, etc.)	126	33.16
Intermediate (Senior High School)	74	19.47
Matric (Junior High School)	56	14.74
Postgraduate degree (Masters/PhD)	49	12.90
No schooling completed	31	8.16
Middle (grades 6 through 8)	24	6.32
Primary (grades 1 through 5)	11	2.90
Below Primary	6	1.58
Diploma/Certificate	3	0.79
Monthly Household Income		
Rs. 0-25,000	106	27.90
Rs. 50,000-100,000	88	23.16
Rs. 25,000-50,000	79	20.79
Rs. 150,000+	56	14.74
Rs. 100,000-150,000	51	13.42
Social Media Usage		
Users	315	82.90
Non-users	65	17.10

organizations and local newspapers, such as WHO and The Express Tribune, respectively, based on their popularity on social media platforms in Pakistan's context.

3) *Risk perceptions:* This section examined whether or not our respondents think that the COVID-19 pandemic is still a threat.

4) *Belief in government, religion, and science:* To shed light on the sociocultural factors that influence COVID-19 misinformation consumption, we asked the respondents about their trust in government, religion, and science.

5) *Information sources:* This section gauged the usage and perceived credibility of digital and nondigital COVID-19 information sources.

6) *Vaccine preferences:* This section explored the respondents' motivations to accept a vaccine during the rise of misinformation about COVID-19 vaccines in Pakistan.

Statistical Analysis

Awareness scores were assessed based on the respondents' belief in COVID-19-related statements. If a respondent identified the truth value of a statement correctly or incorrectly, they were assigned a score of 1 or −1, respectively. If the respondents answered "Not sure,"

they were given a score of 0. A sum of their scores in each of the aforementioned categories was calculated, and these scores were then used to represent the respondents' tendency to believe in a particular category of misinformation. To compare awareness scores of different types of social media users (frequent, moderate, and nonusers), we obtained a cumulative sum of their scores for all the categories. The remaining sections in the survey consisted of a combination of a five-point Likert-type scale and multiple-choice questions. A weighted sum of the responses in each section was assigned as the respondents' perception score for the corresponding category (trust in science, religiosity, trust in government, vaccine hesitancy, and perceived risk of the virus).

Quantitative data were analyzed using IBM SPSS version 28.0 and Python 3.8 scripts. Summary statistics were used to quantify demographic variation in our survey sample. A series of nonparametric tests, such as the Kruskal–Wallis test and Mann–Whitney U test, were deployed to examine the significance of differences in the respondents' perception and awareness score distributions. Furthermore, we extrapolated multiple Spearman's rho correlations between respondents' sociodemographic characteristics and awareness and perception scores. In addition, we supplemented our findings with qualitative data to ensure effective triangulation.

Phase 2: Qualitative Study

The qualitative component, comprising semistructured interviews, was carried out by anthropologists in our core research team. They had the expertise to build rapport with the respondents (see Table 2) and address any sensitivity during extended conversations.

Procedure and Interview Guide

An interview guide was used to ask open-ended questions while allowing respondents to express themselves freely and informally. All interviews were conducted in-person at malls and bazaars, and then audio-recorded and transcribed into English. Respondents provided informed consent to record the interviews, each of which lasted 30–60 min. Data collection continued until a saturation point was reached, at which point additional interviews revealed no new information for analysis.

The interview guide was divided into six sections. The first section comprised the respondents' backgrounds, whereas the second section probed into beliefs related to COVID-19 information and the respondents' reasons for agreeing or disagreeing with the 17 statements. In addition, it investigated the sociocultural factors,

TABLE 2. Characteristics of respondents in the qualitative study ($N = 30$).

Gender	N	$\%$
Male	14	46.67
Female	16	53.33
Age		
18-29	14	46.67
30-39	6	20
40-49	6	20
50-59	0	0
60-69	1	3.33
70 or older	1	3.33
Prefer not to say	2	6.66
Education		
No schooling/Primary	13	43.33
Higher Secondary	9	30
Undergraduate degree	8	26.67
Monthly Household Income		
Rs. 0-25,000	16	53.33
Rs. 50,000-100,000	8	26.67
Rs. 150,000+	6	20.00
Rs. 25,000-50,000	0	0
Rs. 100,000-150,000	0	0
Social Media Usage		
Users	24	80
Non-users	6	20

such as religion and politics, that play a role in forming their perceptions of COVID-19. The "Methodology" and the "Findings and Discussion" sections explored the respondents' understanding of COVID-19 origins, treatment, and risks. The "Limitations" section uncovered the COVID-19 information sources that the respondents rendered trustworthy or untrustworthy and their reasons for doing so. Finally, in the "Conclusion" section, vaccine perceptions were examined to gauge how they are impacted by increasing misinformation about COVID-19 vaccines.

Data Analysis

The transcribed interviews were uploaded on NVivo, and a thematic analysis was conducted. We read each transcript line-by-line and identified codes that would describe sentences and phrases emerging from the data conducive to answering the research questions. The codes were then clustered into themes and subthemes, and similar codes were collated to avoid repetition. The core themes that emerged from the data were then analyzed to form interpretations and explain quantitative results.

FINDINGS AND DISCUSSION

We summarize and discuss the findings from surveys and interviews responses by answering our research questions.

RQ-1: What are the primary sources of COVID-19-related (mis)information?

Most of the survey and interview respondents in this research were young (< 40 years old), which is not surprising considering that 63% of Pakistan's population comprises youth aged between 15 and 33.[20] Social media usage is, therefore, expected to be significant across the country. Our survey sample corroborates this aspect, as 83% of the survey respondents and 80% of the interviewees, out of which 72% and 67% were less than 40 years old, respectively, reported using different types of social media platforms.

Figure 1 indicates that the respondents perceived social media as the most popular source of COVID-19-related misinformation ($\approx$60% respondents). A platformwise distribution of misinformation sources is depicted in Figure 2, as perceived by respondents who claimed to have used social media to access COVID-19-related information. Respondents could select more than one social media platform. While Facebook and WhatsApp top the list, with more than 300 users from a total of 315 respondents, our respondents also voted for YouTube, TikTok, Twitter, and Instagram, signifying that they had access to a diverse set of social media platforms.

From the semistructured interviews, we found that older women from lower income backgrounds had limited access to smartphones and the Internet, and thus relied either on television or their family and friends who used social media to provide them with information on COVID-19, which may or may not have been factual. Overall, 14 out of 30 interviewees expressed trust in the information shared by their family and friends over social media. The potential harm of exhibiting trust in particular sources is that it creates echo chambers and filter bubbles, whereby people share similar viewpoints that contribute to confirmation biases, and thus, reinforce susceptibility to misinformation.

Although abundant misinformation is present on social media platforms, our results show that the survey respondents, who were social media users in our sample, were more aware of COVID-19-related information than nonusers. Figure 3 models the distribution of the cumulative awareness scores of users and nonusers of social media. The median awareness and mean rank awareness scores of users are much higher than those of nonusers. The mean rank scores were calculated using the Mann–Whitney U test, and the variation between social media usage and participants' awareness was significant (*p*-value < 0.01). We used the Kruskal–Wallis test to compare mean rank awareness scores with participants' frequency of social media usage (none, moderate, and high) and all three
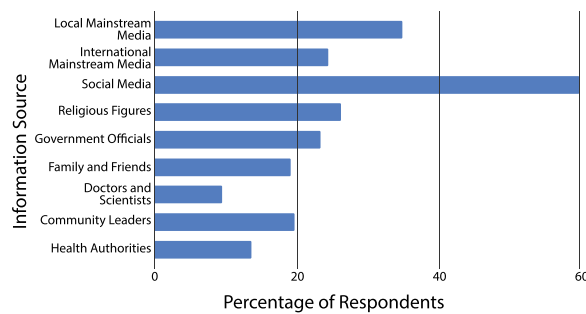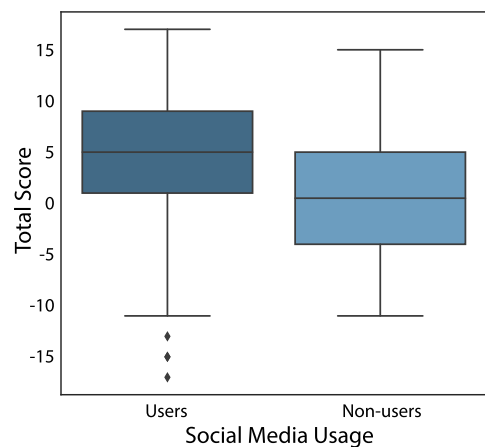
FIGURE 1. Sources of misinformation as perceived by the respondents.
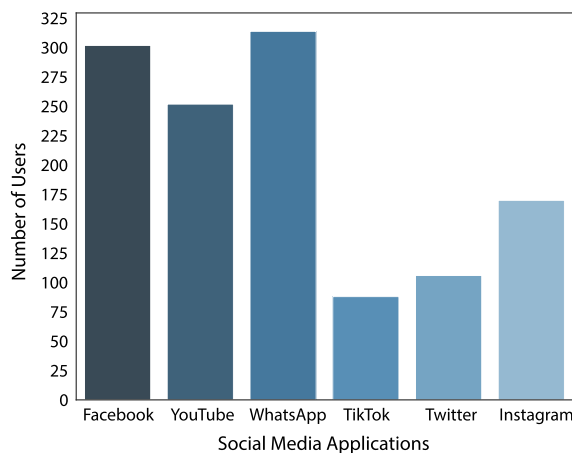
FIGURE 2. Prevalence of misinformation on various social media platforms, as reported by respondents who actively use social media.

FIGURE 3. Distribution of the cumulative awareness scores of users and non-users of social media.

comparisons were statistically significant (p-value < 0.05). The median awareness score was higher for those participants who actively used social media, as shown in Figure 4. While social media may be a popular channel for misinformation proliferation, it also facilitates the spread of authentic information. As most of the social media users in the sample are young people, we infer that they are more aware of the dynamics of social media, and their increased exposure to social media means that they are better equipped at spotting and navigating misinformation online.

While the survey respondents were aware of the prevalence of misinformation on social media as well as other platforms, they remained unclear on verifying the information related to COVID-19 origins, treatment, and vaccines that they came across. Although a significant proportion (77%) reported that they at least attempted to verify COVID-19-related information from different sources (e.g., friends, family, and Facebook groups), only 30% of them verified information against authentic sources. The proportion of users who attempted to verify COVID-19-related information with respect to social media usage is shown in Figure 5. These results are in line with our previous finding that awareness scores increase with higher social media consumption.
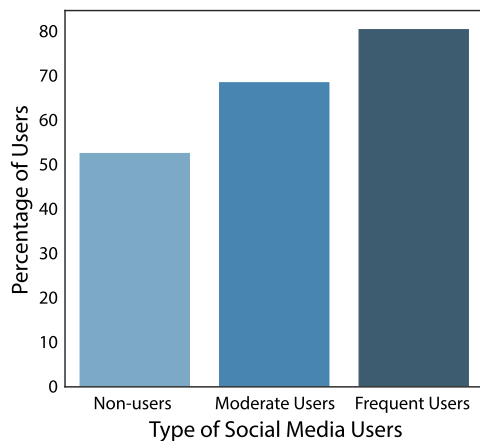
Both the survey and interview respondents directly and indirectly used social media, particularly WhatsApp and Facebook, where they were exposed to a plethora of COVID-19-related (mis)information. The survey helped us determine that the young respondents, predominantly social media users, knew that they came across misinformation regularly on social media but did not verify the information using authentic sources. On the other hand, the interviews allowed us to identify that those who did not have access to social media, especially older people, had indirect access to it through friends and family members, whom they viewed as trusted sources.

RQ-2: How do sociodemographic differentials (e.g., income and education) impact people's awareness about COVID-19-related misinformation?

The data reveal that the survey respondents with higher education and income levels had higher awareness scores, and this variation was significant (p-value < 0.01). The distribution of awareness scores across educational and income levels is shown in Figures 6 and 7, respectively. Figure 8 illustrates the relationship between each income level and compares their mean ranks. It shows that there was no significant variation in awareness scores across adjacent income groups. However, groups with greater financial disparities
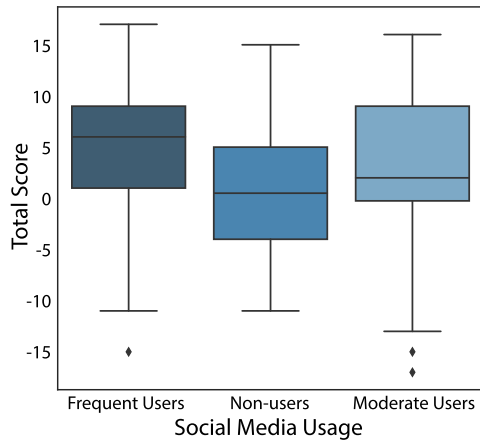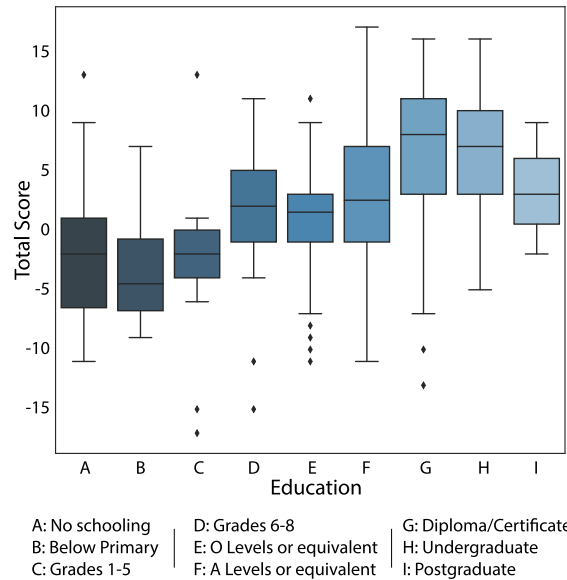
FIGURE 4. Distribution of the cumulative awareness scores of respondents.

A: No schooling   D: Grades 6-8   G: Diploma/Certificate
B: Below Primary   E: O Levels or equivalent   H: Undergraduate
C: Grades 1-5   F: A Levels or equivalent   I: Postgraduate

FIGURE 6. Variation in awareness scores in accordance with educational levels.

FIGURE 5. Proportion of social media users that verify COVID-19-related information.

showed substantial variation in awareness ratings, with the lower income group scoring less.

Similarly, interviewees from high-income and well-educated backgrounds were more wary of COVID-19 preventative measures, interviewees from low-income and poorly educated/uneducated backgrounds paid little attention to them and claimed to continue attending social gatherings during the pandemic amid all the four waves of COVID-19. A respondent with an undergraduate degree, belonging to a high-income background, expressed, "I don't think people are following COVID-19 precautionary measures in Pakistan. People do not care about COVID-19 here at all" (R7). His response stood in contrast to that of the low-paid, uneducated janitorial staff members and waiters. One of the waiters, for instance, said, "We live the same life
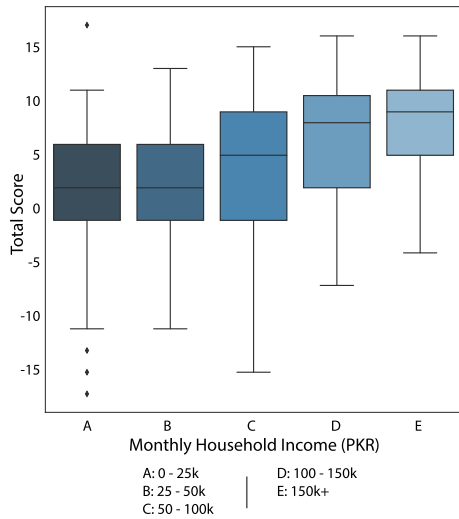
as it was before the pandemic. I still attend all the gatherings with friends" (R4).

Interviewees who belonged to low-income and poorly educated backgrounds struggled to discern the difference between COVID-19 and the common flu, and particularly emphasized upon the importance of mental and spiritual strength in fighting against the virus. One of our interviewees, for instance, exclaimed, "COVID-19 is just hearsay. A fear. Whoever thinks about it falls prey to it" (R11).

Therefore, both the survey results and interviews depict that respondents from high-income and relatively more educated backgrounds, compared to respondents with low-income and poor education levels, were more aware of COVID-19-related misinformation.

RQ-3: Which types of COVID-19 misinformation garner support, and what are the sociocultural aspects undergirding their support?
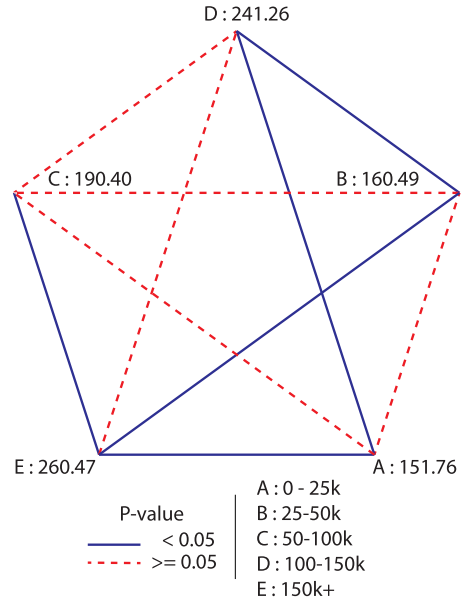
We presented a set of 17 misinformation statements related to COVID-19 to both survey and interview respondents. For the quantitative component, the respondents were asked to agree or disagree with the statements or indicate their lack of surety. In contrast, for the qualitative component, the interviewees were asked to do the same but additionally elucidate their responses to shed new light on the sociocultural aspects impacting their beliefs about COVID-19. The cumulative percentage of survey respondents who were able to identify the truth-value or were unsure about it (as they were not penalized and clubbed

FIGURE 7. Variation in awareness scores in accordance with income levels.

FIGURE 8. Pairwise comparison of income levels and awareness scores. Each node shows the sample average rank of monthly household income (in PKR).

together) for each statement is given in Table 3. Statements about COVID-19 origins and symptoms, the reliability of vaccinations, and religious rhetoric were misconstrued by most participants. Table 4 and Figure 9 provide additional metrics that assess the ability of survey respondents to classify the (mis)information statements posed to them.

Predominantly, mistrust in the government was evident from the survey and interview responses concerning the 17 COVID-19-related statements. More than 50% of both survey and interview respondents believed that the government was exaggerating the number of COVID-19 cases in Pakistan to acquire foreign funding. As the interviews depicted, mistrust in the government stemmed from political volatility in the country, whereby the locals commonly perceived the politicians and bureaucrats to be corrupt, serving vested interests and misusing public funds. Interviewees also exhibited concern about the government-enforced price hikes during the pandemic, which had disproportionately affected the poor. An interviewee exclaimed, "All the government cares about are donations, and the cases they show are merely for international aid. It is affecting Pakistan badly. Children are still dying of hunger. The poor are becoming poorer" (R8). Mistrust in the government also sprung from the frustration at lockdown policies that were not adequately followed by the government authorities. One of the respondents, for instance, voiced his frustration, "Why, if COVID-19 exists, is it not a concern for the government when they carry out political rallies? Meanwhile, wedding halls, offices, and shopping malls were shut down. Why so?" (R21).

Moreover, nearly 30% of all interviewees expressed mistrust in medical experts and were reluctant to consult a doctor for COVID-19 treatment. They believed that "medical practitioners are purposefully murdering COVID-19 patients to earn money," which is a widely spread social media allegation in Pakistan. Rumors such as these may transmit online and carry the potential to misinform individuals in large numbers. The qualitative responses reveal that the surrounding modalities of social media, such as videos and images, play a significant role in misinformation transmission. A respondent narrated, "someone showed me a video where they said that their brother did not have COVID-19 and he went to the hospital. He was diagnosed with COVID-19 there. Whether someone has it or not, doctors are diagnosing everyone with COVID-19 and killing them" (R19). Such mistrust in medical experts and scientific treatments is deepened by the abundance of (mis)information, promoting conspiracies and pseudotreatments, available online.

In the absence of strong trust in government and medical experts, religion has played a particularly important role in people's lives as a means of seeking protection from COVID-19. As Pakistan is primarily a Muslim majority country, Islam played a significant role in shaping people's beliefs of COVID-19. The correlation matrix in Figure 10 shows a negative relationship between religiosity and awareness of religious

TABLE 3. Percentages of respondents who were able to identify the truth value or were unsure about it for each of the 17 statements in the survey.

Statement	Accuracy (%)
Pregnant women can receive a COVID-19 vaccine.	55.8
If you already got infected with COVID-19, you still need to get the COVID-19 vaccine.	70.8
Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with COVID-19.	46.3
Isolation and treatment of people infected with COVID-19 are effective ways to reduce the virus spread.	79.5
Antibiotics cannot prevent or treat COVID-19.	54.3
COVID-19 cannot survive in hot and humid climates.	77.1
COVID-19 is a conspiracy against Muslims.	69.8
The government is exaggerating the number of COVID-19 cases and deaths in Pakistan.	46.6
If you have performed ablution and prayers, COVID-19 will not affect you.	51.3
After receiving the COVID-19 vaccine, people can die within two years.	88.9
COVID-19 does not exist.	89.2
The virus causing COVID-19 was engineered in a Chinese laboratory on purpose as part of a conspiracy.	70.8
The COVID-19 vaccine contains a tracking microchip to monitor people.	87.8
Muslims are less impacted by COVID-19 as compared to non-Muslims.	55.0
The COVID-19 pandemic is God's punishment for peoples' wrongdoings.	48.9
Having ginger and garlic can help cure COVID-19.	64.5
COVID-19 vaccine can cause infertility.	82.9

conspiracies about COVID-19. It is worth noting that stronger religious tendencies are related to lower scores of COVID-19 awareness. The qualitative findings provided rich insights into the types of religious beliefs that were fostering beliefs in COVID-19 misinformation. Nearly 63% of the interviewees referred to religion to reason about their understanding of the COVID-19 pandemic. Interviewees had varied ideas on how COVID-19 originated and why it was affecting people worldwide, and they primarily used religious rhetoric to explain their answers. Most interviewees believed that the COVID-19

TABLE 4. Precision, Recall, and F1 scores of respondents' labeling of the 17 misinformation statements in the survey.

	Precision	Recall	F1
False statements	0.81	0.69	0.75
True statements	0.46	0.61	0.52

pandemic was God's punishment for the ill deeds of humanity. An interviewee explained, "This may be true, as people are astray and they don't focus on their beliefs. Previously, there was this dengue, and now it's the coronavirus. It keeps going on!" (R10). The interviews further shed light on how conspiracy theories of religious nature were spread and reaffirmed through social media platforms. An interviewee explained, "It was portrayed in a video on social media where they (non-Muslims) showed their missiles and stated that they would destroy the Muslim countries who have the ability to retaliate with these missiles. Whereas those who wanted peace would be destroyed by a vaccine. That made me believe that COVID-19 is a conspiracy against Muslims" (R8).

Furthermore, more than 30% of the interviewees expressed doubts in the effectiveness of vaccines. Some of them had gotten vaccinated as per the requirements of their employers. In the absence of any such requirement, only a few interviewees were willing to get vaccinated. An interviewee explained, "I watched an interview on social media that the government is intentionally killing its people. Initially, the health ministry said to get a vaccine of your own will, and now they are blackmailing us that you would not get entry in malls, you would not get petrol, and you can't travel. So, a man becomes afraid" (R11).

The public's existing frustration and mistrust toward the government, lack of trust in medical experts and sci-
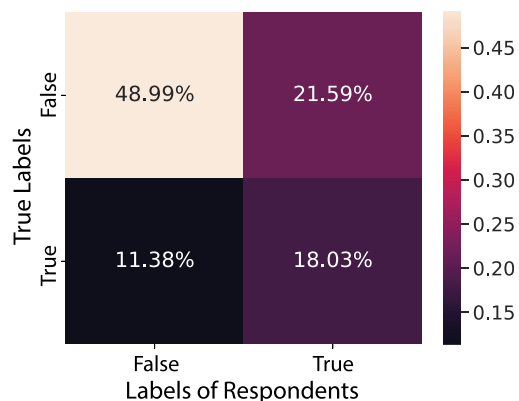
FIGURE 9. Confusion matrix of respondents' and actual labels of the 17 misinformation statements in the survey.
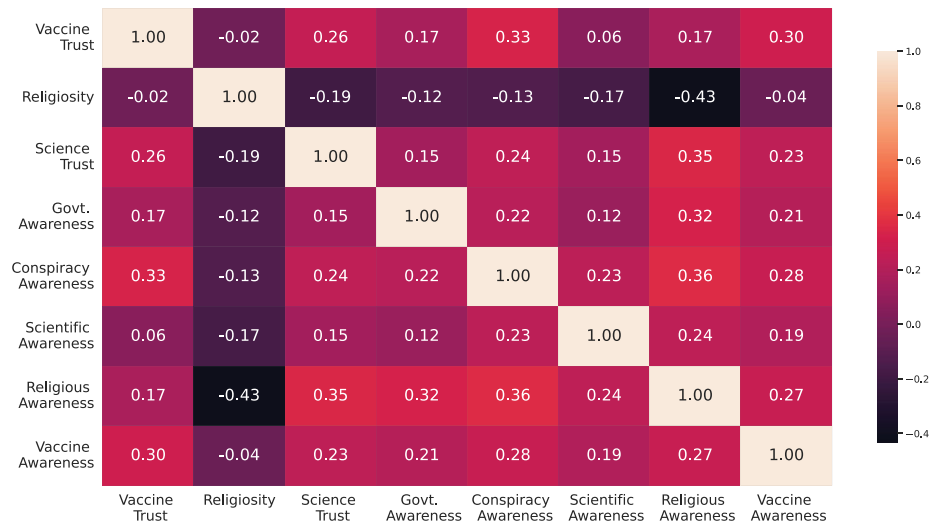
FIGURE 10. Spearman's rho correlation matrix between perception and awareness scores.

entific evidence about COVID-19, and the overuse of religious rhetoric to explain COVID-19 origins and transmission, as well as the proliferation of misinformation on social media, explain how people's perceptions and beliefs about COVID-19 are shaped in Pakistan's context. The sociocultural nuances underpinning the types of misinformation statements that the respondents believe in are necessary to take into account to shed light on their awareness regarding COVID-19 and explain why they give credence to certain kinds of misinformation.

LIMITATIONS

This research should be considered in light of some limitations. First, the in-person surveys do not account for the surrounding modalities of social media, such as images, videos, and comments of other users—all of which may profoundly impact how users perceive information on the web in real life. Second, the sample could be more representative if other public avenues, such as universities, colleges, and hospitals, had been incorporated into the study. However, the fear of contracting COVID-19 in enclosed spaces amid the fourth wave and the government's imposition of lockdowns in the city rendered it arduous to include the aforementioned locations, and we were subsequently compelled to deploy convenience sampling. As a result, the findings of this study are not generalizable to the population of Pakistan. Third, the list of true and false information statements used in this research is not exhaustive, and thereby, deploying a more extensive and diverse pool of statements could reap more accurate estimates. Fourth, given the sample size, accounting for the implications of confounding factors could not come to fruition. For this reason, variables of

interest were segmented into multiple categories (e.g., varying educational levels alongside low, moderate, and high levels of social media usage) and trends were explored within those categories. Finally, academic circles have primarily focused on understanding the interconnections between social media usage, misinformation, and sociocultural nuances in high-income countries during the pandemic.[3] However, this study examines a relatively understudied topic within the South Asian context and uses a mixed methods research design, a methodology not commonly chosen by researchers in Pakistan. As a result, a limited number of prior research studies focusing on South Asia could help lay a foundation for understanding our research problem. Conversely, this limitation can serve as a timely opportunity to address the research gap and highlight the need for further research.

CONCLUSION

This article used mixed methods research design to examine how exposure to social media, alongside misinformation proliferation and sociocultural dimensions, impact people's understanding of COVID-19. We find that the proliferation of misinformation is pronounced among social media users with low-income and low-literacy levels, as they lack media and public health literacy to distinguish between accurate and false information. Furthermore, a substantial proportion of the respondents exhibited limited trust in the information provided by the government and medical experts. Instead, owing to sociocultural nuances, they readily believed in political-, scientific-, and religious-sounding misinformation, especially that their family and friends shared across social media platforms.

People's susceptibility to misinformation poses a severe threat to public health. Therefore, we stress the need for efficient communication flow, particularly on social media platforms, such as WhatsApp and Facebook, that are frequently used, as well as contextual awareness programs that consider the speed and ease with which misinformation spreads. Relevant sociocultural factors also need to be considered to help policy makers shape COVID-19-related policies, increase media and public health literacy, and encourage positive health behaviors. Such interventions may also facilitate spreading cognizance about how important it is to recognize that scientists and medical experts need to be trusted during a health crisis.

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