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Spatial variations in COVID-19 risk perception and coping mechanism in Pakistan

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Abstract

The outbreak of novel coronavirus disease (COVID-19) was declared a pandemic by the World Health Organization, which instigated governments to impose lockdowns across their countries. Amidst the lockdown in Pakistan, this study comprised measures of the COVID-19 risk perception, coping mechanism, and spatial variations. The data from 40 selected indicators was collected using an online questionnaire and grouped into domains (4 risk perception and 3 coping mechanisms domains). The results revealed the spatial variations and the levels of risk perception and coping mechanisms within the study area. Relative to each other, overall risk perception was highest in Northern Areas (Gilgit-Baltistan and Azad Jammu and Kashmir) and Islamabad, and lowest in Balochistan province. Very little spatial variation was observed in terms of coping mechanisms. Age, gender, and marital status influenced the risk perception associated with COVID-19. The findings suggest spatial variation in risk perception, implying the need for localized and modified COVID-19 risk communication and risk reduction strategies.

Keywords

Community response, Coronavirus, Pandemic, Risk communication, Risk management

1. Introduction

The recent worldwide outbreak of the coronavirus disease (COVID-19) has put forth discussions among the public, policymakers, scientists, and country heads about pandemics and their direct and indirect impacts on human lives. The novel COVID-19 was declared a pandemic by the World Health Organization (WHO) on 11 March 2020. According to the WHO, COVID-19 is an infectious disease that causes many cases of mild to moderate respiratory illness. At the same time, those with underlying health conditions or older age can develop severe conditions [1]. Since it mainly spreads through respiratory droplets and contact routes [2, 3], the governments advised people to maintain social distancing (stay approximately 2 m apart) when outside – some countries also imposed complete or partial/smart lockdowns bringing everyday life to almost a complete halt.

The first COVID-19 case was officially reported by China [4]. As of August 2022, 600 million confirmed cases and 6,484,700 associated deaths had been reported worldwide due to COVID-19. Over 12 billion vaccine doses have been administered [5]. To counter such a rapid spread of infection worldwide, a greater emphasis has been placed on mass screening, identification of cases in the community, isolating them, and quarantining the cases to prevent further spread [6, 7]. The strategy to contain COVID-19 with the social

distancing and lockdown of cities and countries has impacted people, organizations, and governments in unprecedented ways [8,9,10]. Businesses have been shut down, people lost their jobs, and the whole supply chain has been disrupted [11]. But the impact has not been uniform for all people, as different people have different physical and psychosocial capacities [12]. However, the direct and indirect impacts of lockdowns are not entirely clear and are still unfolding.

COVID-19 has infiltrated almost every country, and Pakistan has not been an exception. The country is spatially located adjacent to the infection's epicenters, i.e., The Peoples' Republic of China and the Islamic Republic of Iran. Pakistan reported its first confirmed COVID-19 cases, imported from Iran, on 26 February, 2020 [13, 14]. Both cases had a travel history to the Islamic Republic of Iran. To date (as of 27 August 2022), 1,568,183 confirmed cases and 30,571 COVID-19 deaths had been reported, while 291,878,652 vaccine doses have been administered [13]. As a lockdown strategy was used to "flatten the curve", provincial governments under the federal government's ambit initiated the safety protocols. As the number of cases jumped, the provincial government of Sindh announced the lockdown on 23 March 2020, initially for 14 days [15]. To contain the further spread, the provincial governments of Punjab, Khyber Pakhtunkhwa, and Balochistan also went into lockdown on 24th and 25th March 2020 [16]. However, it was soon realized that community cooperation is vital for a successful lockdown.

Risk perception is widely used in disaster risk and climate change adaptation literature to examine individuals, communities, and nations regarding predisposition to accept government policies for a potential hazard [17]. It is also used for predicting the willingness of communities to undertake precautionary measures [18]. In the case of COVID-19, it has been asserted to assess risk perception to support a more effective response [19]. Similarly, for safeguarding mental health, coping mechanisms need to be developed. Despite well-proven knowledge about preventive measures, people still perceive the risk of infectious diseases differently. The level of risk perception varies significantly amongst different individuals. Hence, it becomes imperative to study the risk perception and coping mechanisms to mitigate the negative impacts of COVID-19, and design effective risk communication and reduction strategies. There is also a need to understand how risk perception may vary spatially. Examining the risk perception of the public in the pre-vaccination phase, this study aims to measure COVID-19 risk perception and coping mechanisms, and their spatial variations in Pakistan.

2. Risk perception and pandemics

The scientific community classified diseases as endemic, epidemic, and pandemic [20]. Endemic diseases are the one that continuously stays in a region all over the year, like tuberculosis and hepatitis in Pakistan, or human immunodeficiency virus (HIV) in African countries. Epidemics are diseases that rapidly increase in a specific region at a particular time, and if the epidemic spreads on a global scale, it is called a pandemic [21]. This classification is primarily based on the occurrence and spreading over a geographical area [20]. The word 'pandemic' comes from the Greek words; "pan" which means "all" and "demos" mean "people" [22]. However, pandemics are not something new to humanity. In the past, major pandemics happened in different parts of the world, resulting in an unbelievable number of people losing their lives. A few prominent pandemics are the black death (1331 to 1353), the third plague pandemic (1855), and the Spanish flu (1918 to 1920) [23]. However, the risk of pandemics was never as high in the past as it is in the current age of time. In today's world, humans can travel thousands of miles within hours with multiple layovers. Traveling provides a decent medium for propagating viral infections from one part of the world to another in no time. COVID-19 is a recent example, as this took just four months from the first confirmed case to four million cases.

Risk perception is an important concept that helps gauge the community or individual judgment, reaction, or acceptance regarding an event [24]. It is defined as "...beliefs about potential harm or the possibility of a loss. It is a subjective judgment that people make about the characteristics and severity of a risk" [25]. Risk perception has been massively studied in the fields of psychology, social science, disaster risk, and climate change and has gained much importance in pandemic-related dissertations. In the case of a pandemic, risk perception can be imperative in assessing how severely it could impact a society [26]. The study further highlighted that those individual perceptions and behaviors in case of an infectious disease outbreak, such as staying home, limiting social interaction, taking medicine, etc., would reduce the infection risk at an individual and community levels. People with high-risk perceptions are likely to comply with relevant guidelines in case of an infection outbreak, which therefore lowers their probability of getting affected by a pandemic [27, 28]. Moreover, knowing how risk is perceived is crucial for formulating an effective plan for communicating risk and controlling the outbreak of pandemics [29, 30].

Several studies have investigated the risk perception of communities toward pandemics. A study examined the factors associated with risk perception of pandemic influenzas in Australia, and found location (urban or rural), language, age, and income being crucial in shaping risk perception [30]. Another study explored the dynamics of risk perceptions and precautionary behavior in response to the 2009 (H1N1) pandemic influenza in the United States [26]. They found that household size, gender, and geographical aspects were important in perceiving risk and participating in precautionary activities. While studying the risk perception of the adult population to Avian Influenza in Italy, a study found higher risk perception for less educated people with lower socioeconomic status [28]. Similar results were highlighted in the case of severe acute respiratory syndrome (SARS) risk perception in the Netherlands [31]. The study mentioned that higher risk perceptions were associated with more worry and self-reported precautionary actions. Another study observed the effect of risk perception on the dynamics of the H1N1 pandemic. The study found that mass media campaigns affect risk perception and behavior changes during a pandemic.

In the case of COVID-19, a recent trend in risk perception has started emerging. A study examined the role of socioeconomic factors and social media use on risk perception [32]. This study revealed that social media might contribute to unwarranted fear or overly pessimistic risk perception. Zeballos Rivas et al. (2021) indicated that high social media exposure leads to higher risk perception in Bolivia [33]. Using longitudinal analysis in the UK, Schneider et al. (2021) suggested that socioeconomic factors, direct experience, trust in government, science, and medical professionals, as well as personal and collective efficacy, influence the risk perception of COVID-19 [34]. Gerhold (2020) studied COVID-19 risk perception and coping strategies of people in Germany [35]. The results show that younger people perceive risk more than older people, while men are less concerned about COVID-19 than women. Zeballos Rivas et al. (2021) found the same in Bolivia [33]. A recent study in sub-Saharan Africa shows young people have a lower risk perception of COVID-19 [36]. Similarly, a study in the Netherlands shows that young adults perceive low risk where affective response for their well-being is also low, but is higher for other vulnerable people leading them to adhere to most preventive guidelines frequently [37]. Researchers studied the risk perception of COVID-19 among pharmacists and suggested that the role of media, gender, living in a city, and having children were all associated with an increased perception of COVID-19 risk [38]. Another study examined the risk perception among the public in Finland by analyzing multiple factors and providing recommendations for meaningful risk perception [39]. A study in Pakistan also highlighted the gender differences in COVID-19 risk perception [40]. Another important factor is vaccination which could influence risk perception and vice versa. Recent studies suggested that higher risk perception leads to acceptance and willingness to get vaccinated against COVID-19 in South Carolina [41], Italy [42], and the Netherlands [43]. Despite significant research on COVID-19, studies on the spatial

aspect of COVID-19 risk perception and coping mechanisms are limited and require investigation.

3. Methods

This study relies on the primary data collected through an online questionnaire survey – the survey was designed to capture several aspects of COVID-19 risk perception, where one of the aspects, gender perspective, has been detailed in an earlier study [40]. The current study, touching upon the topic from a different dimension, presents the spatial interpretation of COVID-19 risk perception and coping mechanisms in Pakistan using the same data/indicators. The respondents participated voluntarily in the online survey. The purpose of using the collected data for academic and research purposes was clearly communicated, and consent was sought. The data collected was completely anonymous, and no personally identifiable information was obtained. It is also important to mention that the data was collected before any vaccination was developed.

This study assessed two components: (1) perception of risk related to COVID-19; and (2) behavioral approaches to cope with this pandemic in Pakistan. Apart from examining the relationship between different socioeconomic and risk perception indicators, this study also investigates the spatial variability in risk perception by grouping and analyzing the data from various administrative regions. The official figures on the number of COVID-19-related cases and deaths were also acquired and used to explain any relationship between risk perception (and its spatial variation) and the on-ground pandemic situation.

This study was conducted in Pakistan, which covers an area of around 796,096 sq. km. The country is administratively divided into four provinces, two autonomous territories, and one capital territory. In terms of area, the largest province is Balochistan, and the smallest is Islamabad Capital Territory (ICT). The study area map is presented in Fig. 1.



Fig. 1. Map of the study area.

3.1. Questionnaire design and indicators

A detailed questionnaire was developed to collect the data from individual respondents within four dimensions: (1) socioeconomic characteristics, (2) public health emergency experience, (3) COVID-19-related risk perception, and (4) behavioral approaches to cope with the adverse impacts of this pandemic. The geographical location of the respondents was also attached to each response through a question asking the city name of the respondent. Table 1 gives an overview of the selected dimensions and domains. To describe the socioeconomic characteristics of the respondents, ten indicators - age, gender, education, marital status, household size, type of family, monthly income, profession, number of children/teenagers in the house (< 18 years old), and number of old people in the house (> 60 years old) were selected. The experience of respondents with public health emergencies was assessed through four indicators, namely isolation days (lockdown days), sources of information regarding COVID-19, storing food and other essential items, and past experience of dealing with any public health emergency.

Table 1. The various dimensions and indicators of risk perception established for this study

Dread, Fear, and Worry	
F-1	How much are you afraid for your life from a COVID-19 infection?
F-2	How likely do you think to get a COVID-19 infection?
F-3	How much are you afraid that COVID-19 will persist/spread in the future?
F-4	How much are you worried that this pandemic will disturb your daily lifestyle?
F-5	How much are you worried that this pandemic is dangerous for your family?
F-6	How much do you think this pandemic is a danger for your community?
F-7	How much afraid are you about this pandemic based on current knowledge?
F-8	What are the chances of supply interruption during this pandemic?
Behavior and Attitude	
B-1	How much do you think can deal with the consequences of this pandemic? *
B-2	How much can you adapt to lifestyles because of this pandemic?
B-3	How much do you think this pandemic can change your relationship with your neighbors and relatives?
Awareness and Knowledge	
A-1	How much are you familiar with precautionary measures against this pandemic?
A-2	How much is your community protected from this pandemic? *
A-3	How much do you agree that COVID-19 is completely new for all of us?
Trust and Confidence	
T-1	How much do you trust the information provided by the government about this pandemic?
T-2	How much do you rely on/trust the information about the pandemic obtained from different sources? *
T-3	How much do you trust disaster management agencies to deal with this pandemic?
T-4	How much do you trust emergency management policies to deal with this pandemic?
T-5	How much do you trust the information provided by your government about this pandemic?
T-6	How much do you trust the response provided by your government?
T-7	How much do you trust that science and experts will develop the vaccine within one year?

Scale (1-very low to 5-very high); * Reversed in analysis

The data to assess risk perception was collected in four domains; (1) dread, fear, and worry (8 indicators); (2) behavior and attitude (3 indicators); (3) awareness and knowledge (3 indicators); and (4) trust and confidence (7 indicators). The behavioral attitude to cope with the COVID-19 pandemic was assessed in terms of three different mechanisms (Table 2), namely problem-oriented (6 indicators), emotion-oriented (7 indicators), and action-oriented (6 indicators).

Table 2. The various dimensions and indicators of coping mechanisms established for this study

Problem-oriented	
P-1	I feel safe in my own home
P-2	I listen to the experts and follow their advice
P-3	I actively seek out new information about the current situation.
P-4	I am doing something completely new that I would never have done in other circumstances
P-5	I talk to someone who knows about it
P-6	I am seeking financial support from the government

Emotion-oriented	
E-1	I turn to my work or other activities to distract myself
E-2	I actively seek meditation to calm myself
E-3	It will emerge over time; there is nothing more to do but wait
E-4	I hope for a miracle
E-5	I try to make myself feel better by eating, smoking, or taking medication
E-6	I refrain from things that can trigger bad moods
E-7	I refuse to believe what is happening
Action-oriented	
BE-1	I wash my hands more than usual
BE-2	I avoid going out unnecessarily
BE-3	I avoid public spaces and transport
BE-4	I have bought disinfectants (soap, sanitizers, etc.) more than usual
BE-5	I have bought staple foods (flour, rice, lentils, meat, etc.) more than usual
BE-6	I have bought protective equipment (masks, gloves, etc.) more than usual

Scale: (1-strongly disagree to agree 5-strongly)

3.2. Sampling and data collection

The data was collected through a voluntary response technique, whereas a non-probability approach was used for sampling. The online survey was conducted between 7 and 16 March 2020 to collect the data for the aforementioned dimensions/domains/indicators. The majority of the responses were received from urban areas of the country. In addition, data on COVID-19-related cases and deaths reported by official sources were also collected to understand and explain the risk perception-related findings of this study.

3.3. Data analysis

The data analysis mainly comprised descriptive and statistical tests. Firstly, the socioeconomic characteristics and public health experience of sampled respondents were analyzed using descriptive statistics. Secondly, the indices of risk perception and coping mechanisms were developed using the aforementioned indicators. The index was calculated using the mean average method for all domains and the overall value. Each average value was tabulated and visualized for region-wise comparisons, and the analysis of variance (ANOVA) test (F-test) was performed to analyze significant differences among them. Lastly, a Pearson's correlation was performed on the overall index to suggest a relationship between socioeconomic characteristics and public health emergency experience with risk perception and coping mechanisms. Table 3 summarizes the dimensions and domains used for assessment and statistical tests.

Table 3. Checklist of assessment and analyses of responses in different dimensions and domains

Data		Assessment and General Analysis			Correlation Analysis	
Dimension	Domain	Descriptive statistics of data	Index development and computation	Spatial variability assessment (region-wise)*	Correlation with risk perception	Correlation with coping mechanisms
Socioeconomic characteristics	-	✓	-	✓	✓	✓
Public health emergency experience	-	✓	-	✓	✓	✓
Risk perception		-	✓	✓	N/A	-
	<i>Dread, fear, and worry</i>	-	✓	✓	N/A	-
	<i>Behavior and attitude</i>	-	✓	✓	N/A	-
	<i>Awareness and knowledge</i>	-	✓	✓	N/A	-

	<i>Trust and confidence</i>	-	✓	✓	N/A	-
Coping mechanisms		✓	-	✓	-	N/A
	<i>Problem-oriented</i>	✓	-	✓	-	N/A
	<i>Emotion-oriented</i>	✓	-	✓	-	N/A
	<i>Action-oriented</i>	✓	-	✓	-	N/A

* Data grouped into six administrative regions: Punjab, Sindh, Khyber Pakhtunkhwa (KPK), Balochistan, Northern Areas (AJK+GB), and Islamabad. N/A: Not applicable

The index was constructed using the average weighted index method (Eq. 1). The selected indicators of risk perception and coping mechanisms were merged to form an index (Eqs. 2 and 3).

$$CI = (W_1 + W_2 + W_3 + \dots W_n) / n \quad (\text{Eq. 1})$$

$$= \sum_{i=1}^n W_i / n$$

$$\text{Overall risk perception} = \frac{\text{Fear} + \text{Behavior} + \text{Awareness} + \text{Trust}}{4} \quad (\text{Eq. 2})$$

$$\text{Overall coping mechanism} = \frac{\text{Problem} + \text{Emotion} + \text{Action}}{3} \quad (\text{Eq. 3})$$

4. Results and discussion

A total of 379 individual responses were collected from all over Pakistan. Given the vast variability in social norms and cultural traditions across the country, the data and findings must be interpreted cautiously. Table 4 shows descriptive statistics of the sampled population. Since the data was collected through an online survey, all of the respondents were mostly young (not many people in the older age group use the internet in the country) and educated (most of the people agreeing to complete the questionnaire had a good understanding of this study and possessed high education level). Descriptive statistics revealed that the respondents were 27.62 years old on average – most were young adults (aged 19–28). Around 63% of the total respondents were males and the rest females, whereas, in terms of marital status, around 68% were single, 30% married, and the rest were either divorced/widowed or did not prefer to disclose. The average household size was around 7. The majority of respondents earned more than PKR 25,001 a month (around 23% earned PKR 25,001-50,000, 29% earned PKR 50,001-100,000 and 27% earned more than 100,000 per month). The most common family type was nuclear (63.9%), and most respondents had at least 1–3 children (51.7%) in their households. However, most of the respondents (59.6%) did not have any older person (60 years old or above) living with them. In the case of past public health emergency experiences, about 8% of the respondents have faced it. These public health emergencies included prevalent diseases like tuberculosis, hepatitis, and poliovirus. In the current crisis, most respondents (82.8%) had stored food for less than one-month duration. Similarly, respondents were from all over the country, with various dates for the imposition of lockdowns in their respective areas. A different response was received on the number of lockdown days observed. At the time of the survey, the majority of the respondents (54.2) were under lockdown for a period of 14–21 days.

Table 4 Descriptive statistics of samples

Descriptive Statistics	Groups	Frequency	Percentage
Socioeconomic Indicators			
Age	<19	16	4.2
	19-28	242	63.9
	29-37	73	19.3
	>37	48	12.7

	Mean	27.62	
	Std. Dev	9.62	
Gender	Male	238	62.8
	Female	141	37.2
Education	Up to Class 10	3	0.8
	College	7	1.8
	University	369	97.4
Marital Status	Single	259	68.3
	Married	114	30.1
	Divorced/Widowed	3	0.8
	I prefer not to say	3	0.8
Household size	<5	84	22.2
	5-7	174	45.9
	8-10	78	20.6
	>10	43	11.3
	Mean	7.09	
	Std Dev	4.25	
Type of family	Living alone	40	10.6
	Nuclear	242	63.9
	Joint	88	23.2
	I prefer not to say	9	2.4
Monthly Income (in PKR)	<10,000	39	10.3
	10,000-25,000	40	10.6
	25001-50,000	88	23.2
	50,001-100,000	111	29.3
	>100,000	101	26.6
Number of children in the house (<18 years old)	0	121	31.9
	1-3	126	51.7
	4-6	49	12.9
	>6	13	3.4
	Mean	1.96	
	Std Dev	2.58	
Number of old people in the house (>60 years old)	0	226	59.6
	1	100	26.4
	2	43	11.3
	>2	10	2.6
	Mean	0.79	
Std Dev	3.2		
Public health emergency experience			
Past experience with a public health emergency	Yes	30	7.9
	No	349	92.1
Food storage	Less than one month	314	82.8
	One month to two months	56	14.8
	Two months to three months	6	1.6
	More than three months	3	8
Isolation days (lockdown days)	Less than a week	6	1.6
	1- Less than two weeks	46	12.1
	2- less than three weeks	206	54.4
	3- less than four weeks	81	21.4
	More than four weeks	40	10.6
	Mean	20.44	
Std Dev	7.67		

The geographical split of responses helped ascertain the spatial variations in risk perception and coping mechanisms within the study area (Pakistan). Using the provincial and regional administrative boundaries as a baseline to group the data, it was found that the lowest number of responses were received from Gilgit-Baltistan and Azad Jammu and Kashmir (AJK) areas. Since both the areas share a border (Fig. 1 study area map), these were dealt with as a single entity and named 'Northern Areas' for this study – the data from these regions was processed accordingly.

Punjab, the most populous province of the country, had the highest representation in the data; 186 responses which is around 49% of the data. A total of 51 (13.5%) and 81 (21.4%)

responses were obtained from Sindh and Khyber Pakhtunkhwa provinces, respectively. Balochistan, the least populated province of Pakistan, constituted around 6% (24 responses) of the data, whereas Northern Areas (Gilgit-Baltistan + Jammu & Kashmir) represented around 3% (10 responses) of the total data. Around 7% (27 responses) of data came from the Islamabad Capital Territory.

The respondents were also asked about potential sources of information they pursued, gaining knowledge and awareness about potential COVID-19 risks. Most respondents relied on multiple sources of information, such as social media, television, local government, and others. The most widely used source of information, as per the data, was social media (86.5%), comprising apps/websites, namely Facebook, WhatsApp, Twitter, and YouTube, followed by television (73.5%). News channels and talk shows were the predominant sources of information on television. Around 31.1% of the respondents also used newspapers as a source of information, while 21.6% received announcements from local governments through community leaders and mosques. A relatively small portion of respondents relied on relatives, friends, and work colleagues, the Centers for Disease Control and Prevention (CDC)/WHO website, and government websites. This shows that social media and television can be used as effective mediums for risk communication in any future event in Pakistan.

4.1. COVID-19 risk perception

The risk perception regarding COVID-19 was measured using indicators and their domains. The mean and standard deviations were calculated to ascertain the level of risk perception against each indicator concerning regions and the whole of Pakistan.

4.1.1. Dread, fear, and worry

Fear is considered a vital domain and is sometimes used alternatively to perceive risk [44, 45]. Perceived fear for life was relatively highest in Sindh and Islamabad regions, probably because the initial cases of COVID-19 reported in the country were from these areas (Fig. 2a). The perceived likelihood of getting infected by this virus was highest in Balochistan. Interestingly, respondents from all regions reported (as perceived) below-average chances of getting infected, which shows a serious lack of risk perception among the citizens. Most of the respondents from all the regions showed a higher chance of increased occurrences of such events in the future. When higher perception values of future increases in occurrences (F-3) are seen in comparison with the chances of getting the infection (F-2), the fatalistic attitude of respondents becomes evident. This implies that although there are chances of increased occurrences, respondents believe that others will be in danger and not themselves. Since respondents were observing lockdown at the time of the survey, all the regions showed a serious concern regarding disruption to daily lifestyles. Similarly, most respondents worried that this pandemic would affect their family members or communities. Due to its novelty and limited scientific understanding to neutralize the infection, there was above-average fear based on current knowledge in all regions. Regarding the fear of supply chain interruption in lockdown extensions, all the regions showed above-average fear. Spatially, the fear domain showed almost similar values among all the regions of Pakistan, indicating that it was more or less similar throughout the country.

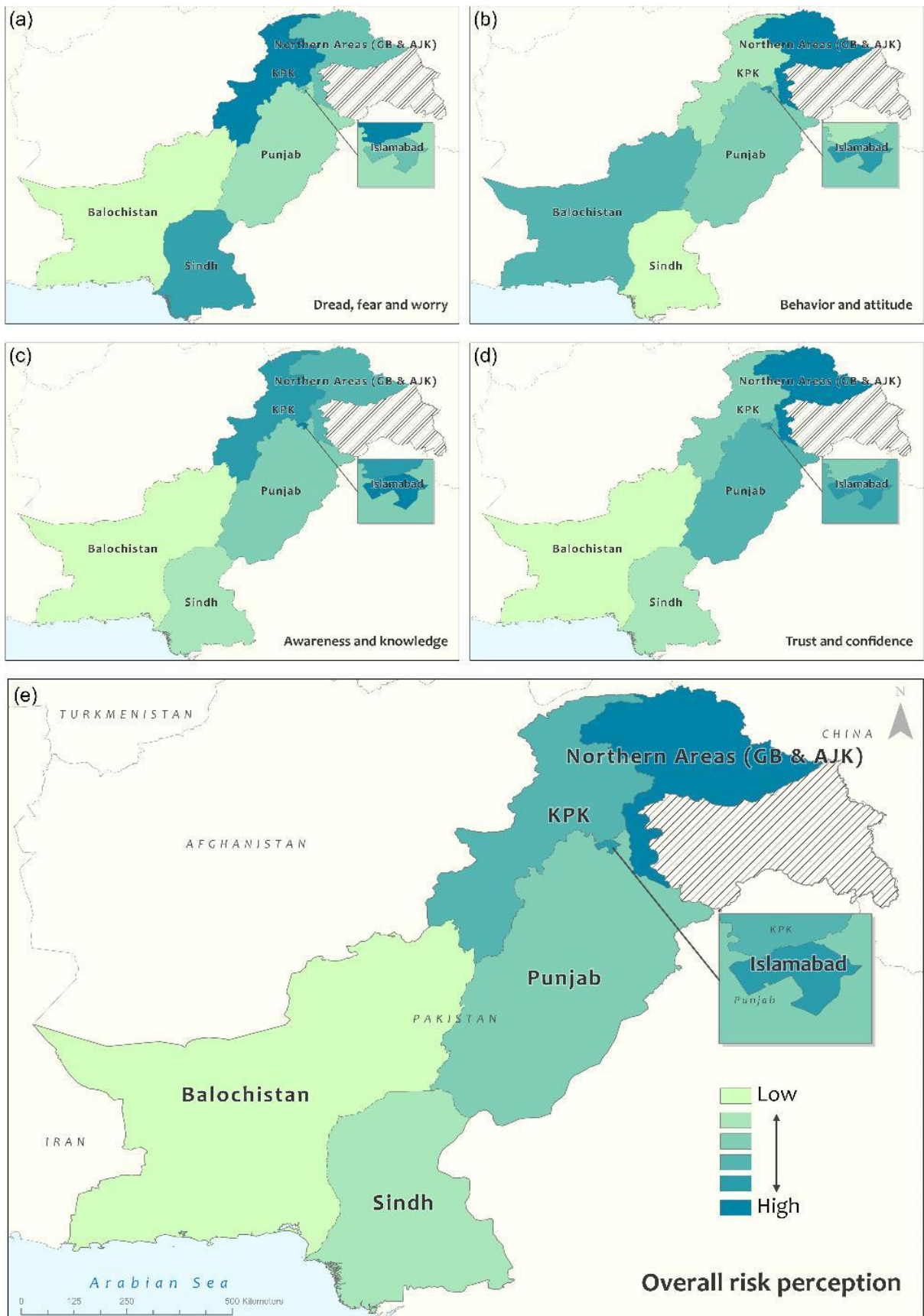


Fig. 2. Indicator-wise variation in (a) dread, fear, and worry; (b) behavior and attitude; (c) awareness and knowledge; (d) trust and confidence; and (e) overall risk perception on a relative scale from 'low' to 'high'

4.1.2. Behavior and attitude

Behavior and attitude regarding a particular hazard/crisis may predict the actions of individuals, groups, or communities [17, 46]. The perceived capacity to deal with a particular hazard would decrease the risk perception of individuals. This indicator suggests that all regions of the country perceived a lack of capacity to deal with this COVID-19 situation (Fig. 2b). Moreover, most respondents perceived above-average chances of adapting to a new future lifestyle. Similarly, due to social distancing, there was a high chance of changing relationships with relatives, friends, and work colleagues. The overall behavior domain of risk perception showed a varying picture in different regions. Relatively, the lowest behavior and attitude values were observed for Sindh province.

4.1.3. Awareness and knowledge

Knowledge, awareness, and familiarity with a particular hazard affect risk perception [47]. A noticeably high value was observed regarding the perceived extent of familiarity with precautionary measures to reduce COVID-19 risk, implying that the respondents were familiar with precautionary measures against this pandemic (Fig. 2c). In terms of how much a community was not protected against this virus, most respondents indicated an above-average concern. This shows that respondents perceived risk to their communities or surroundings. Due to the novelty and originality of the COVID-19 crisis, almost all the respondents showed a high or very high level of danger from an unknown risk – which can significantly influence the risk perception of the respondents. Overall, all regions showed higher than average perceived risk levels in the awareness domain of risk perception. Islamabad showed the highest level of perceived risk with respect to awareness and knowledge regarding COVID-19.

4.1.4. Trust and confidence

Trust and confidence are vital in determining community and government cooperation in reducing risk [48]. Trust in government, policies, and institutions can significantly influence risk perception. Moreover, the reliability of information sources can act as a trust element between the community and the government [45]. Generally, the reliability of government-based sources of information was above average among the respondents (Fig. 2d). The respondents from Sindh, relatively, showed lesser reliability on government sources of information. In the age of “infodemic,” most respondents did not rely on the information sought from social media (most of the respondents were highly educated). In Pakistan, disaster management authorities and health departments lead the fight against COVID-19. Trust in disaster management and health authorities plays a significant role in shaping up the community response towards following the safety protocols or orders from concerned authorities. There was above average trust level in all regions. Relatively, Islamabad and Sindh regions showed a higher level of trust in their government departments. Clear, consistent and transparent government policies can significantly influence trust and risk perception. Except, Sindh and Balochistan, all regions demonstrated above average trust in governmental policies. Similar situation was observed with respect to trust in local administrations as well. Regarding responses about provincial or federal governments’ role in this pandemic, slightly above average trust was reported. However, the respondents from Balochistan province showed the least trust level on the government response. With respect to trust in science and relevant experts, above-average values were observed. Overall, the trust domain of risk perception shows spatial variations in the study area, which can be attributed to the different approaches adopted by the local authorities, provincial governments, and the federal government to tackle this pandemic.

4.1.5. Overall risk perception

The risk perception index was constructed using all the domains and their indicators. With respect to fear, the same picture was observed in six regions (Fig. 2e). Fear in KPK and Sindh provinces was relatively highest. In terms of behavior and attitude domain, a significant difference was observed among all regions (F-value = 2.095, p-value = 0.065). In

terms of awareness and knowledge, no significant difference was observed. Among all the different domains, awareness and knowledge had the highest value. In terms of the trust domain, a significant difference was observed (F-value = 3.568, p-value = 0.004), indicating that trust varied significantly among the six regions of Pakistan. Overall, the COVID-19 risk perception in the country was above average, albeit still low.

4.2. Coping mechanisms against COVID-19

The coping mechanisms against COVID-19 were measured using indicators and three domains, i.e., problem-oriented, emotion-oriented, and action-oriented. The mean and the standard deviations were calculated to ascertain the level of coping mechanism against each indicator with respect to different regions.

4.2.1. Problem-oriented

The problem-solving domain explains how various individuals use coping mechanisms against the COVID-19 crisis. According to the data, most respondents actively seek safety protocols to be adhered to in their homes to cope with/reduce the risk of infection exposure (Table 5). This strategy has been used worldwide to minimize infection rates and “flatten the curve”. As the country started systematically locking down, it was promising to find that educated respondents felt safe in their homes. Similarly, most of the respondents were listening to and following the advice of experts. However, some trusted more reliable sources of advice, such as WHO, while others relied on the expert opinions of government representatives and media outlets.

Because of the rapidly evolving situation, most respondents actively sought out new information about COVID-19 in Pakistan to stay updated about the number of cases/deaths, lockdown extensions, and vaccine development. Since a lockdown situation could induce mental stress, respondents were predisposed to try something new to relieve their minds. This was apparent in all six regions. The respondents also talked with others who may help them understand the current crisis. All the respondents were employed, and at the time of the survey, most were not seeking financial support from the government. However, the respondents from Northern Areas were partially inclined to seek financial support from their respective provincial governments. Overall, the problem-oriented coping mechanism was similar in all regions of Pakistan (Fig. 3a).

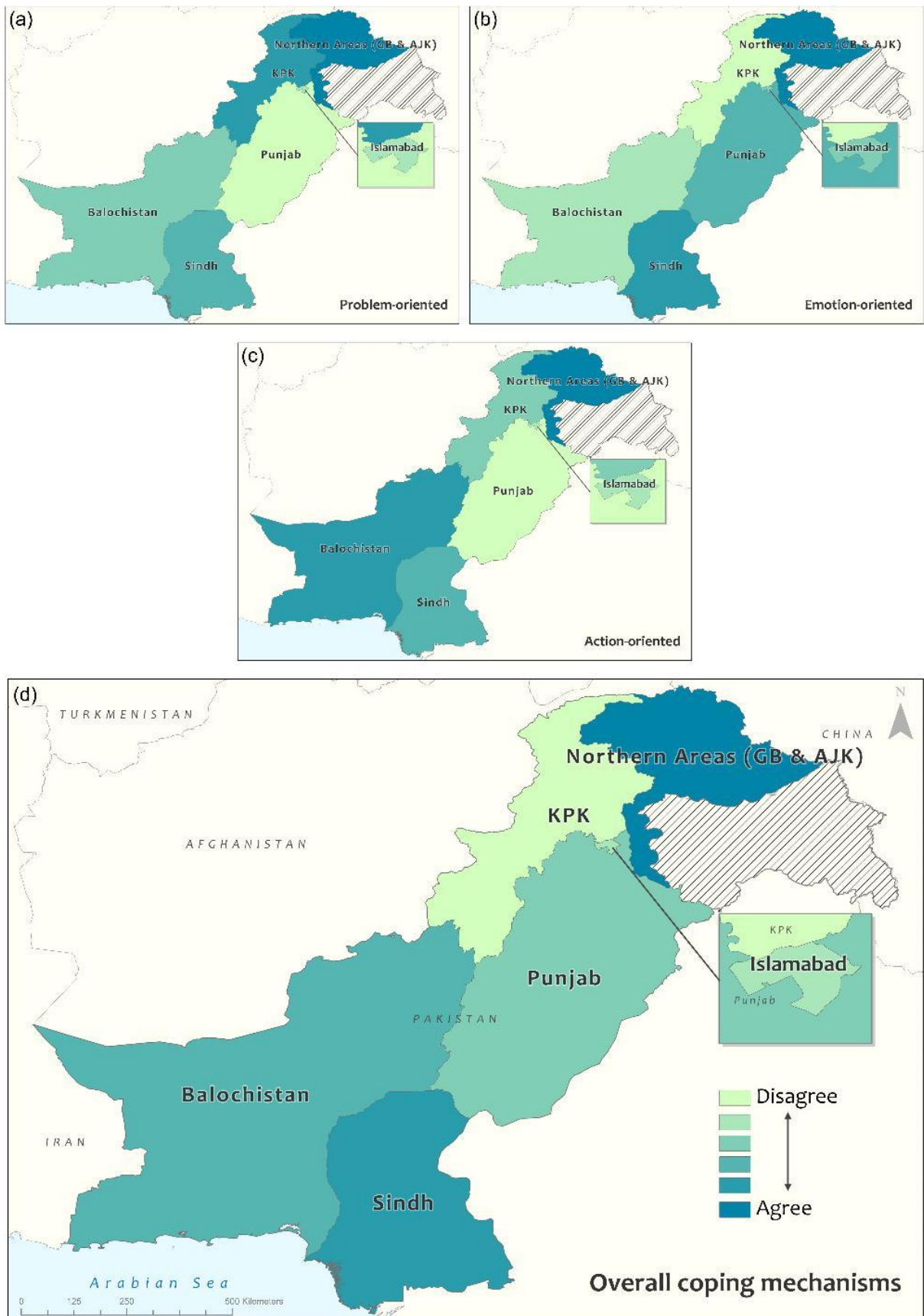


Fig. 3. Indicator-wise variation in: (a) problem-oriented; (b) emotion-oriented; (c) action-oriented; and (d) overall coping mechanism on a relative scale from 'disagree' to 'agree'

4.2.2. Emotion-oriented

Mental health can get significantly affected in a pandemic crisis and prolonged lockdowns. Various statements were asked in the questionnaire to understand the psychological resilience against the COVID-19 pandemic. The above-average value was observed in all regions regarding respondents' focus on work to distract themselves from the current crisis (Fig. 3b). Most of the respondents were not seeking any meditation to calm themselves – however, relatively speaking, respondents from Balochistan province had an above-average value in this regard. Most of the respondents from all the regions agreed that they could not do much other than wait for this crisis to get over. Moreover, the respondents agreed that lockdown was the only solution to combat the COVID-19 crisis, as evident in all the regions. The respondents were hopeful for a successful cure or drug to be developed soon to neutralize the virus. Except for the Northern Areas, all regions were hoping for a miracle to happen. Most respondents did not (over) eat, smoke, or take medication as coping mechanisms. Another indicator of psychological resilience showed that people actively avoided bad moods to reduce mental stress. All the regions showed above-average values for this statement. The statement regarding believing (or denying) this pandemic crisis shows good risk perceptions, which can help them agree or follow experts' advice. Except for KPK, all regions had above-average emotional/psychological resilience values against COVID-19.

4.2.3. Action-oriented

Action-oriented indicators express respondents' physical actions to cope with the COVID-19 pandemic. The foremost action suggested by WHO focused on washing hands for twenty seconds, which can significantly reduce infection risk. It was encouraging to observe that most respondents highly agreed with washing their hands more than usual (Fig. 3c). Relatively, the highest value was observed in Islamabad, implying respondents were acting upon the advice of government and health experts. Similarly, a high level of agreement was also observed regarding avoiding public spaces and public transport. Again, all regions exhibited high levels of agreement, with Islamabad leading the rest. However, regarding buying large quantities of disinfectants/staple foods, the data exhibited a varying value in all regions – generally, the respondents refrained from stockpiling in this crisis. They did not even buy additional protective equipment (gloves or masks). This shows a positive insight into stockpiling essential resources. The government, specifically the National Disaster Management Authority and the Ministry of National Health Services, had started advertising against stockpiling early on ratified ordinances and penalties for restricting food hoarding by traders capitalizing on the COVID-19 pandemic [49]. A slight variation in action-oriented mechanisms was observed among the regions (Fig. 3c).

4.2.4. Overall coping mechanism

The coping mechanism index was constructed using all the domains and indicators, i.e., problem-oriented, emotion-oriented, and action-oriented. With respect to the problem-oriented, a similar pattern was observed in all six regions - relatively. The problem-oriented mechanism was highest in Northern Areas (Fig. 3d). Comparatively, the emotion-oriented coping mechanism was the lowest among the three domains. KPK had the lowest scoring in the psychological domain in the country. Similarly, action-oriented coping mechanisms showed more or less same values in the country. Overall, coping mechanisms and their domains did not significantly differ among the regions. This implies that coping mechanisms in the country do not vary much spatially in Pakistan.

4.3. Relationship between socioeconomic factors and risk perception

Within socioeconomic domain indicators, only age, gender, and marital status were significantly correlated with the perception of risks associated with the COVID-19 pandemic, though the effects of these correlations are small (Table 5). These were women, younger and unmarried people who perceived COVID-19 risks more than men, elderly, and married people. Analyzing the relationship of the identified indicators with the risk perception

domains reveals that not all of them are significantly correlated with the socioeconomic indicators, and there were notable variations. Fear was found to have a significant correlation with the indicator of gender only, as it implies that women have more fear of the COVID-19 pandemic than men, which confirms the findings of some of the studies [26, 38]. The role of gender has been explicitly examined in another study based on the same dataset [40]. Interestingly, it was also found that the behavior domain of risk perception did not have a significant relationship with any of the socioeconomic indicators, which is a deviation from some of the literature findings [50]. This might be because of the distinct variations in socioeconomic behavior and practices across various parts of Pakistan, making it difficult to draw any consistent relationship. The indicators of age and marital status were also found to have significant relations with awareness, implying that elderly and married people were more aware of the precautionary measures to be taken during the COVID-19 pandemic as compared to the younger and unmarried people. Some researchers also identified age as a significant predictor of risk perception during pandemic events. [30, 35]. Men, elderly and married people tended to have less trust in government institutions responsible for dealing with the COVID-19 crisis in Pakistan compared to younger women and younger and unmarried people. Within the public health emergency domain, only the indicator of isolation days was found to have a relationship with the risk perception domain of awareness, and that too is with a small effect size. It also shows that as the number of isolation days increases, people become impatient with respect to practicing precautionary measures consistently, and their awareness of the associated pandemic risks gradually starts declining. Only the gender variable was significant [40].

Table 5: Correlation between respondents' risk perception, socioeconomic conditions, and previous public health emergency experience

Risk Perception	Fear	Behavior	Awareness	Trust	Risk Perception
<i>Socioeconomic</i>					
Age	-0.63	0.12	0.47**	-0.179***	-0.106*
Gender	0.119*	0.048	-0.030	0.172**	0.176**
Marital Status	-0.081	0.028	0.120*	-0.147**	-0.103*
<i>Public health emergency</i>					
Isolation Days	-0.053	-0.048	-0.177**	-0.012	-0.088

significant at * $p < .05$, ** $p < .01$, *** $p < .001$

Note: Only indicators with a significant relationship are shown for brevity purposes.

5. Conclusion

The COVID-19 crisis in Pakistan and other places worldwide is still unfolding. The direct and indirect impacts of the infection itself, and the opted government measures such as lockdown are developing gradually. This study has explored current risk perception concerning the COVID-19 crisis throughout Pakistan. The research has found that risk perception has varying levels in different regions of the country, depicting the spatial variation of COVID-19 risk perception and coping mechanisms. The main difference has been observed in the behavior and trust domains of risk perception, implying people may behave differently in dealing with the risks associated with the infection and complying with the instructions of the respective provincial governments. An alarming trend has been found in the community's response to public health emergencies. As the isolation days progress, the awareness level of the COVID-19 risks tends to decline, showing that the community was not continuously engaged in pandemic risk reduction. Under such circumstances, it is difficult to reap the true benefit of the lockdown measures to contain an epidemic.

This research can be useful for concerned authorities to design risk communication and reduction measures. Findings from risk perception domains and coping mechanism

perspectives also provide useful insights for the policymakers to establish synergies between health, industry, commerce, and information sectors for devising efficient communication mechanisms and resource flow structures according to the area-specific needs to deal with the COVID-19 situation.

This study has its limitations too. Firstly, non-probability sampling has been employed, which cannot be used to generalize its findings to the overall population. Secondly, as the data was collected through an online survey, most respondents were young and highly educated. They had access to the internet which led to an issue of under-representation in the sample. The other limitations of the online survey include a lack of sampling design due to the self-selection of the respondents and a low response mainly because of its self-administrative design and technical issues, especially in the case of a global pandemic. Moreover, measuring risk perception is difficult as many unforeseen factors are at play. Similarly, the coping mechanism is quantified using pre-determined indicators, and individuals or households may have more coping strategies that could not be incorporated in the current study. The findings of this study might not hold true for other developing or developed countries. More samples are needed to ascertain statistical relationships among indicators, domains, and regions. It is suggested that future studies investigate the role of vaccinations on COVID-19 risk perception.

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