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Coronavirus Pandemic

Knowledge, behavior and precautionary measures related to COVID-19 pandemic among the general public of Punjab province, Pakistan

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Abstract

Introduction: The world is facing a formidable challenge to prevent the COVID-19 global outbreak, and health care systems are under pressure globally. The governments alone cannot prevent the spread of this pandemic without creating a sensitive public opinion and cooperation. Therefore, this study analyzed the knowledge, behavior, and precautionary measures taken by the general public to protect themselves from COVID-19 pandemic.

Methodology: For this purpose, snowball sampling technique was used to collect data from 401 respondents through an online survey in the Punjab province of Pakistan. A Multivariate Probit Model was used to determine the factors affecting the choice of precautionary measures to avoid COVID-19 infection.

Results: Majority of the respondents (58.1%) belonged to urban areas in this study. The urban respondents had higher knowledge about Coronavirus disease as compared to rural respondents. Similarly, the hygienic behavior of urban respondents was better than rural respondents. But unavailability of hygienic material (mask and hand sanitizer) was the main problem faced by the general public. Public transportation was considered the most risk-prone place to COVID-19 by the respondents. Majority of the respondents perceived medium to highest risk from COVID-19, and it was found one of the most influential factors affecting the adoption of precautionary measures along with knowledge of this pandemic.

Conclusions: Government needs to start a comprehensive awareness campaign on social media along with the mainstream media create awareness about the importance of social distancing, washing hands and wearing masks among the general public to enhance knowledge and improve the behavior of the general public about COVID-19.

Key words: COVID-19; Coronavirus; knowledge; behavior; precautionary measures.

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Introduction

COVID-19 is the most catastrophic pandemic disease both economically and healthily among all infectious diseases that the modern world has faced until now due to its rapid growth globally. All countries, especially the developing world are highly vulnerable to COVID-19 because of their large population, large rural inhabitants, limited health facilities, high poverty levels, and illiteracy. In a situation like now, the world is in, where infected cases around the globe are increasing every day due to the non-availability of any authentic cure of this disease until now. Preventive measures such as social distancing and self-isolation are the only ways available to keep the spread of this pandemic disease under control. But compliance with any preventive measure is solely dependent on the individual attitudes and willingness of the individuals [1-3]. The precautionary behavior of individuals is shaped by many factors like socioeconomic status, traditional and cultural values, knowledge, beliefs, risk perception, and effectiveness of implemented measures [4-6]. These factors may vary from society to society and country to country [7-8]. Therefore, each country should take its own preventive measures according to the situation and keeping in view the ground realities. The risk of being infected by COVID-19 can also motivate people to take preventive measures announced by health departments of respective countries.

Coronavirus disease 2019 (COVID-19) previously referred (2019-nCoV) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an infectious disease starting from Wuhan, China on December 8, 2019 have already set their pawns around the globe [9-10]. COVID-19 was declared a pandemic disease on 11 March 2020. According to the World Health Organization more than 2.2 million people have been infected already, and more than 0.15 million people have lost their lives due to this disease globally

[11]. Overall rate of death to per number of diagnosed cases is 6.7 percent, but this can vary according to age groups and health problems.

Human health and economy both are interdependent, and COVID-19 has affected the economy of the whole world by restricting the domestic as well as an international movement of people all over the world. Due to domestic as well as international travel restrictions, the demand for certain goods and overall output may also decline. This would result in a negative effect on the economy of the world. For instance, the economic effect of SARS has been valued at the US $30–$100 billion, although the epidemic was restricted to a few months and only < 10,000 individuals were infected [12-15]. Both developing and developed countries are feeling the heat of this disease already, and economies are going into recession. Therefore, each country is taking both economic as well as preventive measures to save its people both economically and healthily. Even though developing countries like Pakistan are also trying hard to prevent the spread of COVID-19, but maybe they are short in both economic as well as health resources to control this pandemic disease. Therefore, the United Nations have appealed for 2 billion dollars from international donors to launch the Global Humanitarian Response Plan to combat COVID-19 for such nations.

Pakistan is a country of more than 212 million people, and 63% of its total population lives in rural areas [16]. The country is highly vulnerable to COVID-19 because of its large population, high population density, limited education and health facilities and rigid religious beliefs of the general public especially in the rural areas of the country, which make these areas more susceptible to pandemic disease (COVID-19). The first infected case from COVID-19 in the country was reported on 26 February 2020, and since then, infected cases are increasing day by day. The confirmed infected instances in Pakistan have risen to 8,000 [17]. Pakistan has one doctor for 963 people and one bed for 1,608 people in the country. But the situation is worse in rural areas of Pakistan, where only one doctor is available for more than 2,500 people [18]. Similarly, only 1.79 ventilators are available for each hospital in the country.

With these limited health care facilities, Pakistan cannot bear the burden of COVID-19, if infected cases increase rapidly. By looking at Pakistan's health care facilities, the nation has only one choice to prevent the spread of COVID-19 that is to take precautionary measures advised by the health department of the country. Therefore, efforts to minimize the economic and health impact of COVID-19 are wholly dependent on each individual, how they react in this situation. Previous studies on people's reactions to pandemic outbreaks show that people can take wrong protective actions (refusing to go into quarantine), contributing to adverse economic and health effects. Pakistan has never faced any pandemic disease like COVID-19 earlier and therefore, there is no such study which can help government agencies to understand the behavior of people during pandemic disease. Thus, the current study was planned to fill this gap. Moreover, research related to knowledge and risk perception during pandemics can increase awareness of health risks associated with the disease and thus, can be helpful in changing the attitude of the general population [19-21]. Similarly, understanding the awareness of community and their possible means to contagious disease coercions would support government agencies to locate information gaps, which may be used in making informative programs to raise understanding of the community [22]. The study has the following objectives: to assess the knowledge of the general public both rural and urban about COVID-19; to determine precautionary measures taken by rural and urban people to avoid COVID-19; to determine the factors affecting precautionary measures; to assess the behavior of rural and urban people towards COVID-19; to check the availability and affordability of essential protective items for rural and urban people.

Methodology

Study Area

Punjab is the most populous province of Pakistan constituting more than half (51%) of the country's total population. Majority of its population live in rural areas [16]. Therefore, this province is more vulnerable to pandemic COVID-19 due to its higher population density and limited health facilities across the province

Table 1. Health care facilities in the study area.

Health care facilities	Total availability	Population per health care facility
Hospitals	388	288,659
Dispensaries	1,286	87,091
Beds	60,191	1,861
Doctors	78,212	1,432

Source [18, 30].

(Table 1). Only one hospital is available for 288,659 people in the province. Similarly, only one bed is available for 1,861 people in hospitals across the province. Moreover, the province has only 6 COVID-19 isolation wards for such a large population. The availability of facilities such as expert doctors, medical equipment, COVID-19 testing kits, and machinery are other issues faced by both doctors and general public to curb the spread of COVID-19 presently. The province has the highest COVID-19 infected people (3,650) until now among all provinces of the country. But experts doubt the present number of infected cases, and they think that extensive testing is needed to know the actual infected cases as COVID-19 current testing is prioritized only for those, who are already sick and have health issues. We considered all of these statistics and selected the Punjab province as the study area.

Sample selection

The target population of this study was people residing in Punjab province of Pakistan. Therefore, next step was to determine the sufficient sample size to represent the whole population. For this, we used Cochran (1963)'s formula for large population to determine a sample size representing population in the province. The following formula was used to extract the minimum required number of sample size to be surveyed.

$$n_0 = Z^2pq/e^2$$

Where: n = sample size; Z = abscissa of the normal curve that cuts off an area α at the tails; e = the desired level of precision; p = the estimated proportion of an attribute; q = 1-p.

With the assumption of p = 0.5 (maximum variability), desired confidence interval, ± 5% precision level and 1.96 Z value, 385 sample size of this study was estimated. This method of sampling was also used in another study to measure the behavior towards food intake in the same region [23].

After determining the sample size, the challenge we faced was to collect data from the general public in these circumstances, when "stay at home and social distancing" is the united slogan and precautionary measure to prevent this outbreak globally. Therefore, online data collection was considered suitable to obtain data from respondents as a country has more than 71 million active internet users [24]. Snowball sampling is a non-probability sampling technique and has its own advantages and disadvantages. As in snowball sampling the researcher has little control over the sampling which may lead to sample bias and may not represent the whole population. But it has also many advantages like time and cost efficiency and researcher can reach out large population easily in the specific study area. People from around the globe are present on the internet and it is hard to target the desired population area with other sampling techniques. Therefore, snowball sampling technique was found suitable to collect data from 401 respondents in the study area. Only respondents older than 15 years of age were eligible to respond to this survey. Before asking questions related to this study, the questionnaire informed the potential participants about the purpose of the study, and once they gave their consent to participate in this survey, then they were directed to the questionnaire page. The collected sample represents each segment of the population in terms of age, gender and residence (Table 2).

Questionnaire Design

A well designed semi-structured questionnaire consisting of five major parts was used for this study. The first part of the questionnaire contained questions related to household characteristics of the participant. The second part of the questionnaire entailed statements related to knowledge about COVID-19. The third part of the questionnaire constituted on questions associated with the behavior of respondents about COVID-19. The fourth part of the questionnaire was consisted of precautionary measures being taken by the participants

Table 2. Comparison of population and sample proportions in terms of age, gender and rural urban population.

Characteristics	Population (%)	Sample (%)
Age (years)		
< 30	64.00	63.60
≥ 30	36.00	36.40
Gender		
Male	50.80	52.30
Female	49.20	47.70
Rural urban population		
Rural	63.90	41.90
Urban	35.10	58.10

Source: [25-31].

to prevent the spread of this pandemic disease. The fifth and last part of the questionnaire comprised questions about facilities and services availability and affordability.

Conceptual framework

COVID-19 is affecting humanity adversely all over the world, but general public can minimize its spread by taking precautionary measures. In this research, we recognize taking precautionary measures as a three-step process (Figure 1). Even though, it may feel odd to include first stage reality vs. myth because its reality is evident already from the severity and growth of this pandemic globally. But keeping in view the cultural values and rigid religious beliefs of the province, many ignorant people still may think that COVID-19 is a conspiracy against their religion to close religious places and take them away from the religion. Therefore, recognizing COVID-19 as a reality will help to prevent the spread of this disease in the country. People considering it as a myth will affect the whole process of controlling this disease negatively. In the second stage, after recognizing it as a reality, the respondent weighs the risk of COVID-19. This risk perception could be influenced by both external and internal factors, such as knowledge of COVID-19. In the third and last stage, the respondent takes measures subject to availability, affordability, and accessibility of facilities and services.

Statistical method

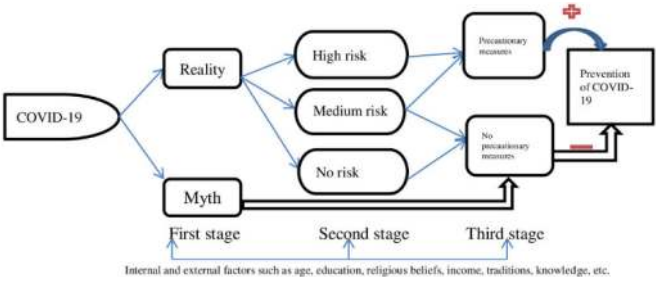
Our study has a total of eight precautionary measures: avoiding public transport, limiting entertainment outside home, limiting contact with relatives/friends, avoiding seeing doctors, using the mask, using hand sanitizer, staying indoor, and limiting shopping to absolute necessary items in the categorical form and each of the participants have the choice to employ more than one precautionary measure. The participants take these measures based on their socio-demographic characteristics, knowledge of COVID-19, risk perception, and availability of protective material variables (Appendix A1). Therefore, Multivariate Probit Model (MVP) was considered a useful method to analyze the factors affecting the adoption of precautionary measures as the MVP model is specially designed to take the simultaneous nature of two or more than two correlated dependent variables. Empirically model can be specified as below:

$$Y_{i1} = X_{ij1}^{`}\beta_1 + \mu_{i1}$$

.

$$Y_{i8} = X_{ij8}^{`}\beta_8 + \mu_{i8}$$

Figure 1. Conceptual framework of this study.



Where: "i" is respondent number, Y_{i1} ….. Y_{i8} are precautionary measures taken by the respondents. The dummy value "1" was assigned to precautionary measures, if it was adopted by the respondent to prevent the spread of COVID-19, otherwise "0". $X_i^{`}$ denote the vector of factors affecting the precautionary measures' adoption, β_j represents the vector of unknown parameters, and μ is the error term.

Eight different Binary Probit Models could also be used to determine the factors for each precautionary measure, but the decisions to take different measures may be correlated. In this case, the following form of the MVP model is used to determine the factors affecting the choice of different precautionary measures:

$$Y_{ij} = X_{ij}^{`}\beta_j + \mu_{ij}$$

Where: j=1…….8 (precautionary measures); i= 1……401 (respondent number); Yij is the j_{th} precautionary measure taken by the i_{th} respondent of the sample; $X_{ij}^{`}$ is a 1×k vector of observed variables affecting the choice of precautionary measures; β_j is k × 1 is parameters to be estimated; μ_{ij} is the unobserved error term.

Results

Socio-demographic characteristics

Socio-demographic characteristics are always important because of their influential effect on the behavior of the people. Therefore, only those variables, which had the potential to affect the adoption of precautionary measures, were considered in this study. Majority of the respondents participating in this study were < 30 years (Table 3). This may be because 64% of Pakistan's total population consisted of young people with age less than 29 years [25] Most of the respondents (59%) had education more than 12 years, and urban respondents had higher education levels as compared to rural respondents. Majority of those respondents who participated in this survey were unmarried. Smartphone and internet have become a necessity, especially in

Table 3. Socio-demographic characteristics of respondents.

	Category/units	Rural	Urban	Overall
Age (Years)				
	< 30	63.50	63.70	63.60
	≥ 30 and < 45	34.30	33.30	33.80
	≥ 45	2.20	3.00 %	2.60
Education (Years)				
	≤ 12	43.50	38.60	41.05
	> 12	56.5 0	61.4	59.95
Marital status				
	Married	37.50	33.00	34.90
	Unmarried	62.50	67.00	65.10
Cable/TV availability at residence				
	No	10.70	11.20	11.00
	Yes	89.30	88.80	89.00
Smart Phone				
	No	2.40	3.00	2.70
	Yes	97.60	97.00	97.30
Active internet package				
	No	21.40	12.00	16.00
	Yes	78.60	88.00	84.00
Current residence		41.9	58.1	100.00
Occupation				
Agricultural		33.40	5.60	19.50
Non-agricultural occupation		67.70	94.30	80.50
Average monthly Income	PKR	43816.17	51984.98	48574.50
Average home to hospital distance	Kilometer	10.55	5.50	7.62
Average home to market distance	Kilometer	8.48	3.54	5.61
Average children <5 years	Number	0.96	0.72	0.82
Average adult persons >50 years	Number	1.58	1.31	1.17

The results are proportion (%) for age, education, marital status, Cable/TV availability, Smart Phone, active internet package, current residence and occupation.

present circumstances, as universities and other institutions have started working online for the general public. Our results also indicated the same reality as more than 97 percent of respondents had a smartphone. These smartphones with internet were also a source of information for the general public as people were keeping themselves up to date through watching news and internet browsing. Urban respondents had a higher income level than rural respondents. The average monthly income of rural respondents was found 43816.17 PKR as compared to 51984.98PKR of urban respondents.

Table 4. Knowledge of COVID-19 pandemic.

Knowledge	Description	Rural (%)	Urban (%)	Overall (%)
		Yes	Yes	Yes
General information about COVID				
Coronavirus a reality	If "yes" then "1" , otherwise "0"	98.50	100.00	99.25
Origin of COVID-19	If know, then "1" , otherwise "0"	90.50	95.70	93.10
Information on infected numbers	If "yes" then "1" , otherwise "0"	89.90	98.30	94.10
Deadly virus	If know, then "1" , otherwise "0"	65.50	82.40	73.95
COVID-19 a Pandemic disease	If know, then "1" , otherwise "0"	47.60	50.20	48.90
Transmission modes knowledge				
Spread through hug and handshake	If know, then "1" , otherwise "0"	88.70	94.80	91.75
Spread through Sneeze droplets	If know, then "1" , otherwise "0"	82.10	93.10	87.60
Spread through the social gathering	If know, then "1" , otherwise "0"	90.50	96.10	93.30
Patient handling and symptoms knowledge				
Knowing symptoms	If know, then "1" , otherwise "0"	97.60	97.90	97.75
How to manage the infected case, if symptoms COVID-19 appear	If know, then "1" , otherwise "0"	95.20	97.90	96.55

Knowledge about coronavirus disease (COVID-19) pandemic

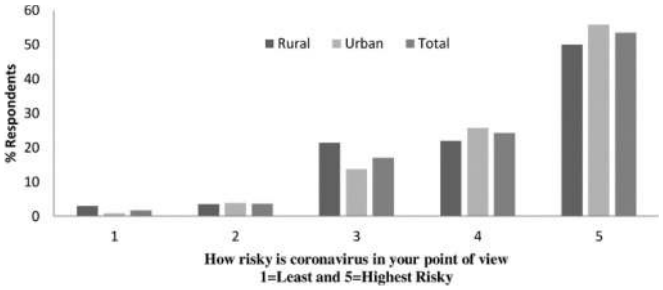
Table 4 shows the knowledge of the respondent about the COVID-19 pandemic. Overall, rural respondents had less general information about COVID-19 as compared to urban respondents. Almost all respondents (99.25%) considered this disease a reality, but still, there were some respondents, who did not recognize it as a reality. Only less than half of the respondents (48.90%) had information that it is a pandemic disease. Similarly, only 65.50% of respondents knew that this virus could be deadly.

Mode transmission knowledge of the COVID-19 category indicates that urban respondents are more knowledgeable than rural respondents. Even though the majority of the respondent knew the ways of transmission of the virus, but still there were some respondents, who did not have this knowledge. More than 12% of the rural respondents did not know that COVID-19 could spread through handshake and hug. Similarly, more than 11% of the rural respondent did not know that sneeze droplets could also be a source of transmission to spread this disease. People were also well aware of the symptoms of coronavirus and how to manage when they appear in any family member.

Behavior of respondents

Behavior of the people along with preventive measures holds the key to curb the spread of COVID-19 in the country. The hygienic behavior included washing hands regularly with soap, use of sanitizer, use of tissue while sneezing, etc. and the avoidant behavior included not shaking hands or hug, informing the government, if somebody escapes from quarantine or comes from COVID-19 affected country. More than 10% of the respondents were not washing their hands, when they were coming home from outside. Similarly, 22.70% of the respondents were not using tissue paper, etc. when they were sneezing, coughing. The government asked all citizens to inform about those people, who came from virus affected countries to take them in quarantine as the country had 61% imported infected cases. But locally transmitted cases were also increasing quickly in the country, making the situation more alarming. Majority of the respondents responded that they would inform the government but 12% of respondents answered that they will not inform the government. A handshake and hug is a tradition of Pakistani society but in present situation, this could be a potential source of virus transmission. Majority of the respondents had left this tradition, but still, more than 28% of rural respondents were continuing as usual (Table 5).

Figure 2. Risk perception.



Risk perception of COVID-19 among respondents

The majority of the respondents associated the highest risk with COVID-19 showing their concerns that it will have serious health effects (Figure 2). More of the urban respondents (55%) perceived the highest level of risk as compared to rural respondents (50%) from coronavirus. Similarly, respondents perceiving high risk from COVID-19 were also greater among urban respondents than rural.

Table 5. Behavior of respondents.

Behavior	Rural		Urban		Overall	
	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)
Hygienic behavior						
Do you wash your hands when you come home from outside?	11.30	88.70	9.90	90.10	10.50	89.50
Do you wash hands regularly even when you remain home?	11.90	88.10	10.70	89.30	11.20	88.80
Are you using soap to wash your hands every time?	7.70	92.30	4.30	95.70	5.70	94.30
Are you using tissue paper etc. when you sneeze, cough?	20.80	79.20	24.00	76.00	22.70	77.30
Do you care during a sneeze, cough to protect others from its drops?	3.00	77.40	3.40	74.70	3.20	75.80
After how many days are you changing your mask?	2.62		2.94		2.77	
Avoidant behavior						
Will you inform the government if somebody comes from the coronavirus affected country?	13.10	86.90	11.20	88.80	12.00	88.00
Do you still hug and shake hands with people?	71.40	28.60	79.00	21.00	75.80	24.20
Are you using some traditional methods to save yourself?	35.10	64.90	42.50	57.50	39.40	60.60

Figure 3. Riskiest place.

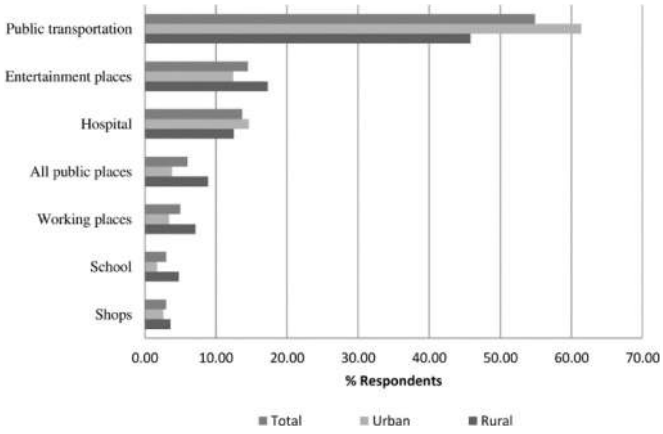


Figure 4. Precautionary measures.

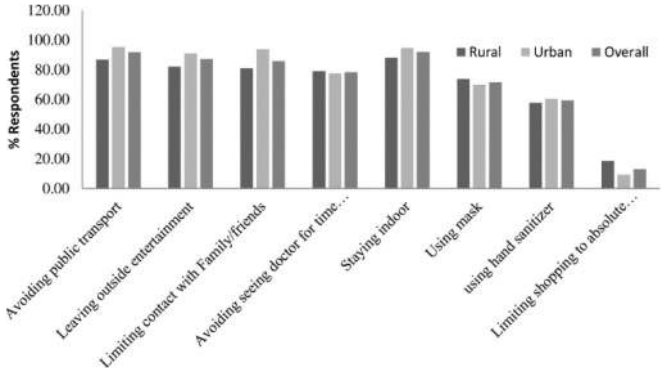


Table 6. Factors affecting the choice of precautionary measures.

Respondent characteristics	Avoiding public transportation		Leaving entertainment outside		Limiting your contact with relatives/friends		Avoiding seeing doctors		Staying indoor		Using mask going outside		Using hand sanitizers		Limiting your shopping to necessary items	
	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	P.value
Socio demographic characteristics																
Age (Years)	-0.026	0.25	0.005	0.804	-0.006	0.741	0.019	0.279	-0.048*	0.005	-0.016	0.279	-0.002	0.896	0.016	0.347
Education	0.069*	0.000	0.080*	0.000	0.017	0.446	0.008	0.693	-0.004	0.869	0.061*	0.001	-0.013	0.456	-0.003	0.891
Monthly Income	0.000	0.512	0.000	0.477	0.000	0.624	0.000	0.564	0.000	0.922	0.000	0.541	0.000	0.950	0.000	0.645
Children <5	-0.012	0.899	-0.036	0.579	0.047	0.513	0.100**	0.047	0.001	0.988	0.081	0.201	0.032	0.549	0.014	0.828
Adults > 50	0.150	0.164	0.125	0.121	0.048	0.539	0.004	0.955	0.143	0.165	0.105	0.138	-0.032	0.578	-0.200*	0.001
Gender	-0.127	0.644	0.083	0.666	-0.375*	0.002	-0.008	0.961	-1.032*	0.002	-0.019*	0.006	0.248*	0.005	0.155	0.449
Marital status	-0.596	0.101	0.167	0.558	0.074	0.801	0.190	0.478	0.782*	0.001	0.030	0.902	0.303	0.168	0.541**	0.054
Urban	0.378	0.153	0.462*	0.009	0.078	0.67	-0.005	0.973	0.254	0.252	-0.204	0.204	0.043	0.765	-0.307**	0.043
TV/cable	-0.577	0.196	-0.544	0.118	-0.192	0.51	-0.039	0.875	0.049	0.878	0.263	0.271	0.049	0.824	-0.029	0.914
Smart phone	-0.204	0.79	0.709	0.126	0.738*	0.009	0.963*	0.010	-0.020	0.975	0.484	0.26	0.385	0.345	0.304	0.63
Internet availability	0.283	0.6	0.184	0.632	-0.297	0.502	-0.020	0.953	0.415	0.358	-0.772***	0.061	-0.734**	0.032	-0.427	0.251
COVID-19 knowledge																
General information	0.221**	0.018	0.278*	0.009	0.089	0.425	0.003	0.978	-0.007	0.959	0.109	0.26	0.051	0.561	0.224*	0.004
Transmission modes	0.045	0.793	0.410	0.028	0.176	0.186	0.237**	0.049	-0.178	0.352	0.025	0.837	0.135	0.246	0.344*	0.006
Patient handling and Symptom knowledge	0.507	0.186	0.097	0.793	0.586**	0.044	0.074	0.81	0.664*	0.034	0.264	0.351	0.002	0.994	0.541**	0.035
Risk perception																
Risk perception	0.122	0.258	0.154**	0.064	0.176*	0.037	0.016	0.835	0.208*	0.042	0.142*	0.005	0.127**	0.048	0.061	0.489
Availability of protective material																
Mask	0.273	0.278	0.119	0.543	-0.239	0.21	-0.242	0.15	-0.075	0.737	0.525*	0.001	0.004	0.980	-0.151	0.458
Sanitizer	0.077	0.773	0.023	0.905	0.427*	0.023	-0.280**	0.079	0.315	0.182	0.156	0.321	0.561*	0.000	0.085	0.652
Constant	-0.846	0.529	-1.563		-1.922*	0.059	-1.410	0.142	0.890	0.435	-1.814***	0.053	-0.907	0.298	-0.503	0.652
Log likelihood (LR) test	-1175.177															
Wald chi2 (136)	287.83															
Prob > chi2	0.000															
Number of observations	401.00															

*, ** and *** represents significance level at 1%, 5% and 10% respectively.

Riskiest Places

According to the results, public transportation was the riskiest place to get infected by COVID-19 (Figure 3). The majority of urban respondents (61%) considered public transportation as the riskiest place as compared to the rural respondent (45%). The results also indicated that entertainment outside the home is the second most vulnerable place to COVID-19.

Precautionary measures to minimize infection chances

Figure 4 shows the precautionary measures taken by both rural and urban participants. Avoidance of public transportation was the consistently taken measures by both urban and rural respondents. It was reported by 95.30% of urban and 86.90% rural respondents that they were avoiding the use of public transport. Even though, majority of the respondents had limited their contact with their relatives and friends already as a precautionary measure to avoid COVID. Still, 19% of the rural participants were not taking this precautionary measure indicating that they meet with their relatives and friends. A large portion of the respondents was not using the face mask (29%) while going outside, and hand sanitizers (40%) increasing the chances of COVID-19 infection. The least taken measure was limiting the shopping to only absolutely necessary items, which was been taken by only 13 percent of respondents.

Determinants of precautionary measures

The MVP model is estimated using the maximum likelihood method at individual level observations. The model fits the data reasonably well. The Wald test that all regression coefficients are jointly equal to zero is rejected [χ^2 (136) = 287.83; p = 0.000]. In order to formally test this, we estimated a constrained specification with all slope coefficients forced to be equal. The likelihood ratio test statistic decisively rejected the null hypothesis of equal-slope coefficients. This result strongly indicates the heterogeneity in adoption of precautionary measures. As expected, the likelihood ratio (LR) test = -1175.17, p = 0.000) of the null hypothesis that the covariance of the error terms across equations are not correlated is also rejected, which supports estimations of MVP model (Table 6).

Socio-demographic characteristics play a vital role in shaping the attitudes and behaviors of a community and thus, also possess the central place in the prevention of any pandemic disease. Age of the respondents was negatively associated with staying indoor precautionary measures indicating that an older respondent was less likely to stay at home as compared to younger respondents. Education was one of the most influential factors having a positive effect on the adoption of precautionary measures. A respondent having a higher education was more likely to leave entertainment outside the home and use mask going outside the home as protective measures to avoid COVID-19 infection. Respondents with children < 5 years were less likely to visit the doctor for the time being as compared to those who did not have children. Married respondents were more likely to stay at home as compared to unmarried respondents. The respondents living in urban areas were less likely to limit their shopping to just absolute necessary items. The ownership of the smartphone was positively associated with limiting contact with relatives and friends.

Knowledge of the COVID-19 pandemic is the key to control the spread of disease in the country. The respondents with general information about COVID-19 were less likely to use public transportation as compared to those without general information regarding COVID-19. A respondent having information about this pandemic disease was more likely to leave entertainment outside the home and limit shopping to only necessary items. The respondents having modes of transmission knowledge were less likely to visit doctors in the present circumstances.

Risk perception was positively associated with most of the precautionary measures considered in this study. The availability of masks in the market was more likely to enhance the use of precautionary mask measure, when people go outside. The availability of sanitizers in the market was more likely to increase the use of sanitizers as a precautionary measure among respondents.

Facilities availability and their affordability

Table 7 describes the information about the facilities' availability and affordability in related cities of the respondents. In response to the question "availability of Coronavirus testing facility, 47.40 % of the respondents said "Yes", 26.90 % of respondents did not know about this, while 25.70 % said that there was no facility of testing Coronavirus in their cities. In relation to the residential area, 57.10 % of urban respondents confirmed the availability of the test facility as compared to 33.90 % rural respondents in their cities. 23.2 % of respondents stated that the test is not affordable, while 48.6% did not know the affordability of the test.

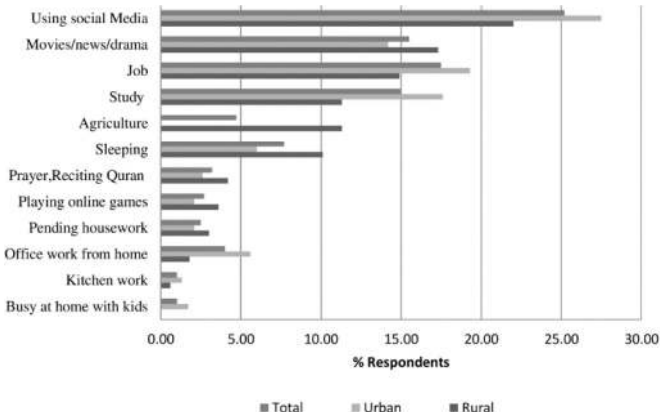
Almost 60 % of the respondents stated that the mask is available easily in the market, while 29.9 % reported non-availability of masks in their city. The affordability

of the mask was confirmed by 64.30 % of the respondents. Similarly, the availability of hand sanitizer was confirmed by only 48.60 %, which may describe that the hand sanitizer is not easily available as compared to the mask in the city. Hand sanitizer affordability was also confirmed by 48.60% of respondents.

Time utilization staying indoor at home

The majority of the respondents (25 %), both rural and urban spent their time on social media while staying at home (Figure 5). The urban respondents spending their time on social media were higher as compared to rural respondents. Similarly, more than 17 % of the rural respondents spent their majority time watching movies/dramas/news as compared to the urban respondent (14 %). Many offices were closed, but people are performing their job online and work from home.

Figure 5. Time utilization while staying at home.



Discussion

The current study was planned to analyze the knowledge, behavior and preventive measures taken by the general public in the largest province of Pakistan to suppress the COVID-19 pandemic. One of the key strength of this study is that this would be the first study

Table 7. Facilities availability and their affordability.

	Rural (%)	Urban (%)	Overall (%)
Availability Coronavirus testing facility			
Don't Know	27.40	26.60	26.90
No	38.70	16.30	25.70
Yes	33.90	57.10	47.40
Affordability of test			
Don't know	45.2	51.1	48.6
No	28.6	19.3	23.2
Yes	26.2	29.6	28.2
Mask availability (easily)			
Don't know	10.1	10.3	10.2
No	33.3	27.5	29.9
Yes	56.5	62.2	59.9
Masks' Affordability			
Don't know	13.10	21.50	18.00
No	20.80	15.50	17.70
Yes	66.10	63.10	64.30
Sanitizers' availability (easily)			
Don't know	28.00	15.40	20.70
No	33.30	28.80	30.70
Yes	38.70	55.80	48.60
Han sanitizers' affordability			
Don't know	35.20	31.30	32.90
No	19.00	18.00	18.50
Yes	45.80	50.60	48.60
Proper facilities for hospitalization, if somebody gets infected in the city			
Don't know	26.20	26.20	26.20
No	40.50	22.70	30.20
Yes	33.30	51.10	43.60
Accessible at any time especially at night easily			
Don't know	26.20	24.00	24.90
No	35.70	21.90	27.70
Yes	38.10	54.10	47.40

about any pandemic disease in the sixth largest country of the world as Pakistan have never faced any pandemic like COVID-19 since its independence like many other developing countries. Knowledge and behavior of the general public in developing countries will determine the rate of spread in any country as their health facilities are not capable of handling any pandemic disease like COVID-19. Proper knowledge about infectious diseases holds the key to mend the behavior of the public during any pandemic [26]. The knowledge about COVID-19 was divided into three categories: (1) general information about COVID-19 (2) modes of transmission (3) COVID-19 patient handling and symptom knowledge. General knowledge can be helpful in shaping the risk perception of the general public. Even though its reality is evident from worldwide increasing patients but still there are some religious hardliners and ignorant people, who do not take it as a reality. These people are more vulnerable to COVID-19 not only themselves but also pose a threat to the whole society due to the zoonotic nature of this disease. Similarly, knowledge about modes of transmission is also vital to take preventive measures and control the spread of this pandemic. Symptom knowledge can also help to avoid COVID-19 infection. Urban people were overall more knowledgeable as compared to rural people about the COVID-19 pandemic.

Behavior of the general public is also important to keep the spread in check of this deadly virus in developing countries. The behavior of the general public towards coronavirus disease was divided into two categories: (1) hygienic behavior (2) avoidant behavior. The people who are not taking any behavioral measure to avoid COVID-19 infection are more important in this kind of viral disease because one single person can be a source of disease transmission to a large population in developing countries without knowing. Similarly more than 28% of the respondents did not avoid handshakes and hug, when they were meeting with each other.

More than half of the total respondents associated the highest risk level with coronavirus infection implying that people understands the implications of this pandemic. But there were still some respondents, who considered it the lowest risky. This may be due to their lack of knowledge about COVID-19 in developing countries. Majority of the general public (61%) considered public transportation as the most vulnerable place for COVID-19 infection. This may be because public transportation is a crowded place and mostly more people travel than its capacity and therefore, people have to sit and stand closely with each other without leaving any space. Thus, majority of the people avoid public transportation to evade COVID-19 infection. Still 39% of the total respondents considered public transportation less risky place and reason of this may be the strict measures taken by the governments such as no-entry without mask and carrying only 50% passengers of the total capacity.

Compliance with protective measures is not obvious [27]. Therefore, particular attention to the determinants prompting attitude change during pandemic disease outbreaks is necessary. Multivariate probit model suggested that the age of the respondents was negatively associated with staying indoor precautionary measures. The reason may be the traditional and cultural values of the society in developing world, where older people spend their most of the day time in a social gathering outside the home. Therefore, it may not be easy for them to leave their social gathering and friends. Only health problems can make it easier to stay at home for older people. The younger respondents can stay indoor as they have many activities such as using social media, movies, dramas, and study, which they can perform and use to utilize their time at home without going outside. Education was one of the most influential factors having a positive effect on the adoption of precautionary measures. Respondents with higher education are expected to be well informed in terms of the current situation of the coronavirus disease around the globe as well as in the country, and measures need to be taken to avoid infection and spread of COVID-19. Similarly, married respondents are more likely to stay at home as compared to unmarried respondents. As most of the offices are closed due to coronavirus, spread in the province and respondents may think that it is the best time to spend with each other. The respondents living in urban areas were less likely to limit their shopping to just absolute necessary items. They may be living near the market, encouraging them to purchase all items without spending too much on fair to reach the market. On the other side, rural respondents mostly have more market distance and therefore, have to spend more on fair to reach the market resulting in only limited shopping. More market distance is a blessing in disguise in these circumstances for rural people. The ownership of the smartphone is positively associated with limiting contact with relatives and friends. The reason may be that respondents with a smartphone can meet their friends and relatives through video calls without visiting them physically.

The respondents having general information about COVID-19 indicate that they were well aware of the situation around the world as well as in their country. Therefore, they are expected to be better prepared as compared to those who don't possess such knowledge. A respondent having information about this pandemic disease was more likely to leave entertainment outside the home and limit shopping to only necessary items. This may be because they know that these places are usually crowded and therefore, can be more vulnerable to COVID-19.

The risk of being infected by any disease may stimulate the general public to take protective measures to decrease the risk, which they perceive [28-29]. For example, the respondents will take precautionary measures to avoid COVID-19 if they think it will be detrimental to their health. It is also evident from our results regarding risk perception and precautionary measures as risk perception was positively associated with most of the precautionary measures considered in this study. It means that respondents think that COVID-19 will have a serious impact on their health. Therefore, they wanted to minimize risk by taking precautionary measures like limiting entertainment outside home, limiting their contact with relatives/friends, using the mask, using hand sanitizer, and staying at home the whole day.

One of the limitations of this study is the online data collection from internet users under present circumstances. Never the less, the study has useful policy information about all necessary influential aspects of knowledge, behavior and factors affecting the adoption of preventive measures to control COVID-19. However, future studies can collect cross-sectional data through face to face surveys for this kind of research in normal circumstances.

Conclusion

The world is facing a formidable challenge to prevent the COVID-19 global outbreak, and the health care system is under pressure both in developing and developed countries. But it looks difficult for developing countries like Pakistan to control the spread of COVID-19 with limited health care facilities. Therefore, the behavior of the general public and the adoption of precautionary measures will determine the fate of the country in the absence of any specific cure. Thus, this study will assist government health agencies in Pakistan and around the globe to understand the behavior, knowledge gaps, and risk perception of the general public concerning COVID-19. Majority of the respondents in the study area belong to the young generation 30 years old of age or younger. A vast majority of the respondents also have smart mobiles with active internet packages. The comparison between urban and rural respondents provides that urban respondents have higher knowledge about COVID-19 as compared to rural respondents. Majority of the rural, as well as urban respondents, are taking hygienic and avoidant behavior to protect themselves from coronavirus, but still, many people not adopting this behavior are not only exposing themselves to COVID-19 but also their whole surroundings. The majority of the people associated medium to highest risk in the study, indicating that people understand the consequences of COVID-19 infection. Public transportation is considered the riskiest place by most of the respondents in the study area. Education was found positively associated with avoiding public transport and leaving entertainment outside the home. Risk perception was found the most influential variable affecting positively to most of the precautionary measures. Even though the majority of the general public abides by precautionary measures but still, there, some people are behaving in an irresponsible way, posing a threat to the whole society because of the nature of this virus, which transmits from infected cases to healthy persons quickly. Therefore, this study has some policy implications, which can assist the government in curbing the spread of this virus.

The majority of the people in the country have smartphones and they are spending most of their time on social media. Therefore, the government needs to start a comprehensive awareness campaign on social media along with mainstream media to create awareness about the importance of social distancing, avoiding crowded places, wearing mask and washing hands properly and regularly among the general public.

Moreover, governments in developing countries should use innovative techniques on the big advertisement boards present at important roads/locations to guide general public about how to use hands and wear face mask properly etc. through images and photos step by step.

The other thing the government needs to do is to control wrong information about COVID-19 as our study indicates that many people both in rural and urban areas are using some traditional methods to protect themselves from this virus, which could be dangerous for health.

Government needs to make sure the availability of protective material such as masks, and sanitizers at affordable prices with useable quality.

Government needs to change its same one-dimensional policy for rural and urban populations as the behavior and living conditions of both areas are totally different. The policy of lockdown and awareness through mainstream media can work well in urban areas, but this policy has limitations in rural areas. Therefore, the government should bisect its policy of preventing COVID-19 into rural and urban policy. Many ignorant people in villages still think that COVID-19 is a conspiracy against their religion to close religious places (mosques) and take them away from the religion. The rural people have respect to the spiritual leaders (Imams), and they seek guidance from them in all life matters. Therefore, the government should take spiritual leaders into confidence to start an awareness campaign in each village through a mosque speaker. Similarly, these spiritual leaders can also convince charitable people to help those affected by lockdown in their neighborhoods

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Annex – supplementary Items

Supplementary Table 1. Explanatory variables used in MVP analysis and their description.

Socio-demographic characteristics	
Age of Respondents	Years
Education	Schooling Years
Monthly Family Income	PKR
Gender	1 for Male otherwise 0
Marital Status	1 for Married otherwise 0
Children < 5 year	Numbers
Adults > 50 years	Numbers
Residential Area	Value "1" if urban, otherwise 0
Cable/TV at Home	(If "yes" then "1" , otherwise "0")
Smart phone	(If "yes" then "1" , otherwise "0")
Internet Availability	(If "yes" then "1" , otherwise "0")
COVID-19 knowledge	
General knowledge	Sum of the following 5 items
Coronavirus a reality (If "yes" then "1" , otherwise "0")	
Origin of COVID-19 (If know, then "1" , otherwise "0")	
Information on infected numbers (If "yes" then "1" , otherwise "0")	
Deadly virus (If know, then "1" , otherwise "0")	
COVID-19 a Pandemic disease (If know, then "1" , otherwise "0")	
COVID-19 Source transmission knowledge	Sum the following 3 items
Spread through hug and handshake (If know, then "1" , otherwise "0")	
Spread through Sneeze droplets (If know, then "1" , otherwise "0")	
Spread through the social gathering (If know, then "1" , otherwise "0")	
Symptom knowledge	Sum of the following 2 items
Knowing symptoms (If know, then "1" , otherwise "0")	
How to manage the infected case, if symptoms COVID-19 appear (If know, then "1" , otherwise "0")	
Risk perception	
How risky is coronavirus in your point of view (Score 1 to 5 as indicated by respondents	
Availability of protective material	
Mask	Value "1" if Available, otherwise "0"
Sanitizer	Value "1" if Available, otherwise "0"