

Evaluation of COVID-19 Disease Awareness and Its Relation to Mental Health, Dietary Habits, and Physical Activity: A Cross-Sectional Study from Pakistan

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Abstract. Coronavirus infection (COVID-19) has significantly increased the mortality and morbidity rates worldwide. The present study was conducted to assess the general public's awareness of COVID-19 and its association with mental health, dietary habits, and physical activity. A web-based survey was conducted to gather information about demographics, knowledge about COVID-19, dietary habits, mental health, and anthropometry among the general public of Pakistan. Descriptive statistics, chi-square test, and multiple logistic regression were used for data analysis. The majority of the participants were suffering from anxiety (71.0%) and depression (52.0%) during the COVID-19 pandemic; 32.4% of participants had poor COVID-19-related knowledge. COVID-19 lockdown reduced the physical activity of 66.9% of participants and increased weight of 38.8% of the survey participants. Demographic variables, including age, gender, ethnicity, education, employment, family type, and geographical location, were significantly associated with knowledge about COVID-19 ($P < 0.05$). Depression was inversely associated with COVID-19 knowledge ($P < 0.05$). Healthy changes in dietary habits including decreased consumption of fast foods, soft and cola drinks, fruit drinks, cooked meat (outside the home), sugar, and fats, and were associated with increased knowledge of COVID-19. Vitamin C and immunity-boosting supplement consumption were significantly associated with increased knowledge regarding COVID-19 (< 0.05). Inadequate knowledge about COVID-19 and the presence of anxiety and depression were found among most of the study participants. There is a need to conduct educational seminars to limit the health consequences resulting from COVID-19 lockdown.

INTRODUCTION

SARS-CoV-2 is a novel coronavirus causing COVID-19. The initial cases of COVID-19 were reported in Wuhan, China, and afterward, it spread rapidly worldwide, affecting nearly 213 countries within 2–3 months.^{1,2} The WHO reported 105,737,348 cases of COVID-19 worldwide, with 2,302,976 deaths as of February 5, 2021. In Pakistan, the first case of COVID-19 was confirmed on February 26, 2020, which spread across the country. At the time of writing, there were 551,842 laboratory-confirmed cases of COVID-19 coupled with 11,886 deaths.³ On March 11, 2020, the WHO declared the COVID-19 outbreak as a global pandemic because of its spread in various countries and China.⁴

The most common symptoms of COVID-19 include breathing difficulties, dry cough, fever, and kidney failure. The risk of catching the infection was highest in the elderly or persons with comorbidities, including diabetes, cardiovascular disease, and lung disease.⁵

There is a need to flatten the curve of COVID-19 by restricting its transmission, which will also avoid economic deterioration. The transmission can be reduced by following general hygienic principles, including frequent handwashing with soap or sanitizers, the use of face masks or personal protective equipment, and to avoid attending public gathering.⁶ Numerous countries have opted for specific strategies such as contact tracing, quarantine of infected persons at home or healthcare facility, restricting mass movement and gatherings, use of print and electronic media to spread the

information on social distancing, personal hygiene, preparation of health facilities with mechanical ventilation, isolation wards, and oxygen therapy for critically ill patients to tackle this COVID-19 pandemic.^{1,7}

Dietary factors and healthy eating habits play a crucial role in human health management. The global pandemic of COVID-19 has significantly changed the dietary patterns and eating habits of the people worldwide, particularly in the area affected by this pandemic.^{8,9} During the COVID-19 pandemic, there is an urgent need to expand public health activities beyond direct clinical management to cover basic principles of management and optimization of resource utilization, especially in terms of nutrition and dietary habits, for mitigating the impact of a pandemic on human health.¹⁰ Therefore, it is vital to determine and change people's conceptions and knowledge regarding healthy dietary habits for maintaining the health status of the peoples in a pandemic.

After the declaration of the COVID-19 pandemic, a lot of information regarding prevention, transmission, and personal hygiene flooded into conventional and social media. The influx of misinformation in the media could negatively affect a person's mental health due to the continuous fear of being infected.¹¹ Lockdown secondary to the COVID-19 pandemic has socially disconnected people, and social disconnectedness is strongly linked to anxiety and depression.¹² Dietary pattern is also strongly associated with anxiety and depression status of people as dietary intake can be affected by the disease, socioeconomic status, behaviors, emotions, and cultural pressures.¹³ Furthermore, changes in the dietary pattern can affect the physical activity and anthropometric measurements of a person. Social connectedness, dietary patterns, anxiety, and depression are linked to one another, and the change in the environment can significantly influence these parameters.¹⁴

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In the past few decades, there is a change observed in the dietary patterns throughout the world, moving from natural foods to processed foods rich in animal fat, animal protein, refined carbohydrates, and sugars with a very minute quantity of dietary fiber.¹⁵ This shift in dietary patterns has tremendously increased the prevalence of autoimmune, inflammatory, and noncommunicable chronic diseases.^{16,17} The consumption of a diet high in fats, refined sugars, and trans fats can contribute to the obesity pandemic. Low-grade systemic inflammation can increase in obese patients. These dietary changes can alter the gut microbiota composition, leading to gut dysbiosis. Gut dysbiosis is associated with increased intestinal permeability and pathogenic entry, and can lead to enhanced immune cell activation in adipose tissue and inflammatory response. Diet-induced obesity can lead to poor monocyte maturation and neutrophil dysfunction in bone marrow tissues. The compromised immune cells are associated with increased severity of pneumonia and acute lung injury. Hence, the relation between diet quality and immunity is robust.¹⁸ Therefore, the present study was conducted to assess the knowledge of COVID-19 disease and its association with anxiety, depression, dietary habits, and physical activity during the COVID-19 lockdown.

MATERIALS AND METHODS

Study design and setting. The present study was a descriptive cross-sectional survey conducted in the Punjab Province of Pakistan. This province was selected because more than half of the population of Pakistan live in Punjab, and it is the most developed province of Pakistan. The present study was conducted and reported following the instructions described in ref. 19.

Sample size calculation. The sample size was calculated by keeping the level of confidence at 99% and the level of precision at 5%, and the anticipated frequency of the target population was set on 50% as the target population proportion from the total population was unknown. The total sample calculated for the present study was 664.²⁰

Adults between the ages of 18–65 years were asked about COVID-19, anxiety and depression, changes in dietary habits, and physical activity during the COVID-19 pandemic. Only participants living in Punjab were included in this study.

Data collection tools. An in-depth literature survey was undertaken to design a well-structured questionnaire.^{3,11,18,21,22} The initial version of the questionnaire was reviewed and validated by an expert panel of three professors of relevant background and two bilingual experts. Minor modifications were made to improve the understanding of the respondents as per the recommendations of the experts. There were four sections to this questionnaire. The components of the first section included demographic data such as age, gender, education, family income, and family type. The second section determined anxiety and depression by using Pakistan Anxiety and Depression Questionnaire, which is already validated in the Pakistani population.²³ For each question, “0” was coded for positive and “1” was coded for a negative response. A total score of six or more indicated the presence of anxiety and depression.²³

Questions related to transmission, vulnerable groups, signs, symptoms, and complications regarding COVID-19 were asked to assess the knowledge about COVID-19 disease in the third section. The responses were coded as “1” for

correct response and “0” for an incorrect response for each question. The cumulative scores were segregated into three categories afterward, including inadequate knowledge ($\leq 60\%$), intermediate knowledge (61–80%), and good knowledge ($\geq 80\%$). This criterion has already been used in the literature.²¹

In the last section, the changes in dietary habits due to the COVID-19 disease situation were asked via closed-ended questions regarding the consumption of major food groups (increased, decreased, or not affected), including fast food, soft drinks, fruit juices and drinks, fruits and vegetables, meat, and proteins, added fats, and sugar and dairy products. The participants were also asked about the consumption of specific diet or bioactive components for immunity boosting.

A pilot study was conducted with a group of respondents (data excluded) to measure the internal consistency of the questionnaire, which was found to be in an acceptable range (> 0.7).

Data collection procedure. All data were collected using an online, self-administered questionnaire developed via Google forms because of COVID-19 disease lockdown all over Punjab. The online questionnaire was disseminated to the target population via various media platforms, including Facebook and Whatsapp, and their responses were collected.

Ethical permission. This study was conducted according to the guidelines described in “Strengthening the Reporting of Observational Studies in Epidemiology: explanation and elaboration-2007.” Online informed consent was obtained from all subjects/patients before getting the required information via Google forms and various social media platforms. In addition, ethics permission was obtained before the start of the study.

Data analysis. The collected data were analyzed using Statistical Package for Social Sciences version 25 (IBM, Armonk, NY). Level of significance was set at $P < 0.1\%$. The associations between knowledge regarding COVID-19 and demographic variables, anthropometric data, physical activity, and dietary habits were assessed using the chi-square test, and observed frequencies and percentages were calculated. Multiple linear regression was performed to assess the relationships among various demographic variables and COVID-19 knowledge. Odds ratios and CIs for the odds ratios were also calculated.

RESULTS

Of total ($N = 1956$), the majority of the participants (55.4%) were between the age of 21–30 years, were females (72.1%), and had an undergraduate degree (67.6%). Nearly 80% of the study participants (79.1%) were unemployed and belonged to urban areas (78.2%).

The physical activity of the participants was affected because of the COVID-19 lockdown as 66.9% of the participants had a decrease in physical activity and around 40% of the participants also gained weight because of COVID-19 lockdown (Table 1).

Only 7.4% of participants had good knowledge about COVID-19. The data show strong associations among various demographic variables, including age, gender, ethnicity, education, employment status, family income, and geographical location with a knowledge score regarding COVID-19 ($P < 0.05$). With an increase in age, COVID-19-related knowledge

TABLE 1
Demographic characteristics of study population (N = 1956)

Demographic variable	n (%)	Male, n (%)	Female, n (%)	P-value
Age-group (years)				
< 20	759 (38.8)	102 (18.7)	657 (46.6)	< 0.001
21–30	1,083 (55.4)	348 (63.7)	735 (52.1)	
> 30	114 (5.8)	96 (17.6)	18 (1.3)	
Ethnicity				
Urdu	1,119 (57.2)	228 (41.8)	891 (63.2)	< 0.001
Punjabi	606 (31.0)	147 (26.9)	459 (32.6)	
Siraiki	231 (11.8)	171 (31.3)	60 (4.3)	
Education				
Intermediate	156 (8.0)	36 (6.6)	120 (8.5)	< 0.001
Undergraduate	1,323 (67.6)	246 (45.1)	1,077 (76.4)	
Postgraduate	477 (24.4)	264 (48.4)	213 (15.1)	
Employment status				
Employed	408 (20.9)	246 (45.1)	162 (11.5)	< 0.001
Unemployed	1,548 (79.1)	300 (54.9)	1,248 (88.5)	
Geographical location				
Urban	1,530 (78.2)	345 (63.2)	1,185 (84.0)	< 0.001
Rural	426 (21.8)	201 (36.8)	225 (16)	
Family income				
Nuclear	1,287 (65.8)	258 (47.3)	1,029 (73.0)	0.001
Joint	1,083 (34.2)	288 (52.7)	381 (27.0)	
Body mass index				
Underweight	261 (13.3)	33 (6.0)	228 (16.2)	< 0.001
Normal	1,095 (56.0)	294 (53.8)	801 (56.8)	
Overweight	429 (21.9)	165 (30.2)	264 (18.7)	
Obese	171 (8.7)	54 (9.9)	117 (8.3)	
Anxiety status				
No	567 (29.0)	189 (34.6)	378 (26.8)	0.001*
Yes	1,389 (71.0)	357 (65.4)	1,032 (73.2)	
Depression status				
No	939 (48.0)	300 (54.9)	639 (45.3)	< 0.001
Yes	1,017 (52.0)	246 (45.1)	771 (54.7)	
COVID-19 knowledge				
Poor (less than 60% points)	633 (32.4)	150 (27.5)	483 (34.3)	< 0.001
Intermediate (60 to less than 80% points)	1,179 (60.3)	330 (60.4)	849 (60.2)	
Good (80% or more)	144 (7.4)	66 (12.1)	78 (5.5)	
Effect of COVID-19 lockdown on physical activity				
Increased	210 (10.7)	60 (11.0)	150 (10.6)	0.225
Decreased	1,308 (66.9)	378 (69.2)	930 (66.0)	
Not effected	438 (22.4)	108 (19.8)	330 (23.4)	
Effect of COVID-19 lockdown on weight				
Increased	759 (38.8)	225 (41.2)	534 (37.9)	0.325
Decreased	375 (19.2)	96 (17.6)	279 (19.8)	
Not effected	822 (42.0)	225 (41.2)	597 (42.3)	

also increased as the maximum proportion of people having good knowledge (15.8%) were from the age-group of > 30 years compared with 2.8% (\leq 20 years ago) and 9.7% (21–30 years of age). Male participants (good knowledge = 12.1%) had more knowledge about COVID-19 than females (good knowledge = 5.5%). Siraiki ethnic group (good knowledge = 13.0%) (a local ethnic group within Punjab Province Pakistan) had significantly more knowledge than the other ethnic groups, including Urdu (good knowledge = 6.7%) and Punjabi (good knowledge = 6.4%). The participants having postgraduate education (good knowledge = 13.2%) were more aware of the COVID-19 than other groups (good knowledge = 5.4–5.8%). Employed participants (good knowledge = 15.4%) were more educated regarding COVID-19 than unemployed (good knowledge = 5.2%), and similarly, participants from urban settings were more aware of COVID-19 than rural locations. Overall, an inconsistent trend was observed among the family income and knowledge of COVID-19, but maximum knowledge was found in the highest family income groups (good knowledge = 10.9%) (Table 2).

Around 70% of the participants were suffering from anxiety, and 52% were depressed because of the COVID-19 pandemic and lockdown. No association was found between anxiety status and COVID-19 knowledge. Depression status (P ; 0.000*) and body mass index (BMI, P ; 0.001*) were found to be significantly associated with the knowledge score regarding COVID-19 ($P < 0.05$). Depressed participants (4.7% good knowledge) had less knowledge than nondepressed participants (10.2% good knowledge).

The BMI of 21.9% of participants was lower than the standard, as shown in Table 1. Participants having normal and obese BMI categories had more knowledge than overweight participants (Table 3). Consumption of fast foods, soft/cola drinks, fresh fruits, fresh/cooked vegetables, cooked meat (outside/homemade), milk and dairy products, sugar, and fats was found to have a significant association with the knowledge of COVID-19. The decrease in fast foods, soft/cola drinks and fruits, juices/drinks, cooked meat (outside the home), sugar, and fat consumption was associated with an increased level of knowledge

TABLE 2
Association of demographic variables and knowledge regarding COVID-19

Variable	Category	COVID-19 knowledge, n (%)			Average knowledge score (%)	P-value
		Poor	Intermediate	Good		
Age-group (years)	≤ 20	345 (45.5)	393 (51.8)	21 (2.8)	61	< 0.001
	21–30	273 (25.2)	705 (65.1)	105 (9.7)	68	
	> 30	15 (13.2)	81 (71.1)	18 (15.8)	72	
Gender	Male	150 (27.5)	330 (60.4)	66 (12.1)	68	< 0.001
	Female	483 (34.3)	849 (60.2)	78 (5.5)	65	
Ethnicity	Urdu	414 (37)	630 (56.3)	75 (6.7)	64	< 0.001
	Punjabi	183 (30.2)	384 (63.4)	39 (6.4)	66	
	Siraiki	36 (15.6)	165 (71.4)	30 (13)	71	
Education	Intermediate	54 (34.6)	93 (59.6)	9 (5.8)	63	< 0.001
	Undergraduate	483 (36.5)	768 (58)	72 (5.4)	64	
	Postgraduate	96 (20.1)	318 (66.7)	63 (13.2)	70	
Employment status	Employed	84 (20.6)	261 (64)	63 (15.4)	70	< 0.001
	Unemployed	549 (35.5)	918 (59.3)	81 (5.2)	64	
Family type	Nuclear	432 (33.6)	762 (59.2)	93 (7.2)	65	0.278
	Joint	201 (30)	417 (62.3)	51 (7.6)	66	
Family income (PKR)	< 20,000	75 (30.9)	162 (66.7)	6 (2.5)	66	< 0.001
	21,000–40,000	195 (41.9)	234 (50.3)	36 (7.7)	64	
	41,000–60,000	153 (40.2)	207 (54.3)	21 (5.5)	63	
	61,000–80,000	84 (26.4)	213 (67)	21 (6.6)	67	
	> 80,000	126 (23)	363 (66.1)	60 (10.9)	68	
Geographical location	Urban	477 (31.2)	930 (60.8)	123 (8)	66	0.021
	Rural	156 (36.6)	249 (58.5)	21 (4.9)	64	

PKR = Pakistani rupee.

about COVID-19, but the poor knowledge category results was inconsistent with healthy dietary changes. An increase in fresh fruits', fresh vegetables'/cooked, cooked meat (homemade), and milk and dairy products' consumption was associated with an increased level of knowledge. All healthy changes in diet were associated with an increased level of knowledge about COVID-19. The usage of vitamin C and supplements for immunity boosting purposes was associated with a lower proportion of poor knowledge regarding coronavirus 2019 (Table 4).

The combined effect of all predictor variables was 80.21. Except for family type, all predictor variables had a significant association with COVID-19 knowledge score. By moving from male to female, the COVID-19 knowledge score decreases by 1.862 points from the combined effect (P -value 0.006*, CI: 75.973–84.448). From employed participants to unemployed ones, the COVID-19 knowledge score decreases by 5.432 points from the combined effect (P -value 0.000*, CI: –3.201 to –0.524). Changing geographical location from urban to rural, the COVID-19 knowledge score decreases by 2.412 points from the combined effect (P -value 0.000*, CI: –3.761 to –1.063). By moving the status of depression from negative to positive, the COVID-19 knowledge score decreases by 2.02

points from the combined effect (P -value 0.002*, CI: –3.291 to –0.75) (Table 5).

DISCUSSION

The present study was conducted among the general public of Punjab, Pakistan, to assess the knowledge of COVID-19 disease and its association with anxiety and depression, dietary habits, and physical activity during the COVID-19 lockdown. This study revealed that one-third of the participants had intermediate knowledge about COVID-19, around 78% had anxiety, and half of them were depressed. Changes in dietary habits were associated with higher knowledge regarding COVID-19, and depression disorder was inversely associated with COVID-19 knowledge.

Fear of death and extinction of humanity, loneliness, isolation at home, and sadness contribute to psychological and depressive disorders.^{24,25} The findings of this study suggested that around one-third of the participants were suffering from anxiety and one-fifth were having depressive symptoms due to the COVID-19 outbreak/lockdown, but the response was the same in both males and females.²⁶ We found fourth/fifth of the study population with anxiety, and around 50%

TABLE 3
Association of anxiety, depression, and body mass index with knowledge regarding COVID-19

Variables	Categories	COVID-19 knowledge, n (%)			Average knowledge score (%)	P-value
		Poor	Intermediate	Good		
Anxiety status	Normal	183 (32.3)	336 (59.3)	48 (8.5)	65	0.482
	Anxiety	450 (32.4)	843 (60.7)	96 (6.9)	66	
Depression status	Normal	276 (29.4)	567 (60.4)	96 (10.2)	67	< 0.001
	Depression	357 (35.1)	612 (60.2)	48 (4.7)	65	
Body mass index	Underweight	96 (36.8)	156 (59.8)	9 (3.4)	64	0.001
	Normal	366 (33.4)	633 (57.8)	96 (8.8)	66	
	Overweight	126 (29.4)	282 (65.7)	21 (4.9)	65	
	Obese	45 (26.3)	108 (63.2)	18 (10.5)	66	

TABLE 4
Association of dietary habits and knowledge regarding COVID-19

Consumption of various foods	Categories	Overall, n (%)	COVID-19 knowledge, n (%)			P-value
			Poor	Intermediate	Good	
Fast foods	Increased	231 (11.8)	63 (27.2)	159 (68.8)	9 (3.8)	0.004*
	Decreased	1,380 (70.6)	468 (33.9)	813 (58.9)	99 (7.1)	
	Not affected	345 (17.6)	102 (29.5)	207 (60)	36 (10.4)	
Soft drinks/cola drinks	Increased	315 (16.1)	96 (30.4)	210 (66.6)	9 (2.8)	0.008*
	Decreased	1,158 (59.2)	384 (33.1)	678 (58.5)	96 (8.2)	
	Not affected	483 (24.7)	153 (31.6)	291 (60.2)	39 (8)	
Fruit juices and fruit drinks	Increased	1,059 (54.1)	357 (33.7)	633 (59.7)	69 (6.5)	0.312
	Decreased	387 (19.8)	114 (29.4)	243 (62.7)	30 (7.7)	
	Not affected	510 (26.1)	162 (31.7)	303 (59.4)	45 (8.8)	
Bakery items	Increased	318 (16.3)	90 (28.3)	198 (62.2)	30 (9.4)	0.307
	Decreased	1,074 (54.9)	360 (33.5)	642 (59.7)	72 (6.7)	
	Not affected	564 (28.8)	183 (32.4)	339 (60.1)	42 (7.4)	
Fresh fruits	Increased	1,275 (65.2)	393 (30.8)	771 (60.4)	111 (8.7)	0.007*
	Decreased	288 (14.7)	111 (38.5)	165 (57.2)	12 (4.1)	
	Not affected	393 (20.1)	129 (32.8)	243 (61.8)	21 (5.3)	
Fresh vegetables/cooked	Increased	1,242 (63.5)	396 (31.8)	738 (59.4)	108 (8.6)	0.001*
	Decreased	171 (8.7)	45 (26.3)	123 (71.9)	3 (1.7)	
	Not affected	543 (27.8)	192 (35.3)	318 (58.5)	33 (6.1)	
Cooked meat outside	Increased	501 (25.6)	147 (29.3)	315 (62.8)	39 (7.7)	0.014*
	Decreased	831 (42.5)	267 (32.1)	489 (58.8)	75 (9)	
	Not affected	624 (31.9)	219 (35.1)	375 (60.1)	30 (4.8)	
Cooked meat homemade	Increased	1,059 (54.1)	336 (31.7)	630 (59.4)	93 (8.7)	0.019*
	Decreased	234 (12.0)	84 (35.8)	144 (61.5)	6 (2.5)	
	Not affected	663 (33.9)	213 (32.1)	405 (61.1)	45 (6.7)	
Milk and dairy products	Increased	930 (47.5)	297 (31.9)	576 (61.9)	57 (6.1)	< 0.001*
	Decreased	189 (9.7)	93 (49.2)	90 (47.6)	6 (3.1)	
	Not affected	837 (42.8)	243 (29)	513 (61.3)	81 (9.6)	
Sugar and fats	Increased	663 (33.9)	231 (34.8)	390 (58.8)	42 (6.3)	0.023*
	Decreased	522 (26.7)	141 (27)	342 (65.5)	39 (7.4)	
	Not affected	771 (39.4)	261 (33.8)	447 (57.9)	63 (8.1)	
Taking vitamin C for immunity boosting	Yes	810 (41.4)	222 (27.4)	531 (65.6)	57 (7)	< 0.001*
	No	1,146 (58.6)	411 (35.9)	648 (56.5)	87 (7.6)	
Taking immunity-boosting supplement	Yes	414 (21.2)	105 (25.4)	288 (69.6)	21 (5.1)	< 0.001*
	No	1,542 (78.8)	528 (34.2)	891 (57.8)	123 (8)	
Source of food in COVID-19 lockdown	Homemade	1,443 (73.8)	477 (33.1)	849 (58.8)	117 (8.1)	0.042*
	Ordered food from outside	24 (1.2)	9 (37.5)	12 (50)	3 (12.5)	
	Both	489 (25.0)	147 (30.1)	318 (65)	24 (4.9)	
Food ordered in COVID-19 lockdown	Conventional/desi foods	300 (15.3)	87 (29)	189 (63)	24 (8)	0.098
	Fast foods	288 (14.7)	105 (36.5)	162 (56.3)	21 (7.3)	
	Both	408 (20.9)	111 (27.2)	264 (64.7)	33 (8.1)	
	Not applicable	960 (49.1)	330 (34.4)	564 (58.8)	66 (6.9)	

* Significant association.

were depressive. Like previous studies, females in our study population were more depressed and anxious than males.²⁷

The COVID-19-related knowledge of the survey participants had a significant association with age, gender, education, and place of residence, which is in accordance with a previous study conducted in Pakistan and Jordan.^{21,22}

Another study conducted to assess knowledge, attitudes, practice, and misconceptions related to COVID-19 showed an inverse association between age and COVID-19 knowledge (P-value 0.037*).^{28,29}

A study conducted in Palestine showed an increase in weight in 41.7% of participants, and physical activity was

TABLE 5
Multiple linear regression for knowledge about COVID-19

	Unstandardized coefficients		Standardized coefficients			95.0% CI for beta	
	B	SE	Beta	t-value	Sig.	Lower bound	Upper bound
Constant	80.211	2.161		37.123	< 0.001*	75.973	84.448
Gender	-1.862	0.683	-0.067	-2.728	0.006*	-3.201	-0.524
Employment	-5.432	0.738	-0.178	-7.356	< 0.001*	-6.88	-3.984
Geographical location	-2.412	0.688	-0.08	-3.507	< 0.001*	-3.761	-1.063
Family type	0.075	0.602	0.003	0.125	0.901	-1.106	1.257
Anxiety	2.423	0.704	0.089	3.441	0.001*	1.042	3.804
Depression	-2.02	0.648	-0.081	-3.118	0.002*	-3.291	-0.75

Knowledge regarding COVID-19 (%) was predicted by various binary variables, including gender (male/female), employment (employed/unemployed), geographical location (urban/rural), family type (nuclear/joint), anxiety (no/yes), and depression (no/yes).

* Significant association.

reduced in 39.8% of the female participants owing to COVID-19 lockdown.³⁰ Compared with these findings, our study showed that three-fourth of the participants experienced a decreasing trend in physical activity, and 38.9% had gained weight during the lockdown (Table 1). Prolonged confinement and restricted movement may have adverse effects on human health, including weight gain, irregular sleep, changes in dietary habits, and loss of cardiorespiratory fitness.³¹ Furthermore, previous studies have also shown a link of weight gain with food insecurity, persistent stay at home, and physical inactivity.³² According to a cohort study, mood changes (anxiety and depression) are associated with elevated BMI, mediated by poor dietary habits and lifestyle habits.³³

A study conducted to assess the impact of COVID-19 lockdown reported a decrease in sugar-added drinks (26.2%), an increase in vegetable intake by 39.5%, fruits intake by 33.2%, dairy products by 33.2%, fried foods by 36.7%, and sweets intake by 46.5%.³⁰ Similarly, in the present study, fast food consumption was decreased by 70.6%, soft drinks by 59.2%, fruits juices/drinks increased by 54.1%, fresh fruits by 65.2%, vegetables by 63.5%, and milk and dairy products by 47.5%. The consumption of sugar and fats was also increased by 33.9%. However, all these positive changes were significantly associated with an increased good level of COVID-19-related knowledge.

All previous studies only focused on assessing the knowledge of COVID-19 and stress dietary and lifestyle changes induced by COVID-19 lockdown individually. However, our study's novelty is that we assessed not only all these parameters together but also the relation of anxiety, depression, dietary, and lifestyle changes with the knowledge of COVID-19 in the adult population. The current manuscript demands comprehensive educational programs for COVID-19-related knowledge, nutrition education, and stress management to manage the consequences related to COVID-19 among the general public of Pakistan.

The authors acknowledge certain limitations of this study. First, the data were collected using a convenience sampling method which may cause response bias, and the results could not be generalized to the whole Pakistani population. Second, the questionnaire was disseminated through various social media networking websites; therefore, only participants with access to the Internet and social media participated in this study. Most of the young population in Pakistan are aware and familiar with the use of the Internet and social media; therefore, more than half of our study participants were young. However, our study is unable to get a response from other vulnerable populations such as older adults. Third, our research is based on self-reported data; therefore, participants may provide more socially acceptable answers rather than being truthful. A study with a large sample size covering participants with different age-groups using a random sampling approach is needed to warrant our study's findings.

This study concludes that the knowledge about the COVID-19 pandemic of most of the study population is intermediate. The COVID-19 lockdown and pandemic have significantly increased the level of anxiety and depression among the survey participants. Dietary habits have also been affected by this lockdown, and people reported more willingness to consume foods that have a positive impact on the immunity of the peoples. Furthermore, knowledge about COVID-19 was found to be associated with depression, BMI, and changes in dietary habits.

The unprecedented COVID-19 pandemic has brought changes in the living style of almost every human being. Our study provides baseline information about the impact of COVID-19 lockdown on dietary habits, anxiety, and depression in Pakistani population that can help formulate concrete policy-making for the Pakistani population in terms of public health prospects. Mass-level educational programs should be launched via print and electronic media to enhance public awareness about COVID-19 and to improve dietary behavior of people. Furthermore, telehealth services should be initiated to help people to cope with their mental health issues.

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