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Assessment of Post-COVID Syndrome Manifestations among COVID-19 Subjects in Kannur District of Kerala

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ABSTRACT

A 6-month community-based, prospective, and cohort study was conducted among 250 post-COVID subjects in Kannur district of Kerala by assessing dietary diversity score (DDS), comorbidities, symptoms during COVID and post-COVID, fatigue, stress, and insomnia. Out of the 250 patients, 47.2% were male and 52.8% were female and 48% belonged to the 18–29-year age group. Among the patients, 22% had a high DDS. The most common comorbidities observed were hypertension (26%), followed by diabetes mellitus (23.2%) and cardiovascular disease (15.2%). During the period of infection, the most common symptom among patients was the loss of appetite (93.2%), followed by dry cough (92.4%) and tiredness (92%). Headache (92%) and breathlessness (90%) were the other significant symptoms. The most prevalent post-COVID symptoms were breathing difficulty (94.4%), joint pain 92.4%), (weakness (89.2%), and abdominal pain (87.2%). During COVID, 21.6% of the patients were severely fatigued, 48.8% of the patients had a moderate level of perceived stress, and 38% of the patients had subthreshold insomnia. During post-COVID, 56.8% were severely fatigued; moderate stress was found in 53.2%, of the subjects; and 56% of the study subjects had subthreshold insomnia. Through analysis of variance analysis, it is concluded that exercise has an impact on fatigue, stress level, diet pattern, and sleep pattern. Using Karl Pearson correlation coefficient of different parameters, the positively correlated variables were sleep and fatigue, sleep and stress, and stress and fatigue. The prevalence of new-onset fatigue, perceived stress, and insomnia was significant among COVID-19 survivors.

Keywords: Comorbidities, COVID-19, Fatigue, Insomnia, Post-COVID syndrome, Symptoms

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Introduction

The pandemic of new coronavirus disease (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), continues to pose a global threat.[1] The COVID-19 pandemic had an equal impact on people of different socioeconomic situations, both sexes, and different ages.[2,3] These viruses have been linked to respiratory, gastrointestinal, hepatic, and neurological illnesses.[4] Independent of viral status, long COVID is characterized by a set of symptoms that start to manifest weeks or months after becoming infected with SARS-CoV-2. Other names for long COVID include "Post-COVID," "Chronic COVID Syndrome," "Long-Haul COVID," "Post-acute Sequelae of SARS-CoV-2 infection," and "Post-Acute COVID-19 Syndrome (PACS)".[5] There is a chance that one or more acute COVID symptoms will persist or develop into new symptoms. Conditions following COVID-19 may affect one's ability to perform routine duties. A good nutritional state and a varied diet will assist to alleviate the severity of symptoms. COVID imparts fatigue, stress, and insomnia. In Kerala, especially in the Kannur district, very little study has been done on COVID. The goals of this study were to gather data on the sociodemographic characteristics of the participants, evaluate their nutritional status, and gain insight into any health-related issues, they were experiencing both before and after COVID.

Materials and Methods

Two hundred and fifty individuals from the Kannur district of Kerala were selected, in the age group of 18–60 between July 2021 and January 2022. The participants were chosen from the research area based on data made available by the Primary Health Centre. The sociodemographic profile, anthropometry and dietary assessment, comorbidity assessment, symptoms during and after COVID, stress, fatigue, and insomnia were assessed by an interview schedule.

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Between 0 and 6 months after the initial infection, the post-COVID symptoms in multiple systems, including discomfort or burning in the chest, weakness, joint pain, sore throat, dry cough, and lack of appetite, were evaluated. Participants responded to the best of their knowledge on a 4-point Likert scale for each symptom during COVID that was classified as absent, mild, moderate, or severe. COVID-19 is anticipated to have a significant impact on physical, cognitive, mental, and social health status in individuals.

The Perceived Stress Scale was used to measure individual stress (PSS-10-C). Several direct questions about the current levels of stress experienced were included and in each case, the respondents were asked how many times they felt a particular condition. The PSS-10-C consists of 10 items, each of which has five possible answers: Never, rarely, occasionally, almost always, and always. Items 1, 2, 3, 6, 9, and 10 are directly rated from 0 to 4, while items 4, 5, 7, and 8 are scored from 4 to 0. The PSS score and the degree of stress are correlated. Low stress was defined as a score of 0 to 13. A score of 14–26 indicated moderate stress, a score of 27–40 severe perceived stress.[6]

Measures of fatigue or tiredness were determined using the Chalder Fatigue Scale (CFQ-11). On a scale of 0 to 3, there are 11 items. The CFQ-11 uses a scoring method called bimodal scoring, in which each item's response is divided into two categories: 0 (0 to 1) or 1 (2–3), creating a scale from 0 to 11.[1] The CFQ 11 enables the user to differentiate between "cases" and "non-cases" of fatigue. The respondent is given a global binary tiredness score ranging from 0 to 11, rather than the physical and mental weariness subscales, as they are not used in this study. A score of 3 or less on the global binary fatigue scale indicates that a person is not yet fatigued, whereas a score of 4 or more indicates severe fatigue.[8]

The subjective complaints, outcomes, and level of dysfunction caused by these sleep disturbances are evaluated by the Insomnia Severity Index (ISI). The ISI has seven domains: (a) The severity of sleep onset (initial), (b) sleep maintenance (middle), (c) early morning awakening (terminal) problems, and (d) the degree to which the patient was satisfied with current sleep pattern, (e) impact on daily activities, (f) observed by others/interfering with the quality of life, and (g) the level of distress level caused by the sleep problem. The results are interpreted as follows: Absence of insomnia (0–7), subthreshold insomnia (8–14), moderate insomnia (15–21), and severe insomnia (22–28).[9]

DDS compiles a list of all the food and beverages, they consumed the previous 2 days (meals and snacks), both during the day and at night. The food groups "Cereals" and "White roots and tubers" make up the IDDS's food category called "Starchy basics." A new variable called "Starchy staples" was created by combining the responses to "Cereals" and "White roots and tubers." Poor dietary diversity was defined as having fewer DDS <4 and a score between 6 and 9 indicates a high dietary variety. When calculating DDS, each dietary group was only taken into account once.

Analysis of variance (ANOVA) emphasizes on the difference of variances.[10] A one-way ANOVA was performed to compare the effect of exercise, on sleep, diet, stress, and fatigue. The groups considered under this factor (exercise pattern) are "No exercise," "Regular exercise," and "Sometimes exercise."

The null hypothesis is proposed as there is no significant effect of exercise, on sleep, diet, stress, and fatigue. An alternative hypothesis is proposed as there is a significant effect of exercise on sleep, diet, stress, and fatigue.

A correlation is a measurement of the relationship between variables. The magnitude of one variable is associated with the magnitude of another variable in correlated data, either in the same direction (positive correlation) or the opposite direction (negative correlation).[11] The researcher used Pearson correlation to identify the relationship between the variables sleep and diet, fatigue and diet, sleep and fatigue, sleep and stress, stress and fatigue, and stress and diet during the period of infection and in post-COVID.

Results and Discussion

The study comprised 250 patients, with 118 (47.2%) men and 132 (52.84%) women. On studying the age-wise distribution of the subjects, 120 (48%) were in the 18–29 age group, 48 (19.2%) in the 30–39 age group, 31 (12.4%) in the 40–49 age group, 24 (9.6%) in the 50–59 age group, and 27 (10.8%) in the above 60 age group. According to the educational status of the study subjects, 40 (16%) had attained post-graduation, 174 (69.6%) were graduates, 23 (9.2%) had attained higher secondary education, and 13 (5.2%) had secondary education [Table 1].

The BMI categories of the patients based on the WHO show that 2.4% of subjects were underweight, 67.4% were normal, 23.6% were overweight, and 6.6% were obese. By the Asia-Pacific BMI classification, 2.4% of subjects were underweight, 63.8% were normal, 17.3% were overweight, and 16.5% were obese [Table 2].

It was observed that the subjects were giving importance to cereals and the majority 67% were having medium DDS (Score 4 or 5) whereas 22% were having high dietary diversity (Score >6) and only 11% were found to have low DDS (Score ≤3) because of consuming three or <3 food groups. When considering the dietary diversity in detail, it was noticed that majority of samples were only giving importance to rice, wheat, pulses and legumes, and other vegetables [Figure 1].

The different systems of medicines adopted to treat COVID-19 infection were studied, with 40 (16%) of subjects adopting

Table 1: Sociodemographic status of study subjects (*n*=250)

Serial number	*Sociodemographic characteristics*	*Frequency, n (%)*
	Gender	
1	Male	118 (47.2)
2	Female	132 (52.8)
	Age (years)	
1	18–29	120 (48)
2	30–39	48 (19.2)
3	40–49	31 (12.4)
4	50–59	24 (9.6)
5	Above 60	27 (10.8)
	Educational status	
1	PG and above	40 (16)
2	Graduation	174 (69.6)
3	Higher secondary	23 (9.2)
4	Secondary	13 (5.2)

Table 2: Anthropometric assessment of the subjects by BMI classification (***n***=250)

Serial number	*BMI*	*WHO (BMI)*	*Percentage*	*Asia-Pacific (BMI)*	*Percentage*
1	Under weight	<18.5	2.4	<18.5	2.4
2	Normal	18.5–24.9	67.4	18.5–22.9	63.8
3	Over weight	25.0–29.9	23.6	23.0–24.9	17.3
4	Obese	≥30.0	6.6	≥25.0	16.5

BMI: Body mass index

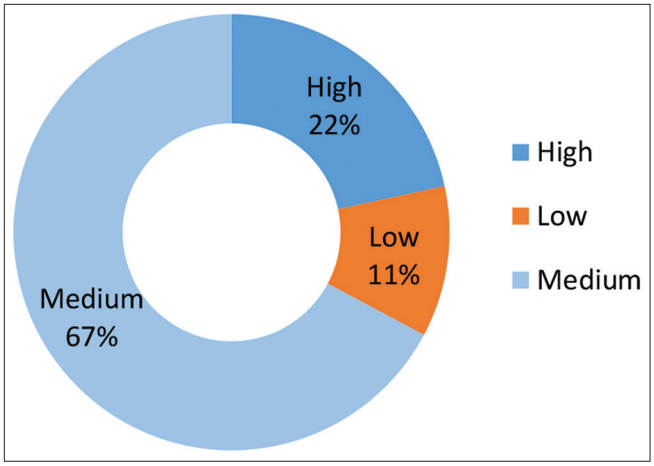

Figure 1: Dietary diversity score among patients

Ayurveda, 175 (70%) adopted Allopathy, 30 (12%) adopted homeopathy, and about 5 (2%) adopted other modes of treatment [Table 3].

The most common comorbidity among patients was hypertension 65 (26%), followed by diabetes mellitus 58 (23.2%), obesity 41 (16.4%), and cardiovascular disease 38 (15.2%). The least observed comorbidities were kidney disease 23 (9.2%), chronic lung disease 11 (4.4%), cancer 10 (4%), and liver disease 4 (1.6%). The present study observed that hypertension (26%) is the most prevalent comorbidity [Table 4].

It can be observed that loss of taste/smell 232 (93.2%) was the most prevalent symptom among the COVID patients, followed by dry cough 231 (92.4%), tiredness 230 (92%), headache 230 (92%), and breathlessness 225 (90%). Diarrhea 178 (71.2%), chest pain 145 (58%), and skin rashes 112(44.8%) were the other significant symptoms. In a study conducted by Amin *et al.*,[12] conducted among 439 people in Bangladesh who recovered from COVID-19 the most common symptoms reported by the study subjects were fever (93.60%), tiredness (88.80%), and cough (70.80%) [Figure 2].

The most common post-COVID symptoms among the subjects were breathing difficulty 236 (94.4%) followed by joint pain 231 (92.4%), weakness 223 (89.2%), abdominal pain 218 (87.2%), and sore throat 215 (86%). Palpitation 184 (73.6%) and itchy skin 149 (59.6%) were the other common symptoms. The occurrence of new allergies 91 (36.4%) was the least prevalent symptom [Figure 3].

Fatigue is common in individuals with a variety of chronic health conditions and can have significant negative effects on quality of life including feelings of weariness, tiredness, a lack of energy, or decreased motivation to continue on a task. During COVID, only 54 (21.6%) of the patients were severely fatigued, while 142 (56.8%) were severely fatigued during post-COVID. Those who had fatigue symptoms for more than 6 months following SARS were more likely to suffer psychological illnesses [Table 5].

During COVID, 122 (48.8%) of the subjects had a moderate level of perceived stress, 124 (49.6%) had a low level of stress, and 4 (1.6%) had a high level of stress. On analyzing the results of Post-COVID, low stress was found in 76 (30.4%) of the subjects, moderate stress in133 (53.2%), and high stress in 41(16.4%) of the subjects [Figure 4]. In a cross-sectional web-based survey done by Laxmi *et al.* in 2021,[13] dental professors from all five government dental colleges in Kerala reported experiencing some amount of perceived stress, which was shared by all participants in the present study. In total, 162 professors responded. About 67.3% of all respondents reported moderate levels of felt stress and 6.8% reported high levels of stress.

During the infection period, 130 (52%) of the subjects had no clinically significant insomnia, 95 (38%) had subthreshold insomnia, 20 (8%) had moderate insomnia, and 5 (2%) had severe insomnia. In the Post-COVID period, 80 (32%) of the subjects had no clinically significant insomnia, 140 (56%) had subthreshold insomnia, 18 (7.2%) had moderate insomnia, and 12 (4.8%) had severe insomnia [Table 6].

A one-way ANOVA was performed to compare the effect of exercise, on sleep, diet, stress, and fatigue. The groups considered under this factor (exercise pattern) are "No exercise," "Regular exercise," and "Sometimes exercise."

H_0: There is no statistically significant relationship of exercise on sleep, diet, stress, and fatigue.

H_1: There is a statistically significant relationship of exercise on sleep, diet, stress, and fatigue.

Table 3: System of medicine adopted to treat COVID-19 infection (*n*=250)

Serial number	*System of medicine*	*Frequency, n (%)*
1	Ayurveda	40 (16)
2	Allopathy	175 (70)
3	Homeopathy	30 (12)
4	Other	5 (2)

Table 4: Assessment of comorbidities among patients (***n***=250)

Serial number	*Comorbidity*	*Frequency, n (%)*
1	Hypertension	65 (26)
2	Diabetes mellitus	58 (23.2)
3	Cardiovascular disease	38 (15.2)
4	Obesity	41 (16.4)
5	Chronic lung disease	11 (4.4)
6	Kidney disease	23 (9.2)
7	Liver disease	4 (1.6)
8	Cancer	10 (4)

Table 5: Assessment of Fatigue using Chalder fatigue scale 11 scale among patients (*n*=250)

Serial number	*Score*	*Interpretation*	*Frequency, n (%)*	
			During COVID	*Post COVID*
1	0–3	Not severe	196 (78.4)	108 (43.2)
2	4–11	Severe	54 (21.6)	142 (56.8)

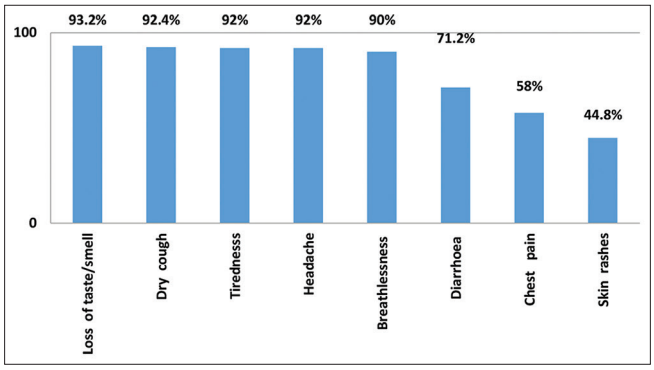

Figure 2: Assessment of symptoms during COVID-19 infection period

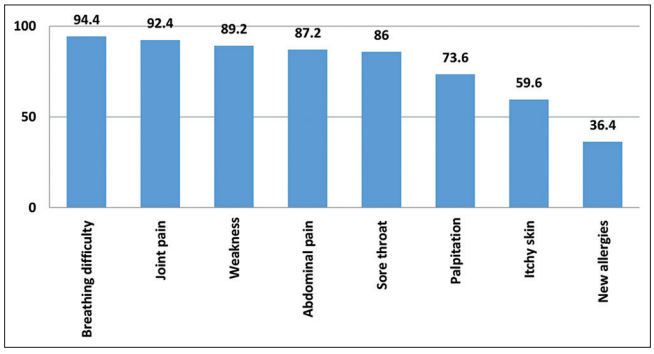

Figure 3: Assessment of post-COVID symptoms during the infection period

$P < 0.05$ was required for significance. The ANOVA was significant for sleep ($P = 0.048 < 0.05$) and diet ($P = 0.020 < 0.05$). This result allowed to accepting the null hypothesis H_0. This indicates that there is no significant effect of exercise on sleep and diet. The results of the ANOVA allowed to rejecting the null hypothesis H_0

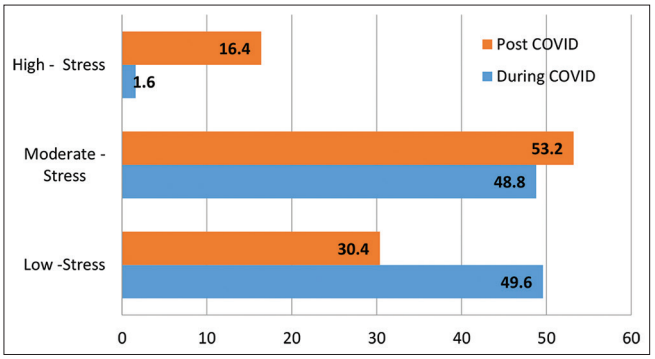

Figure 4: Assessment of Perceived Stress using PSS-10-C scale among patients

Table 6: Insomnia severity index to assess sleep among patients (*n*=250)

Serial number	*Score*	*Interpretation*	*Frequency, n (%)*	
			During COVID	*Post COVID*
1	0–7	Absence of insomnia	130 (52)	80 (32)
2	8–14	Subthreshold insomnia	95 (38)	140 (56)
3	15–21	Moderate insomnia	20 (8)	18 (7.2)
4	22–28	Severe insomnia	5 (2)	12 (4.8)

Table 7: Analysis of variance between exercise and sleep, diet, stress, and fatigue during the period of infection (*n*=250)

Variables	*df*	*SS*	*MS*	*F*	*P*
Sleep					
Between groups	97.633	2	48.817	4.174	0.048
Within groups	2888.543	247	11.695		
Total	2986.543	249			
Diet					
Between groups	417.183	2	208.592	5.909	0.020
Within groups	8718.801	247	35.299		
Total	9135.984	249			
Fatigue					
Between groups	22.854	2	11.427	0.404	0.67
Within groups	6978.528	247	28.253		
Total	6848.144	249			
Stress					
Between groups	4.695	2	2.347	0.582	0.57
Within groups	995.247	247	4.029		
Total	999.942	249			

df: Degrees of freedom, SS: Sum of square, MS: Mean square

for fatigue ($P = 0.67 > 0.05$) and stress ($P = 0.57 > 0.05$). This accepts the alternative hypothesis H_1 thus supporting the conclusion that there is a statistically significant and strong relationship of exercise on sleep, diet, stress, and fatigue [Table 7].

The ANOVA was significant for sleep ($P = 0.04 < 0.05$) and diet ($P = 0.028 < 0.05$). This outcome made the null hypothesis H_0 acceptable. This indicates that there is no significant effect of exercise on sleep and diet. The results of the ANOVA allowed to rejecting the null hypothesis H_0 for fatigue ($P = 0.70 > 0.05$) and stress ($P = 0.94 > 0.05$). This validates the alternative hypothesis H_1, which supports the finding that exercise has a statistically significant and powerful impact on sleep, diet, stress, and fatigue [Table 8].

According to the findings of Pearson's correlation analysis, during the period of infection, the negatively correlated variables were sleep and diet (–0.003 <0.5), fatigue and diet (– 0.196 <0.5). The positively correlated variables were sleep and fatigue (0.614> 0.5), sleep and stress (0.581 >0.5), stress and fatigue (0.662 >0.5), and

Table 8: ANOVA between exercise and sleep, diet, stress, and fatigue during post-COVID (*n*=250)

Variables	*df*	*SS*	*MS*	*F*	*P*
Sleep					
Between groups	97.633	2	48.817	4.174	0.04
Within groups	2888.543	247	11.695		
Total	2986.176	249			
Fatigue					
Between groups	56.865	2	28.432	1.449	0.28
Within groups	4845.624	247	19.617		
Total	4376.249	249			
Stress					
Between groups	19.854	2	9.927	0.359	0.70
Within groups	6828.290	247	27.645		
Total	6848.144	249			
Diet					
Between groups	0.282	2	0.141	0.061	0.94
Within groups	561.962	247	2.275		
Total	562.244	249			

df: Degrees of freedom, SS: Sum of square, MS: Mean square

Table 9: Karl Pearson correlation coefficient of different parameters among the subjects (*n*=250)

Variables	*Karl Pearson correlation coefficient (P)*	
	During COVID	*Post-COVID*
Sleep and diet	–0.003	–0.001
Fatigue and diet	–0.196	–0.118
Sleep and fatigue	0.614*	0.796*
Sleep and stress	0.581*	0.761*
Stress and fatigue	0.662*	0.738*
Stress and diet	0.014	0.036

**P*>0.5 considered significant

stress and diet (0.014 <0.5). The correlation coefficient is >0.5 indicating that the groups are significant.

In post-COVID, the negatively correlated variables were, sleep and diet (–0.001 <0.5), fatigue and diet (–0.118 <0.5), and the positively correlated variables were sleep and fatigue (0.796 >0.5), sleep and stress (0.761 >0.5), stress and fatigue (0.738 >0.5), and stress and diet (0.036 <0.5) in post-COVID [Table 9].

Conclusion

The present study provides valuable data on health and nutritional status of post-COVID patients. Hypertension has been reported as the highest pre-existing comorbidity (26%), followed by diabetes mellitus (23.2%) and cardiovascular disease (15.2%). Loss of appetite has been reported as the most prevalent symptom 93.2%, followed dry cough 92.4% and tiredness 92%. The other significant symptoms were the headache 92% and breathlessness 90%). During COVID, 21.6% of the patients were severely fatigued, 48.8% of the patients had a moderate level of perceived stress, and 38% of the patients had subthreshold insomnia. During post-COVID, 56.8% were severely fatigued; moderate stress was found in 53.2%, of the subjects; and 56% of the study subjects had subthreshold insomnia. Through ANOVA analysis, it is concluded that exercise has an impact on fatigue, stress level, diet pattern, and sleep pattern. Using Karl Pearson correlation coefficient of different parameters, the positively correlated variables were sleep and fatigue, sleep and stress, and stress and fatigue. Post-COVID is associated with comorbidities and disease severity. The prevalence of new-onset fatigue, perceived stress, and insomnia was significant among COVID-19 survivors. Given that COVID-19

affects several systems and has an effect on health and well-being, understanding its long-term effects is just as crucial as resolving its immediate symptoms.

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