

Coronavirus Pandemic

Post-recovery experience among COVID-19 patients: A population-based online survey in India

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Abstract

Introduction: Patients who recovered from the acute phase of COVID-19 experience several post-COVID-19 health and social problems. This study was therefore done to explore the living experiences and the various health problems experienced by people and their determinants during the post-recovery phase of COVID-19.

Methodology: This cross-sectional study was conducted in Mangalore in March 2022. Data were collected using a semi-structured questionnaire designed as a Google Doc. Post-COVID-19 conditions were defined as adverse health consequences returning, new, or persistent beyond 1 month after SARS-CoV-2 infection. The experiences in the post-recovery phase of COVID-19 were assessed based on a scoring system for the related items in the questionnaire.

Results: Out of 235 participants, 204 (86.8%) reported post-COVID-19 health problems between 1 and 6 months following SARS-CoV-2 infection. The majority of them reported fatigue [114 (55.9%)]. Self-perceived health status and social relationships were significantly poorer among participants in the post-COVID-19 phase than before infection. In the multivariable analysis, unmarried/divorced/widow status, staying within city limits, and history of being admitted to the hospital due to various COVID-19-related emergencies were independently associated with the presence of post-COVID-19 conditions among the participants. The living experience in the post-recovery phase was positive only among 22 (9.4%) participants and was found to be significantly associated with the severe status of COVID-19 at the time of disease presentation.

Conclusions: Post-COVID-19 health problems were present among several participants. Those identified to be at risk of developing these conditions need to be periodically screened and managed with a multi-disciplinary care and rehabilitation program. There is also a need to address social problems and encourage positive living experiences among COVID-19 patients during the post-recovery phase of the disease.

Key words: Post COVID-19 conditions; general population; online survey.

J Infect Dev Ctries 2024; 18(5):710-718. doi:10.3855/jidc.17945

(Received 16 January 2023 – Accepted 25 September 2023)

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Introduction

The incidence of COVID-19 in the community has declined due to good vaccination coverage and personal protection measures practiced among people. However, for those who recovered from this disease, there has been a widespread report of its short to long-term sequelae [1]. This is also referred to as the post-acute sequelae of the COVID-19 condition. It can involve multiple systems with significant effects on morbidity, mortality, and quality of life of people who recently recovered from COVID-19 [2,3].

The causes of the persistence of various post-COVID-19 conditions are yet to be completely understood. Various mechanisms, such as endothelial dysfunction leading to microthrombosis, immune dysregulation, or virus-mediated disruption of the

autonomic nervous system, have been suggested [4]. This threatens to be a significant global health problem in the months to come [5].

Additionally, the various health problems experienced by these patients can have other consequences. There have been reports of the fear of infecting family members during the recovery stage, reports of not going to work leading to socio-economic problems, and also of reports of the stigma associated with the infection leading to problems affecting mental health and well-being [6].

This study was therefore done to explore the living experiences and the various health problems experienced by people during the post-recovery phase of COVID-19 and to study their determinants. This

information might help in the improvement of care for those patients who recently recovered from COVID-19.

Methodology

This population-based online survey was a cross-sectional study conducted in Mangalore in March 2022. Approval was taken from the Institutional Ethics Committee. The approval number was IEC KMC MLR 03-2022/99. Sample size was calculated using the formula $4pq/d^2$. Substituting “p” as 46% (proportion of COVID-19 patients with post-COVID-19 morbidities) based on the findings of a previous study done in Bangladesh [7], at 95% Confidence Intervals, 15% relative precision, and adding 10% to accommodate for non-responses, the minimum sample size of 230 participants was calculated.

Data were collected during the ongoing COVID-19 pandemic using a semi-structured questionnaire designed as a Google Doc. It was content validated with the help of subject experts. The link was shared among the general population of Mangalore through email and WhatsApp. It was pilot-tested among ten participants who were not included in the main study. The link to the questionnaire was then circulated among the general population of Mangalore using email and WhatsApp.

The study information sheet and the consent form formed the starting page of the questionnaire. Participants aged 18 years and older and those who developed COVID-19 infection more than one month ago were included in this study. Those who did not consent and those who did not develop COVID-19 in the past were excluded from this study.

The questionnaire had four sections, each to obtain details of sociodemographic variables, COVID-19-related information, health problems of participants between 1- and 6 months following recovery from COVID-19, and the living experiences of participants within six months following isolation.

Post-COVID-19 conditions were defined as adverse health consequences that were returning, new, or persistent beyond 1 month after SARS-CoV-2 infection as per national and international guidelines [1,8].

The participants were instructed to fill in the post-COVID-19 conditions experienced in relation to the most recent episode of COVID-19.

Mild severity of COVID-19 was considered when the individual had usual signs and symptoms of COVID-19 such as body ache, fever, sore throat, cough, loss of smell and taste, vomiting, and diarrhoea but did not have breathlessness or any lesions in chest X-ray. Moderate severity of COVID-19 was considered when the individual had lower respiratory disease supported

by clinical assessment or imaging studies, but oxygen saturation measured by pulse oximetry was normal. Severe COVID-19 was considered when the individuals had SpO₂ less than 94% or respiratory rate > 30 breaths per minute [9].

Modified BG Prasad classification of 2021 was used to assess the participants’ socio-economic status (SES) [10].

The living experiences in the post-recovery phase of COVID-19 were categorized as follows: if constant fear of re-infection was present, then score 0; if no fear, then a score of 2 was given. If got re-tested for COVID-19, then score 0; if not, then a score 1 was given. If colleagues interacted differently, a score of 0 was given; if not, a score of 1 was given. If experienced stigma “always” or “most of the times” then score 0, if “sometimes” then score 1, if “rarely” then score 2, and if “never” then score 3. Behavioural changes concerning COVID-19 preventive measures if present, then score 1, and if not then score 0 was given. If there was a positive change in dietary habits then a score of 1 was given, else score 0 was given. If respondents took any dietary supplements, the score given was 1, and if not the score 0 was given. If there was improvement in exercising habits, a score of 1, and if not, a score of 0 was given. If the participants had taken a new health insurance coverage inclusive of COVID-19 care or if had one already, then a score of 1, or else a score of 0 was given. If the participants shared their personal experiences during the isolation period on various social media platforms, then a score of 1, else a score of 0 was given.

The total of the minimum possible score was 0 and the maximum possible score was 13. Scores between 0 to 4 were taken as a negative experience, 5 to 9 as a neutral experience, and 10 to 13 as a positive experience.

Submitted responses were transferred to SPSS version 25.0, Armonk, New York, for analysis.

The Kaplan-Meier curve was generated to study the cumulative time to development of post-COVID-19 conditions among the participants.

Bivariate analysis was done using unpaired t-test, Fisher’s Exact test, and Pearson’s Chi-square test. All variables associated at *p* value of 0.15 or less in bivariate analysis were introduced into the binary logistic regression model. A *p* value ≤ 0.05 was considered statistically significant association. Cronbach’s alpha value of the reliability of the questionnaire was found to be 0.794, indicating good internal consistency.

Results

The form was sent to 504 people. Out of which 423 people responded giving a response rate of 83.9%. Among them, 7 refused to give consent for participation. Out of the remaining 416, 165 who did not test positive for COVID-19 in the past were also excluded. So, a total of 251 participants took part in this online survey. Out of the 251 filled-in forms, 6 were discarded as the respondents were aged below 18 years and 10 were discarded as they developed COVID-19 one or within one month of the survey. Hence, the final number of participants was 235.

The mean age of the 235 participants was 34.3 ± 14.8 years. There were 69 (29.4%), 45 (19.1%), 38 (16.2%), 45 (19.1%), 27 (11.5%), and 11 (4.7%) participants aged between 18-20, 21-30, 31-40, 41-50, 51-60, and > 60 years respectively. The majority were males [127 (54%)]. Marital status was unmarried among 114 (48.5%) and married among 116 (49.4%). Four were divorced and one was a widow.

The type of family was nuclear, joint, and three-generation among 178 (75.7%), 42 (17.9%), and 15 (6.4%) participants respectively. As many as 2 (0.9%), 4 (1.7%), 20 (8.5%), 125 (53.2%), and 84 (35.7%) participants were illiterates, educated up to high school, intermediate or diploma, graduate, and post-graduate level respectively. Occupational status was unemployed, semi-skilled, skilled, clerical/business, semi-professional, professional, student, housewife, and retired among 2 (0.9%), 2 (0.9%), 9 (3.8%), 13 (5.5%), 38 (16.2%), 72 (30.6%), 83 (35.3%), 11 (4.7%), and 5 (2.1%) participants respectively. Information on per capita income was known among 217 participants.

Table 1. COVID-19 related characteristics and distribution of its risk factors among the participants (n = 235).

Characteristics	Number	Percentage
Habits*		
Alcohol consumption	36	15.3
Smoking	15	6.4
Tobacco chewing	6	2.5
Co-morbidities*		
Diabetes mellitus	37	15.7
Hypertension	29	12.3
Asthma	14	6.0
Anxiety disorders	11	4.7
Others**	12	5.1
Number of times tested positive for COVID-19		
Once	199	84.7
Twice	29	12.3
Three or more times	7	3.0
Current COVID-19 vaccination status		
Taken three doses	43	18.3
Taken two doses	184	78.3
Taken a single dose	5	2.1
Not vaccinated at all	3	1.3

*Multiple responses; **Hypothyroidism 5, Cardiomyopathy 2, Allergy 2, Cancer 1, Depression 1, Irritable Bowel Syndrome 1.

Among them, 200 (92.2%) belonged to Class I socio-economic status.

Most of the participants [230 (97.9%)] were Indians. One was a foreigner and four were non-residential Indians. The place of residence was urban (within city limits) and semi-urban parts of Mangalore among 191 (81.3%) and 44 (18.7%) participants respectively.

The majority of the participants had Diabetes mellitus [37 (15.7%)], and the majority had taken two doses of COVID-19 vaccination [184 (78.3%)] (Table 1).

The reported time gap between the diagnosis of the most recent episode of COVID-19 and the date of the survey was more than 1 month, 2 months, 3 to 5 months, and 6 months among 38 (16.2%), 49 (20.8%), 32 (13.6%), and 116(49.4%) participants respectively. The severity of COVID-19 during the most recent episode was reported to be mild, moderate, and severe at the time of disease presentation among 155 (66%), 64 (27.2%), and 16 (6.8%) participants respectively. History of hospitalization was reported by 38 (16.2%) and being put on ventilator by 5 (2.1%) participants following the most recent episode of COVID-19.

When tested positive, 17 (7.2%) developed COVID-19 after the stipulated 14 days after the second dose of COVID-19 vaccination. 114 (48.5%) participants had no health insurance coverage for COVID-19.

Among the 235 participants who developed COVID-19 in the past, 189 (80.4%), 26 (11.1%), 19

Table 2. Living experiences among participants soon after recovery from COVID-19.

Characteristics	Number	Percentage
Immediate reactions soon after completion of the isolation period*		
Sigh of relief	164	69.8
Feeling of happiness	100	42.5
Appreciated the value of freedom	70	29.8
Regained a sense of control over life	43	18.3
It felt like being gifted with a new life	1	0.4
Do you live with the fear of getting COVID-19 again?		
Yes	75	31.9
Voluntarily tested for COVID-19 on a later date to reassure COVID-19 negative status		
Yes	119	50.6
Colleagues at the workplace interacted differently		
Yes	39	16.6
Stigmatized at the workplace		
Always/Most of the times	14	5.9
Sometimes	47	20.0
Rarely	38	16.2
Never	136	57.9
Had written or narrated isolation experiences with others as a part of health education campaigns		
	47	20.0
Total	235	100.0

*Multiple responses.

(8.1%), and 1 (0.4%) were isolated at home, hospital, hostel, and a hotel, respectively.

Most of the participants [164 (69.8%)] experienced a sigh of relief soon after completion of isolation. 75 (31.9%) feared getting COVID-19 again, and 99 (42.1%) had experienced stigma at their workplace. Forty-seven (20%) participants had written or narrated their isolation experiences with others as a part of health education campaigns (Table 2). Among them, the common medium of communication used by these participants to share their experiences were WhatsApp [33 (70.2%)], other social media platforms [10 (21.3%)], guest lectures delivered on offline or online platforms [10 (21.3%)], newspaper write-ups [5 (10.6%)], creating a blog [1 (2.1%)], and online group discussion involving newly diagnosed COVID-19 patients [1 (2.1%)].

Habit of handwashing was practiced much more than before among 113 (48.1%) participants (Table 3).

As many as 151 (64.2%) participants had taken dietary supplements during the post recovery phase of COVID-19. The various supplements taken by them were Vitamin C tablets [136 (90.1%)], Zinc tablets [94 (62.2%)], Vitamin D3 tablets [63 (41.7%)], Calcium tablets [52 (34.4%)], Ayurvedic preparations [36 (23.8%)], Homeopathic preparations [2 (1.3%)], multivitamin preparations [2 (1.3%)], Vitamin B complex capsules [2 (1.3%)], and Omega-3 fish oil capsules [1 (0.7%)].

As many as 204 (86.8%) participants reported post COVID-19 conditions after 1 month and within 6

Table 3. Distribution of changes in behaviour, food/drinking, exercising habits and taking a new health insurance policy among participants in the post-recovery stage of COVID-19.

Characteristics	Number	Percentage
Behavioural changes in relation to COVID-19 preventive measures*		
The habit of washing hands much more than before	113	48.1
Wearing masks more consistently	112	47.7
Using hand sanitizers much more frequently	106	45.1
Avoiding social gathering	94	40.0
Disinfection of fomites periodically	1	0.4
Changes in food/drinking habits		
Ate only nutritious food	5	2.1
Avoided junk foods	4	1.7
Avoided eating foods ordered from outside	1	0.4
Reduced alcohol consumption	1	0.4
Improved exercising habits during the post-recovery phase of COVID-19	96	40.8
Took a new health insurance policy inclusive of COVID-19 treatment coverage		
Yes	42	17.9
No	114	48.5
Had taken already in the past	79	33.6
Total	235	100.0
Multiple responses*		

months following SARS-CoV-2 infection. The majority of them reported fatigue [114 (55.9%)] (Table 4).

The other health problems that these 204 participants reported were cough [71 (34.8%)], hair loss [60 (29.4%)], anxiety [50 (24.5%)], breathing difficulty [47 (23%)], loss of smell [39 (19.1%)], reduced sleep [34 (16.7%)], change in mood [34 (16.7%)], altered taste sensation [31 (15.2%)], increased sleep [24 (11.8%)], depression [23 (11.3%)], memory loss [20 (9.8%)], palpitations [16 (7.8%)], diarrhoea [15 (7.3%)], constipation [11 (5.4%)], hearing loss [7 (3.4%)], tremors [7 (3.4%)], reduced appetite [4 (2%)], weight gain [2 (1%)], skin rashes [1 (0.5%)], generalized body ache [1 (0.5%)], excessive sweating [1 (0.5%)], weight loss [1 (0.5%)], and strain in the eyes [1 (0.5%)].

Among the 38 participants who developed COVID-19 more than one month ago, the most common post-COVID-19 conditions reported were fatigue [18 (47.4%)], cough [14 (36.8%)], and hair loss [9 (23.7%)]. Among the 49 participants who developed COVID-19 more than two months ago, the most common post-COVID-19 conditions reported were fatigue [28 (57.1%)], cough [16 (32.6%)], hair loss [13 (26.5%)], and anxiety [12 (24.5%)]. Among the 20 participants who developed COVID-19 more than three months ago, the most common post COVID-19 conditions reported were fatigue [11 (55%)], hair loss [11 (55%)], and breathing problems [8 (40%)]. Among the 9 participants who developed COVID-19 more than

Table 4. Distribution of various health problems experienced by participants after 1 month and within six months following recovery from COVID-19 (n = 235).

Health problems	Number	Percentage
Present among	204	86.8
Type of morbidity (n = 204)		
Fatigue	114	55.9
Perceived state of blood sugar control in a Diabetes mellitus patient after recovering from COVID-19 (n = 37)		
Poor control	16	43.2
Perceived state of blood pressure control in a hypertensive patient after recovering from COVID-19 (n = 29)		
Poor control	8	27.6
Perceived feeling that the working capacity is affected after developing COVID-19 (n = 235)		
Strongly agree	17	7.2
Agree	64	27.2
Neutral	62	26.4
Disagree	55	23.4
Strongly disagree	37	15.8
Perceived feeling that performance of routine household activities is being affected after developing COVID-19 (n = 235)		
Strongly agree	12	5.1
Agree	68	28.9
Neutral	63	26.8
Disagree	57	24.3
Strongly disagree	35	14.9

four months ago, the most common post-COVID-19 conditions reported were fatigue [7 (77.8%)], loss of smell [5 (55.5%)], and hair loss [4 (44.4%)]. Among the three participants who developed COVID-19 more than five months ago, all reported anxiety. Among the 116 participants who developed COVID-19 six or more months ago, the most common post-COVID-19 conditions reported were fatigue [48 (41.4%)], cough [31 (26.7%)], anxiety [23 (19.8%)], breathing problems [22 (19%)], and loss of smell [19 (16.4%)], between 1 and 6 months following recovery from COVID-19.

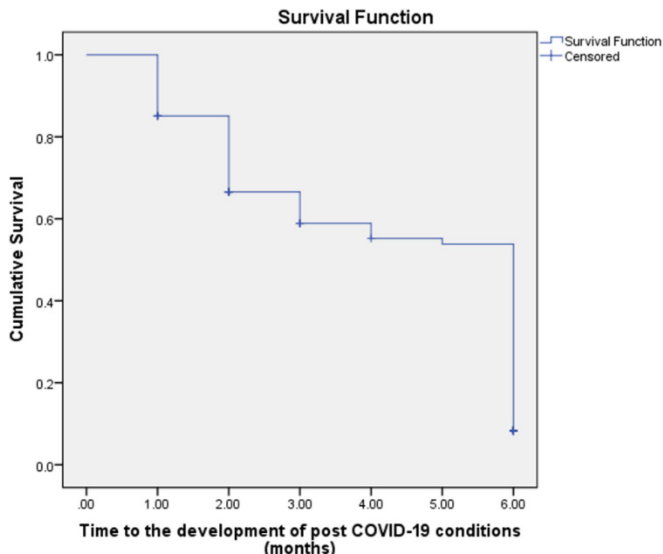
The mean time to development of post-COVID-19 conditions among the participants in this study was 4.195±0.137 months (95% CI is 3.928-4.463) (Figure 1).

Self-perceived assessment of health status among the participants (n = 235) on a scale of 1 (indicating worst) to 10 (indicating best) before getting COVID-19 infection was 8.7 ± 1.3. It was 7.8 ± 1.8 after recovering from COVID-19 among them (t = 8.645, p < 0.001).

Self-perceived assessment of social relationships among the participants (n = 235) on a scale of 1 (indicating worst) to 10 (indicating best) before getting COVID-19 infection was 8.4 ± 1.8. It was 7.9 ± 2.0 after recovering from COVID-19 among them (t = 3.623, p < 0.001).

Out of the 235 participants, 77 (32.8%) strongly agreed, 105 (44.7%) agreed, 38 (16.2%) were neutral, 6 (2.5%) disagreed, and 9 (3.8%) strongly disagreed that COVID-19 vaccines were beneficial.

Figure 1. Kaplan-Meier survival curve illustrating the cumulative time to the development of post COVID-19 conditions among the participants (n = 235).



79 (33.6%) participants stated that they were planning to take vaccines for other diseases in the future. This comprised of influenza vaccine [50 (63.3%)], pneumococcal vaccine [36 (45.6%)], and Hepatitis B vaccine [4 (5.1%)].

In the multivariable analysis, unmarried/divorced/widow status [AOR = 2.722, 95% CI 1.199-6.178], staying within city limits [AOR = 2.511, 95% CI 1.051-5.998], and history of being

Table 5. Association between various determinants and post COVID-19 conditions among the participants (n = 235).

Characteristics	Post COVID-19 conditions Present (%)	Post COVID-19 conditions Absent (%)	Total, Chi-Square value, p value	OR (95% CI)	AOR (95% CI)	p value
Age group (years)						
≤ 30	104 (91.2)	10 (8.8)	114			
> 30	100 (82.6)	21 (17.4)	121			
			$\chi^2 = 3.776, p = 0.052$	2.184 (0.98-4.868)	1.341 (0.279-6.457)	0.714
Marital status						
Unmarried/ Divorced/ Widow	109 (91.6)	10 (8.4)	119			
Married	95 (81.9)	21 (18.1)	116			
			$\chi^2 = 4.83, p = 0.028$	2.41 (1.08-5.37)	2.722 (1.199-6.178)	0.017
Place of residence						
Urban area	170 (89)	21 (11)	191			
Semi-urban area	34 (77.3)	10 (22.7)	44			
			$\chi^2 = 4.3, p = 0.038$	2.38 (1.03-5.5)	2.511 (1.051-5.998)	0.038
Number of times tested positive for COVID-19						
More than once	34 (94.4)	2 (5.6)	36			
Once	170 (85.4)	29 (14.6)	199			
			$p = 0.185$	2.9 (0.661-12.733)		
Severity status of COVID-19 at the time of disease presentation						
Severe	16 (100)	0 (0)	16			
Mild/ Moderate	188 (85.8)	31 (14.2)	219			
			$p = 0.139$	1.165 (1.104-1.229)		
History of being admitted to the hospital due to various COVID-19 related emergencies						
Yes	37 (97.4)	1 (2.6)	38			
No	167 (84.8)	30 (15.2)	197			
			$p = 0.036$	6.647 (0.878-50.303)	8.178 (1.063-62.901)	0.043

admitted in the hospital due to COVID-19 related emergencies [AOR = 8.178, 95% CI 1.063-62.901] was independently associated with the presence of post COVID-19 conditions among the participants. The severity status of COVID-19 among the participants at the time of disease presentation and the number of times they tested positive for COVID-19 were eliminated from this model as the P values of these parameters in the adjusted model were close to 1 (Table 5).

There was no association of the development of post COVID-19 conditions with gender ($p = 0.385$), education ($p = 0.256$), occupation ($p = 0.29$), socio-economic status ($p = 0.71$), type of family ($p = 0.83$), nationality ($p = 1$), chewing tobacco ($p = 0.576$), smoking status ($p = 1$), alcohol consumption status ($p = 0.893$), presence of co-morbidities ($p = 0.531$), history of being put on a ventilator following COVID-19 infection ($p = 1$), and COVID-19 vaccination status ($p = 0.62$) among the participants.

The participants' living experience in the post-recovery phase of COVID-19 was positive among 22 (9.4%), neutral among 200 (85.1%), and negative among 13 (5.5%) of them (Table 6).

COVID-19 status if severe at the time of disease presentation was associated with a positive living experience in the post-recovery period among the participants in the binary logistic regression analysis [AOR=4.256, 95% CI 1.127 to 10.681, $p = 0.036$] (Table 6).

Positive living experience, was however not associated with gender ($p = 0.96$), occupation ($p = 0.56$), educational status ($p = 0.72$), marital status ($p = 0.405$), type of family ($p = 0.861$), number of family members ($p = 0.21$), number of children ($p = 0.174$), place of residence ($p = 1$), nationality ($p = 0.391$), tobacco chewing status ($p = 1$), smoking status ($p = 1$), alcohol consumption status ($p = 0.543$), presence of co-morbidities ($p = 0.9$), number of times tested positive for COVID-19 ($p = 1$), place of isolation ($p = 0.719$), presence of post COVID-19 conditions ($p = 1$), history of being admitted in the hospital due to various COVID-19 related emergencies ($p = 0.38$), and COVID-19 vaccination status ($p = 0.5$) among the participants.

Discussion

Post-COVID-19 conditions were present among 86.8% of the participants in this study and among 43.4% to 87.4% of the patients in previous studies [2,3,7].

The most common morbidity in the present study was fatigue, as also reported among 33% to 55% of the participants in previous studies [1-3,7]. The predominance of fatigue might be due to the immune system alterations following viral infection [11]. COVID-19 patients who recently recovered from this disease, therefore, need to be trained in self-management strategies to minimize fatigue in their day-to-day lives on a priority basis. This involves measures like graded exercise therapy, breathing exercises, aerobics, balance training, resistance strength training, and increasing Vitamin C intake in diet [1].

The next common symptom reported by the participants in the present study was cough. This was present among 8.5% of the patients in a study done in Bangladesh [7]. The persistent cough in COVID-19 is due to the involvement of the nervous system. Infection results in activation of the Vagus nerve that leads to inflammatory events and a cough hypersensitivity state [12]. This augmented cough reflex sensitivity is responsible for a persistent cough. There are other theories too that explain the persistence of cough in COVID-19. For instance, entry of SARS-CoV-2 through the upper and lower airway epithelial cells is mediated through angiotensin-converting enzyme 2 (ACE2) receptors [13]. Binding of the virus to this receptor increases concentration of bradykinin and its metabolites. This causes constriction of airway smooth muscles thereby evoking cough [14].

Hair loss was the third most common symptom reported in the present study and by 22% of the patients in the study done in China [15]. This happens because of the strong cytokine response induced by the virus, thereby exposing the follicular cells to inhibitory and disruptive responses among COVID-19 patients during the period of convalescence [16]. Psychological stress which is common among post COVID-19 patients is also responsible for hair loss among them [17].

Table 6. Association of variables with the type of living experiences among participants during the post COVID-19 period (n = 235).

Characteristics	Positive experience (%)	Neutral/ Negative experience (%)	Total, p value	OR (95% CI)	AOR (95% CI)	p value
History of being put on the ventilator after developing COVID-19						
Yes	2 (40)	3 (60)	5			
No	20 (8.7)	210 (91.3)	230			
			$p = 0.07$	7 (1.104, 44.387)	4.033 (0.525, 30.968)	0.18
Severity status of COVID-19 at the time of disease presentation						
Severe	4 (25)	12 (75)	16			
Mild/ Moderate	18 (8.2)	201 (91.8)	219			
			$p = 0.05$	3.722 (1.088, 12.735)	4.256 (1.127, 10.681)	0.036

Other common post-COVID-19 conditions reported in prior studies were headache [7,11], breathlessness [2,3,7,11], cognitive dysfunction [3], joint pain [2], attention disorder [11], chest pain [2], sleep-related disorders [7], and vertigo [7].

Close to one-fourth of participants in the present study had anxiety, and more than one-tenth of them had depression. In the COMEBAC study, anxiety was reported among 31%, depression among 22%, and post-traumatic stress among 14% of the patients four months after the COVID-19 infection [18]. In the study done in China, 23% of patients reported anxiety or depression as a post-COVID-19 condition [15]. Davis *et al.* reported that 72.8% of participants reported memory impairments [3]. These mental health problems are reported to be quite common after the acute phase of COVID-19 illness due to the fear of not fully recovering from the disease, fear of a serious form of the disease, minimal social visits from friends and relatives, the experience of social stigma, and also due to the inflammatory and immunological changes following infection [6]. The proportion of patients with psychiatric disorders could be much more as the patients infrequently report these morbidities, leading to a further delay in its diagnosis [6].

Sleep was reported to be reduced among 16.7%, while it was increased among 11.8% of the participants in this study. In other studies, 26% to 78.6% of the participants reported sleep difficulties [1,3,15]. The involvement of the hypothalamus in COVID-19 infection, which results in circadian rhythm sleep disturbances could be the reason behind this presentation [7,19]. Simple measures like listening to soothing music in a dimly lit room are beneficial to reduce sleep latency [1]. However, usage of caffeine, alcohol consumption, using mobile phones and computers just before bedtime, and self-medication with hypnotics need to be strictly avoided [1].

Loss of smell was reported by 19.1% participants in this study and 11% [15] and 38% [20] participants in previous studies. This is due to olfactory neuropathy following the SARS-CoV-2 infection facilitated by ACE2 receptors. The SARS-CoV-2 has a high affinity for ACE2 receptors in neurons and glial cells [1].

Altered taste sensation was present among 15.2% of the patients in this study. This also occurs as an aftermath of the inflammatory response following the binding of the virus to the ACE2 receptors in the oral mucosa [21]. In the post-COVID-19 phase, the median adjusted frequency for loss of smell was 23.6%, and for altered taste sensation was 15.6% as stated by the Ministry of Health and Family Welfare, Government of

India [1]. The various chemosensory disorders like smell and taste disturbance were reported to be persisting symptoms of the acute phase of COVID-19 rather than new symptoms of post COVID-19 period [1].

Palpitations were reported among 7.8% of the participants in this study and among 9% of them during the six-month follow-up period, as per the observations of the Ministry of Health and Family Welfare, Government of India [1]. The various reasons for this could be premature ventricular contractions or ventricular arrhythmias. The underlying cause being myocardial fibrosis and scarring, inappropriate sinus tachycardia, and postural orthostatic tachycardia syndrome following a hyperadrenergic state in the post-COVID-19 recovery phase [1].

Diarrhoea was present among 7.3% and constipation among 5.4% of the participants in this study during the post-COVID-19 phase. The entry and replication of the Coronavirus in the epithelium of the gastrointestinal tract facilitated by the presence of ACE2 receptors results in gastrointestinal manifestations. These symptoms were sometimes reported even before the onset of fever and other respiratory symptoms [1].

Several long-term health effects of COVID-19 were observed in this study. This can also be explained in the background of the damage caused by the cytokine storm following infection, due to co-morbidities, and the adverse drug reactions of the drugs used to treat COVID-19 [1].

Self-perceived health status and social relationships were significantly poor among participants in this study in the post-COVID-19 phase compared to the period before infection. Considering the varied problems experienced by patients in the post-recovery phase, a multi-disciplinary care and rehabilitation program is required.

Unmarried, divorced, or widowed participants were found to be at risk of developing various post-COVID-19 conditions in the present study. This could be due to the minimal post-COVID-19 care they might have received compared to the married participants. History of being admitted to the hospital due to various COVID-19 related emergencies was associated with the presence of post-COVID-19 conditions among the participants. This could be due to the intensive care unit experience along with the probability of having received mechanical assistance to breathe that might have resulted in anxiety, post-traumatic stress syndrome and depression among several participants during the recovery phase [22]. Greater proportion of

the participants residing within the city limits were also found to have post COVID-19 conditions. This might be due to various psychological reasons influenced by greater proximity to health facilities in the setting. In other studies, older age [1], female gender [7], presence of more than five symptoms in the acute phase of COVID-19 [1], the severity of illness [7], severe COVID-19 status requiring hospital admission [1], and being obese [1], were associated with the presence of post COVID-19 conditions among the participants.

Participants who developed severe COVID-19 at the time of disease presentation had a positive living experience of COVID-19 in the recovery phase. This could be because of more excellent self-care among them after having gone through a critical period in life.

Conclusions

About one-third of the participants had the fear of getting COVID-19 again. Close to 90% of the participants experienced one or the other health problems between 1 and 6 months following COVID-19 infection. High-risk groups associated with post COVID-19 conditions need to be periodically screened for various health problems during their post-recovery period. Considering the diverse nature of various post-COVID-19 conditions, the screening activities must be supported by a comprehensive treatment and rehabilitation program offered by a multi-disciplinary team of personnel. This would help reduce further long-term disabilities and economic problems among this population.

Hardly 10% of participants had a positive living experience during the post-recovery phase.

More than one-third of the participants had the fear of getting COVID-19 again and, more than 40% experienced stigma at their workplace during the post-COVID-19 period. Just one-fifth of the participants had written or narrated their isolation experiences with others as a part of health education campaigns. Less than half of the participants reported practicing the various COVID-19 preventive measures much more than in the period before getting COVID-19. Hardly 40% of the participants improved their exercising habits in the post-COVID-19 period. This again emphasizes the need to address social problems and encourage positive behavioural changes among COVID-19 patients during the post-recovery phase of the disease.

More research is required to better understand the post-COVID-19 conditions among the population. This would be beneficial for planning suitable remedial measures to handle the long-term problems of COVID-19.

Limitations

A few of the reported post-COVID-19 conditions may be due to other diseases. Moreover, this was a cross-sectional study conducted among the general population. Longer follow-up studies are required to better understand the complete spectrum of COVID-19. Data were collected during the ongoing COVID-19 pandemic using a Google Doc. This was done to minimize exposure during the data collection process. However, participants without internet access were not able to participate, which could be another limitation of this study. This being an online survey has other limitations like low response rate and use of a non-random sampling method for enrolling the participants.

Acknowledgements

The authors of this study would like to thank all the participants of Mangalore who took part in this study.

Authors' contribution

NJ: guarantor of this research work, concept, design, literature search, tool preparation, data collection, data analysis, interpretation of data, manuscript preparation, revising the work critically for important intellectual content. PR, PC, A, SJ, HY, PK: literature search, data collection, manuscript editing, revising the work critically for important intellectual content. This manuscript has been read and approved by all the authors. This was a population-based study. Hence, there was a need to have seven investigators to get the required number of responses during the data collection phase.

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Conflict of interests: No conflict of interests is declared.