



A study of the clinical and metabolic profile of a population presenting to an outpatient clinic with post-COVID-19 infection

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Abstract

Aim: We aim to assess the individuals with clinical, metabolic, and demographic parameters for post-COVID-19 positive patients who visited our Wellness Assessment Center.

Materials and Methods: This was an observational cross-section study. In the test group, individuals with prior history of COVID-19 infection without any major co-morbidity were included. The control group included individuals with no documented COVID-19 infection and without any major co-morbidity. All individuals were observed based on routine Annual health check-ups. Medical laboratory tests, aspartate transaminase (SGOT), alanine transaminase (SGPT), fasting blood sugar level, postprandial blood sugar level, glycated hemoglobin (HbA1C), triglycerides (TG), high-density lipoprotein (HDL-C), Serum creatinine, and ultrasound -

abdomen for Fatty liver were conducted. Moreover, pulmonary function tests, ECG, TMT/2D Echo, with chest X-rays were observed for both groups. The quality of life with a functional status scale for COVID-19-positive patients was also measured.

Results: Out of 653 individuals aged 25 to 50, a total of 346 (52.99%) had SARS-CoV-2 infection ($p=0.664$). The primary health concern was diabetes and prediabetes conditions affecting 16.08% of individuals in both groups. Common symptoms included chronic fatigue, hair loss, hypertension, joint pain, brain fogging, and recurrent cold. Fatty liver (47.69%) was observed in individuals with post-COVID-19 infection. Both chest x-ray and serum creatinine findings were normal in both groups.

Conclusion: Post-COVID-19 infection, individuals exhibited a significant prevalence of diabetes, prediabetes, and symptoms like chronic fatigue, hair loss, hypertension, joint pain, brain fogging, and recurrent cold. Fatty liver was also observed in a considerable proportion of patients.

Keywords: Post-COVID-19 health, long-term health consequences, Prediabetes, fatigue, hair loss, hypertension, brain fogging, joint pain

Introduction

The global COVID-19 pandemic has brought the globe to a halt, inflicting enormous loss and disruption. While the primary focus has been on stopping the virus's spread and saving lives, there is growing concern about the long-term health repercussions that people may experience even after surviving the initial infection. As the world begins to recover from the grip of the pandemic, it is critical to recognize and treat the potential health consequences that COVID-19 survivors may face.¹⁻³

COVID-19 primarily targets the respiratory system. Growing evidence indicates its impact on multiple organs and systems. Even those with mild symptoms may suffer lasting health issues, profoundly affecting their quality of life.⁴⁻⁶

One of the concerning health outcomes following COVID-19 is the development of long-term respiratory difficulties. Studies indicate that many survivors experience persistent symptoms such as shortness of breath, coughing, and reduced lung capacity, which can greatly impact daily activities and physical exertion.^{7,8}

Individuals with diabetes and prediabetes are particularly vulnerable to the health consequences of COVID-19 infections. Emerging evidence suggests that COVID-19 can worsen glycemic control and increase the risk of complications in these individuals. The interplay between diabetes, prediabetes, and COVID-19 presents unique challenges, including a higher likelihood of severe illness, longer recovery times, and potential long-term health impacts. Understanding and addressing the specific health consequences faced by diabetic and prediabetic individuals after COVID-19 infection is crucial for effective management and support in this vulnerable population.^{9,10}

COVID-19 survivors have reported neurological symptoms such as chronic headaches, dizziness, and other abnormalities. Concerns about long-term effects on the neurological system include encephalopathy and strokes. Additionally, emerging data suggest a potential association between COVID-19 and an elevated risk of neurodegenerative diseases like Parkinson's and Alzheimer's, but further research is required for conclusive evidence.^{11,12}

COVID-19 survivors may encounter a variety of psychological health issues. Individuals around the world have experienced unparalleled stress, anxiety, and depression as a result of the pandemic. Social isolation and economic insecurity had an impact on people's cognitive health. Many people have experienced symptoms of sadness, anxiety, and post-traumatic stress disorder (PTSD) after COVID-19. The psychological impact of the pandemic might be long-lasting, necessitating thorough support and cognitive health measures.^{13,14}

Our study focused on clinical, metabolic, and demographic parameters to understand the health consequences of post-COVID-19 patients visiting our Wellness Assessment Center. It's important to note that these consequences go beyond physical health, affecting individuals socially, emotionally, and economically. A holistic approach to post-COVID-19 care is essential, involving physical rehabilitation, cognitive health support, and social reintegration. As we enter the post-pandemic era, the long-lasting effects of COVID-19 on respiratory, cardiovascular, neurological, and cognitive health become increasingly evident. Addressing these complications is crucial to providing comprehensive care for COVID-19 survivors.

Materials and Method

Study Design:

This study utilized an observational cross-sectional design to assess the health consequences of COVID-19 infections in individuals. This study was conducted at the Wellness Assessment Center (OPD) of Aditya Birla Memorial Hospital (ABMH), Chinchwad, MH, India, between September 2022 to January 2023. The study followed ethical guidelines and principles, obtaining informed consent from all participants while ensuring the confidentiality and privacy of their information. The study protocol received approval from the institutional ethics committee before implementation.

The study recruited adult participants of both genders (Age group 25–50 years) who met the inclusion criteria, which required a documented history of COVID-19 infection confirmed by RT-PCR or RAT testing at least three months prior. The COVID-19 group comprised individuals with no major co-morbidity, while an age and gender-matched control group included participants with no documented history of COVID-19 infection and no major co-morbidity. The exclusion criteria encompassed pre-existing illnesses, co-morbidities before COVID-19 infection, and acute illnesses during the study period. Patients who had not done COVID-19 testing were also excluded from the research.

Data Collection and Analysis:

The study approached participants visiting the Wellness Assessment Center for Annual Health Check-ups and obtained informed consent. For the COVID-19 group, relevant information such as infection date, testing method and positive result was collected, along with demographics. Medical records were reviewed to confirm the COVID-19 history. The control group underwent similar data collection. Clinical and laboratory test parameters were examined for both groups (Table No.1). The functional status scale (FSS) was assessed to understand the quality of life of infected patients only.²⁶

Descriptive statistics were used to summarize the demographic characteristics of the participants, including age, gender, BMI, and infection duration. The presence of the COVID-19 infection and

associated complaints were presented as percentages. Lab parameters and diagnostic findings were analyzed using appropriate statistical methods.

Results

The study included data from 653 participants, with 52.99% (346 individuals) testing positive for COVID-19. The test group had a gender distribution of 75.43% male and 24.57% female. The analysis focused on individuals aged 25 to 50 years ($p = 0.664$). The average BMI in the test group was 26.91 Kg/m^2 ($p = 0.230$, $SD = 3.94$), indicating an overweight range.

Table No. 1: Test parameters: Listed parameters are used to understand the effect of COVID-19 infection post-recovery on individuals contributing to co-morbidities and related health consequences.

n= 653

	COVID- 19 POSITIVE	COVID - 19 NEGATIVE	p-value
	Total = (346)	Total = (307)	
Age (year)			0.664
≤ 30	48	46	
31-40	188	173	
41-50	109	88	
> 50	1	0	
Gender			0.303
Male	261	242	
Female	85	65	
BMI			0.041
NORMAL	111	122	
RAISED	235	185	
Laboratory Parameter			
SGPT			0.395
normal	290	255	

raised	39	42	
HbA1C			0.882
normal	113	93	
raised	43	34	
TG			0.633
normal	211	201	
raised	116	102	
HDL-C			0.298
NORMAL	323	296	
RAISED	4	7	
Fatty Liver			0.107
Present	166	128	
Absent	180	179	

All individuals in the control group were fully vaccinated. However; in the test group, 342 individuals were fully vaccinated. The most prevalent co-morbidity observed in the overall study population was prediabetes and diabetes, (16.08%). Chronic fatigue was a common symptom reported by 38 individuals (10.98%), followed by hair loss in 14 individuals (4.05%) in the test group. The recurrent cold-like symptoms (3.47%), hypertension (2.31%), headache (2.02%), joint pain (1.73%), brain fogging (0.87%), and other health consequences (4.62%) were also reported by a smaller percentage of participants. (Table No. 2) It is important to note that these numbers represent the prevalence within the study population, not the overall prevalence in the general population. (Figure No. 1) One hundred and eighty-five individuals (53.47%) did not report any specific health consequences after COVID-19 infection. The severity of COVID-19 infection was classified according to the ICMR classification;²⁵ 322 individuals were categorized as mild infection, 3 were categorized as moderate, and one individual was categorized into the severe infection category. Additionally, on the FSS assessment, 277 individuals were graded “0” status, 67 individuals were graded a scale “1”, and 2 were graded a scale “2” functional status.²⁶ This study was a cross-section observational study. Therefore, with this limitation, the resulting p-values were non-significant for all studied parameters.

Table No. 2: Duration of COVID-19 positive infection in months: This table explains the health consequences that occurred within the duration of post-COVID-19 infection

Health Consequences	COVID 19 Positive	COVID 19 Negative
PREDIABETES	45 (13%)	43 (12.4%)
DIABETES MELLITUS	24 (6.9%)	8 (2.3%)
HYPERTENSION	11 (2.3 %)	0
CHRONIC FATIGUE	38 (10.7)	0
OTHER SYMPTOMS	49 (12.7%)	0

Figure No.1:Health Consequences: Shows the number of health consequences in individuals post-COVID-19 infection

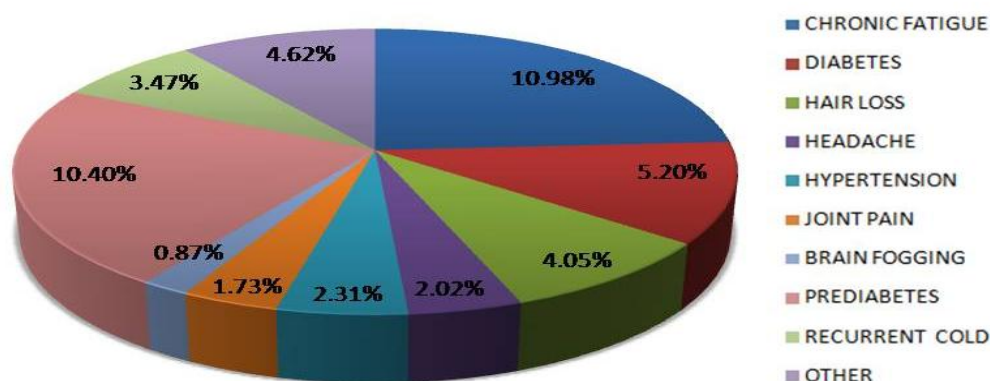
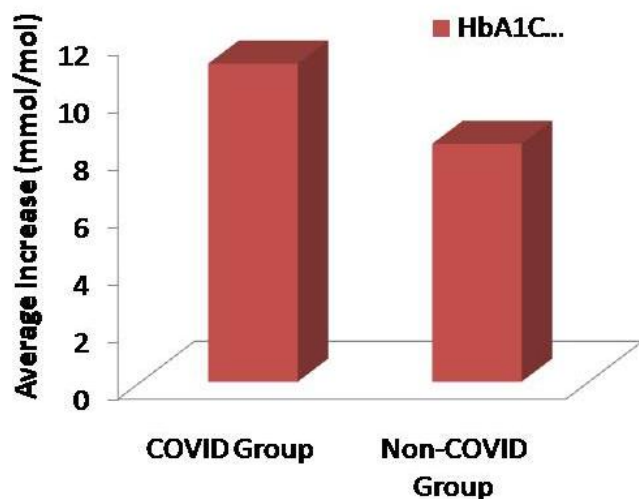
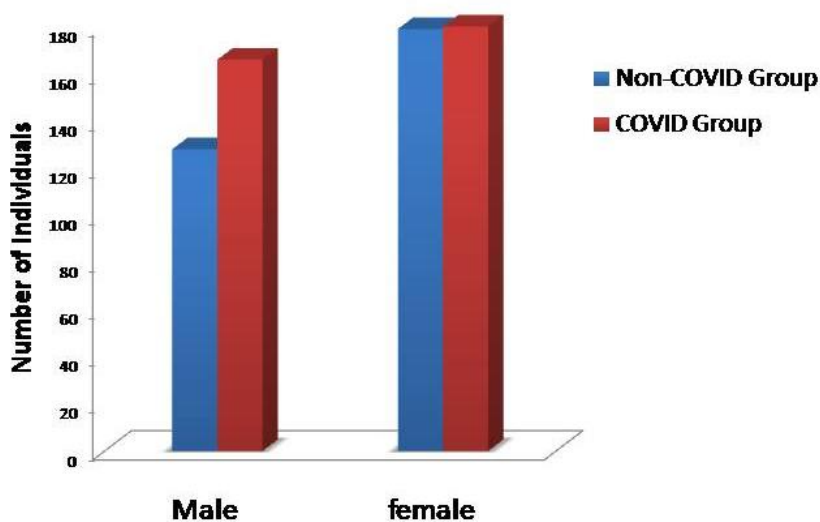


Figure No.2:HbA1C levels:The level increase observed in the laboratory test after COVID-19 infection compare to the non-COVID group. However; prediabetic and diabetic conditions were also newly observed in the controlled group.



Both groups showed a significant increase in blood sugar levels. (Figure No. 2) Fatty liver was observed in 47.69% of the test group and 43.54% of the control group. In females, the percent increase in fatty liver after COVID-19 infection was 50.14% compared to the control group. (Figure No. 3) Chest X-ray and serum creatinine findings were normal in both groups.

Figure No. 3:Fatty Liver status: Post-COVID-19 infection individuals presented with fatty liver were more compared to the non-COVID-19 group. Results showed an increased female population compared to males prone to fatty liver post-COVID-19 infection.



Overall, the results suggest that chronic fatigue, diabetes, hair loss, and hypertension were among the commonly reported health consequences in the studied population. Further analysis and evaluation of these health consequences are necessary to understand the long-term impacts of COVID-19 infections on an individual's health.

Discussion

The study's findings showed some intriguing discoveries concerning the health implications faced by individuals following COVID-19 infection. One significant finding was that mild patients in the COVID-positive category outnumbered moderate or severe cases. This observation is consistent with prior research demonstrating that a considerable proportion of COVID-19 individuals present with mild or even asymptomatic symptoms.^{5,15}

Prediabetes and diabetes were found to be the most prevalent health consequence reported by the participants. This finding highlights the potential impact of COVID-19 on glucose metabolism and the increased risk of developing diabetes or prediabetes after infection. However, the control group also showed increased levels of blood sugar, though all individuals in the control group were vaccinated, and showed negative COVID-19 tests. The association between COVID-19 and prediabetes may be attributed to the inflammatory response and the impact on insulin resistance. Further, longitudinal studies are needed to investigate the long-term implications of prediabetes in individuals recovering from COVID-19.^{16,17}

Chronic Fatigue, hair loss, hypertension, brain fogging, and joint pain were also prevalent health consequences reported by the participants. Chronic Fatigue has been widely reported as a common symptom experienced during and after COVID-19 infection. The persistence of fatigue after recovery suggests the need for ongoing support and management for individuals affected by COVID-19.^{18,19}

Hair loss was observed in a considerable number of participants, which can be distressing for individuals experiencing it. The underlying mechanisms linking COVID-19 and hair loss are not yet fully understood. It is speculated that hair loss may be related to the physical and emotional stress associated with the infection.²⁰

Hypertension, brain fogging, and joint pain were also reported by some participants. Hypertension and high blood pressure have been associated with severe COVID-19 outcomes and may be linked to the systemic inflammation caused by the infection. Brain fogging and joint pain may be related to the neurologic and musculoskeletal effects of the virus.^{21,22}

Interestingly, the average BMI was found to be higher in the COVID-positive group compared to the non-COVID group. This finding suggests a potential association between COVID-19 infection and weight gain or obesity. It is important to address the impact of weight management and lifestyle interventions in individuals recovering from COVID-19 to reduce the risk of obesity-related complications.²³

Both chest X-ray and serum creatinine findings came out normal in all patients, indicating that there were no apparent abnormalities in the lungs or kidney function in the studied population. However, it is important to note that these findings do not rule out the possibility of more subtle or long-term effects on these organs. Additional imaging and follow-up evaluations may be necessary to comprehensively assess the respiratory and renal health of an individual's post-COVID-19 infection.²⁴

It is important to interpret these results in the context of the study's limitations. The cross-sectional design limits the ability to establish causal relationships between COVID-19 infection and the observed health consequences. Additionally, the study relied on self-reported symptoms, which may introduce recall bias. The findings may also be influenced by selection bias, as the study was conducted in a specific population visiting a wellness assessment center.

Conclusion

This study provides valuable insights into the health penalty experienced by individuals after COVID-19 infection. It was important to interpret these findings with caution, considering the limitations of the study, such as the cross-sectional design and the reliance on self-reported symptoms. The results indicate a high prevalence of prediabetes, fatigue, hair loss, hypertension, brain fogging, and joint pain in the studied population. Additionally, the study highlights a potential association between COVID-19 and higher BMI. Further, we recommend research, including longitudinal studies and more diverse populations, to fully understand the long-term

health implications of COVID-19 and develop appropriate interventions to support individuals in their recovery.

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