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Original Article

Metabolic Parameters of Post-COVID Patients in a Tertiary Care Hospital in Bangladesh

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Abstract

Background: *COVID-19 has led to lasting health impacts, including post-COVID syndrome, persistent symptoms beyond three months. SARS-CoV-2 affects various metabolic pathways, contributing to chronic sequelae. This study examines metabolic parameters among post-COVID patients in Bangladesh, focusing on clinical and laboratory findings.* ***Methods:*** *A cross-sectional study of 236 patients with post-COVID-19 syndrome was conducted at the Respiratory Medicine Department of Bangladesh Medical University, from August 2021 to July 2022. Clinical symptoms and physical measurements (height, weight, BMI) were recorded. Parameters assessed included WBC count, platelet count, serum ferritin, blood glucose, HbA1c, serum creatinine, serum electrolytes, and fasting serum lipid profile. Data were analyzed using SPSS 26 version, with t-tests, Chi-square, and Fisher's exact tests.* ***Results:*** *The study revealed significant alterations in metabolic parameters post-COVID. Mean WBC count was 9,000 cells/mm (SD=2,500), while mean platelet count was 200,000 (SD=30,000). Mean serum ferritin levels were elevated to 550 ng/mL (SD=200). A significant increase in blood glucose was noted, with a mean of 140 mg/dL ($p<0.05$), while HbA1c reached 6.8% ($p=0.03$). Serum creatinine levels increased by 15% ($p<0.01$), indicating renal stress. A higher prevalence of dyslipidemia was observed, with 55% of patients showing elevated fasting serum LDL levels.* ***Conclusion:*** *The study identified significant metabolic abnormalities in post-COVID patients, including elevated blood glucose, HbA1c, serum ferritin, serum creatinine, and fasting serum LDL levels. These findings suggest increased risks of diabetes, systemic inflammation, renal dysfunction, and dyslipidemia. Routine metabolic screening and long-term follow-up are recommended to detect and manage post-COVID complications effectively.*

Keywords*: Post-COVID Syndrome, Metabolic Parameters, COVID-19, Blood Glucose, Dyslipidemia*

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Introduction

The COVID-19 pandemic, triggered by the SARS-CoV-2 virus, first appeared in Wuhan, China, in December 2019 and has since posed major challenges to global public health. By mid-2021, it had infected over 149 million people worldwide, causing more than 3 million deaths.[1] In Bangladesh, over 750,000 cases and 11,000 deaths were recorded by this time, overwhelming the healthcare system.[1] Initially identified for its respiratory symptoms, COVID-19 is now recognized as a systemic illness with diverse long-term effects. Post-COVID syndrome, or "long COVID," affects 10–30% of recovered patients, with symptoms like fatigue, shortness of breath, cognitive difficulties, chest pain, gastrointestinal issues, and neurological problems persisting for three months or longer.[2–5] Beyond respiratory and neurological impacts,

the influence of COVID-19 on metabolic health is of increasing concern. SARS-CoV-2 targets organs like the pancreas, liver, and kidneys, which express ACE2 receptors, facilitating viral entry and disruption of metabolic pathways, potentially exacerbating or triggering disorders such as hyperglycemia, insulin resistance, dyslipidemia, liver impairment, and renal dysfunction.[6-10] A common metabolic issue is glucose dysregulation, with elevated blood glucose, increased HbA1c, and new diabetes cases reported, even in those without prior history.[6,11,12] Lipid abnormalities, including elevated total cholesterol, triglycerides, and LDL cholesterol, are also prevalent, raising cardiovascular risks, often worsened by inflammation or corticosteroid use.[6,13,14] Elevated serum ferritin, indicating inflammation and oxidative stress, is frequently observed in long COVID.[7,15] Kidney complications, such as raised serum creatinine and reduced glomerular filtration rate, suggest persistent renal stress.[9,16] Electrolyte imbalances and metabolic alkalosis may arise from fluid shifts, tubular damage, or gastrointestinal losses.[4,6] Globally, 20–30% of long COVID patients exhibit metabolic dysfunction, with higher rates in severe cases.[8,13] In Bangladesh, where non-communicable diseases like diabetes and heart disease are widespread, these metabolic changes pose significant risks, potentially delaying recovery and increasing long-term complications.[11,14] Given these concerns, thorough metabolic assessments are essential for post-COVID patients to identify and manage complications early. This study evaluated socio-demographic profiles, clinical symptoms, and laboratory findings in post-COVID individuals to deepen understanding of the disease's long-term metabolic effects.

Methods

Study Design

This study utilized a cross-sectional design and consecutively enrolled 236 adult patients with post-COVID-19 syndrome attending the Department of Respiratory Medicine between August 2021 and July 2022. Eligible participants were individuals with RT-PCR-confirmed SARS-CoV-2 infection who experienced ongoing symptoms lasting at least three months following recovery, with alternative diagnoses ruled out. Individuals with pre-existing chronic disorders, such as cardiovascular, pulmonary, renal, or liver diseases, as well as those previously diagnosed with diabetes mellitus or dyslipidemia before COVID-19 infection, were excluded from the study.

Sample Size Calculation. We determined the sample size following the conventional formula for proportion estimation in population studies:

Where:

- n = calculated sample size requirement
- Z = critical value for 95% confidence interval (1.96)
- p = anticipated prevalence of metabolic complications following COVID-19 (set at 50% to ensure maximum sample size given absence of local precedent data)
- d = acceptable error margin (6.5% or 0.065)

Sample Size and Statistical Methods

The calculated minimum sample size was 228 participants. A buffer of 3–5% was added to accommodate potential dropouts or incomplete data, resulting in a final target of 236 individuals. Two eligible participants declined participation during recruitment, while the remainder were successfully enrolled.

Statistical Analysis

All collected data were systematically reviewed, coded, and analyzed using SPSS version 26.0. Descriptive statistics, including means, standard deviations, and frequency distributions, were used to summarize the data. Relationships between categorical variables were assessed using the Chi-square test, while comparisons of continuous variables were performed with Student's t-test. When expected cell counts were too low for Chi-square analysis, Fisher's exact test was applied. A p-value of less than 0.05 was considered statistically significant, with all analyses conducted at a 95% confidence level.

Results

The study included 236 patients who suffered from COVID-19. The sociodemographic information of them is depicted here.

Figure 1 shows the age distribution of the post-COVID patients. It revealed that the highest percentage (27.55%) belonged to the 51–60 age group, followed by those aged 31–40 and 41–50 years. A p-value of 0.434 indicated no statistically significant difference in age distribution between male and female participants. In contrast, a marked gender imbalance was observed, with males representing 68.2% of the sample and females 31.8%. This difference was statistically significant, as demonstrated by a p-value of 0.03.

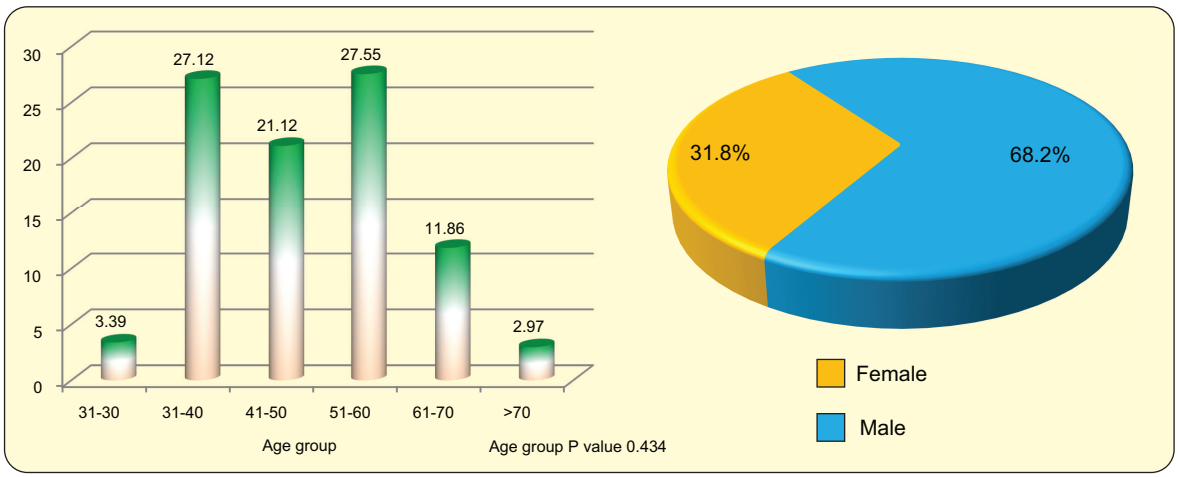

Figure 1:

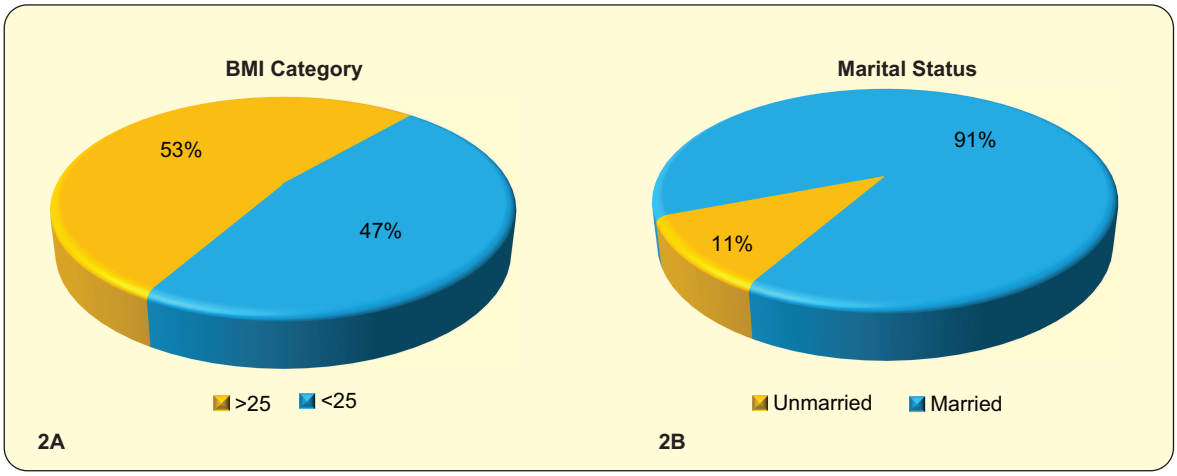

Figure 2: BMI category and marital status and of the participants

In terms of body mass index (BMI), more than half (53%) were classified as overweight or obese (BMI > 25), while the remaining 47% had a normal BMI (BMI < 25) (2A). A p-value of 0.000 indicated a statistically significant gender difference in BMI distribution. A large majority (89.41%) were married, while only 10.59% were unmarried (2B).

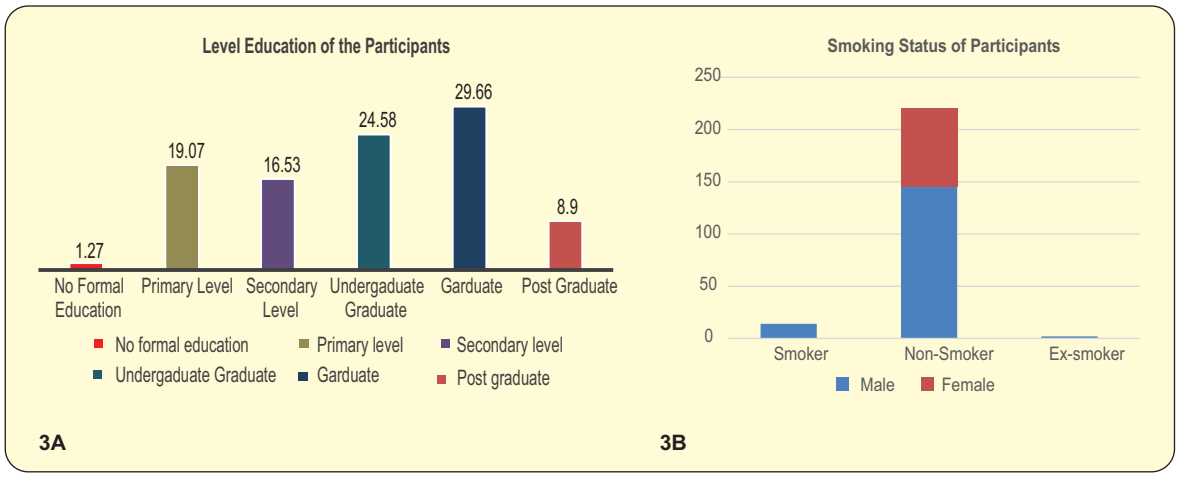

Figure 3: Education levels (3A) and smoking status (3B) of the post-COVID-19 patients

Figure 3 presents the sociodemographic characteristics of the study participants. Most participants in the study had achieved at least primary education, with a considerable proportion possessing college or postgraduate degrees (3A). The majority of individuals were non-smokers; however, 14 male participants identified as current smokers, with no reports of smoking among female participants (3B).

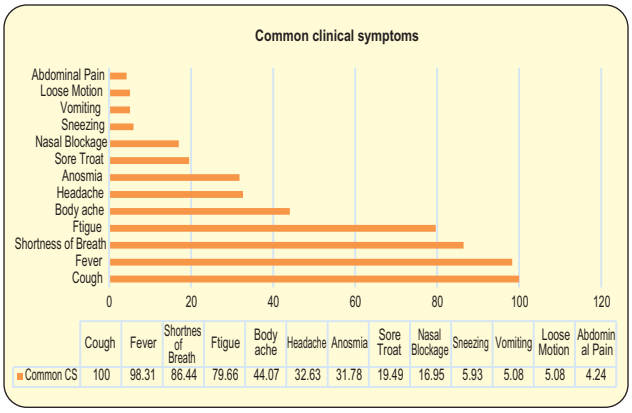

Figure 4: *Common Clinical Symptoms (N=236)*

Cough (100%) and fever (98.31%) were the most frequently reported symptoms among participants. Shortness of breath (86.44%) and fatigue (79.66%) were also widely observed. A p-value of 0.001 indicates a statistically significant association between the presence of symptoms and patient demographic characteristics.

Table 1. Random Blood Sugar (RBS) Levels (N=236)

RBS (mg/dL)	Frequency (%)	p-value
<100	78 (33.05)	0.011
101-140	104 (44.07)	
>140	54 (22.88)	
Total	236 (100)	

Table 1 depicts the glycemic status of the participants. The majority of the patients had random blood sugar (RBS) levels between 101–140 mg/dL, suggesting mild to moderate impairment in glucose metabolism. Furthermore, 22.88% of participants showed RBS levels above 140 mg/dL, potentially indicating hyperglycemia.

Table 2. Serum ferritin levels of the participants (N=236)

Ferritin (ng/mL)	Frequency (%)	p-value
<300	72 (30.51)	0.032
300-500	101 (42.80)	
>500	63 (26.69)	
Total	236 (100)	

Table 2 shows serum ferritin levels of the post-COVID-19 patients. A significant number of patients had serum ferritin concentrations ranging from 300 to 500 ng/mL, indicating the presence of a persistent systemic inflammatory response.

Table 3. HbA1c levels of the participants (N=236)

HbA1c (%)	Frequency (%)	p-value
<5.7	73 (30.92)	0.015
5.7-6.4	80 (33.90)	
>6.4	83 (35.20)	
Total	236 (100)	

Table 3 presents the glycemic status of the participants. More than 35% of patients had HbA1c levels higher than 6.4%, suggesting a high prevalence of diabetes or prediabetes.

Discussion

Demographic Characteristics

The study population demonstrated a male proponderance (males 68.2% and females 31.8%). This is consistent with previous research[17] showing a greater occurrence of persistent COVID-19 symptoms among men. The predominance of middle-aged adults (31–60 years) mirrors global observations, where individuals in this age range are more susceptible to lingering post-COVID symptoms.[18] However, in our study, these results may be affected by differences in health-seeking behavior among males and females and among different age groups, and may not represent the actual age and sex distribution in the general patient population.

Educational Attainment and Socio-economic Considerations

The highest proportion of participants had primary-level education, with a good proportion completing college or postgraduate studies. Similar patterns were observed in other studies,[19] which found that individuals with higher education levels were more inclined to seek treatment for long COVID. However, educational achievement was notably higher among male participants compared to females, reflecting

persistent gender-based educational disparities in Bangladesh.[20] These discrepancies may affect healthcare delivery and outcomes among post-COVID patients.

Smoking Behavior and Associated Health Practices

We found 8.7% of current male smokers, while no female participants reported smoking, which is almost similar to the national statistics of Bangladesh.[21] Despite its low occurrence, smoking is a recognized risk factor for more severe manifestations of COVID-19 and its lingering effects.[22] Lippi et al.[23] described that smokers are more likely to experience respiratory issues and prolonged recovery following infection.

Body Weight and Metabolic Health

Over half (53%) of participants were either overweight or obese (BMI >25 Kg/M^2). Obesity has been consistently linked to severe COVID-19 outcomes and prolonged recovery.[24,25] Studies[24,25] suggest that higher BMI is associated with immune dysfunction and chronic inflammation, which may worsen post-COVID conditions. The rising obesity trend in Bangladesh, as reported[26], makes this finding particularly concerning and highlights the need for preventive strategies targeting weight management.

Clinical Symptoms and Respiratory Involvement

Cough (100%), fever (98.3%), shortness of breath (86.4%), and fatigue (79.7%) emerged as the most frequently reported symptoms among participants. These results are consistent with earlier research[3], which identified fatigue, breathing difficulty, and persistent cough as key features of post-COVID conditions. Additionally, findings by other investigators[27] have emphasized lasting lung damage and functional decline as potential causes of these ongoing respiratory complaints.

Metabolic Parameters and Disruptions

Significant metabolic disturbances were observed. The mean random blood sugar was 132 ± 52 mg/dL, and the mean HbA1c was 7.12 ± 1.02%, indicating poor glycemic control. These findings support studies showing that SARS-CoV-2 disrupts glucose metabolism.[6,28] This study reported an increased risk of new-onset diabetes post-COVID.

The mean serum ferritin level was 622.02 ± 494.24 ng/mL, consistent with systemic inflammation[29]. Elevated serum ferritin has been associated with disease severity and inflammatory burden [30]. ALT levels were also raised (88.2 ± 34.12 U/L), suggesting hepatic injury, which has been well documented in post-COVID cohorts.[31]

Lipid abnormalities were prominent, with elevated triglyceride levels (252 ± 84 mg/dL), further linking COVID-19 to dyslipidemia.[32] These findings reflect those[23], who showed that altered lipid profiles may increase cardiovascular risk in post-COVID patients. The current findings align with global data indicating elevated glucose, lipids, and inflammatory markers in post-COVID populations.[24-34]

Limitations:

The cross-sectional design limits causal inference between COVID-19 and metabolic abnormalities. Longitudinal data are needed to assess progression. As data were collected from a single tertiary center, findings may not reflect the broader Bangladeshi population. Mild cases may have been under-represented. Despite excluding known metabolic disorders, undiagnosed chronic conditions may have influenced results. Self-reported data may be subject to recall and social desirability bias. Longer-term outcomes beyond three months remain unknown.

Conclusions:

This study identified significant metabolic disturbances among post-COVID patients in Bangladesh, including elevated blood glucose, HbA1c, ferritin, and LDL levels, along with a high prevalence of overweight and obesity. These findings underscore the potential long-term health burden of COVID-19. Routine monitoring of metabolic parameters, lifestyle interventions targeting weight and nutrition, and increased public awareness are essential to mitigate post-COVID complications.

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Declarations

Funding: Bangladesh Medical University, Dhaka.

Conflict of interest: The authors have no conflicts of interest to declare.

Ethical approval: This study strictly followed the ethical guidelines of Bangladesh Medical University, Dhaka. All participants were informed about the study's objectives and procedures, and written informed consent was obtained from each participant.

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