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Immediate and post-COVID complications of symptomatic and asymptomatic COVID-19 patients in Bangladesh: a cross-sectional retrospective study

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Abstract: The COVID-19 pandemic has cost a large number of lives worldwide. Most of the COVID-19 patients recover within two weeks of illness, but many survivors are experiencing different post COVID-19 clinical complications. In this cross-sectional retrospective study, we investigated the immediate and post COVID-19 complications with secondary effects in symptomatic and asymptomatic COVID-19 patients of Bangladesh. A total of 632 patients diagnosed with COVID-19 from December, 2020 to February, 2021 were included in this study. The data were collected by telephone interview with patients consent and reviewing their call records using questionnaire and checklist. Results demonstrate that among the 632 patients, 77.53 % of cases were symptomatic, where fever was the most common symptom (82.24%). The other symptoms were headache (58.16%), sore throat (53.65%), cough (45.51%), weakness (41.22%), breathlessness (40%), loss of smell (37.55%), tastelessness (31.84%), diarrhea (19.39%), and vomiting (14.69%). Comorbidities like asthma, hypertension, diabetes mellitus (DM), cardiovascular disease, and other chronic diseases were pronounced in symptomatic patients. Post COVID-19 complications varied significantly ($P < 0.05$) between the symptomatic and asymptomatic observations. Asthma, hypertension, and diabetes were newly reported in symptomatic patients with the rate of 3.06 %, 2.45 %, and 2.24 %, respectively, while the proportions were 1.41%, 1.41%, and 0.70% for the asymptomatic group. Tiredness, weight loss, hair loss, and insomnia were the most observed post COVID-19 complications found higher in symptomatic patients than in asymptomatic groups. A newly developed visual anomaly was also identified in the symptomatic group (1.42%), which was absent in asymptomatic COVID-19 recovered patients. These findings concluded that post-COVID-19 complications were high in symptomatic and comorbid patients compared with asymptomatic individuals. We hope that this study will contribute in post COVID-19 management and help the concerned authority toward decision making in the treatment of post-COVID-19 complications.

Keywords: COVID-19; Bangladesh; Comorbidity; Post-COVID-19 complications

1. Introduction

Coronaviruses are large, positive-stranded, protein enveloped RNA viruses that are distributed broadly among birds, humans, and other mammals (Weiss and Leibowitz, 2011). A total of seven different species of coronaviruses are found to infect humans. Among them, the species named 229E, OC43, NL63, and HKU1 have been considered inconsequential pathogens causing the “common cold” in immunocompetent individuals

(Su *et al.*, 2016; Zhu *et al.*, 2019). The other three strains (e.g., SARS-CoV, MERS-CoV, and SARS-CoV-2) are highly pathogenic and sometimes cause fatal illness in the infected individuals (Paules *et al.*, 2020). The recently emerged novel coronavirus (SARS-CoV-2) also known as 2019-nCoV, is zoonotic in origin and was first identified in Wuhan, China in November 2019. This 2019-nCoV genome is 80% identical to the SARS-CoV genome and uses the similar angiotensin-converting enzyme 2 (ACE-2) receptor for viral entry inside the host cells (Zhou *et al.*, 2020; Hoffmann *et al.*, 2020). This viral infection has been confirmed in millions of people and the outbreak has already been declared as a pandemic by WHO in March 2020 (Johns Hopkins Coronavirus Resource Center, 2020; WHO, 2020). In Bangladesh, the first reported COVID-19 infection was on March 8, 2020 (Mina *et al.*, 2020). Although all aged groups are susceptible to this viral infection, the severity and lethality of the disease are much more in older and immune-compromised individuals (Annweiler *et al.*, 2021). A broad spectrum of clinical symptoms are expressed in COVID-19 patients, and the semiology of older patients differs from those encountered younger ones (Carfi *et al.*, 2020). It affects almost every organ system including renal (acute kidney injury), gastrointestinal, endocrine and musculoskeletal, nervous (neuropathy, encephalopathy), cardiovascular, and respiratory system of the body (White-Dzuro *et al.*, 2020; Annweiler *et al.*, 2021). Multiple symptoms like fever, body aches, cough, diarrhea, shortness of breath, etc. have been reported in many patients during COVID-19 infection (Iranmanesh *et al.*, 2021).

The post-COVID-19 clinical expressions are still unknown, but some emerging evidence showed that COVID-19 survivors are experiencing medium and long term problems. An Italian study of 143 individuals who had been followed up seven weeks after discharge found that 53% have fatigue, 43% with breathlessness, and 27% having joint pain (Halpin *et al.*, 2021). Similar types of clinical complication were also reported in pathogenic SARS and MERS coronavirus infected patients. Post-COVID complications like post-traumatic stress disorder (PTSD), anxiety, sleepiness, and stress were also observed among the recovered individuals from SARS and MERS (Yuan *et al.*, 2021). Long-term glucometabolic, cardiopulmonary, and neuropsychiatric problems have been reported following infections with coronavirus (Dasgupta *et al.*, 2020). Patients with diabetes, chronic obstructive pulmonary disease (COPD), cardiovascular diseases (CVD), malignancies, hypertension, and other comorbidities are the most susceptible to COVID-19 life-threatening situations (Ejaz *et al.*, 2020).

An epidemiological study in Bangladesh found that the recovered individuals experienced some short-term outcomes, including pains and aches (31.8%), anxiety or depression (23.1%) and weakened attention span (24.4%) (Mannan *et al.*, 2021). On the other hand, subclinical lung abnormalities may be associated with asymptomatic COVID-19 patients as identified by CT scan (Oran and Topol, 2020). Research on COVID-19 patients in the Eastern Province of Saudi Arabia demonstrated that abnormal chest radiographs were in 15.5% of asymptomatic and 46% of symptomatic patients (AlJishi *et al.*, 2021). It still remains elusive about the difference in comorbidities and post-COVID-19 complications among the symptomatic and asymptomatic COVID-19 cases in Bangladesh. In this study, we investigated the immediate and long-term secondary effects of symptomatic and asymptomatic COVID-19 patients. Additionally, we compare the post-COVID-19 complications between symptomatic and asymptomatic COVID-19 patients of Bangladesh.

2. Materials and Methods

2.1. Study design

For this retrospective study, we selected the patients diagnosed with COVID-19 infection by Reverse Transcription-Polymerase Chain Reaction (RT-PCR) assay from December, 2020 to February, 2021. Patients who were tested negative after two consecutive RT-PCR tests at least at a gap of 24 hrs and 28 days prior to the interview date were considered for studying post-COVID-19 complications in individuals. Patients who did not give their consent during the telephone interview were excluded from this study. Furthermore, patients exhibiting no post-COVID-19 complications at an interval of one month after being tested negative were also excluded.

2.2. Data collection

All the data for retrospective study were collected by telephone interviews and were recorded in a well-structured questionnaire which was approved by the Ethical Clearance Committee (ECC) of Noakhali Science

and Technology University, Noakhali. The data were stored in a Microsoft Excel file on completion of data collection.

2.3. Ethical consideration

Verbal consent was taken from the patients at the beginning of the study. The study protocol was approved by the ECC, Faculty of Science, Noakhali Science and Technology University.

2.4. Statistical analysis

The collected data were analyzed using descriptive (frequency counts and percentages) and inferential statistics. T-test was performed to evaluate the association between categorical variables. P-values less than 0.05 were considered significant. All the statistical analyses were carried out by using SPSS Statistics 25 (IBM, Armonk, New York) and Graph-Pad Prism version 8.4.3 (Graph-Pad, San Diego, CA, USA).

3. Results

3.1. Demographic information of COVID-19 positive patients

The demographic profile of symptomatic and asymptomatic COVID-19 patients varied in our study participants (Table 1). Our study was conducted on 632 patients where 77.53% of the patients were symptomatic while the rest of them did not show any symptoms. Among the symptomatic groups, male patients had a higher proportion (70%) compared to females (30%). A similar trend was also observed in the asymptomatic group: male (68 %) and female (32 %) (Figure 1). The average age of symptomatic and asymptomatic patients was 45.52 ± 17.67 and 41.46 ± 13.27 years, respectively. A substantial difference was found in symptomatic and asymptomatic COVID-19 patients of different age groups ($P=0.0029$). A higher ratio of symptomatic cases was observed in the age groups of 31-40 (24.49%), 21-30 (22.24%), and 41-50 (18.37%) years (Figure 2). In this study, O+ve and B+ve blood group patients were more susceptible to COVID-19 infection both in the symptomatic and asymptomatic groups. No significant correlation was observed in symptomatic and asymptomatic COVID-19 patients with smoking, traveling or contract history.

3.2. Clinical features of COVID-19 positive patients

Most of the symptomatic COVID-19 patients had a fever (82.24%) followed by a headache and sore throat with 58.16% and 53.65%, respectively (Table 2). The symptomatic group also experienced cough (45.51%), breathlessness (40%), weakness (41.22%), tastelessness (31.84%), loss of smell (37.55%), vomiting (14.69%), and diarrhea (19.39%). A significant dichotomy ($P=0.0064$) was observed between the comorbidities in symptomatic and asymptomatic individuals (Table 2). Comorbidities like asthma (21.43%), hypertension (19.18%), diabetes mellitus (22.24%), cardiovascular disease (11.22%), chronic disease (6.94%), and others (4.69%) were pronounced in the symptomatic group where the mentioned comorbidities were low in the asymptomatic group: 18.31%, 16.9%, 13.38%, 9.86%, 5.63% and 3.52%, sequentially (Figure 3).

3.3. Post-COVID-19 complications in positive patients

Post-COVID-19 complications varied significantly ($P<0.05$) among the symptomatic and asymptomatic observations (Table 3). Interestingly, the number of comorbid patients was higher in the symptomatic group than in the asymptomatic. Asthma, hypertension, and diabetes mellitus were newly reported in 3.06 %, 2.45 %, and 2.24 %, respectively of symptomatic patients, while the proportions were 1.41%, 1.41%, and 0.70% for the asymptomatic group. Tiredness, weight loss, hair loss, and insomnia were the most observed post-COVID-19 complications found in both symptomatic and asymptomatic group; (12.45 % and 4.22%), (9.18% and 4.93%), (5.92% and 4.22%), and (5.71% and 4.22%) respectively. Among other complications, chronic disease, allergy, mental confusion, sleepiness, chest pain, cough, anorexia, irritable mood, nausea, and dyspepsia were reported in both symptomatic and asymptomatic COVID-19 positive patients after recovery. No visual anomaly was reported in asymptomatic patients, but 1.42% of the symptomatic individuals developed a visual problem (Table 3).

Table 1. Demographic information of COVID-19 positive patients (n=632).

| Characteristics | Symptomatic patients n= 490 (77.53%) | Asymptomatic patients n= 142 (22.47%) | P value ^a |
|-------------------------------|---|--|----------------------|
| Sex | | | |
| Male | 344 (70%) | 97 (68%) | 0.2529 |
| Female | 146 (30%) | 45 (32%) | |
| Age (years) (mean±SD) | 45.52 ± 17.67 | 41.46 ± 13.27 | 0.0112 |
| Age Range (years) | 2-80 | 5-66 | |
| Age group (years) | | | |
| 0-10 | 09 (1.83%) | 03 (2.11%) | 0.0029 |
| 11-20 | 26 (5.31%) | 05 (3.52%) | |
| 21-30 | 109 (22.24%) | 55 (38.73) | |
| 31-40 | 120 (24.49%) | 45 (31.69%) | |
| 41-50 | 90 (18.37%) | 19 (13.38%) | |
| 51-60 | 84 (17.14%) | 10 (7.04%) | |
| >60 | 52 (10.61%) | 05 (3.52%) | |
| BMI (kg/m²) | 22.83 | 21.31 | |
| Blood Group | | | |
| A+ | 103 (21.02%) | 29 (20.42%) | 0.0695 |
| AB+ | 20 (4.02%) | 07(4.93%) | |
| B+ | 132 (26.94%) | 31(21.83%) | |
| O+ | 229 (46.73%) | 73(51.41%) | |
| O- | 06 (1.22%) | 02 (1.41%) | |
| Smoking History | | | |
| Yes | 103 (21.02%) | 32 (22.54%) | 0.3403 |
| No | 387 (78.98%) | 110 (77.46%) | |
| Contact History | | | |
| Yes | 167 (34.08%) | 47 (33.1%) | 0.1916 |
| No | 323 (65.92%) | 95 (66.9%) | |
| Travel History | | | |
| Yes | 17 (3.47%) | 05 (3.52%) | 0.4773 |
| No | 473 (96.53%) | 137 (96.48%) | |

Abbreviations: BMI, body mass index;

^a t-test for categorical variables, used in analysing p values. p < 0.05 was considered statistically significant.**Table 2. Clinical features of COVID-19 positive patients (n=632).**

| Characteristics | Symptomatic patients n= 490 (77.53%) | Asymptomatic patients n= 142 (22.47%) | P value |
|------------------------|---|--|---------|
| Symptoms | | | |
| Fever | 403 (82.24%) | 0 | <0.0001 |
| Headache | 285 (58.16%) | 0 | |
| Cough | 223 (45.51%) | 0 | |
| Breathlessness | 196 (40%) | 0 | |
| Weakness | 202 (41.22%) | 0 | |
| Tastelessness | 156 (31.84%) | 0 | |
| Sore throat | 258 (532.65%) | 0 | |
| Loss of smell | 184 (37.55%) | 0 | |
| Vomiting | 72 (14.69%) | 0 | |
| Diarrhea | 95 (19.39%) | 0 | |
| Comorbidities | | | |
| Asthma | 105 (21.43%) | 26 (18.31%) | 0.0064 |
| Hypertension | 94 (19.18%) | 24(16.9%) | |
| DM | 109 (22.24%) | 19(13.38%) | |
| Cardiovascular Disease | 55 (11.22%) | 14 (9.86%) | |
| Chronic Disease | 34 (6.94%) | 08 (5.63%) | |
| Others | 23 (4.69%) | 05 (3.52%) | |

Abbreviations: DM, diabetes mellitus

^a t-test for categorical variables, used in analysing p values. p < 0.05 was considered statistically significant.

Table 3. Post COVID-19 complications among positive patients (n=632).

| Characteristics | Symptomatic patients n= 490 (77.53%) | Asymptomatic patients n= 142 (22.47%) | P value |
|------------------|---|--|---------|
| Asthma | 15 (3.06) | 02 (1.41%) | 0.0004 |
| Hypertension | 12 (2.45%) | 02 (1.41%) | |
| DM | 11 (2.24%) | 01 (0.7%) | |
| Chronic Disease | 10 (2.04) | 02 (1.41%) | |
| Visual Problem | 07 (1.42%) | 00 (0.00%) | |
| Allergy | 13 (2.65%) | 03 (2.11%) | |
| Weight Loss | 45 (9.18%) | 07 (4.93%) | |
| Hair Loss | 29 (5.92%) | 06 (4.22%) | |
| Mental Confusion | 08 (1.63%) | 01 (0.7%) | |
| Tiredness | 61 (12.45%) | 06 (4.22) | |
| Sleepiness | 23 (4.69%) | 03 (2.11%) | |
| Chest Pain | 08 (1.63%) | 01 (0.7%) | |
| Cough | 31 (6.33%) | 04 (2.82%) | |
| Anorexia | 16 (3.27%) | 04 (2.82%) | |
| Insomnia | 28 (5.71%) | 06 (4.22%) | |
| Irritable Mood | 24 (4.9%) | 02 (1.41%) | |
| Nausea | 05 (1.02%) | 00 (0.00%) | |
| Dyspepsia | 06 (1.22%) | 01 (0.7%) | |

Abbreviations: BMI, body mass index;

^a t-test for categorical variables, used in analyzing p values. $p < 0.05$ was considered statistically significant.

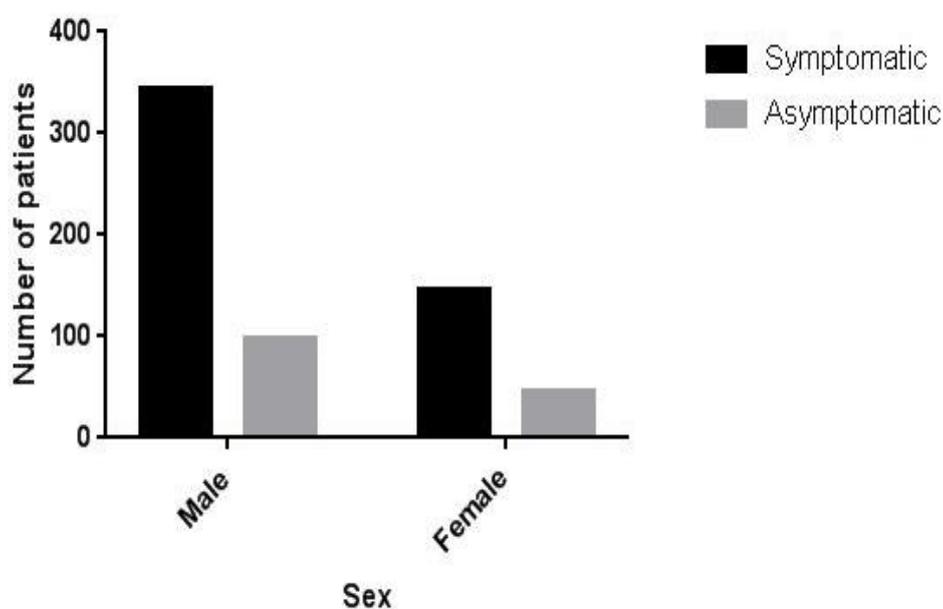


Figure 1. Number of male and female COVID-19 patients in symptomatic and asymptomatic groups.

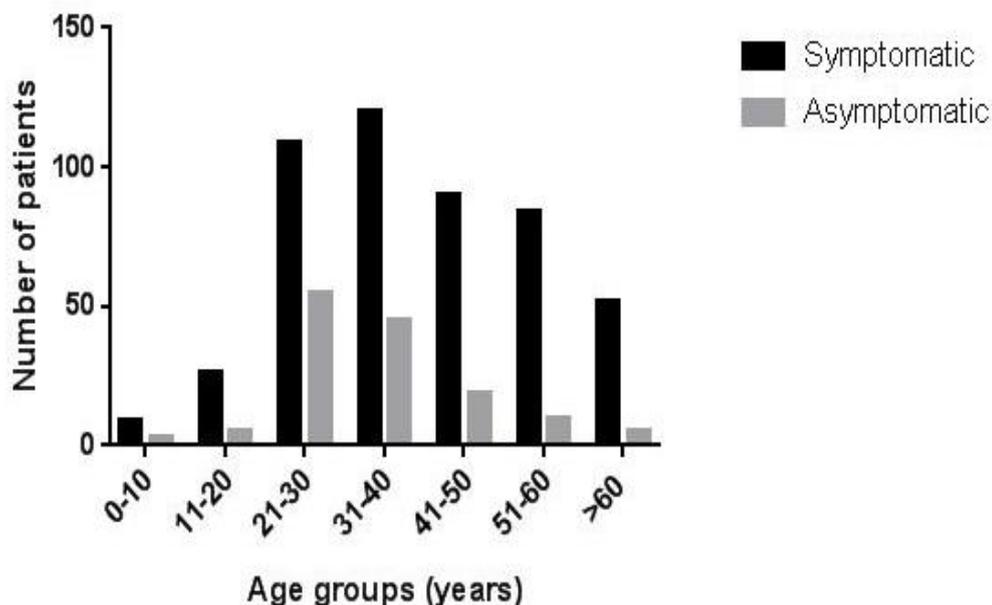


Figure 2. Distribution of different age groups in symptomatic and asymptomatic COVID-19 patients.

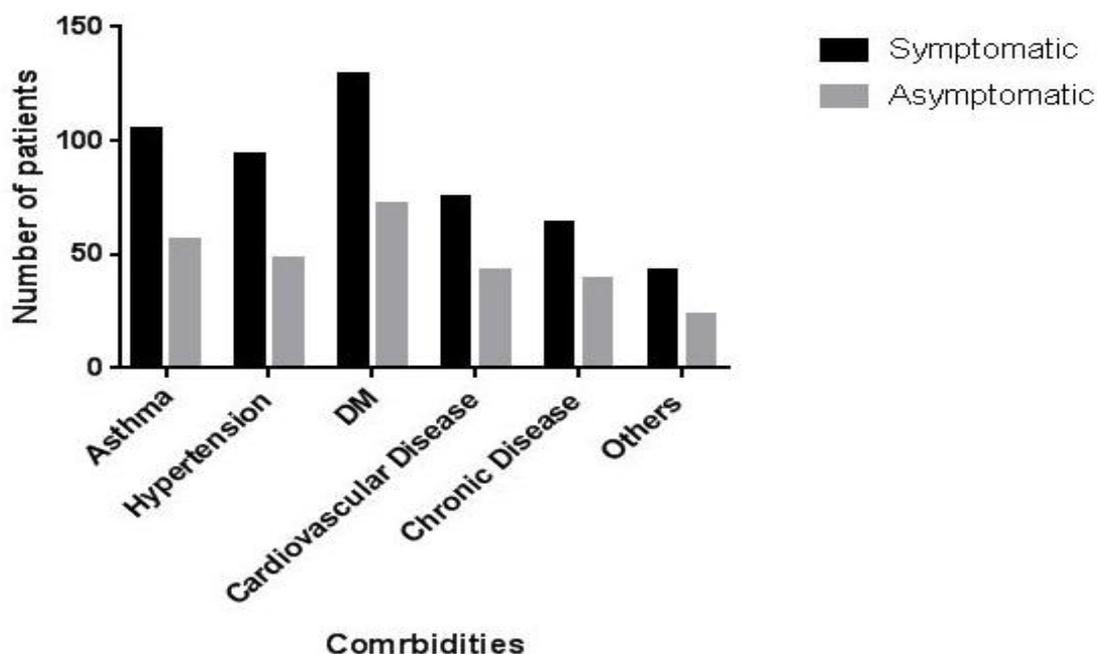


Figure 3. Number of COVID-19 positive patients with different comorbid conditions in symptomatic and asymptomatic groups.

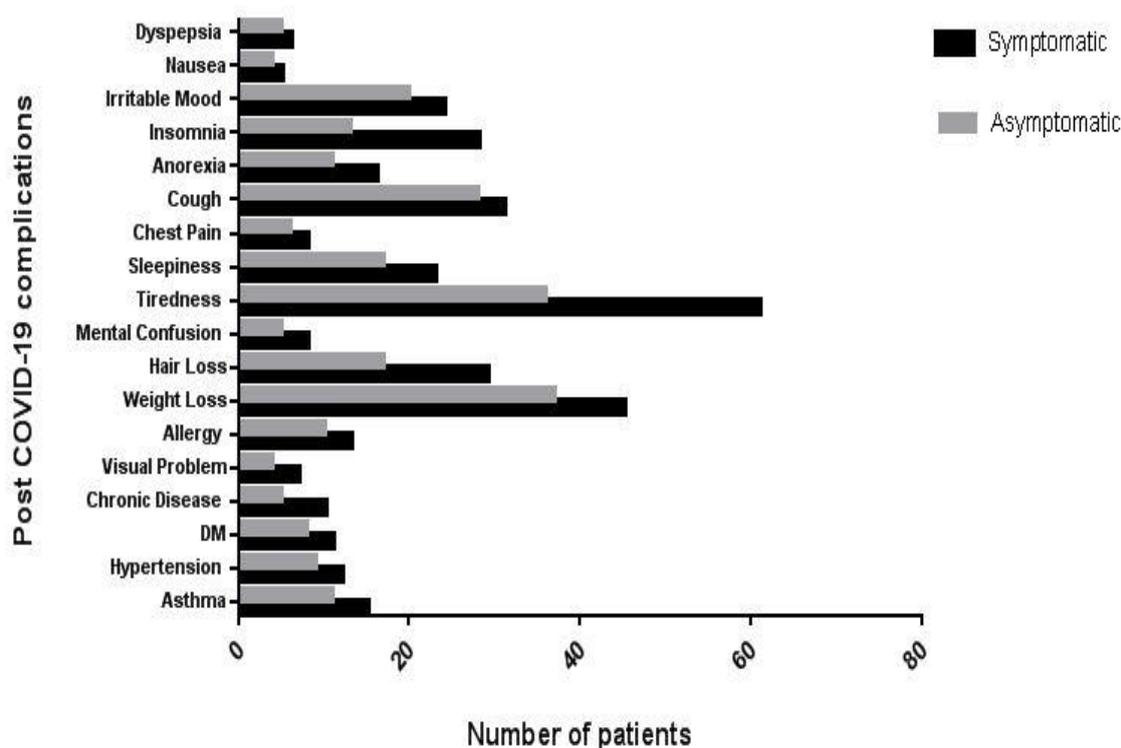


Figure 4. Pattern of post-COVID-19 complications in symptomatic and asymptomatic groups.

4. Discussion

The highly contagious COVID-19 disease caused by SARS-CoV-2 primarily infects the respiratory tract cells and can develop mild to severe interstitial pneumonia and acute respiratory distress syndrome (ARDS) (Zou *et al.*, 2020; Weiskopf *et al.*, 2020). However, SARS-CoV-2 also affects other cells of different systems like central nervous, cardiovascular, musculoskeletal, and gastrointestinal system where ACE-2 receptors are widely expressed (Gheblawi *et al.*, 2020; Candan *et al.*, 2020; Hamming *et al.*, 2004). Although several reports have been found on COVID-19 complications, however, the long-term effects have not been fully understood yet due to its short history of emergence. In this study, we present the immediate and long-term clinical features of the COVID-19 patients reported from Bangladesh. The majority of the patients were in two groups, namely symptomatic and asymptomatic. A total of 632 COVID-19 positive participants (mean age \pm SD=45.66 \pm 17.63 years) were included in this current study, where the most patients were symptomatic (77.53%). Figure 1 showed the total ratio of male and female patients in both symptomatic and asymptomatic groups. A significant difference was found in symptomatic and asymptomatic COVID-19 patients of different age groups. A higher prevalence of COVID-19 positive was observed in the age group ranging from 21-30. In contrast, a lower prevalence of COVID-19 positive was detected in the age group ranging from 0-10 and 11-20 (Table 1). This finding indicates the children are prone to benign COVID-19 infection than older people. Moreover, the majority of the symptomatic patients were above 30 years old (70.61%) (Figure 2).

Results of this study also provided compelling evidence that blood groups had a significant relationship with the patients being asymptomatic or symptomatic. The majority of the symptomatic (46.73 %) and asymptomatic (51.41 %) COVID-19 patients belonged to O+ve blood group. The other's with B+ve and A+ve groups were also highly susceptible to COVID-19 both in symptomatic and asymptomatic patients (Table 1). This might be due to B+ve and O+ve blood groups are the most common blood group among Bangladeshis (Dipta *et al.*, 2011). We did not find any significant relation between the symptomatic and asymptomatic patients with smoking history. However, our study reported that 3.47% and 3.52% of symptomatic and asymptomatic individuals with COVID-19 infection had travel history and didn't show any significant difference in patients falling into each group (Table 1). From our study, we observed one or more clinical symptoms in the symptomatic COVID-19 patients. The most common clinical complication observed in symptomatic COVID-19 patients is fever (82.24%) followed by headache (58.16%), sore throat (53.65%), cough (45.51%), weakness (41.22%), breathlessness (40%), loss of smell (37.55%), tastelessness (31.84%), diarrhea (19.39%), and

vomiting (14.69%) (Table 2). A meta-analysis showed a similar frequency of COVID-19 associated fever in the patents of SARS and MERS, but the cough frequency was higher in COVID-19 than MERS (Rodriguez-Morales *et al.*, 2020). Previous studies on COVID-19 reported fever and cough were the dominant symptoms, and gastrointestinal symptoms were uncommon (Leung *et al.*, 2003; Assiri *et al.*, 2013). Interestingly, our findings also completely correlate with the previously reported data.

SARS-CoV-2 can infect people of all age groups, but patients aged above 60 years, along with comorbid conditions like chronic respiratory disease, diabetes, and cardiovascular diseases, are at a higher risk of developing complications (Ejaz *et al.*, 2020). A significant dichotomy ($P=0.0064$) was observed in this study between comorbid conditions in symptomatic and asymptomatic groups. Comorbidities like asthma (21.43%), diabetes mellitus (22.24%), hypertension (19.18%), cardiovascular disease (11.22%), chronic disease (6.94%), and others (4.69%) were pronounced in the symptomatic group as compared to the asymptomatic group of study: 18.31%, 16.9%, 13.38%, 9.86%, 5.63%, and 3.52%, sequentially (Figure 3). Our data revealed that individuals with comorbid conditions were more prone to COVID-19 severe infections and symptoms. A meta-analysis showed that hypertension was the most prevalent in COVID-19 patients, which was found in 1/5 of the patients and is consistent with the tendency of the virus to bind with ACE-2 receptors (Aghili *et al.*, 2020).

However, post-COVID-19 complications vary widely from patients to patients in both symptomatic and asymptomatic groups. This study showed that post-COVID-19 complications varied significantly ($P<0.05$) between symptomatic and asymptomatic COVID-19 patients (Table 3). Interestingly, tiredness (12.45%) and weight loss (9.18%) were more frequent in symptomatic groups than in asymptomatic groups. Body muscle contains ACE-2 receptor that acts as the entry receptor for this virus, which might explain these effects (Yamamoto *et al.*, 2020).

Asthma, hypertension, diabetes mellitus, allergy, weight loss, hair loss, tiredness, sleepiness, cough, insomnia, irritable mood were more frequent in both groups as post COVID-19 complications. On the other hand, visual problems, mental confusion, chest pain, anorexia, nausea, dyspepsia were less frequent in both groups (Table 3). Taken together, the data of symptomatic and asymptomatic patients provided convincing evidence that the COVID-19 symptomatic patients possessed several newly experienced complications than the asymptomatic patients (Figure 4). Approximately 30% of people with SARS or MERS had persisting lung abnormalities after their acute illness (Fraser, 2020). Similarly, in COVID-19 infection, our study found that the COVID-19 symptomatic patients were newly experienced with respiratory complications like asthma (3.06%), where asymptomatic patients were 1.41%. Recent studies reported that after recovering from COVID-19, many patients experienced persistent respiratory complications like cough, fibrotic lung disease, bronchiectasis, and pulmonary vascular disease (Fraser, 2020; Oronsky *et al.*, 2021).

One of the newest major post-COVID-19 complications observed in COVID-19 patients is diabetes mellitus (DM). A plausible reason could be due to an imbalance of ACE-2 receptor activation in the pancreas. Such imbalance would lead to acute β -cells dysfunction and ultimately resulting in a hyperglycemic state (Cuschieri and Grech, 2020). Since SARS-CoV-2 uses the ACE-2 receptor as a cellular entry point, it could be possible that entry of the virus in β -cells impair pancreatic insulin secretion and thereby either aggravating DM or triggering new-onset DM (Groß *et al.*, 2020; Maddaloni and Buzzetti, 2020). During the SARS-CoV-1 outbreak, acute DM was commonly observed in individuals with no DM or glucocorticoid use history before the viral infection (Yang *et al.*, 2006). Not surprisingly, we observed that around 2.24% of symptomatic patients were newly experienced with diabetes mellitus, where 0.7% was asymptomatic.

Like DM, hypertension ranks the second most newly observed post-COVID-19 complication in COVID-19 patients. We found that COVID-19 symptomatic (2.45%) patients were more experienced with new-onset hypertension than asymptomatic (1.41%) patients. Downregulation of ACE-2 enzymes results in the reduced degradation of angiotensin II (ANG II) (Mascolo *et al.*, 2020; Silva-Aguiar *et al.*, 2020). Furthermore, the imbalance of ANG II in Renin-angiotensin system (RAS) can lead to genesis and worsening of hypertension in COVID-19 patients (Li *et al.*, 2020).

After infection of SARS-CoV-2, occurrence of gastrointestinal diseases, including anorexia, diarrhea, and abdominal pain found common in COVID-19 patients. In this study, the symptomatic COVID-19 patients were possessed more new-onset of anorexia (3.27%), nausea (1.02%), and dyspepsia (1.22%) than the asymptomatic patients (Figure 4).

The various studies showed that SARS-CoV-2 might infect the nervous system and skeletal muscles (Asadi-Pooya and Simani, 2020). Neurologic signs and symptoms were retrospectively investigated in COVID-19 patients. This study reported that after recovery of COVID-19, symptomatic patients were more prone to new-onset of mental confusion, sleepiness, insomnia, and irritable mood than asymptomatic patients (Figure 4).

It has been found in several studies that dermatological complications are common in some COVID-19 patients. A Dermatological manifestation of COVID-19 occurred after (64%) or concurrent to (15%) other acute COVID-19 symptoms (Freeman *et al.*, 2020). Another study also reported that only 3% of COVID-19 patients developed a skin rash at six months follow-up in the post-acute COVID-19. Approximately 20% of COVID-19 patients suffered hair fall problems predominantly (Huang *et al.*, 2021). In our study, hair loss problems were found to be more prevalent in both symptomatic (5.92%) and asymptomatic (4.22%) groups. In addition, about 2.65% of symptomatic and 2.11% of asymptomatic COVID-19 patients were newly experienced with skin allergy (Table 3).

Fever is one of the most prominent symptoms of COVID-19, along with headache, cough and loss of taste and smell. Sometimes, cough can persist for long time after SARS-CoV-2 infection. A study from the USA reported that 75 (15.4%) of COVID-19 patients noted a new or worsening cough two months after discharge from hospital (Chopra *et al.*, 2020). Another study found that about 10% of non-hospitalized patients had a cough four months after symptom onset (Stavem *et al.*, 2021; Petersen *et al.*, 2020). However, in comparison to the previous studies, our studies identified that the frequency of COVID-19 symptomatic patients with cough was higher in symptomatic patients, even if they were recovered from the disease (Figure 4). It is still remaining elusive whether the acute phase could precisely determine the persistence of cough.

5. Conclusions

This study provides a comprehensive analysis of immediate and post COVID-19 complications in symptomatic and asymptomatic patients. The outcome of this research will be helpful for the management of COVID-19 and raise awareness of the patients to seek health care for any conditions they may develop after recovered from COVID-19.

Conflict of interest

None to declare.

Authors' contribution

Shuvo Chandra Das and Mohabbat Hossain designed the work. Md Thosif Raza, Istiaq Uddin Ahmed, Ishrat Jahan Eva, Tasnimul Karim, and Prashanta Chakraborty collected and summarized the data. Mohabbat Hossain and Shuvo Chandra Das analyzed and interpreted the data. Shuvo Chandra das, Md Thosif Raza Istiaq Uddin Ahmed, and Mohabbat Hossain wrote the manuscript. Shipan Das Gupta and Shuvo Chandra Das critically reviewed and edited the manuscript. All authors read and approved the final manuscript.

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