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Original Research Article

Impact of Age, Gender and Comorbidities on Covid-19 Infection

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Abstract

Introduction: Corona virus disease (COVID-19) is highly infectious and has great transmission rate. Research evidences show that age, gender, and comorbidities may be the risk factors for COVID-19 infection. In the present study, we aimed to study the impact of these risk factors i.e. age, gender and comorbidities on COVID-19 infection.

Aim: To study the impact of age, gender and comorbidities on COVID-19 infection.

Materials and Methods: The study was conducted in the Department of Physiology and Department of Respiratory Medicine, SGRRIMHS, Dehradun, prospectively in COVID-19 patients who were admitted to the Department of Respiratory Medicine, Shri Mahant Indiresh Hospital, SGRRIMHS, Dehradun, COVID ward with positive RT PCR (real-time reverse-transcriptase-polymerase-chain-reaction) test. Descriptive statistics were calculated.

Results: The mean age of patients involved in the study was 58.7 ± 12.2 years and it was found that prevalence of COVID-19 infection is more in middle age group (40-60 year) individuals as compared to young (18-40 years) and elderly (above 60 years) individuals. Compared with females the prevalence of COVID-19 infection is more in males. In addition 47% patients had comorbidities and 53% patients were without comorbidities. The most frequent comorbidity observed among patients was hypertension followed by diabetes. Statistically high significant association was found among comorbidities in elderly (above 60 years) individuals. Comorbidities were found more among males as compared to females but no significant association was observed.

Conclusion: Impact of Covid-19 infection was found more among middle age individuals, in men and in elderly individuals with coexisting comorbidities.

Keywords: COVID-19, Age, Gender And Comorbidities.

Introduction

Corona virus disease (COVID-19) is highly infectious and has great transmission rate. The COVID-19 outbreak first appeared in Wuhan, China in the month of December 2019.[1,2] The World Health Organization (WHO) declared the epidemic a global health hazard of planetary consequence on 30 Jan 2020. Due to its phylogenetic similarity to the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) that leads to the SARS outburst in 2003, the pathogen has been identified as a novel β-coronavirus and it is designated as SARS-CoV-2 (Severe Acute Respiratory

Syndrome Coronavirus-2).[3,5] The World Health Organization (WHO) has named the SARS-CoV-2 infection as COVID-19 disease, which is very infectious and spreads rapidly across the countries and around the world.[2] This virus infects human beings and, infecting them with respiratory and other illnesses.[4,5] It causes diffuse alveolar injury, in severely affected individuals with Acute Respiratory Distress Syndrome (ARDS).[4-8]

Research evidences shows that age, gender, and comorbidities may be the risk factors for the COVID-19 infection. Age is one of the strong risk factors for severe illness, complications, and death.[9,10] Elderly individuals are considered to be at higher risk due to presence of age related or coexisting comorbidities or compromised immune system. Children and adults are considered to be less susceptible to Covid 19 infection as they have better immunity. The issue is that there is disproportionately more research has been done on the severity of COVID-19 in elderly people than in young individuals.[11] However, clinicians should not always extrapolate the age-related tendencies from the population to the individual level. Otherwise, a patient may be classified as high or low risk based on their age rather than their real health state, which might result in an inaccurate risk assessment, inefficient use of resources, and poor patient treatment. Numerous researches suggest that COVID-19 infection affect men and women differently. Men and women had similar risks of acquiring the disease, according to Chinese research. However, regardless of age, males with COVID-19 infection are more likely to experience worse results and die.[12] There have been numerous studies linking the presence of comorbidities to COVID-19's unfavourable outcomes.[13,14] Patients with COVID-19 disease who have coexisting co-morbidities have serious and fatal problems.[15,16] According to a study conducted in China, COVID-19 individuals with comorbidity had lower clinical outcomes than those without any comorbid condition, and having more comorbidities was also linked to worse clinical outcomes.[17] Taking into consideration these risk factors we aimed to study the impact of age, gender and comorbidities on COVID-19 infection, that could help physicians to develop age, gender and comorbidity specific intervention strategies.

Materials And Methods

The study was conducted in the Department of Physiology and Department of Respiratory Medicine, SGRRIMHS, Dehradun, prospectively in COVID-19 patients who were admitted to the Department of Respiratory Medicine, Shri Mahant Indiresh Hospital, SGRRIMHS, Dehradun, covid ward with positive RT PCR (real-time reverse-transcriptase-polymerase- chain-reaction) test. The study was carried out for 1 year from August 2020 to August 2021. 400 COVID-positive patients were included in the study.

Patients were divided into three groups as follows:

According To Age

Group A– Patients, 18-40 years of age

Group B–Patients, 40-60 years of age

Group C– Patients, above 60 years of age

According To Gender

Group M - Male Patients

Group F- Female Patients

According To Comorbidity

Group I - Patients with at least one of the comorbidities (diabetes mellitus, cardiovascular diseases including hypertension, chronic pulmonary disease, chronic liver disease, chronic kidney disease, neurological disease, autoimmune disease, endocrinal disease and any other disease or risk factor).

Group II - Patients without any co-morbidity

Patients fulfilling the inclusion and exclusion criteria were eligible for inclusion in the study.

Inclusion Criteria

- Age more than 18 years.

- Patients of either sex admitted to the Department of respiratory medicine with positive RT-PCR test reports for COVID-19 disease.
- Patients presenting with COVID-19 infection associated with co-morbidities like hypertension, diabetes mellitus, renal failure, and chronic lung disease.

Exclusion Criteria

- COVID -19 RT-PCR Negative test report.
- Patients presenting with acute or severe chronic diseases (i.e. active cancer).
- Any condition that, in the opinion of the investigator, does not justify the subject's inclusion in the study.
- Detailed history of the patient was taken from patients/attendants.
- Informed consent from patients/attendants was taken.

Data analysis

- The data was collected, coded, compiled and entered in Microsoft-Excel and then analyzed and statistically evaluated by using SPSS-PC- 23 version.
- Quantitative data were expressed by mean and standard deviation.
- Student T-test and ANOVA [Analysis of Variances] were used to compare means between groups having quantitative data.
- Odds ratio and 95% confidence interval were used to quantify the risk factors.
- Pvalue>0.05 was considered statistically non-significant.
- P value<0.05 was considered statistically significant.
- P value<0.01 was considered statistically highly significant.

Results

Age

The mean age of all the subjects involved in the study was 58.7 ± 12.2 years SD. The patients were classified into three age groups i.e. 18 to 40 years (Group A), 40-60 years (Group B) and above 60 years (Group C) and it was found that maximum patients belonged to Group B [40%] with mean age of 51.4 ±6.0 years followed Group A [35.8%], with mean age of 30.4 ±5.6 years [Table 1,Figure 1].

Table 1: Distribution of Subjects According to Age

Age Group	N [%]	Mean ±SD
Group A (18-40 years)	143 [35.8]	30.4 ±5.6
Group B (40-60 years)	160 [40]	51.4 ±6.0
Group C (above 60 years)	97 [24.3]	70 ±7.5
Total	400	

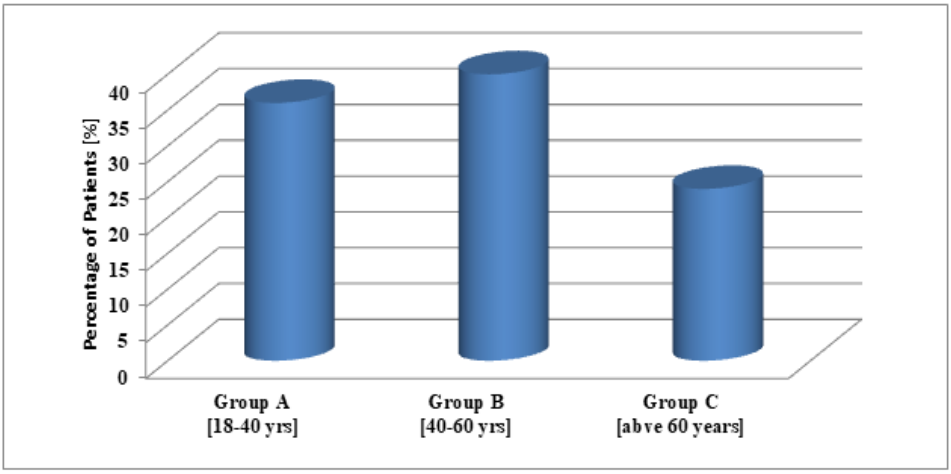

Figure 1: Distribution of Subjects According to Age

Gender

In the present study 64% participants were males and 36% were females out of total enrolled Covid-19 patients [Table 2, Figure 2].

Table 2: Distribution of Subjects According to Gender

Gender Group	N [%]
Group M (Male)	257 [64]
Group F (Female)	143 [36]
Total	400

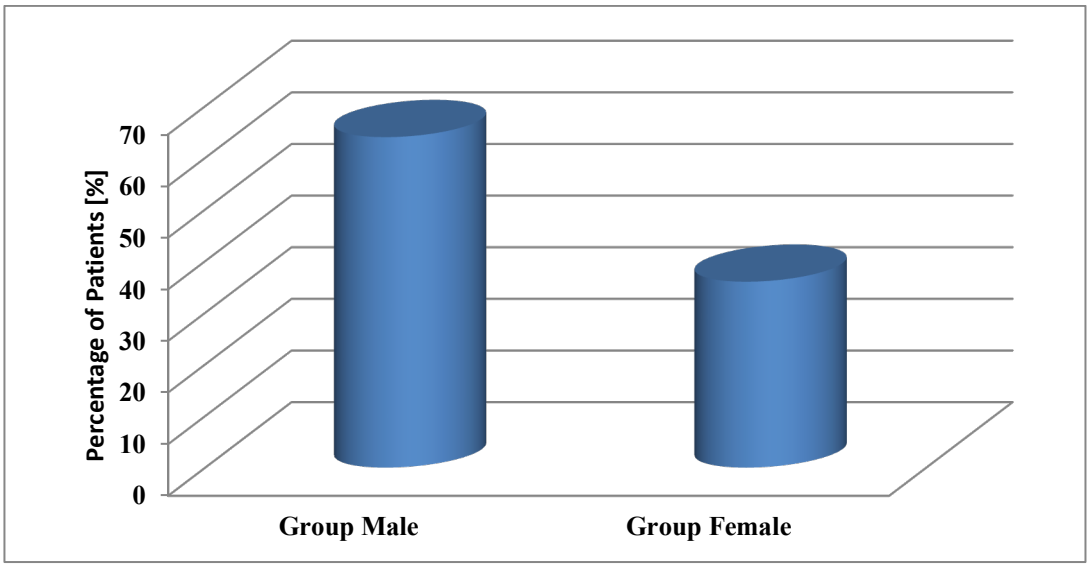

Figure 2 : Distribution of Subjects According to Gender

Comorbidities

In our study, 47% patients had comorbidities (Group I) and 53% patients were without comorbidities (Group II) [Table-3,Figure-3].The most frequent comorbidity among patients was hypertension [31.3%] followed by Diabetes [22%] [Table 4,Figure 4]. 21.5% patients had other comorbidities that included hypothyroidism, benign prostate hypertrophy, coronary artery disease, pulmonary embolism, pulmonary Tuberculosis, scrub typhus, chronic kidney disease, scrub typhus, rheumatoid arthritis, asthma, pancreatitis, pneumonitis and bronchitis.

Table 3: Distribution of Subjects According to Comorbidities

Comorbidity Group	N [%]
Group I (with co-morbidity)	189 [47.3]
Group II (without co-morbidity)	211[52.8%]
Total	400

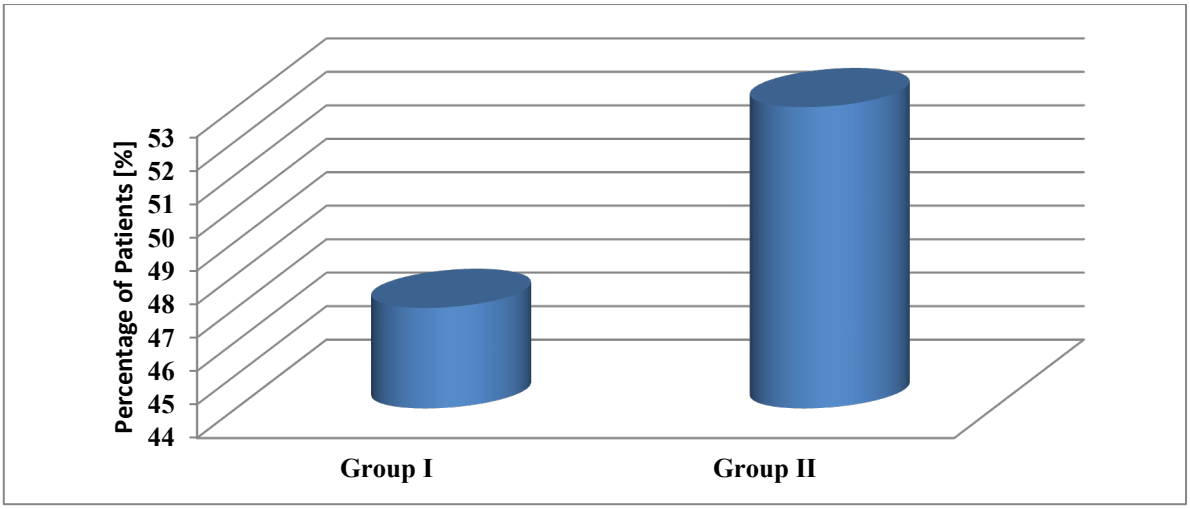

Figure 3: Distribution Of Subjects According To Comorbidities

Table 4: Comorbidities Among Patients

Comorbidity	N [%]
Hypertension	125 [31.3]
Diabetes	88 [22]
Other comorbidities include hypothyroidism, benign prostate hypertrophy, coronary artery disease, pulmonary embolism, pulmonary Tuberculosis, scrub typhus, chronic kidney disease, scrub typhus, rheumatoid arthritis, asthma, pancreatitis, pneumonitis, bronchitis	86 [21.5]
Without comorbidity	211 [52.8]

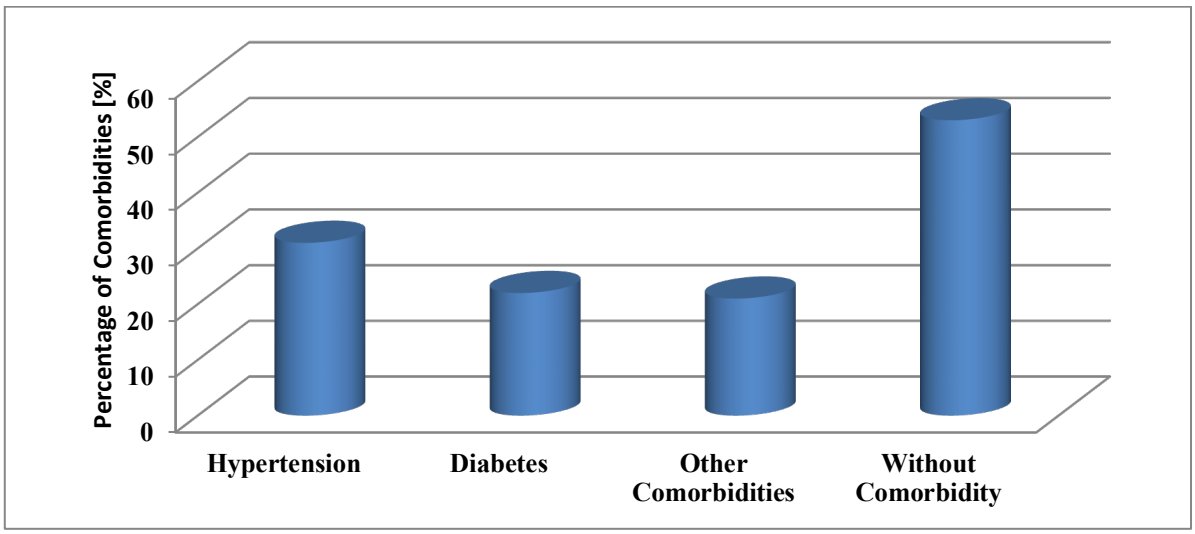

Figure 4: Comorbidities Among Patients

Additionally, the maximum number of patients with co-morbidity belongs to Group C (79.4%) followed by Group B (56.9%) and Group A (14.7%) and the number of patients without co-morbidity belongs maximum to Group A (85.3%) followed by Group B (43.1%) and Group C (20.6%). On comparison statistically high significant difference was seen among different age groups (P=0.00) [Table

5,Figure 5]. Our study also demonstrated that the number of patients with comorbidity is more in Group M (47.9%) than Group F (46.2%). Similarly, the number of patients without comorbidity are also found more in Group M (52.1%) than group F (53.8%), but on comparison, there no significant difference was observed [table 6,Figure 6].

Table 5: Association Of Age With Comorbidity

	Group I N [%]	Group II N [%]	Total	p-value
Group A	21 [14.7]	122 [85.3]	143	0.00**
Group B	91 [56.9]	69 [43.1]	160	
Group C	77[79.4]	20 [20.6]	97	

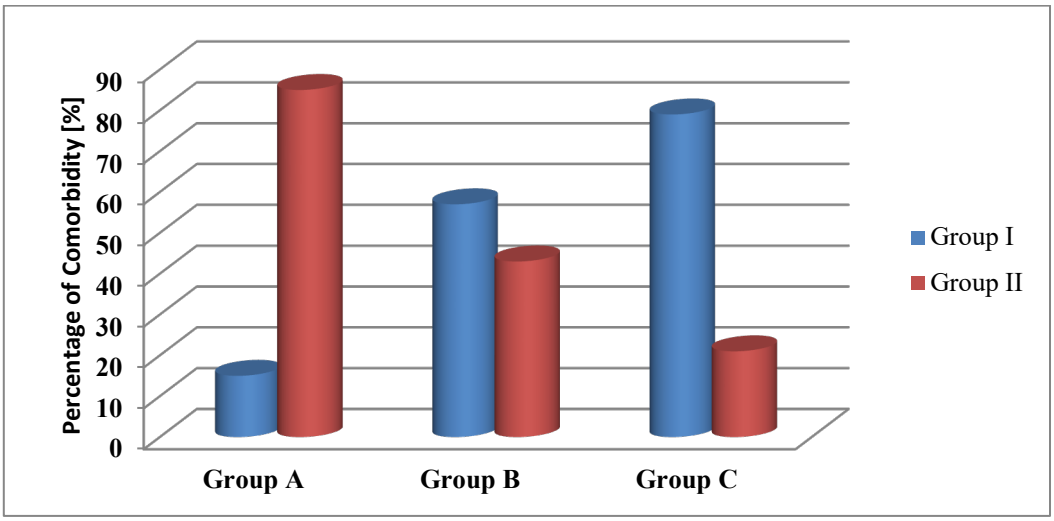

Figure 5: Association Of Age With Comorbidity

Table 6: Association Of Gender With Comorbidity

	Group I	Group II	Total	p value
Group Male N [%]	123 [47.9]	134 [52.1]	257	0.66
Group Female N [%]	66 [46.2]	77 [53.8]	143	

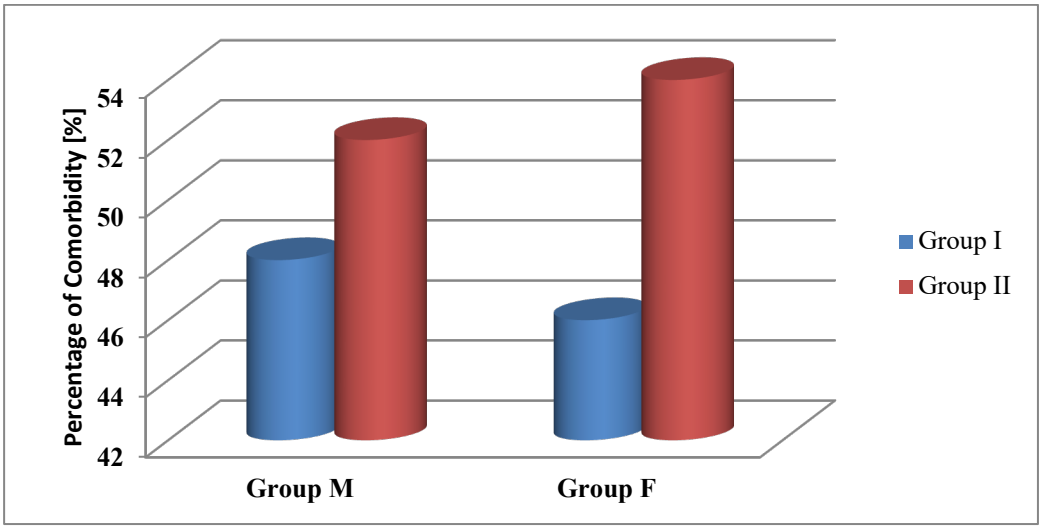

Figure 6: Association Of Gender With Comorbidity

Discussion

The mean age of all the subjects involved in our study was 58.7 ± 12.2 years SD. The patients were classified into three age groups i.e. 18 to 40 years (Group A), 40-60 years (Group B) and above 60 years (Group C) and it was found that maximum patients belonged to Group B [40%] with mean age of 51.4 ±6.0 years followed Group A [35.8%], with mean age of 30.4 ±5.6 years [Table 1]. Thus, for the present study maximum patients were from the 40-60 years. Similar results were reported by Hamza A et al in their study. They reported that the severity of illness increased with the increasing age while more deaths were seen in the 40–60-year age (middle age) group as compared to the other age groups although the association was not found significant.[18]

Thus, it is clear from present study and from previous studies that age appears to be a strong risk factor for COVID-19 severity and outcomes. This is because as age increases the immune system of the people get compromised. This is further supported by the fact that children are less susceptible to severe forms of COVID-19 compared to adults as the immune system in children are better comparatively.[19] Furthermore, it has been also reported that SARS-CoV-2 viral load is higher in the elder age group.[20] However, there are controversial findings about the young or middle age group individuals. The issue is that there is disproportionately more research has been done on the severity of COVID-19 in elderly people than in young or middle age individuals.[21] It is observed that with the young adults the reduced compliance with social distancing may impact the effect of Covid-19 but as their immune system is less compromised compared to elderly patients and the age specific rate of morbidity and mortality is low.[22]

However, our results contrast with previous findings that middle age group individuals are less susceptible than elder age group. Possible reasons for the high prevalence of COVID-19 in middle age group may be changes in different parts of the immune system from aging that make the middle-aged more vulnerable to Covid-19 infection, even if they are healthy and have no underlying medical conditions or comorbidities. There may also be lifestyle factors, such as a greater likelihood of encountering the virus in social and work settings that contribute to their vulnerability.

In the present study 64% participants were males and 36% were females [Table 2]. It has been reported by Jun Mi et al., that the prevalence of COVID-19 was higher in males compared to the females. [23]In another study by Hamza A et al. it was found that the number of males admitted were twice that of the females but it was found that the females who were admitted had a slightly higher severity of illness and a greater number of deaths but the difference was not significant.[18] In a similar study by Miatech JL et al., 68% participants were male and 32% were female.[24] So far, the mechanisms underlying the observed gender differences are not entirely clear. Based on the current understanding of gender differences in respiratory virus diseases, some assumptions can be put forward. Some lifestyles, such as smoking, are most likely associated with the negative progression and adverse outcomes of COVID-19 in males.[25]In addition, it is known that, in general, innate and immune responses are more intense and stronger in females than in males. Proinflammatory cytokines and chemokines express stronger in males. In particular, the core cytokine storm, IL-6 receptor, is highly expressed in lung epithelial cells in males, suggesting that males are more susceptible to cytokine storm that can lead to the deterioration of COVID-19 [26], which is in consistent with our results. Angiotensin I converting enzyme 2 (ACE2) is crucial for SARS CoV-2 entry into host cells which is similar to SARSCoV. ACE2 is the main receptor

mediating viral attachment to target cells.[27] Cell type-specific expression of the ACE2 receptor in type II alveolar epithelial cells is higher in males than in females.[26,27] Therefore, male respiratory system is more vulnerable. The immune system of females has been reported to be twice as strong as that of males.[28] The gender disparity in the efficiency of the immune response correlates with the disease outcomes. Thus, mortality for COVID-19 is twice in males.[29] Some researchers have associated these findings with genes allocated in the X chromosome.[30] Estrogens may potentiate immune activities of vitamin D, thus improving infection outcomes.[31]Conversely, male sex hormones make men vulnerable to COVID-19 and worsen the disease prognosis. First, they are thought to promote viral entry by increasing the activity of the ACE2 receptor the entry point for the SARS-CoV-2 coronavirus. Second, testosterone exerts immunosuppressive effects and may blunt antibody response. Men may benefit from stimulants of T-cell immune responses and anti-testosterones. Estrogens can be administered to reduce COVID-19 disease severity.[32] Another explanation of male gender prevalent in this study could be the fact that more females stayed at home during the law of curfew than males, which made males more exposed to the infection.

Comorbidities are the diseases that coexist with the disease of interest, which may directly affect the outcome of the disease of interest.[33,34] Comorbidity has been reported as an important risk factor for mortality in COVID-19 patients.[35]In our study, 47% patients had comorbidities (Group I) and 53% patients were without comorbidities (Group II) [Table 3].The most frequent comorbidity among patients was hypertension [31.3%] followed by Diabetes [22%] [Table 4]. 21.5% patients had other comorbidities that included hypothyroidism, benign prostate hypertrophy, coronary artery disease, pulmonary embolism, pulmonary Tuberculosis, scrub typhus, chronic kidney disease, scrub typhus, rheumatoid arthritis, asthma, pancreatitis, pneumonitis and bronchitis. Similar to our observations, Jun Mi et al., also found that hypertension, diabetes and coronary heart disease were the most common comorbidities among COVID-19 patients.[23] In our study hypertension and diabetes mellitus were the most common comorbidities associated with COVID-19 infection followed by other comorbidities. Additionally, the maximum number of patients with co-morbidity belongs to Group C (79.4%) followed by Group B (56.9%) and Group A (14.7%) and the number of patients without co-morbidity belongs maximum to Group A (85.3%) followed by Group B (43.1%) and Group C (20.6%). On comparison statistically highly significant difference was seen among different age groups (P=0.00).

Comorbidities increase the chances of infection. Based on the current information and clinical expertise, the elderly, especially those in long-term care facilities, and people of any age with serious underlying medical conditions are at a greater risk of getting COVID-19.[36] The elderly, a vulnerable population, with chronic health conditions such as diabetes and cardiovascular or lung disease are not only at a higher risk of developing severe illness but are also at an increased risk of death if they become ill.[37] People with underlying uncontrolled medical conditions such as hypertension, diabetes, lung, liver, and kidney disease, cancer patients on chemotherapy, smokers, transplant recipients, and patients taking steroids chronically are at increased risk of COVID-19 infection.[36]Earlier studies suggested that the higher COVID-19 mortality may be contributed by the higher burden of comorbidities in men [23,38,39] our study also demonstrated that the number of patients with comorbidity is more in Group M (47.9%) than Group F (46.2%).

Similarly, the number of patients without comorbidity are also more in Group M (52.1%) than group F (53.8%), but on comparison, there was no significant difference was observed.

Conclusion

The age, gender and comorbidity disparities observed in COVID-19 vulnerability emphasise the need to understand the impact of age, gender and comorbidity on the incidence and case fatality of the disease and to tailor the treatment according to age and gender. Experiences from the past outbreaks and pandemics have clearly shown the importance of incorporating age, gender and comorbidity analysis into the preparedness and response efforts of health interventions. The policies and public health efforts, however, have not yet addressed the age, gender and comorbidity impacts on disease epidemics, outbreaks or pandemics. Some countries have not disaggregated data by age, gender and comorbidity the way other countries have. In conclusion, the governments in all the countries should disaggregate and analyse data for age, gender and comorbidity differences. Furthermore, as prophylactic and therapeutic treatment studies begin, inclusion of age, gender and comorbidity analyses in their protocols must occur.

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