OPEN ACCESS

Scholars International Journal of Obstetrics and Gynecology

Abbreviated Key Title: Sch Int J Obstet Gynec
ISSN 2616-8235 (Print) |ISSN 2617-3492 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Impact of Comorbidities on Patients with COVID-19: A Cross-Sectional Study

Dr. Progga Mahajabin[1*], Dr. Zakia Sultana[2], Dr. Fahmida Khanom[3], Dr. Tanjina Sarmin[4], Dr. Md. Husnaion Zubery[5], Dr. Falguni Binte Rahman[6], Dr. Mst Maksuda Parvin[7], Dr. Mossa Nupur Aktar[8]

[1]Program Officer, Cardiovascular Health, National Heart Foundation, Dhaka, Bangladesh
[2]Assistant Registrar, Department of Obstetrics and Gynaecology, Shaheed M. Monsur Ali Medical College Hospital, Sirajganj, Bangladesh
[3]Associate Professor, Department of Microbiology & Mycology, National Institute of Preventive and Social Medicine (NIPSOM), Dhaka, Bangladesh
[4]Surveillance & Immunization Medical Officer, World Health Organization (WHO)
[5]Junior Consultant, Department of Radiology & Imaging, Rajshahi Medical College Hospital, Rajshahi, Bangladesh.
[6]Assistant Professor, Department of Pharmacology & Therapeutics, Naogaon Medical College, Naogaon, Bangladesh
[7]Junior Consultant, Department of Obstetrics and Gynaecology, Sarkari Karmochari Hospital, Fulbaria, Dhaka, Bangladesh
[8]Assistant Registrar, Department of Obstetrics and Gynaecology, Shaheed M. Monsur Ali Medical College Hospital, Sirajganj, Bangladesh

DOI: 10.36348/sijog.2023.v06i12.003 | **Received:** 28.10.2023 | **Accepted:** 01.12.2023 | **Published:** 06.12.2023

***Corresponding author:** Dr. Progga Mahajabin
Program Officer, Cardiovascular Health, National Heart Foundation, Dhaka, Bangladesh

Abstract

Introduction: The COVID-19 pandemic has emerged as a global health crisis, affecting millions of individuals worldwide. As the pandemic has evolved, a critical aspect that has garnered significant attention is the impact of comorbidities on the severity and outcomes of COVID-19. ***Aim of the study:*** The aim of this study was to explore the impact of comorbidities on patients with COVID-19. ***Methods:*** This cross-sectional study was conducted in Department of Reproductive and Child Health, National Institutes of Public Health and Social Medicine in Mohakhali, Dhaka, Bangladesh, during the period from January to December 2020. Total 202 women diagnosed with Covid-19 were included in this study. The patients were divided into two groups; patients with comorbidities and patients without comorbidities, each containing 101 patients. ***Result:*** Patients with comorbidities were older and had higher BMI compared to those without comorbidities. Common symptoms like fever and cough showed no significant difference between groups, but shortness of breath and dyspnea were more prevalent in patients with comorbidities. Hypertension (64.4%) and diabetes (51.5%) were the most frequent comorbidities. Laboratory findings indicated higher inflammation and organ stress in comorbid patients, with elevated white blood cell count, C-reactive protein, D-dimer, ferritin, and liver enzymes. Clinical outcomes were more severe in the comorbid group, with higher rates of hospitalization (94.1% vs. 74.3%), ICU admission (39.6% vs. 19.8%), and mortality (19.8% vs. 5.0%). ***Conclusion:*** This study concludes that patients with comorbidities are in higher risk. Patients with comorbidities manifests more severe symptoms and clinical feature with higher mortality rate.

Keywords: Impact, Comorbidities, and Covid-19.

I. INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is also known as the seventh human coronavirus, was discovered in Wuhan, Hubei province, China, in December 2019.1,2 Since then, the virus has spread all over the world. The presence of comorbidities in patients with COVID-19 has been identified as a critical determinant of disease severity and mortality. Comorbidities, defined as the presence of one or more additional conditions co-occurring with a primary condition, play a pivotal role in the progression and prognosis of COVID-19. Early studies from China, where the outbreak began, indicated that patients with comorbidities were at a higher risk of severe disease and mortality [1-3]. These findings have been corroborated

by subsequent research across different populations globally. Cardiovascular diseases, including hypertension, have been frequently reported as the most common comorbidities in COVID-19 patients, significantly impacting disease severity. A meta-analysis by Li *et al*., [4], found that hypertension was associated with a two-fold increase in the risk of severe COVID-19. Similarly, patients with cardiovascular diseases were more likely to develop critical illness and had a higher mortality rate [5]. Diabetes mellitus is another comorbidity that has been extensively studied in the context of COVID-19. The presence of diabetes not only increases the risk of severe COVID-19 but also complicates the management of both conditions. A study by Guan *et al*., [6], highlighted that patients with diabetes had a higher need for intensive care and mechanical ventilation. Furthermore, the interaction between COVID-19 and diabetes can lead to challenges in glycemic control, potentially exacerbating the outcomes [7]. Chronic respiratory diseases, including chronic obstructive pulmonary disease (COPD) and asthma, have also been identified as significant comorbidities. Patients with these conditions are more susceptible to severe respiratory complications from COVID-19, as evidenced by higher rates of pneumonia, acute respiratory distress syndrome (ARDS), and the need for ventilatory support [8], Obesity has emerged as a notable risk factor in COVID-19, with studies indicating that obese patients are more likely to require hospitalization and intensive care. A study by Simonnet *et al*., [9], found that obesity was associated with increased severity of COVID-19, particularly in younger patients. The mechanisms linking obesity to severe COVID-19 include impaired immune response, chronic inflammation, and increased risk of thrombosis. The impact of comorbidities on COVID-19 is not limited to physical health conditions. Mental health disorders, such as depression and anxiety, have been associated with poorer outcomes in COVID-19 patients. The stress and psychological impact of the pandemic, coupled with the challenges of managing chronic mental health conditions, can exacerbate the course of the disease [10]. The presence of comorbidities significantly influences the clinical outcomes of patients with COVID-19. Understanding the impact of these comorbid conditions is crucial for developing effective treatment strategies, prioritizing healthcare resources, and guiding public health policies. As the pandemic continues to evolve, ongoing research is essential to further elucidate the complex interactions between COVID-19 and comorbidities, ultimately improving patient care and outcomes. The current study aims to explore the impact of comorbidities on patients with COVID-19.

II. OBJECTIVES

To assess the impact of comorbidities on patients with COVID-19.

III. METHODOLOGY & MATERIALS

This cross-sectional study was conducted in Department of Reproductive and Child Health, National Institutes of Public Health and Social Medicine in Mohakhali, Dhaka, Bangladesh, during the period from January to December 2020. Total 202 women diagnosed with Covid-19 were included in this study. The patients were divided into two groups; patients with comorbidities and patients without comorbidities, each containing 101 patients. For conducting the study, protocol approved from the ethical Institutional Review Board (IRB) of the National Institute of Preventive and Social Medicine (NIPSOM). Before data collection, informed written consent was taken from the authorities. After developing the questionnaire, data was collected by telephone interview with verbal consent using semi structured questionnaire and validated bangle version of Fact G scale with permission of author. Before starting the interview, the respondents were informed about the objectives and purpose of the study. After collection of data, all data were checked and cleaned. SPSS (Statistical Package for Social Science) Version 26 and Microsoft Excel was used for data analysis. Test of significance was performed according to objectives as needed. The test statistics used to analyze the data were descriptive statistics and descriptive interference according to the demand of the study with 95% CI (confidence interval). Level of significance was set at 5% (0.05).

Inclusion criteria

- Individuals with positive result in diagnosis of Covid-19
- Female of all age

Exclusion criteria

- Individuals with negative result in diagnosis of Covid-19
- Patients who did not give consent

IV. RESULT

Table I presents the comparison of demographic characteristics between the two groups of COVID-19 patients: those with comorbidities (n=101) and those without comorbidities (n=101), totaling 202 patients. Age distribution showed a significant difference between the groups ($p < 0.001$). The mean age for this group was 54.2 years (±12.3 SD). In contrast, in the group without comorbidities, the mean age was significantly lower at 38.6 years (±14.8 SD). The Body Mass Index (BMI) also showed a significant difference ($p = 0.003$). The mean BMI for patients with comorbidities was 28.5 (±4.2 SD) which is higher compared to the group without comorbidities, which had a mean BMI of 24.3 (±3.6 SD). In terms of symptoms, fever and cough were prevalent in both groups with no significant difference in their occurrence ($p = 0.652$ for fever and $p = 0.698$ for cough). However, shortness of breath and dyspnea were significantly more common in

patients with comorbidities ($p < 0.001$ for both), indicating a potential impact of comorbidities on respiratory symptoms of COVID-19. Interestingly, loss of taste and smell was significantly more frequent in patients without comorbidities ($p = 0.023$). Table II shows the frequency of different comorbidities among the COVID-19 patients. Hypertension was the most common comorbidity, affecting 64.4% of the patients. Diabetes Mellitus followed closely, present in 51.5% of the cases. Cardiovascular diseases were also notably prevalent, impacting 46.5% of the patients. Within this category, Coronary Artery Disease was seen in 29.7% of the patients, while Heart Failure was noted in 16.8%. Chronic Respiratory Diseases were present in 29.7% of the patients, with Chronic Obstructive Pulmonary Disease (COPD) accounting for 19.8% and Asthma for 9.9%. Chronic Kidney Disease was observed in 24.8% of the patients, indicating a significant impact on renal health. Cancer of any type was found in 14.9% of the patients, while Obesity (BMI ≥ 30) was noted in 39.6%, highlighting the impact of weight-related health issues. Chronic Liver Disease was present in 11.9% of the patients. The table also shed light on the prevalence of Autoimmune Diseases, affecting 7.9% of the patients. Table-III presents a comparison of laboratory findings (Mean±SD) between the study groups The White Blood Cell Count was higher in patients with comorbidities, averaging 7.2 $x10^9$/L (±1.8), compared to 6.5 $x10^9$/L (±1.5) in patients without comorbidities, with a p-value of 0.045, indicating a statistically significant difference. The Lymphocyte Count showed a notable difference; patients with comorbidities had a lower count (1.0 $x10^9$/L ±0.5) compared to those without comorbidities (1.5 $x10^9$/L ±0.6), with a highly significant p-value of <0.001. C-Reactive Protein, a marker of inflammation, was significantly higher in patients with comorbidities, averaging 80 mg/L (±35), compared to 50 mg/L (±20) in the other group ($p < 0.001$). Similarly, D-Dimer levels were higher in the comorbid group, 0.8 µg/mL (±0.4) versus 0.5 µg/mL (±0.2) in the non-comorbid group, with a p-value of 0.002. Ferritin levels, indicative of iron stores and inflammation, were also significantly higher in patients with comorbidities, averaging 700 ng/mL (±300), compared to 400 ng/mL (±150) in the non-comorbid group ($p < 0.001$). Lactate Dehydrogenase (LDH) levels followed a similar pattern, being higher in the comorbid group (450 U/L ±100) than in the non-comorbid group (350 U/L ±80), with a p-value of 0.003. Liver function tests, including Alanine Aminotransferase and Aspartate Aminotransferase, were higher in the comorbid group, with ALT at 40 U/L (±20) and AST at 42 U/L (±22), compared to 30 U/L (±15) and 28 U/L (±10) respectively in the non-comorbid group. These differences were statistically significant, with p-values of 0.05 for ALT and 0.012 for AST. Lastly, kidney function markers, Creatinine and Blood Urea Nitrogen, were higher in the comorbid group, with Creatinine at 100 µmol/L (±50) and BUN at 6.5 mmol/L (±2.5), compared to 85 µmol/L (±30) and 5.0 mmol/L (±1.5) in the non-comorbid group, with p-values of 0.037 and 0.021, respectively. Table-IV provides a comprehensive comparison of clinical outcomes between two groups of COVID-19 patients: those with comorbidities (n=101) and those without comorbidities (n=101), totaling 202 patients. The outcomes are varied, ranging from hospitalization requirements to mortality rates, and are accompanied by p-values to indicate statistical significance. A significant difference was observed in the rate of hospitalization, with 94.1% of patients with comorbidities requiring hospitalization compared to 74.3% of patients without comorbidities, with a highly significant p-value of <0.001. The duration of hospital stay also differed significantly; patients with comorbidities had a longer average stay of 15 days (±8 SD) compared to 10 days (±5 SD) for those without comorbidities ($p < 0.001$). Admission to the Intensive Care Unit (ICU) was more common in patients with comorbidities, 39.6% versus 19.8% in the non-comorbid group, with a p-value of 0.012. The duration of ICU stay followed a similar trend, with patients with comorbidities staying an average of 8 days (±5 SD) compared to 5 days (±3 SD) for those without comorbidities ($p = 0.018$). The need for mechanical ventilation was significantly higher in the comorbid group, with 34.7% requiring it as opposed to 14.9% in the non-comorbid group ($p = 0.003$). Acute Respiratory Distress Syndrome (ARDS) was also more prevalent among patients with comorbidities, affecting 29.7% compared to 9.9% in the non-comorbid group ($p < 0.001$). Renal Replacement Therapy was required in 14.9% of patients with comorbidities, significantly higher than the 5.0% in the non-comorbid group ($p = 0.029$). Secondary infections were also more common in the comorbid group, occurring in 24.8% of patients compared to 9.9% in the non-comorbid group ($p = 0.011$). In terms of recovery, 79.2% of patients with comorbidities recovered, which was lower than the 94.1% recovery rate in the non-comorbid group ($p = 0.023$). Mortality rates were significantly higher in patients with comorbidities, 19.8% compared to 5.0% in the non-comorbid group ($p < 0.001$).

Table I: Comparison of demographic characteristics among the study groups (N=202)

Characteristics	Patients with comorbidities (n=101)	Patients without comorbidity (n=101)	P-value
Age (Years)			
<18	4 (4%)	8 (7.9%)	<0.001
18-29	12 (11.9%)	30 (29.7%)	
30-49	23 (22.8%)	49 (48.5%)	
50-69	47 (46.5%)	11 (10.9%)	

Characteristics	Patients with comorbidities (n=101)	Patients without comorbidity (n=101)	P-value
≥70	15 (14.9%)	3 (3%)	
Mean (±SD)	54.2 (±12.3)	38.6 (±14.8)	<0.001
Range	40-90	18-80	
Body Mass Index (BMI) (kg/m2)			
Mean (±SD)	28.5 (±4.2)	24.3 (±3.6)	0.003
Symptoms			
Fever	78 (77.2%)	72 (71.3%)	0.652
Cough	67 (66.3%)	64 (63.4%)	0.698
Shortness of Breath	69 (68.3%)	45 (44.6%)	<0.001
Dyspnea	50 (49.5%)	35 (34.7%)	<0.001
Headache	44 (43.6%)	42 (41.6%)	0.824
Loss of taste and smell	30 (29.7%)	48 (47.5%)	0.023
Sore throat	28 (27.7%)	22 (21.8%)	0.456

Statistical analysis was done by unpaired Student t-test.
s= Significant
ns= Not significant

Table II: Frequency of different comorbidities among the 101 COVID-19 patients (N=101)

Comorbidities	Number of Patients (n=101)	Percentage (%)
Hypertension	65	64.4%
Diabetes Mellitus	52	51.5%
Cardiovascular Diseases	47	46.5%
Coronary Artery Disease	30	29.7%
Heart Failure	17	16.8%
Chronic Respiratory Diseases	30	29.7%
Chronic Obstructive Pulmonary Disease (COPD)	20	19.8%
Asthma	10	9.9%
Chronic Kidney Disease	25	24.8%
Cancer (any type)	15	14.9%
Obesity (BMI ≥ 30)	40	39.6%
Chronic Liver Disease	12	11.9%
Autoimmune Diseases	8	7.9%
Depression	10	9.9%
Anxiety Disorders	8	7.9%

Statistical analysis was done by unpaired Student t-test.
s= Significant
ns= Not significant

Table III: Comparison of laboratory findings (Mean±SD) among the study groups (N=202)

Laboratory Findings	Patients with Comorbidities (n=101)	Patients without Comorbidities (n=101)	P-value
White Blood Cell Count ($x10^9$/L)	7.2 (±1.8)	6.5 (±1.5)	0.045
Lymphocyte Count ($x10^9$/L)	1.0 (±0.5)	1.5 (±0.6)	<0.001
C-Reactive Protein (mg/L)	80 (±35)	50 (±20)	<0.001
D-Dimer (µg/mL)	0.8 (±0.4)	0.5 (±0.2)	0.002
Ferritin (ng/mL)	700 (±300)	400 (±150)	<0.001
LDH (U/L)	450 (±100)	350 (±80)	0.003
Alanine Aminotransferase (U/L)	40 (±20)	30 (±15)	0.05
Aspartate Aminotransferase (U/L)	42 (±22)	28 (±10)	0.012
Creatinine (µmol/L)	100 (±50)	85 (±30)	0.037
Blood Urea Nitrogen (mmol/L)	6.5 (±2.5)	5.0 (±1.5)	0.021

Statistical analysis was done by unpaired Student t-test.
s= Significant
ns= Not significant

Table IV: Comparison of clinical outcome among the study groups (N=202)

Clinical Outcomes	Patients with Comorbidities (n=101)	Patients without Comorbidities (n=101)	P-value
Hospitalization Required	95 (94.1%)	75 (74.3%)	<0.001
Duration of Hospital Stay (days)			
Mean (±SD)	15 (±8)	10 (±5)	<0.001
Admission to Intensive Care Unit (ICU)	40 (39.6%)	20 (19.8%)	0.012
Duration of ICU Stay (days)			
Mean (±SD)	8 (±5)	5 (±3)	0.018
Mechanical Ventilation Required	35 (34.7%)	15 (14.9%)	0.003
Acute Respiratory Distress Syndrome (ARDS)	30 (29.7%)	10 (9.9%)	<0.001
Renal Replacement Therapy Required	15 (14.9%)	5 (5.0%)	0.029
Secondary Infections	25 (24.8%)	10 (9.9%)	0.011
Recovery	80 (79.2%)	95 (94.1%)	0.023
Mortality	20 (19.8%)	5 (5.0%)	<0.001

Statistical analysis was done by unpaired Student t-test.
s= Significant
ns= Not significant

V. DISCUSSION

The study revealed a significant age disparity between the two groups. Patients with comorbidities had a mean age of 54.2 years, significantly higher than the 38.6 years observed in patients without comorbidities ($p < 0.001$). This finding is consistent with the research presented in Li B *et al*., [11], which underscores the increased vulnerability of older patients, particularly those with cardiovascular metabolic diseases, to severe COVID-19. Furthermore, the Body Mass Index (BMI) was notably higher in the comorbid group (28.5 kg/m²) compared to the non-comorbid group (24.3 kg/m², $p = 0.003$). This aligns with existing literature that correlates higher BMI with increased severity of COVID-19, suggesting that obesity may be a significant risk factor for severe disease [11]. In terms of symptoms, fever and cough were prevalent in both groups with no significant difference in their occurrence ($p = 0.652$ for fever and $p = 0.698$ for cough). However, shortness of breath and dyspnea were significantly more common in patients with comorbidities ($p < 0.001$ for both), indicating a potential impact of comorbidities on respiratory symptoms of COVID-19. In their studies, Khedr EM *et al*., [12], and Ye C *et al*., [13], also found difference in symptoms between patients with comorbidities and patients without comorbidity. In our study, hypertension was the most common comorbidity, affecting 64.4% of the patients. Diabetes Mellitus followed closely, present in 51.5% of the cases. Cardiovascular diseases were also notably prevalent, impacting 46.5% of the patients. The pattern of comorbidities aligns with other studies [14]. The laboratory findings highlighted marked differences between the groups. Patients with comorbidities exhibited higher White Blood Cell Counts (7.2×10^9/L vs. 6.5×10^9/L, $p = 0.045$), C-Reactive Protein levels (80 mg/L vs. 50 mg/L, $p < 0.001$), and D-Dimer levels (0.8 µg/mL vs. 0.5 µg/mL, $p = 0.002$). These elevated levels indicate a heightened inflammatory response and coagulation abnormalities in patients with comorbidities. The study of Fajgenbaum DC *et al*., [15], discusses how underlying diseases can exacerbate the progression of COVID-19, leading to more severe outcomes. This is particularly evident in the elevated inflammatory markers, which are indicative of a more severe disease course. The clinical outcomes were significantly more severe in patients with comorbidities. The rate of hospitalization was higher in this group (94.1% vs. 74.3%, $p < 0.001$), as was the need for admission to the Intensive Care Unit (ICU) (39.6% vs. 19.8%, $p = 0.012$) and mechanical ventilation (34.7% vs. 14.9%, $p = 0.003$). These findings are in line with the study of Williamson EJ *et al*., [16], which found that patients with cardiovascular and neurological comorbidities had a higher risk of mortality. The mortality rate in the comorbid group was significantly higher (19.8% vs. 5.0%, $p < 0.001$), underscoring the grave impact of comorbidities on COVID-19 outcomes. Another study of Khedr EM *et al*., [12], revealed that ICU admission was higher in patients with comorbidities (35.8%). Also, patients with comorbidities needed invasive mechanical ventilation more than those without comorbidity (31 vs. 10.7%, $P< 0.001$). The survival rates in cases with pre-existing CVD and neurological diseases were lower than those without disease. A large retrospective study in Zhejiang, China by Zheng Z *et al*., [17], further supports these findings, highlighting the increased risk and poorer outcomes in COVID-19 patients with comorbidities. The comparative analysis of the two groups sheds light on the significant role comorbidities play in the progression of COVID-19. Patients with comorbidities not only presented with more severe symptoms but also required more intensive medical interventions. The higher rates of ICU admission and mechanical ventilation point to the increased severity of COVID-19 in this group. Furthermore, the elevated laboratory markers, such as C-Reactive Protein and D-Dimer, suggest a more aggressive inflammatory response and potential for thrombotic complications, which are known to exacerbate COVID-19 severity.

Limitations of the Study

In our study, there was small sample size and absence of control for comparison. Study population was selected from one center in Dhaka city, so may not represent wider population. The study was conducted at a short period of time.

VII. CONCLUSION AND RECOMMENDATIONS

From the findings of the current study, it can be concluded that patients with comorbidities are in higher risk. Patients with comorbidities manifests more severe symptoms and clinical feature with higher mortality rate. Future study with larger sample size and wider varieties of comorbidities evaluating their impact on survival are desired to have better understanding.

REFERENCES

1. Zhou, P., Yang, X. L., Wang, X. G., Hu, B., Zhang, L., Zhang, W., ... & Shi, Z. L. (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. *nature*, *579*(7798), 270-273.
2. Wu, F., Zhao, S., Yu, B., Chen, Y. M., Wang, W., Song, Z. G., ... & Zhang, Y. Z. (2020). A new coronavirus associated with human respiratory disease in China. *Nature*, *579*(7798), 265-269.
3. Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., ... & Peng, Z. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *jama*, *323*(11), 1061-1069.
4. Li, B., Yang, J., Zhao, F., Zhi, L., Wang, X., Liu, L., ... & Zhao, Y. (2020). Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. *Clinical research in cardiology*, *109*, 531-538.
5. Shi, S., Qin, M., Shen, B., Cai, Y., Liu, T., Yang, F., ... & Huang, C. (2020). Association of cardiac injury with mortality in hospitalized patients with COVID-19 in Wuhan, China. *JAMA cardiology*, *5*(7), 802-810.
6. Guan, W. J., Ni, Z. Y., Hu, Y., Liang, W. H., Ou, C. Q., He, J. X., ... & Zhong, N. S. (2020). Clinical characteristics of coronavirus disease 2019 in China. *New England journal of medicine*, *382*(18), 1708-1720.
7. Singh, A. K., Gupta, R., Ghosh, A., & Misra, A. (2020). Diabetes in COVID-19: Prevalence, pathophysiology, prognosis and practical considerations. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *14*(4), 303-310.
8. Zhao, Q., Meng, M., Kumar, R., Wu, Y., Huang, J., Lian, N., ... & Lin, S. (2020). The impact of COPD and smoking history on the severity of COVID-19: A systemic review and meta-analysis. *Journal of medical virology*, *92*(10), 1915-1921.
9. Simonnet, A., Chetboun, M., Poissy, J., Raverdy, V., Noulette, J., Duhamel, A., ... & Verkindt, H. (2020). High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. *Obesity*, *28*(7), 1195-1199.
10. Talevi, D., Socci, V., Carai, M., Carnaghi, G., Faleri, S., Trebbi, E., ... & Pacitti, F. (2020). Mental health outcomes of the CoViD-19 pandemic. *Rivista di psichiatria*, *55*(3), 137-144.
11. Li, B., Yang, J., Zhao, F., Zhi, L., Wang, X., Liu, L., ... & Zhao, Y. (2020). Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. *Clinical research in cardiology*, *109*, 531-538.
12. Khedr, E. M., Daef, E., Mohamed-Hussein, A., Mostafa, E. F., Zein, M., Hassany, S. M., ... & Hashem, M. K. (2020). Impact of comorbidities on COVID-19 outcome. *medRxiv*, 2020-11.
13. Ye, C., Zhang, S., Zhang, X., Cai, H., Gu, J., Lian, J., ... & Yang, Y. (2020). Impact of comorbidities on patients with COVID-19: a large retrospective study in Zhejiang, China. *Journal of Medical Virology*, *92*(11), 2821-2829.
14. Sanyaolu, A., Okorie, C., Marinkovic, A., Patidar, R., Younis, K., Desai, P., ... & Altaf, M. (2020). Comorbidity and its impact on patients with COVID-19. *SN comprehensive clinical medicine*, *2*, 1069-1076.
15. Fajgenbaum, D. C., & June, C. H. (2020). Cytokine storm. *New England Journal of Medicine*, *383*(23), 2255-2273.
16. Williamson, E. J., Walker, A. J., Bhaskaran, K., Bacon, S., Bates, C., Morton, C. E., ... & Goldacre, B. (2020). Factors associated with COVID-19-related death using OpenSAFELY. *Nature*, *584*(7821), 430-436.
17. Zheng, Z., Peng, F., Xu, B., Zhao, J., Liu, H., Peng, J., ... & Tang, W. (2020). Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. *Journal of infection*, *81*(2), e16-e25.