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A Study on the Severity and Outcome of Covid-19 in Obese Patients

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Abstract

Background: The COVID-19 pandemic is rapidly spreading worldwide, notably in India, Europe and North America where obesity is highly prevalent. Obesity has previously been recognized as an independent predisposing factor for severe H1N1, SARS &MERS pulmonary infection and now is also considered an independent factor determining the severity of COVID-19 Infection. This study is aimed at establishing the relationship between severity and outcome of Covid 19 patients among obese and non-obese individuals among patients admitted in a tertiary referral centre in Tamil Nadu.

Aims and Objectives: (1) To compare the severity of COVID-19 infection between obese and non-obese patients. (2) To assess the difference in treatment outcome between obese and non-obese patients. (3) To assess whether the co-existence of other chronic comorbidities influence the severity and outcome of obese COVID-19 patients.

Materials and Methods: This was a prospective study among 200 Covid 19 positive patients admitted in Rajiv Gandhi Government General Hospital, Chennai between the time period of 15th July to 15th August 2020. Subjects were selected by simple random sampling and classified according to the BMI into various categories as underweight, normal, overweight, obese class I, obese class II and obese class III and followed up for a period of one month. The severity and outcome was assessed based on the clinical parameters, blood parameters such as NLR, CRP, Ferritin, requirement of ventilator support and duration of stay. The data was analysed statistically.

Results: 59.5 % of our study population were obese or overweight. There was no significant difference in the clinical severity and outcome among the obese and non-obese patients. However among the obese cohort with Diabetes as a co-morbidity there was a significant increase in the severity of illness in terms of duration of stay (p value 0.009) and duration on need for oxygen requirement (p value 0.008) but no significant difference in outcome as compared with diabetic non-obese individuals.

Keywords: Obesity; Diabetes; Duration of Stay; Oxygen Requirement

Introduction

The SARS Cov 2 virus is a novel corona virus causing severe acute respiratory syndrome, isolated in Wuhan causing the pandemic the world hasn't seen after the Spanish flu. The prevalence is around 36 million cases as on October 2020 worldwide and India suffers the second largest cases around 7 million cases (19%). The earlier coronaviruses which caused epidemics, namely SARS and MERS coronaviruses had a few predisposing factors, obesity being one among them

[1]. It was also a predictor of severity of the disease. During the H1N1 pandemic (2009) also, obesity was identified as an independent risk factor [2]. Though obesity has been recognized as a risk factor in the respiratory epidemics of H1N1, SARS and MERS, its importance in COVID 19 has not yet been elucidated completely though co morbidities like diabetes, hypertension, immunocompromised state and advancing age were mentioned in earlier studies [3-5], obesity as a risk factor for COVID-19 was not recognized. Later, only few studies like US [6] and French [7] studies have commented about obesity in COVID 19. In India the prevalence of obesity is around 135 million, women affected slightly higher than men. Hence, deriving some relationship between COVID 19 and obesity is important in Indian population because of the increasing number of obese population and COVID-19 patients in India.

Aims and Objectives

- To compare the severity of COVID-19 infection between obese and non-obese patients.
- To assess the difference in treatment outcome between obese and non-obese patients.
- To assess whether the co-existence of other chronic comorbidities influence the severity and outcome of obese COVID-19 patients.

Research Question

Is obesity associated with increased severity and poor outcome in COVID-19 infection compared to non-obese individuals?

Hypothesis

Obese individuals are associated with more severity and poor outcome of COVID-19 infection compared to non-obese individuals.

Materials and Methods

Study Design

This was a prospective observational study done among 200 Covid 19 patients admitted in Rajiv Gandhi Government Medical College Hospital during the period of 1 month from 15th July to 15th August, 2020. The study was approved by the Institution Ethical Committee, Madras Medical College. The subjects were randomly selected.

Eligibility

All hospitalized patients of both gender who meet the criteria of

1. Age 18-60 years.
2. Covid positive by RT-PCR testing of nasopharyngeal or oropharyngeal sample.

Patients with co morbidities other than chronic cardiac/ respiratory/ renal/ liver diseases were included. Patients not willing to participate for the study were excluded. Pregnant and breastfeeding mothers were excluded.

Tools for observation

After obtaining informed consent for participation from subjects, the basic registration details were collected and their clinical parameters – heart rate, respiratory rate, saturation on admission; blood parameters – NLR (Neutrophil Lymphocyte Ratio), CRP, Ferritin; need for ventilator support such as nasal oxygen, high flow nasal oxygen, CPAP ventilation, invasive ventilation were noted. All subjects had their weight measured using the same standardized digital weighing machine and height using stadiometer and BMI calculated The subjects were prospectively followed up for a period of 1 month and the duration of need for ventilator support, duration of stay and outcome (discharge or death or continuing care) at the end of the study period were assessed. The details were entered in MS Excel software and analysed statistically. Statistical analysis was done using ANOVA and T-test (Figure 1 & Table 1).

Results

The 200 subjects enrolled in the study were classified into 5 categories as per BMI as follows (Table 1):

S. No.	Category	BMI	Frequency	Percentage
1	Underweight	<18.5	11	5.5
2	Normal	18.5–24.9	70	35
3	Overweight	25-29.9	80	40
4	Obese Class I	30-34.9	30	15
5	Obese Class II	35-39.9	6	3
6	Obese Class III	>40	3	1.5
Total			200	100

Table 1: BMI Categories of study participants.

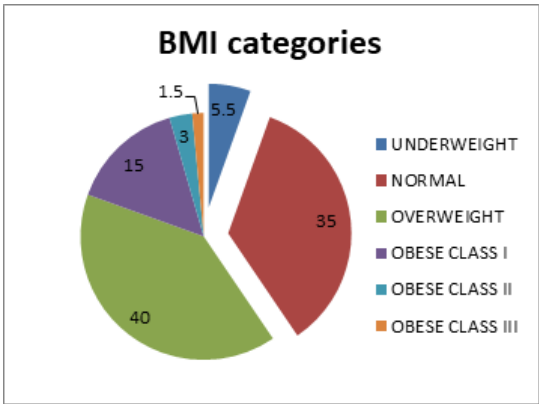

Figure 1: BMI Categories of study participants.

59.5 % of the study population were either overweight or obese in our study.

The number of male participants were 108 and female were 92.

Subjects were followed up and clinical parameters, blood parameters and need for oxygen, duration of stay and outcome were observed as mentioned above.

The severity of illness was assessed by the need of respiratory support in the form of supplemental oxygen, CPAP or invasive mechanical ventilation and the duration of stay (Table 2). The average number of days on these supports was calculated and the difference between groups assessed statistically. Among the 200 participants 120 of them needed ventilatory support at some point of time during their stay in the form on nasal oxygen (109), HFNO (2) and CPAP (9).

BMI	N	Mean	Std. Deviation	Std. Error Mean
DAYS ON O2 >= 25.000000000000000	119	6.622	7.2146	0.6614
< 25.000000000000000	81	5.185	6.1035	0.6782
DAYS ON HFNO >= 25.000000000000000	119	0.51	2.724	0.25
< 25.000000000000000	81	0.4	2.102	0.234
DAYS ON VENTI >= 25.000000000000000	119	0.87	3.417	0.313
< 25.000000000000000	81	0.86	4.321	0.48
DURATION OF STAY >= 25.000000000000000 119 13			6.989	0.641
< 25.000000000000000	81	12.48	7.189	0.799

Table 2: Average duration of need of respiratory support and average duration of stay in normal weight vs overweight individuals.

This table shows that there was no significant difference between obese and non-obese individuals with respect to the duration of need of respiratory support and duration of stay in hospital (Tables 3-7).

The inflammatory markers were classified as per our hospital protocol as follows:

S. No	CRP	Frequency	Percentage
1	<50	140	70
2	50-100	35	17.5
3	>100	25	12.5
TOTAL		200	100

Table 3: CRP values of subjects.

S. No	NLR	Frequency	Percentage
1	<3	91	45.5
2	5-Mar	54	27
3	>5	55	27.5
TOTAL		200	100

Table 4: NLR values of subjects.

S.NO	Ferritin	Frequency	Percentage
1	<600	160	80
2	600-1500	31	15.5
3	>1500	9	4.5
Total		200	100

Table 5: Ferritin values of subjects.

The average value of inflammatory markers between normal weight and overweight was also statistically assessed and no significant difference was found between the two groups.

BMI	N	Mean	Std. Deviation	Std. Error Mean
NLR >= 25.000000000000000	119	4.5966	4.78199	0.43836
< 25.000000000000000	81	4.6305	4.71015	0.52335
CRP >= 25.000000000000000	119	52.5303	82.52713	7.56525
< 25.000000000000000 81		39.9622	65.93067	7.32563
FERRITIN >= 25.000000000000000	119	413.9872	469.42666	43.03227
< 25.000000000000000	81	377.856	466.73486	51.85943

Table 6: Comparing the average value of inflammatory markers between normal weight and overweight individuals.

Outcome was as follows: Among the 200 subjects 182 were discharged, 10 deceased, 4 continued to require hospital stay, 4 were lost to follow up due to Against Medical Advice discharge. The outcome was also not statistically different between the two groups.

Among the participants 74 were diabetics and 43 were hypertensive.

The number of diabetics who were obese (BMI >25) were 48. A similar analysis as done above was proceeded in these two subgroups and a comparison drawn between obese and non-obese individuals.

A significant difference was found between normal weight and overweight individuals in terms of duration of stay and requirement of oxygen.

	Diabetes	Mean	SD	Mean difference	t value	p- value
Duration Of Stay (Days)	Non Obese	11.63	6.366	-3.387	-2.659	0.009
	Obese	15.02	7.436			
Duration On Oxygen (Days)	Non Obese	5.183	6.7893	-3.5669	-2.716	0.008
	Obese	8.75	7.3673			
Duration On Ventilator (Days)	Non Obese	0.9	3.578	0.089	0.139	0.89
	Obese	0.81	3.2			

Table 7: Average duration of need of respiratory support and average duration of stay in normal weight vs overweight individuals.

Significant p value was obtained on consideration duration of stay (p value 0.009) and duration on oxygen (p value 0.008) between obese diabetics and non-obese diabetics. No significant difference was found between these groups in the duration of ventilator requirement or in outcome. No such difference was found between obese and non-obese individuals in the hypertensive subgroup. There was also no significance when both diabetes and hypertension were considered among obese and non-obese cohorts.

At the end of the study conducted we were able to conclude that with the recommended treatment protocol at Rajiv Gandhi Government General Hospital carried out for covid positive in patients there is no significant difference in the severity or outcome among obese cohort and non-obese cohort. However among the obese cohort with diabetes there was a significant difference in the severity observed in the aspects of duration of stay and duration on oxygen when

compared to obese non diabetic cohort. This significance was not met among hypertensive obese and hypertensive non obese cohort in our study.

Discussion

The correlation between COVID 19 and obesity has always been a topic of hot discussion till date. The initial clinical demographic data from China, Italy and USA [3-5], did not mention obesity as a risk factor in COVID 19.The interest of considering obesity as a risk factor in COVID 19 began with Richardson, et al. in USA who found that 41.7% of COVID patients in their study were obese [8,9]. Further observations by Simmon, et al. [6] in US patients and Lighter, et al. [7] in French patients established obesity as a significant risk factor in their cohort of patients. Whether obesity is an independent risk factor of COVID 19 infection or whether the stated risk is due to the confounding effect of the associated comorbidities like diabetes mellitus and hypertension was the discussion put forward by all these studies [1]. However the study by Lighter, et al. showed that obesity may an independent risk factor in individuals less than 60 years of age [7]. Now so many meta-analyses have suggested a positive correlation between obesity and COVID-19 infection in terms of severity or outcome [10-16].

This study is to analyse the relevance of obesity in the cohort of patients in and around Chennai in Tamil Nadu. A subgroup analysis of obese patients with specific comorbidities was also analysed in this study. 59.5% of our study sample was overweight or obese. But we found no significant difference in the duration of stay between obese and non-obese individuals. Also, the need of some form of respiratory support was not significantly different between the two groups. This study is in contrast to most other studies done previously. However, the study done by Lighter, et al. [7] in a larger cohort of patients did not specifically exclude or include hypertensives and diabetics and Simmon, et al. [6] statistically excluded the confounders of hypertension and diabetes and found that obesity was an independent risk factor in COVID 19. Our subgroup analysis showed that obese diabetic individuals had a significantly higher duration of stay and longer need of supplemental oxygen than non-obese diabetics. However, such a relationship does not exist in hypertensives.

Hence, it may not just be the causal association between obesity, diabetes and hypertension [1,3] which contributed to some positive correlation between the severity of COVID 19 and BMI, but some deeper mechanisms may exist.

Abdominal obesity is associated with impaired ventilation of the base of the lungs, resulting in reduced oxygen saturation of blood [13]. Furthermore, the abnormal secretion of adipokines and cytokines such as tumor necrosis factor-alpha and interferon characterize a chronic low-grade inflammation characteristic of abdominal obesity, which may impair immune response and have effects on the lung parenchyma and bronchi [11-13]. Altogether, it appears likely that obesity per se may be an independent risk factor for SARS-CoV-2 based on these literature. However our study did not find a significant difference between obese and non-obese individuals in terms of severity, outcome or mortality.

Both obesity and diabetes mellitus are proinflammatory states [11,12] and a hyper inflammatory state is seen in the pathogenesis of COVID 19. Hence, two pro inflammatory diseases, rather than one could probably increase the severity of the infection. However, we did not get a significant difference between the serum or blood levels of inflammatory markers CRP, ferritin, NLR between the obese and the non-obese group, also within the diabetic and hypertensive subgroup. Hence, other mechanisms could exist to explain our findings.

Kruglikov, et al. [10] have given a possible explanation of these findings in his review. It is now well established that SARS CoV 2 virus binds to ACE 2, enters the cell and downregulates ACE 2 expression. ACE 2 is the enzyme which cleaves angiotensin II to the inactive form angiotensin (1-7), the former being a potent pulmonary vasoconstrictor which can aggravate lung injury. Both obesity and diabetes mellitus are conditions associated with ACE 2 overexpression. Few pulmonary conditions including COPD, pulmonary hypertension and pulmonary embolism were less severe in obese individuals as compared with non-obese individuals. This has been called 'The Obesity Paradox' [10] and maybe due to the lower circulating levels of angiotensin 2 due to high ACE 2 expression. A similar discrepency has also been observed in Acute Lung Injury between diabetic and non-diabetic individuals. ACE 2 downregulation has been reported with both SARS and SARS CoV-2 viruses. This may explain the higher correlation of obesity with the disease severity and mortality in SARS and COVID 19 [10], as seen in most studies. The increased severity of COVID 19 in the diabetic obese is could be a sort of double hit causing increased viral uptake and high viral load but low ACE 2 and angiotensin II. ACE 2 upregulation is not a mechanism postulated in essential hypertension and hence maybe the reason why we did not get significant differences in severity between the hypertensive obese and hypertensive non-obese individuals.

Our study did not find a significant increase in mortality in the obese group as compared to the non-obese group, including within the subgroups of diabetes and hypertension. A study by Moriconi, et al. also found no significant increase in mortality in obese COVID patients as compared to non-obese patients.

Conclusion

Covid 19 pandemic is ardently being fought by the health care workers all over the country. Certain category of patients especially like obesity, diabetes, hypertension need to be taken special care to fight the illness. Patients with multiple co morbidities demand close monitoring and treatment to overcome the disease, even more than a patient with a single comorbidity. The combined prevalence of diabetes and obesity should always alert a physician to be more cautious. However, only very few clinical studies exist regarding the importance of obesity as a risk factor in COVID. We need further large scale clinical studies to further understand this area of COVID pathogenesis in a more clinical sense.

References

1. Dietz W, Santos BC (2020) Obesity and its Implications for COVID-19 Mortality. Obesity 28(6): 1005.

2. Kerkhove MDV, Vandemaele KAH, Shinde V, Giovanna JG, Artemis K, et al. (2011) Risk factors for severe outcomes following 2009 influenza A (H1N1) infection: a global pooled analysis. PLoS Med 8(7): e1001053.

3. Zhou F, Yu T, Du R, Fan G, Ying L, et al. (2020) Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 395(10229): 1054-1062.

4. Li Q, Guan X, Wu P, Xiaoye W, Lei Z, et al. (2020) Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med 382: 1199-1207.

5. Grasselli G, Zangrillo A, Zanella A, Massimo A, Luca C, et al. (2020) Baseline Characteristics and Outcomes of 1591 Patients Infected With SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy. JAMA 323(16): 1574-1581.

6. Arthur Simmonet High prevalence of Obesity in Severe Acute Respiratory Syndrome Coronavirus -2 (SARS CoV-2) Requiring Invasive Mechanical Ventilation. Obesity 28: 7.

7. Jennifer L, Michael P, Sarah H, Stephanie S, Diane J, et al. (2020) Obesity in Patients Younger Than 60 years is a Risk Factor for COVID–19 Hospital Admission. Clin Infect Dis 71(15): 896-897.

8. Richardson S, Hirsch JS, Narasimhan M, James MC, Thomas MG, et al. (2020) Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. JAMA 323(20): 2052-2059.

9. Moriconi D, Masi S, Rebelos E, Virdis A, Maria LM, et al. (2020) Obesity prolongs the hospital stay in patients affected by COVID-19, and may impact on SARS-COV-2 shedding. Obes Res Clin Pract 14(3): 205-209.

10. Kruglikov IL, Shah M, Scherer PE (2020) Obesity and diabetes as comorbidities for COVID-19: Underlying mechanisms and the role of viral-bacterial interactions. Elife 9: e61330.

11. Gleeson LE, Roche HM, Sheedy FJ (2021) Obesity, COVID-19 and innate immunometabolism. Br J Nutr 125(6): 628-632.

12. Huttunen R, Syrjänen J (2013) Obesity and the risk and outcome of infection. Int J Obes 37(3): 333-340.

13. Peters U, Dixon AE (2018) The effect of obesity on lung function. Expert Rev Respir Med 12(9): 755-767.

14. Qingxian C, Fengjuan C, Tao W, Fang L, Xiaohui L, et al. (2020) Obesity and COVID-19 Severity in a Designated Hospital in Shenzhen, China. Diabetes Care 43 (7): 1392-1398.

15. Pranata R, Lim MA, Yonas E, Vania E, Lukito AA, et al. (2021) Body mass index and outcome in patients with COVID-19: A dose–response meta-analysis, Diabetes Metab 47(2): 101178.

16. Yang, J, Jiahui H, Chunyan Z (2020) Obesity aggravates COVID-19: A systematic review and meta-analysis. Journal of medical virology 93(1): 257-261.