

## Supplementary Materials

### **Predictors of Hypoxemia and Related Adverse Outcomes in Patients Hospitalized With COVID-19: A Double-Center Retrospective Study**

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#### **Supplementary Results**

##### *Association between BSA versus BMI and oxygen saturation in hospitalized COVID-19 patients*

Morbid obesity has been shown to be an important risk factor for respiratory infections and for severe COVID-19 [1,2]. Although body surface area (BSA) has become a robust measure for indexing hemodynamic parameters, its prognostic value as compared to body mass index (BMI) in patients hospitalized with COVID-19 has not yet been studied. Therefore, we further sought to examine our hypothesis that BSA is positively correlated with COVID-19 severity as detected by low oxygen saturation levels in patients hospitalized with COVID-19. Moreover, we examined the differential associations of BSA compared with BMI in predicting low SpO<sub>2</sub>.

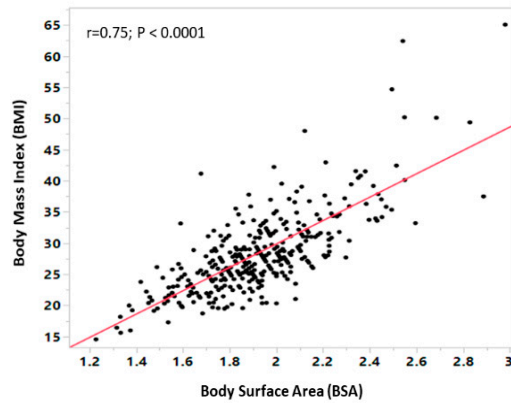
When analyzed as continuous variables, BSA strongly correlated with BMI as expected ( $r=0.75$ ;  $p<0.001$ ) (Figure S1). We found that both BSA and BMI significantly but weakly correlated with oxygen saturation levels ( $r=0.20$ ,  $p<0.0001$  and  $r=0.26$ ;  $p<0.0001$ , respectively) (Figure S2). Patients were then stratified by the median values of BSA (low;  $BSA<1.9$  and high;  $BSA\geq 1.9$ ) and BMI (low;  $BMI<27$  and high;  $BMI\geq 27$ ). Patients with high BSA showed significantly lower oxygen saturation (SpO<sub>2</sub>) as compared to those with low BSA values ( $92.1 \pm$

5.2 vs.  $94.0 \pm 3.8$ ;  $p < 0.001$ ) (Figure S3A). Similarly, patients with higher BMI had significantly lower SpO<sub>2</sub> compared with patients with low BMI ( $92.0 \pm 5.3$  vs.  $94.1 \pm 3.6$ ;  $p < 0.001$ ) (Figure S3B). Patients who presented with both high BSA and high BMI had the lowest oxygen saturation percentages ( $91.8\% \pm 3.5\%$ ,  $n=193$ ) when compared to patients with high BSA and low BMI ( $93.4\% \pm 4.2\%$ ,  $n= 52$ ) or high BMI with low BSA ( $92.8\% \pm 4.8\%$ ,  $n=53$ ), while those presented with both low BSA and low BMI had the highest SpO<sub>2</sub> values ( $94.2\% \pm 3.5\%$ ,  $n=194$ ) ( $p < 0.001$  by ANOVA). When comparing differences between these 4 subgroups, we found that patients admitted due to COVID-19 and had their BSA and BMI both elevated, had significantly lower oxygen saturation than those with both low BSA and BMI measurements ( $p < 0.001$  using Tukey's post hoc analysis), while no significant differences in SpO<sub>2</sub> were observed comparing other subgroups (Figure IV in Supplementary Materials).

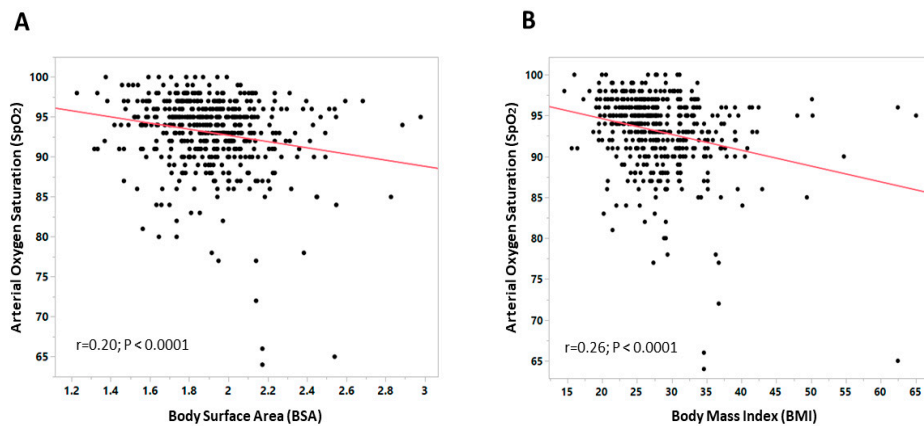
## References

1. Cai, Q.; Chen, F.; Wang, T.; Luo, F.; Liu, X.; Wu, Q.; He, Q.; Wang, Z.; Liu, Y.; Liu, L.; et al. Obesity and COVID-19 Severity in a Designated Hospital in Shenzhen, China. *Diabetes care* **2020**, *43*, 1392–1398.
2. Yang, J.; Hu, J.; Zhu, C. Obesity aggravates COVID-19: A systematic review and meta-analysis. *Journal of Medical Virology* **2021**, *93*, 257–261.

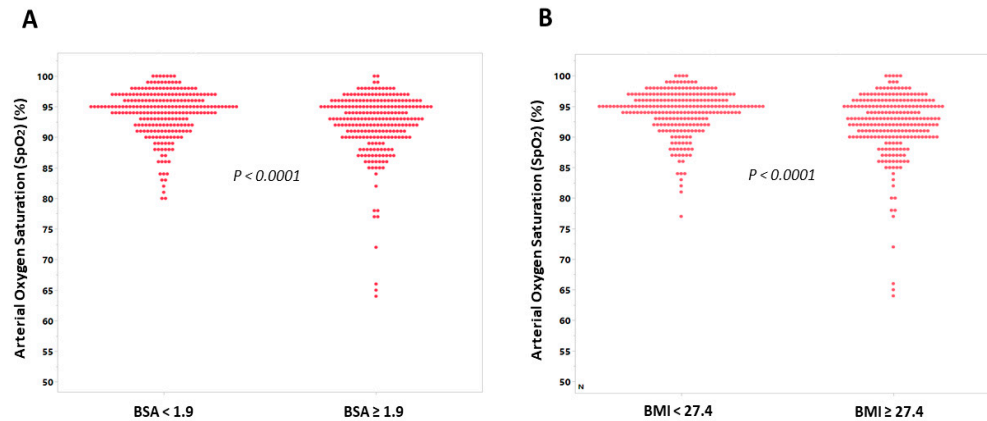
## Supplementary Figures



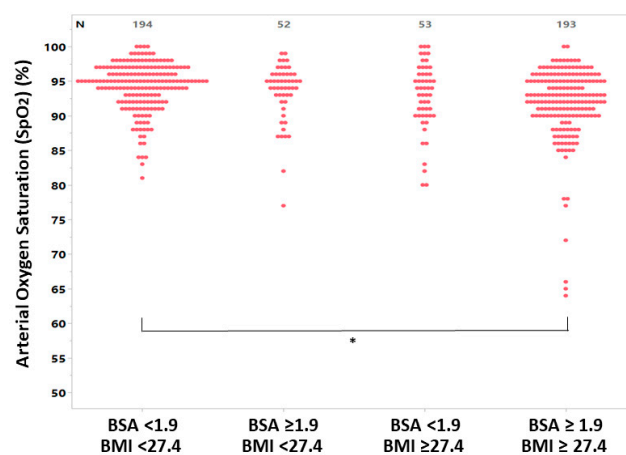
**Figure S1.** Correlation between BSA and BMI in hospitalized COVID-19 patients. BSA is presented in  $\text{m}^2$ , and BMI in  $\text{kg}/\text{m}^2$ . Pearson correlation coefficient;  $r=0.75$ ,  $p<0.0001$ ,  $N=492$ .



**Figure S2.** Correlations of BSA (A) and BMI (B) with oxygen saturation ( $\text{SpO}_2$ ).  $\text{SpO}_2$  is presented in percentages, BSA in  $\text{m}^2$ , and BMI in  $\text{kg}/\text{m}^2$ . Pearson correlation coefficient;  $r=0.20$ ,  $p<0.0001$  for BSA and  $r=0.26$  for BMI,  $p<0.0001$ ,  $N=492$ .

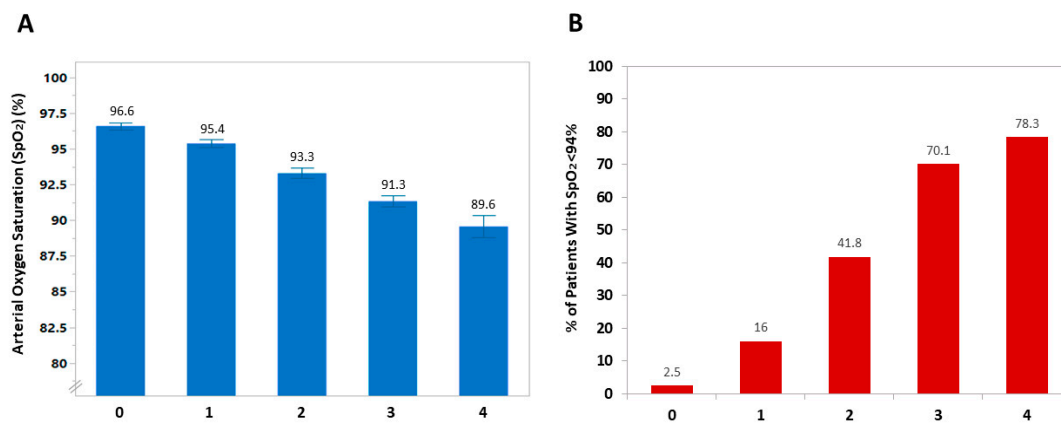


**Figure S3.** Association of body habitus with arterial oxygen saturation (SpO<sub>2</sub>) in hospitalized COVID-19 patients. **(A)** SpO<sub>2</sub> was significantly lower in patients with high BSA than those with low BSA (92.1%±5.2% vs. 94.0%±3.8%; n=492; p<0.0001). **(B)** SpO<sub>2</sub> was significantly lower in patients with high BMI than those with low BMI (92.0%±5.3% vs. 94.1%±3.6%; n=492; p<0.0001).



**Figure S4.** Differences in arterial oxygen saturation (SpO<sub>2</sub>) among hospitalized COVID-19 patients stratified according to their BSA and BMI measures. SpO<sub>2</sub> is presented in percentages.

The mean $\pm$ SD of SpO<sub>2</sub> was 94.2% $\pm$ 3.5% (n=194), 93.4% $\pm$ 4.2% (n=52), 92.8% $\pm$ 4.8% (n=53), and 91.8% $\pm$ 5.4% (n=193) for low BSA and BMI, high BSA and low BMI, low BSA and high BMI, and high BSA and BMI, respectively; p<0.0001 for the whole model by one-way ANOVA analysis. P<0.001 for subgroup analysis of SpO<sub>2</sub> in patients with high BSA and BMI vs. those with low BSA and BMI subgroups by Tukey's post hoc analysis.



**Figure S5.** (A) Arterial oxygen saturation (SpO<sub>2</sub>) according to the number of risk factors (age  $\geq$ 50 years, BSA  $\geq$ 1.9 m<sup>2</sup>, lymphocyte count <1,400 cells/ul, and CRP  $\geq$ 4 mg/dl) in each patient at the time of hospitalization with COVID-19. (B) The proportion of patients with SpO<sub>2</sub> <94% according to the number of these risk factors.