Association of higher body mass index (BMI) with severe coronavirus disease 2019

(COVID-19) in younger patients

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To the Editor:

The coronavirus disease 2019 (COVID-19) pandemic has resulted in significant strain on healthcare systems and intensive care unit (ICU) resources worldwide. Advanced age is a well-recognized risk factor for development of severe disease [1, 2], however the impact of obesity on disease severity has not been thoroughly explored. Obesity was associated with increased severity and mortality in pandemic H1N1 influenza and other respiratory viruses [3, 4].

Lighter and colleagues reported that obesity (defined as body mass index [BMI] ≥30) was significantly associated with increased admission to hospital and critical care [5]. Simonnet and colleagues found that severe obesity (BMI ≥35) was associated with increased requirement of mechanical ventilation [6]. However, there has been limited data on the impact of obesity in Asian populations. It is known that Asian populations have higher disease risks at lower BMI thresholds, possibly due to variations in fat distribution and lipid metabolism [7, 8]. We hypothesized that a lower BMI cut-off level would be associated with severe disease manifestations of COVID-19 in our multi-ethnic Asian population in Singapore.

We conducted a retrospective study of 182 patients with laboratory confirmed COVID-19 (by polymerase chain reaction assay) admitted to the National Centre for Infectious Diseases, Singapore. All patients gave written consent (approved by National Healthcare Group Domain Specific Review Board, Study Reference 2012/00917). Clinical data were collected from medical records by study investigators. 91 patients did not have either height or weight recorded and were excluded from analysis. Adverse outcomes analyzed were hypoxia requiring supplemental oxygen, ICU admission, mechanical ventilation, and mortality.

In the study population, 51 (56.0%) had BMI <25, 29 (31.9%) had BMI 25 – 30, 7 (7.7%) had BMI 30 – 35, and 4 (4.4%) had BMI >35. There were no significant differences in baseline characteristics or clinical outcomes between patients with BMI ≥25 and patients with BMI <25 when all age groups

were included (Table 1). However, similar to findings by Lighter and colleagues, a sub-group analysis of patients aged <60 years old found that BMI ≥25 was significantly associated with pneumonia on chest radiograph on admission (p-value = 0.017), requiring low-flow supplemental oxygen (OR 6.32, 95% CI 1.23 – 32.34) and mechanical ventilation (OR 1.16, 95% CI 1.00 – 1.34). BMI ≥25 was also associated with significantly higher serum lactate dehydrogenase levels (p-value = 0.011), which was associated with disease severity in COVID-19 [9].

These findings add to the growing literature highlighting obesity as a significant risk factor for the development of severe COVID-19, especially in younger patients aged <60 years old. It illustrates the importance of a lower BMI cut-off for risk stratification in Asian populations, similar to what is seen in other metabolic and cardiovascular diseases [7]. As the COVID-19 pandemic progresses, risk stratification for optimal resource allocation will be increasingly important, and this distinct risk group should be emphasized to avoid under-triaging and potentially adverse outcomes.

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Table 1. Clinical characteristics and outcomes of patients with BMI ≥25 and BMI <25, for all age groups and those aged <60 years old.

Characteristic	BMI ≥25	BMI <25	Odds ratio	p-value
All patients	**n=40**	**n=51**		
Demographics				
Age, years	51 (35 – 61)	58 (43 – 68)		0.087
Male gender	27 (67.5%)	24 (47.1%)		0.059
Weight, kg	80.2 (69.9 – 91.8)	57.6 (52.0 – 66.0)		<0.001
Height, m	1.67 (1.60 – 1.74)	1.63 (1.55 – 1.72)		0.246
BMI, kg/m^2	27.8 (25.9 – 30.3)	22.3 (21.4 – 23.5)		<0.001
Comorbidities				
Diabetes mellitus	7 (17.5%)	11 (21.6%)		0.792
Hypertension	15 (37.5%)	15 (29.4%)		0.502
Cardiovascular disease	5 (12.5%)	4 (7.8%)		0.499
Smoking	3 (7.9%)	1 (2.0%)		0.314
Charlson's score	0 (0 – 1)	0 (0 – 1)		0.742
Baseline investigations				
Pneumonia on chest radiograph	21 (52.5%)	17 (33.3%)		0.087
White blood count (x10^9/L)	5.05 (3.40 – 6.15)	5.40 (4.40 – 6.50)		0.224
Neutrophil count (x10^9/L)	3.18 (2.26 – 4.55)	3.69 (2.39 – 4.41)		0.401
Lymphocyte count (x10^9/L)	0.89 (0.76 – 1.34)	1.08 (0.74 – 1.42)		0.455
C-reactive protein (mg/L)	17.2 (4.4 – 72.1)	12.3 (5.5 – 49.1, n=48)		0.375
Lactate dehydrogenase (U/L)	575 (421 – 655)	474 (375 – 634, n=50)		0.094
Creatinine (umol/L)	83.5 (61 – 94)	69 (60 – 83)		0.084
Clinical outcomes				
Low flow supplemental oxygen [a]	18 (45.0%)	17 (33.3%)	1.64 (95% CI 0.70 – 3.84)	0.284
High flow supplemental oxygen [b]	9 (22.5%)	9 (18.0%)	1.32 (95% CI 0.47 – 3.72)	0.608
ICU admission	12 (30.0%)	15 (29.4%)	1.03 (95% CI 0.42 – 2.54)	1.000
Mechanical ventilation	8 (20.0%)	8 (15.7%)	1.34 (95% CI 0.46 – 3.96)	0.594
Mortality	1 (2.6%)	3 (6.1%)	0.40 (95% CI 0.04 – 4.04)	0.426
Characteristic	**BMI ≥25**	**BMI <25**	**Odds ratio**	**p-value**
Patients less than 60 years old	**n=29**	**n=26**		
Demographics				
Age, years	44 (30 – 52)	43 (27 – 52)		0.613
Male gender	21 (72.4%)	12 (46.2%)		0.058
Weight, kg	81.8 (72.1 – 92.9)	58.8 (52.8 – 67.3)		<0.001
Height, m	1.68 (1.61 – 1.75)	1.64 (1.56 – 1.72)		0.200
BMI, kg/m^2	27.8 (25.9 – 31.1)	22.4 (21.3 – 23.6)		<0.001

Comorbidities				
Diabetes mellitus	2 (6.9%)	2 (7.7%)		0.910
Hypertension	7 (24.1%)	3 (11.5%)		0.303
Cardiovascular disease	1 (3.4%)	0 (0.0%)		0.339
Smoking	2 (6.9%)	1 (3.8%)		0.337
Charlson's score	0 (0 – 0)	0 (0 – 0)		0.168
Baseline investigations				
Pneumonia on chest radiograph	12 (41.4%)	3 (11.5%)		**0.017**
White blood count (x10^9/L)	5.00 (3.40 – 6.10)	5.35 (4.15 – 6.40)		0.521
Neutrophil count (x10^9/L)	3.14 (2.39 – 4.50)	3.33 (2.17 – 4.38)		0.768
Lymphocyte count (x10^9/L)	0.90 (0.78 – 1.29)	1.15 (0.83 – 1.88)		0.197
C-reactive protein (mg/L)	10.7 (3.3 – 54.6)	7.9 (1.8 – 15.5)		0.199
Lactate dehydrogenase (U/L)	512 (406 – 652)	387 (353 – 547, n=25)		**0.011**
Creatinine (umol/L)	83.0 (60.0 – 94.0)	66.5 (58.8 – 79.8)		**0.026**
Clinical outcomes				
Low flow supplemental oxygen	10 (34.5%)	2 (7.7%)	6.32 (95% CI 1.23 – 32.34)	**0.022**
High flow supplemental oxygen	5 (17.2%)	1 (3.8%)	5.21 (95% CI 0.57 – 47.90)	0.197
ICU admission	6 (20.7%)	2 (7.7%)	3.13 (95% CI 0.57 – 17.13)	0.257
Mechanical ventilation	4 (13.8%)	0 (0.0%)	1.16 (95% CI 1.00 – 1.34)	**0.049**
Mortality	0 (0.0%)	0 (0.0%)	-	-

[a] Low flow supplemental oxygen was defined as oxygen flow of ≤5L/min
[b] High flow supplemental oxygen was defined as oxygen flow of ≥5L/min, or using a Venturi face mask or high-flow nasal cannula device.
Continuous variables are reported as median (interquartile range), and discrete variables are reported as number (percentage).
Comparison of discrete variables was with Fisher's exact test or chi-squared test as appropriate, and comparison of continuous variables was with Mann-Whitney U test. P-value of <0.05 was considered significant.