Obesity could shift severe COVID-19 disease to younger ages

Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 was first reported in China in late December, 2019, and has since evolved into a global pandemic. As of April 29, 2020, COVID-19 has been confirmed in more than 3 million individuals in 185 countries and regions, with an overall mortality rate of more than 6%.[1] Severe disease involves bilateral interstitial pneumonia requiring intensive care unit (ICU) ventilatory support and can evolve into adult respiratory distress syndrome with high mortality. The largest study of 1591 ICU patients from Italy reported a median age of 63 years, with only 203 patients (13%) younger than 51 years.[2] Common comorbidities are hypertension, cardiovascular disease, type 2 diabetes, and, more rarely (42 [4%] of 1043), obstructive pulmonary disease. Similar data have been reported from China.[3]

When the COVID-19 epidemic began in the USA, we anticipated a similar ICU population. News reports and communications from the US Federal Government had emphasised that COVID-19 was a particular problem for older people, and a resistance to social distancing and sheltering in place by younger people might have been informed by this idea. However, as the pandemic hit the Johns Hopkins Hospital in late March, 2020, younger patients began to be admitted to our ICU, many of whom were also obese. An informal survey of colleagues directing ICUs at other hospitals around the country yielded similar findings. At this time, news editorials were noting obesity as an underappreciated risk factor for COVID-19.[4] This risk is particularly relevant in the USA because the prevalence of obesity is around 40%, versus a prevalence of 6·2% in China, 20% in Italy, and 24% in Spain.[5]

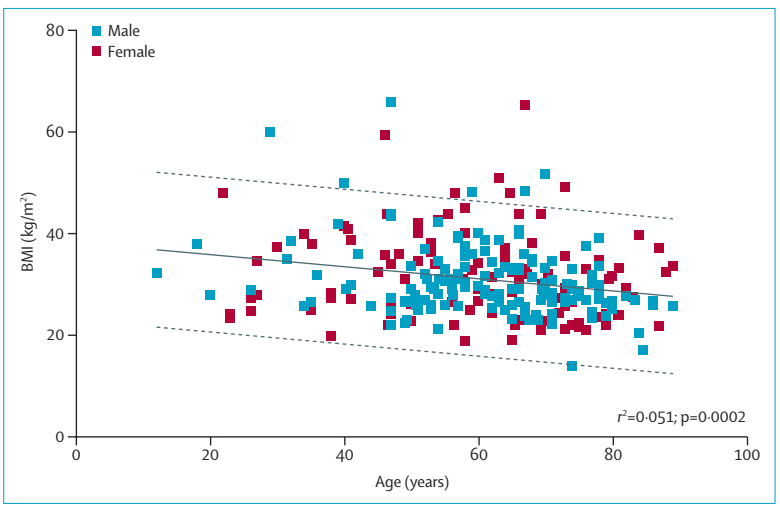

Figure: **Negative correlation between BMI and age in 265 patients with coronavirus disease 2019 in intensive care units in the USA**
BMI=body-mass index. The solid line is the least squares linear regression model fit. Dashed lines are 95% prediction bands.

With use of least squares univariate and multivariate linear regression, we examined the correlation between body-mass index (BMI) and age in patients with COVID-19 admitted to ICU at university hospitals at Johns Hopkins, University of Cincinnati, New York University, University of Washington, Florida Health, and University of Pennsylvania (appendix). Acquisition of the de-identified data for this analysis was approved by the Johns Hopkins University Institutional Review Board.

In our dataset of 265 patients (58% male patients), we found a significant inverse correlation between age and BMI, in which younger individuals admitted to hospital were more likely to be obese (figure). There was no difference by sex (p=0·9). The median BMI was 29·3 kg/m², with only 25% of individuals having a BMI of less than 26 kg/m², and 25% exceeding a BMI of 34·7 kg/m².

Obesity can restrict ventilation by impeding diaphragm excursion, impairs immune responses to viral infection,[6] is pro-inflammatory, and induces diabetes and oxidant stress to adversely affect cardiovascular function.[7] We conclude that in populations with a high prevalence of obesity, COVID-19 will affect younger populations more than previously reported. Public messaging to younger adults, reducing the threshold for virus testing in obese individuals, and maintaining greater vigilance for this at-risk population should reduce the prevalence of severe COVID-19 disease.

We thank John Wells, Judith Hochman, Yindalon Aphinyanaphongs, Barry J Byrne, Carmen Leon-Astudillo, Ali Ataya, Kenneth B Margulies, Srinivas Denduluri, Deeptankar DeMazumder, and Kevin D O'Brien for sharing de-identified data for the analysis in this Correspondence. The authors declare no competing interests.

*David A Kass, Priya Duggal, Oscar Cingolani
dkass@jhmi.edu

Johns Hopkins University School of Medicine (DAK, OC) and The Bloomberg School of Public Health (PD), Johns Hopkins University, Baltimore, MD 21205, USA

1 Johns Hopkins University. COVID-19 dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). 2020. https://coronavirus.jhu.edu/map.html (accessed April 29, 2020).
2 Grasselli G, Zangrillo A, Zanella A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. *JAMA* 2020; published online April 6. DOI:10.1001/jama.2020.5394.
3 Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020; **395:** 1054–62.
4 Ludwig DS, Malley R. Americans are already too diseased to go back to work right now. March 30, 2020. https://www.nytimes.com/2020/03/30/opinion/obesity-us-health-coronavirus.html (accessed April 7, 2020).

Published **Online**
April 30, 2020
https://doi.org/10.1016/S0140-6736(20)31024-2

See **Online** for appendix

Submissions should be made via our electronic submission system at http://ees.elsevier.com/thelancet/

5 WHO. Global Health Obsevatory (GHO) data: overweight and obesity. 2017. https://www.who.int/gho/ncd/risk_factors/overweight_obesity/obesity_adults/en (accessed April 29, 2020).

6 Honce R, Schultz-Cherry S. Impact of obesity on influenza A virus pathogenesis, immune response, and evolution. *Front Immunol* 2019; **10:** 1071.

7 GBD 2015 Obesity Collaborators, Afshin A, Forouzanfar MH, et al. Health effects of overweight and obesity in 195 countries over 25 years. *N Engl J Med* 2017; **377:** 13–27.