Obesity in Coronavirus disease

Hubert Galant, Wojciech Timler

Definition

- **Coronavirus disease 2019** (COVID-19) is a contagious respiratory and vascular disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Common symptoms of COVID-19 include fever, cough, fatigue, breathing difficulties, and loss of smell and taste. [9]

- **Obesity** is a medical condition in which excess body fat has accumulated to an extent that it may have a negative effect on health. People are generally considered obese when their body mass index (BMI), a measurement obtained by dividing a person's weight by the square of the person's height is over 30 kg/m^2; the range 25-30 kg/m^2 is defined as overweight. Obesity is correlated with various diseases and conditions, particularly cardiovascular diseases, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis. High BMI is a marker of risk, but not proven to be a direct cause, for diseases caused by diet, physical activity, and environmental factors. [10]

Epidemiology

- The WHO points obesity as a global epidemic, estimating that in 2016 more than 650 million people over aged 18 years were obese worldwide. Since obesity is a risk factor for several diseases, including infectious ones, these data become even more alarming. The bodies of obese patients are in constant chronic inflammation, due to the high concentrations of chemokines, adipokines and pro-inflammatory cytokines. This chronic inflammation causes a delayed and inferior immune response, with decreased activation of macrophages in infection course. In addition, the immune memory of obese individuals is also impaired, both humoral and cellular, weakening both adaptive response of immune system to disease and immunization of these patients. [3]

- In view of alarming number of cases **in countries like the U.S., where it is estimated that around 36% of population is obese, and in Europe, where, according to the most recent WHO estimates, obesity affects 10%–30% of the population**, obesity represents a serious problem when related to COVID-19. [3]

- **Metabolic syndrome is a risk factor that influences COVID-19 progression and prognosis.** The prevalence of obese, diabetic, hypertensive or liver damage patients with severe cases of COVID-19, in multiple countries, demonstrates the importance of the care with this risk group, in prophylaxis, monitoring and treatment. [3]

- Pooled analysis show **individuals with obesity were more at risk for COVID-19 positive, >46.0% higher** (OR = 1.46; 95% CI,1.30–1.65;$p < 0.0001$); for hospitalization, 113% higher (OR = 2.13; 95% CI,1.74–2.60;$p < 0.0001$); for ICU admission, 74% higher (OR = 1.74; 95% CI,1.46–2.08); and for mortality, 48% increase in deaths (OR = 1.48; 95% CI, 1.22–1.80;$p < 0.001$). [8]

Morbidity

- A study carried out in New York City (NYC), U.S., showed that among the 3615 patients who tested positive for COVID-19, **21% had obesity and 16% of total had a body mass index (BMI) > 35 kg/m²** (severe obesity). Being much more likely to develop the most severe forms of the disease, these patients had a greater need for hospitalization and care in the intensive care unit (ICU). [3]

- In another study also in NYC that followed 4103 patients with COVID-19, of which 1999 (48.9%) were hospitalized, it was observed **that individuals with BMI > 40 kg/m² were six times more likely to be hospitalized**. [3]

Course of illness

- According to our meta-analysis and systematic review, patients with higher BMI have a greater risk for ICU admission and especially for Invasive Mechanical Ventillation in all comparisons. The association between obesity and poor clinical outcomes is certainly multifactorial since obesity itself is widely associated with several prognostic factors. In COVID-19 patients, **hypertension, diabetes and cardiovascular problems are the most common comorbidities that may share similar pathways with obesity related to the renin-angiotensin system** (RAS). Obesity modulates the RAS activity, which can lead to pathological processes in COVID-19. [2]

- **Age, male sex, BMI $\geq$ 35 kg/m² and current or prior smoking were significant predictors for increasing oxygenation requirements in the multivariate analysis, while male sex, age and BMI $\geq$ 35 kg/m² were significant predictors in the multivariate analysis for the outcome of intubation.** [5]

- In a retrospective study using a nationwide health checkup database which was linked to the Korea Centers for Disease Control and Prevention (KCDC) COVID-19 patient registry, dedicated to collecting information on all confirmed cases in Korea, **high FPG levels and low eGFR were significantly associated with the risk of severe COVID-19 (including fatal disease) among women and patients aged < 70 years**. High BMI was associated with severe illness among women. These findings suggest that the baseline metabolic characteristics exert differential sex and age-related effects on disease severity among patients diagnosed with COVID-19. [7]
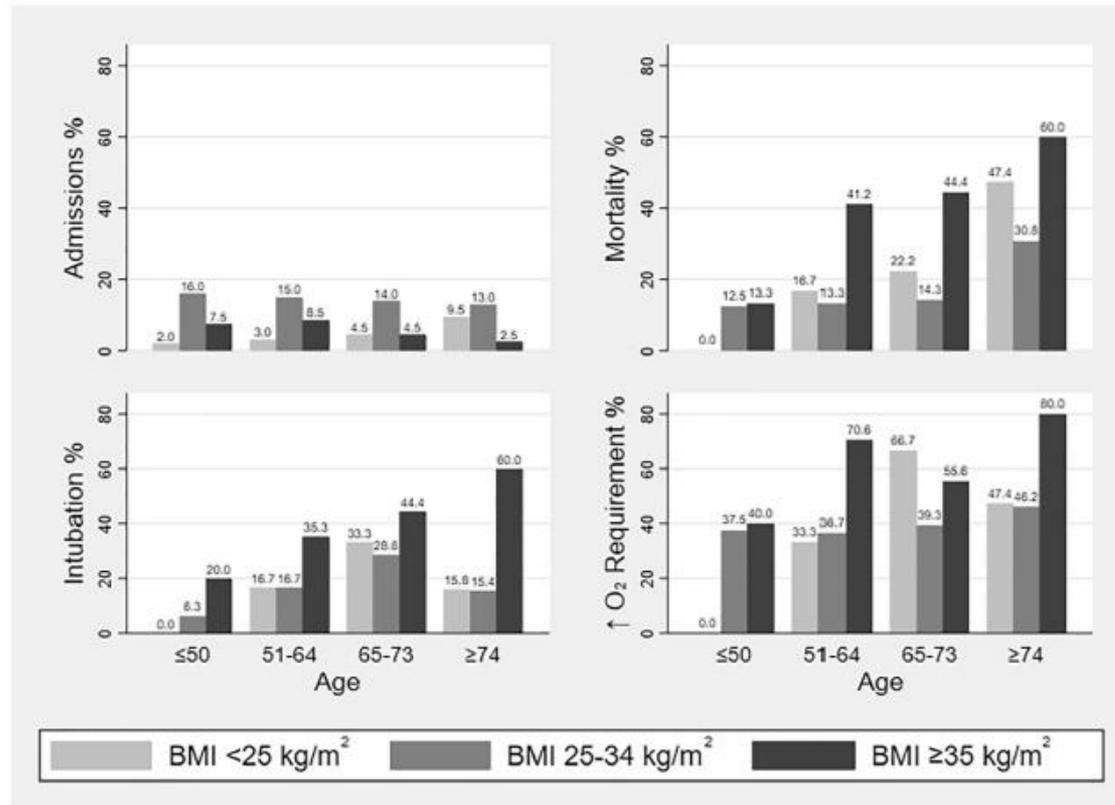
In-hospital outcomes per age group and BMI

Fig. 1. Study population, in-hospital mortality and secondary outcomes per age group (≤50, 51–64, 65–73, and ≥74 years) and body mass index (BMI <25, 25–34, and ≥35 kg/m²).

[5]

Mortality

- Obesity is independently associated with adverse outcomes in COVID-19 patients when controlled for age, gender, hypertension, diabetes, and qSOFA score. Both groups with **an elevated BMI showed an increased probability for mortality and intubation compared to the patients with normal BMI**. [4]

- Obesity was only associated with increased mortality in studies with fewer chronic or critical patients . When body mass index (BMI) was examined as a continuous variable, risk of death decreased as BMI increased in studies with a mean age of the patients of >60 years. [1]

- In a retrospective study of 112 patients with COVID-19 conducted at a hospital in Wuhan city, the BMI of patients in critical group (BMI > 25 kg/m^2) was significantly higher than the non-critical group, and of 17 patients who died, 15 (88.2%) had a BMI > 25 kg/m^2 [3]

- In retrospectively analyzed data of patients with COVID-19 hospitalized to a large academic hospital system in New York City, for the younger population, **BMI ≥ 40 was independently associated with mortality for the older population, BMI ≥ 40 was also independently associated with mortality to a lesser extent**. This study demonstrates that hospitalized patients younger than 50 with severe obesity are more likely to die of COVID-19. [6]

Bibliography

1. Predictors of in-hospital COVID-19 mortality: A comprehensive systematic review and meta-analysis exploring differences by age, sex and health conditions (*Mesas AE et al.*)
2. Obesity is a risk factor for developing critical condition in COVID-19 patients: A systematic review and meta-analysis (*Földi M et al.*)
3. Metabolic syndrome and COVID-19: An update on the associated comorbidities and proposed therapies (*Costa FF et al.*)
4. The impact of obesity on COVID-19 complications: a retrospective cohort study (*Nakeshbandi M et al.*)
5. Severe obesity, increasing age and male sex are independently associated with worse in-hospital outcomes, and higher in-hospital mortality, in a cohort of patients with COVID-19 in the Bronx, New York (*Palaiodimos L et al.*)
6. Severe Obesity as an Independent Risk Factor for COVID-19 Mortality in Hospitalized Patients Younger than 50 (*Klang E et al.*)
7. Impact of obesity, fasting plasma glucose level, blood pressure, and renal function on the severity of COVID-19: A matter of sexual dimorphism? (*Huh K et al.*)
8. Individuals with obesity and COVID-19: A global perspectiveon the epidemiology and biological relationships (*Popkin BM et al.*)
9. https://en.wikipedia.org/wiki/Coronavirus_disease_2019
10. https://en.wikipedia.org/wiki/Obesity