

This report focusses on **COVID-19 and its association with Diabetes and Obesity:**

Diabetes:

The emergence of the 2019 novel coronavirus (COVID-19), has now evolved into a worldwide crisis and was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020 ([WHO](#)). An early observational study in Wuhan, found that individuals with type 2 diabetes had a high prevalence of chronic illness and 22% did not survive the infection ([Yang et al. 2020](#)), this trend has also followed in other countries ([Wan et al. 2020](#); [Richardson et al. 2020](#); [Bode et al. 2020](#)), including in England ([Barron et al. 2020](#)). A report, in a cohort of 7,336 COVID-19 patients, showed that type 2 diabetes correlates with worst outcome for COVID-19 ([Zhu et al. 2020](#)). It has been previously shown that diabetic patients have already been linked to increased susceptibility in a broad range of infections ([Muller et al. 2005](#)), including other coronaviruses such as MERS ([Alqahtani et al. 2019](#)).

A study found that diabetes was associated with increased lung angiotensin-converting enzyme 2 (ACE2) expression and could be a link ([Rao et al. Preprint](#)), as clearance of SARS-COV-2 was delayed in patients with diabetes ([Chen et al. Preprint](#)). Angiotensin-converting enzyme inhibitors (ACEi) and angiotensin- receptor blockers (ARBs), are used widely in people who are diabetic and have been questioned that it could be a connecting link with COVID-19 ([Fang et al. 2020](#)). ACEi blockers leads to upregulation of ACE-2, a type 1 integral membrane glycoprotein that is constitutively expressed in the lungs, heart, intestine, kidney and vascular endothelium ([Wang et al. 2020](#)).The ACE-2 receptor is a link for viral entry of SARS-COV and is now being associated with COVID-19 ([Gheblawi et al. 2020](#)). Clinical trials are now undergoing assessing the use of ACE-2 blockers ([ClinicalTrials.gov Identifier: NCT04318418](#)). Several cardiology associations released a statement for patients to continue with their medication. Furthermore, one study found that among 112 patients, despite COVID-19 combined with CVD are associated with a higher risk of mortality, ACEi and ARB use did not affect the morbidity and mortality of COVID-19 combined with CVD ([Peng et al. 2020](#)), also supported by others ([Rico-Mesa et al. 2020](#); [Mehra et al. 2020](#)).

Insulin is a safe choice under most circumstances and remains the sole therapy for people with type 1 diabetes and can be considered as a superior alternative in people with type 2 diabetes since having poor glycaemic control can be considered a direct link to severe outcomes in COVID-19 ([Bode et al. 2020](#); [Muniyappa & Gubbi, 2020](#)). Additionally, there is no association with increased ACE-2 receptor and insulin, suggesting diabetic patients should maintain good blood glucose control by using insulin ([Rico-Mesa et al. 2020](#)). Use of antiviral therapy (kaletra and intergeron) as well as antibacterial therapy and corticosteroids have

showed promising findings ([Wan et al. 2020](#)). In a case report of a young diabetic patient who presented with ground-glass opacities and consolidations in bilateral lungs, and COVID-19 symptoms of cough and high fever, he received antiviral agents and antibiotics. All abnormal laboratory data gradually improved or became unremarkable and he finally recovered and was discharged from the hospital on the 15th day after admission ([Han et al. 2020](#)). Chloroquine and hydroxychloroquine in the treatment of COVID-19 has shown promising findings in a very small study ([Gautret et al. 2020](#)) and their potential use in India ([Singh et al. 2020](#)) but recent evidence has shown no benefit and its use is actually associated with decreased in-hospital survival and an increased frequency of ventricular arrhythmias when used for treatment of COVID-19 ([Mehra et al. 2020](#)).

In conclusion, whilst a vaccine is still under investigation, some medication treatments may be considered for diabetic patients, however there is no sole treatment as of yet. Practical recommendations for patients with COVID-19 taking medication for management of diabetes has been published ([Bornstein et al. 2020](#)).

Obesity:

Patients aged <60 years have been generally considered a lower risk group of COVID-19 disease severity. However, obesity appears to be an unrecognized risk factor for hospital admission and need for critical care. Patients aged <60 years with a BMI between 30-34 were more likely to be admitted to acute and critical care, compared to individuals with a BMI <30 ([Lighter et al. 2020](#)). A study in the UK's Intensive Care National Audit and Research Centre has now been released, indicating that two-thirds of people who have developed serious or fatal COVID-19-related complications were overweight or obese. The report includes data from all COVID-19 admissions in intensive care units in the UK until midnight, March 19, 2020. The study shows that almost 72% of those in critical care units had either overweight or obesity, suggesting the impact of obesity in seriously ill COVID-19 patients (<https://www.icnarc.org/About/Latest-News>) ([Malavazos et al. 2020](#)). This has also been a trend in other countries ([Simonnet et al. 2020](#)).

Obesity and excess fat mass have been linked to impairment in insulin resistance, reduced beta cell function and systemic low-grade inflammation. This puts an obese individual at higher risk of cardiovascular diseases such as hypertension, diabetes, coronary heart disease, stroke, atrial fibrillation, renal disease and heart failure which are already known risk factors for increased severity in COVID-19 patients ([Sattar et al. 2020](#); [Van Gaal et al. 2006](#); [Clerkin et al. 2020](#); [Golay & Ybarra, 2005](#)).

Obese and obese-diabetic subjects have an alteration at different steps of the innate and adaptive immune response, characterized by a state of chronic and low-grade inflammation. This pathway contributes to systemic metabolic dysfunction that is associated with obesity-linked disorders. Adipose tissue is generally 'pro-inflammatory' due to its increased expression of cytokines and adipokines and dysregulated leukocyte expression, which is could be why obese subjects have prolonged virus time than non – obese subjects ([Luzi & Radaelli, 2020](#)). Therefore, overexpression of inflammatory adipokines from visceral fat can affect the immune response and play a role in the 'cytokine storm', where an excessive inflammatory and immune response, especially in the lungs, can lead to acute respiratory distress syndrome (ARDS). Indeed, the pro-inflammatory state accompanying obesity potentially predisposes patients to lung injury ([Wang, 2014](#)). It has been postulated that a potential contributor to the high morbidity from COVID-19 amongst obese patients might be the high prevalence of undiagnosed obstructive sleep apnoea (OSA). It could be that pro-inflammatory processes in the lungs of OSA patients might be further worsen by repeated airway obstruction during the disease process ([Memtsoudis et al. 2020](#)).

Emerging evidence indicates that there are potential benefits when managing the cytokine storm in COVID-19 patients by administering steroids, IL-6/IL-6-receptor (IL-6R) blocking antibodies, TNF inhibitors, IL-1 antagonists and Janus kinase inhibitor (JAK) inhibitors ([McCreary & Pogue, 2020](#); [Stebbing et al. 2020](#); [Mehta et al. 2020](#); [Wu & Yang, 2020](#); [Sanders et al. 2020](#)). A study with 21 patients with severe COVID-19 symptoms when medicated with an acute dose of tocilizumab (400mg) was associated with 91% clinical improvement, as measured by improved respiratory function and successful discharge ([Xu et al. 2020](#)). However, larger trials are now required with specific investigation targeting pharmacological treatment for Obese patients.

Non-pharmacological treatment such as regular bouts of short-lasting (i.e. up to 45 minutes) moderate intensity exercise is beneficial for host immune defence, particularly in older adults and people with chronic diseases ([Simpson et al. 2020](#)). Considering that old age, is one of the strongest risk factors for mortality of COVID19 ([Zhou et al. 2020](#)), several studies indicate that maintaining physical activity has immune benefits in older adults, for example, it reduces the systemic inflammation (immunosenescence) associated with chronic age-related diseases. Therefore, physical activity can prevent or ameliorate age-related multi-morbidity by boosting immune function ([Duggal et al. 2019](#)).

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