The following information resources have been selected by the National Health Library and Knowledge Service Evidence Virtual Team in response to your question. The resources are listed in our estimated order of relevance to practicing healthcare professionals confronted with this scenario in an Irish context. In respect of the evolving global situation and rapidly changing evidence base, it is advised to use hyperlinked sources in this document to ensure that the information you are disseminating to the public or applying in clinical practice is the most current, valid and accurate. For further information on the methodology used in the compilation of this document—including a complete list of sources consulted—please see our National Health Library and Knowledge Service Summary of Evidence Protocol.

YOUR QUESTIONS

What is the risk of a person with obesity contracting COVID-19 compared to someone without obesity? What is the risk of a person with obesity developing severe illness from COVID-19? How is severe illness defined for people with COVID-19 who are obese? Do people with obesity have a higher mortality from COVID-19? How does obesity affect children with COVID-19? Rehabilitation post-COVID-19 for obese patients?

IN A NUTSHELL

Specific risks associated with obesity and COVID-19

Obesity is a medical condition with complex pathophysiology which is a significant risk factor for increased prevalence, morbidity, and mortality in the context of COVID-19[11]. According to the US CDC, severe obesity is associated with multiple serious chronic diseases and underlying health conditions that can increase the risk of severe illness from COVID-19[3]. Severe COVID-19 infection can be defined as tachypnoea of ≥30 breaths per minute, oxygen saturation ≤93% at rest, or PaO2/FiO2 ratio <300 mm Hg. Critical infection involves respiratory failure requiring mechanical ventilation, septic shock, or other organ dysfunction or failure requiring intensive care[9]. International literature includes various studies looking at the vulnerability of people with obesity. Obese individuals show diminished protection from influenza immunization: despite vaccination, obese recipients are 2–3 times more prone to infection compared to non-obese[15]. Simonnett et al and Kalligeros et al report a high frequency of obesity among patients admitted to intensive care for SARS-CoV-2, showing an increase in disease severity with increased BMI[18], [19]. The Intensive Care National Audit and Research Centre, UK reports a correlation between patients with COVID-19 receiving advanced respiratory support and BMI between 30-40+[49].

Obesity in Metabolic Associated Fatty Liver Disease was associated with a ~6-fold increased risk of severe COVID-19 illness[12]. Watanabe et al and other groups hypothesise that obesity could predispose to serious COVID-19 complications through several mechanisms: immune dysregulation, reduced cardiorespiratory reserve, systemic chronic inflammation, endothelial dysfunction, related comorbidities such as diabetes, increased complement system activation, and IL-6 secretion[22]. Mortality in patients with COVID-19 and obesity is also reviewed. Severe obesity is associated with higher in-hospital mortality even after adjusting for confounding factors in an early cohort of hospitalized patients in New York[16]. An Italian study links obesity as a risk factor for higher mortality in patients with COVID-19[26]. A Mexican study to devise a clinical score to predict COVID-19 mortality found that "obesity mediates 45.5% of the effect of diabetes on COVID-19 lethality"[24].

Paediatric obesity and COVID-19

A small amount of literature is currently available regarding the impact of COVID-19 in children, but BMI/weight/obesity has not always been recorded. The CDC Information for Pediatric Health Care Providers mentions obesity as an underlying health condition and a recent CDC Weekly Surveillance Summary notes obesity as an underlying condition in children hospitalised with COVID-19[4, 5].

In their review of 46 Paediatric Intensive Care Units, Shekerdemian et al include obesity as a notable comorbidity and Chao et al in their study of 67 children found that obesity and asthma were highly prevalent[55, 57]. Pending further studies, children and young people with comorbidities similar to adults, i.e. heart disease, obesity, cerebrovascular disease, should be considered high risk[55 57]. Woo Baidal et al mentions obesity related to COVID-19 mortality and reviews approaches to reduce obesity including telehealth/digital technology for a paediatric weight management collaborative[60].

Post-COVID-19 rehabilitation in obese patients

There is consensus that a specialised rehab programme is paramount to cater for the wide and varied patients needing rehabilitation post-COVID-19. Zhao et al state that "the respiratory rehabilitation team should customize a respiratory rehabilitation plan based on the unique problems of each patient"[63]. Similarily, Brugliera et al discuss "the need for a multidisciplinary rehabilitative approach, especially for those patients with serious COVID-19

illness, advanced age, obesity, multiple chronic diseases, and organ failure"[65]. Sheehy et al point to the necessity of an individualised, focused patient rehabilitation programme whilst Vittaca et al highlight the fact that "regardless of the type of intervention, the intensity, timing and modality must be tailored to the individual patient's needs, in particular for those with severe/critical illness, elderly patients, obesity, comorbidity and other complications [69, 68].

IRISH AND INTERNATIONAL GUIDANCE

What does the Health Protection Surveillance Centre (Ireland) say?

Underlying conditions in confirmed cases of COVID-19 in Ireland[1]

As part of the public health follow-up of confirmed cases of COVID-19, information is routinely collected on whether a case has the following medical conditions:

- chronic heart disease
- chronic neurological disease
- chronic respiratory disease
- chronic kidney disease
- chronic liver disease
- asthma requiring medication
- immunodeficiency
- diabetes
- BMI ≥ 40
- cancer/malignancy

Information is available on underlying medical conditions for 17,135 confirmed cases of COVID-19 for notifications up to and including 20/05/2020. BMI >=40 is recorded for all cases in hospital (4.1%), community (1.0%) and ICU (16.6%).

European Association for the Study of Obesity

Position Statement on the Global COVID-19 Pandemic[2]

People with obesity have an elevated risk of hospitalization, serious illness and mortality, likely due to chronic low-grade inflammation, an altered immune response to infection, as well as related cardiometabolic comorbidities and the COVID-19 pandemic is likely to have a significant impact.

There is emerging evidence that obesity is associated with significantly higher intensive care unit resource utilization and that critically ill patients with obesity who also have malnutrition experience worse outcomes than patients with obesity without malnutrition. Emerging data demonstrate that people with obesity may also experience more severe COVID-19 symptoms and be more likely to need complex intensive care treatment. A retrospective cohort study conducted in France found that patients with severe obesity

(body mass index [BMI] >40 kg/m^2) who contracted COVID-19 were more likely to need invasive mechanical ventilation, independent of age, hypertension, and diabetes.

What do the Centers for Disease Control and Prevention (United States) say?

Groups at Higher Risk for Severe Illness – Severe Obesity[3]

Severe obesity increases the risk of a serious breathing problem called acute respiratory distress syndrome (ARDS), which is a major complication of COVID-19 and can cause difficulties with a doctor's ability to provide respiratory support for seriously ill patients. People living with severe obesity can have multiple serious chronic diseases and underlying health conditions that can increase the risk of severe illness.

CDC Information for Pediatric Healthcare Providers[4]

People of all ages, including children and adolescents with certain underlying medical conditions might be at higher risk for severe illness from COVID-19. Underlying medical conditions include:

- chronic lung disease
- moderate to severe asthma
- serious heart conditions such as congenital heart defects
- immunocompromised conditions
- severe obesity: body mass index [BMI]≥40
- diabetes
- chronic kidney disease on dialysis
- liver disease

CDC (2020) COVID View: A Weekly Surveillance Summary of U.S. COVID-19 Activity (week ending 9th May[5]

Among COVID-19 laboratory confirmed hospitalisations, obesity was an underlying condition for 58.3% of cases among children.

POINT-OF-CARE TOOLS

What does BMJ Best Practice say?

Coronavirus disease 2019 (COVID-19)[6]

Obesity is a common risk factor for severe disease and intensive care admission. Data from 5700 hospitalised patients in New York found that 42% of patients had obesity and this may be a risk factor for respiratory failure leading to invasive mechanical ventilation. It is thought that obesity may be a significant risk factor for the development of severe COVID-19, even in younger people <60years of age.

What does UpToDate say?

Coronavirus disease 2019 (COVID-19): Considerations in children[7]

Potential risk factors for severe disease — Infants <1 year of age and children with certain serious underlying conditions. The most common underlying conditions were medical complexity, defined as dependence on technological support in association with developmental delay and/or genetic anomalies. Other medical conditions that may increase the risk of severe disease in children based on data from adults include:

- chronic kidney disease undergoing dialysis
- chronic liver disease
- endocrine disorders
- severe obesity: body mass index ≥120 percent of the 95th percentile values

What does Dynamed say?

COVID-19 and Pediatric Patients[8]

Possible risk factors include:

- immunocompromising conditions such as ongoing treatment for cancer
- serious heart conditions including congenital heart defects
- chronic lung disease
- moderate-to-severe asthma
- severe obesity: body mass index ≥ 40 kg/m2

INTERNATIONAL LITERATURE

What does the international literature say?

Verity, R et al (30 March 2020) Estimates of the Severity of Coronavirus Disease 2019: A Model-Based Analysis[9]

Clinical studies of hospitalised patients have shown that, at onset of COVID-19, patients frequently show symptoms associated with viral pneumonia, most commonly fever, cough, sore throat, myalgia, and fatigue. The case definition adopted in China and elsewhere includes further stratification of cases as severe (defined as tachypnoea [≥30 breaths per min], oxygen saturation ≤93% at rest, or PaO_2/FiO_2 ratio <300 mm Hg) and critical (respiratory failure requiring mechanical ventilation, septic shock, or other organ dysfunction or failure that requires intensive care). According to the report from the WHO–China Joint Mission on COVID-19, 80% of the 55 924 patients with laboratory-confirmed COVID-19 in China to Feb 20, 2020, had mild-to-moderate disease, including both non-pneumonia and pneumonia cases, while 13·8% developed severe disease and 6·1% developed to a critical stage requiring intensive care. In a study of clinical progression in 1099 patients, those at highest risk for severe disease and death included people over the age of 60 years and those with underlying conditions, including hypertension, diabetes, cardiovascular disease, chronic respiratory disease, and cancer.

BUTLER et al (18 April 2020) The Impact of Nutrition on COVID-19 Susceptibility and Long-Term Consequences[10]

The high rate of consumption of diets high in saturated fats, sugars, and refined carbohydrates, collectively called Western diet (WD) worldwide, contribute to the prevalence of obesity and type 2 diabetes, and could place these populations at an increased risk for severe COVID-19 pathology and mortality. WD consumption activates the innate immune system and impairs adaptive immunity, leading to chronic inflammation and impaired host defense against viruses. Furthermore, peripheral inflammation caused by COVID-19 may have long-term consequences in those that recover, leading to chronic medical conditions such as dementia and neurodegenerative

disease, likely through neuroinflammatory mechanisms that can be compounded by an unhealthy diet.

PETRAKIS et al (5 May 2020) [Review] Obesity - a risk factor for increased COVID-19 prevalence, severity and lethality[11]

The authors review obesity and COVID-19 with specific consideration of:

- metabolic links
- obesity and age
- obesity and inflammation
- obesity and immune response
- lipotoxicity and obesity
- pregnancy obesity and COVID-19

Novel data from a single centre retrospective study confirmed that obesity had a high frequency among patients admitted in intensive care for SARS-CoV-2 requiring invasive mechanical ventilation and that disease severity increased with BMI. Indeed, a very recent report on a large sample of patients younger than 60 years tested positive for COVID-19, correlated higher BMIs values with increased probability for admission. Pregnancy-associated obesity needs to be studied further in connection to COVID-19 as this infection could pose high risk both to pregnant women and the foetus.

ZHENG et al (19 April 2020) Obesity as a Risk Factor for Greater Severity of COVID-19 in Patients with Metabolic Associated Fatty Liver Disease[12]

In a review of 214 patients with laboratory confirmed COVID-19 aged 18-75 in three hospitals in Wenzhou China, the presence of obesity in MAFLD patients was associated with a ~6-fold increased risk of severe COVID-19 illness. Notably, this association with obesity and COVID-19 severity remained significant even after adjusting for age, sex, smoking, diabetes, hypertension, and dyslipidaemia.

SATTAR et al (22 April 2020) Obesity a Risk Factor for Severe COVID-19 Infection: Multiple Potential Mechanisms[13]

Obesity or excess ectopic fat deposition may be a unifying risk factor for severe COVID-19 infection, reducing both protective cardiorespiratory reserve as well as potentiating the immune dysregulation that appears, at least in part, to mediate the progression to critical illness and organ failure in a proportion of COVID-19 patients. Whether obesity is an independent risk

factor for susceptibility to infection requires further research. Mechanistic understanding of the relationship between obesity and COVID-19 may suggest therapeutic interventions [eg proven weight loss drugs, low calorie diets] to potentially reduce the risk of developing severe COVID-19 illness. Indeed, this pandemic has highlighted that more, not less, must be done to tackle and prevent obesity in our societies for the prevention of chronic disease and greater adverse reactions to viral pandemics.

ONG et al (8 May 2020) Association of Higher Body Mass Index (BMI) With Severe Coronavirus Disease 2019 (COVID-19) in Younger Patients[14]
A retrospective study of 182 patients confirmed COVID-19 admitted to the National Centre for Infectious Diseases, Singapore. "Our 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."

MICHALAKIS et al (April 29 2020) SARS-CoV-2 Infection and Obesity: Common Inflammatory and Metabolic Aspects[15]
Obese individuals have shown diminished protection from influenza immunization, since - despite being vaccinated - obese recipients are 2–3 times more prone to suffer from infection compared to non-obese. Thus, the potential implications for obesity in the SARS-CoV-2 outbreak should be elucidated. The authors present "mechanistic" obesity-related problems that aggravate SARS-CoV-2 infection as well as tentative molecular links between obesity and SARS-CoV-2 infection.

PALAIODIMOS et al (9 May 2020) [Preprint Not Yet Peer Reviewed] Severe obesity is associated with higher in-hospital mortality in a cohort of patients with COVID-19 in the Bronx, New York[16]
In this early cohort of hospitalized patients with COVID-19 in an underserved, minority predominant population in the Bronx, the authors found that severe obesity was associated with higher in-hospital mortality even after adjusting for other pertinent potential confounding factors.

TAMARA et al (2020) Obesity as a predictor for a poor prognosis of COVID-19: A systematic review[17]
Obesity has been associated with impaired immune system, increasing the susceptibility for 2019-nCoV infection. We aimed to study the impact of obesity to the prognosis and disease severity of COVID-19. We obtained three

retrospective cohort studies — Wu J et al, Lighter J et al, and Simonnet A et al — to be critically appraised using Newcastle Ottawa Scale. The findings of all included studies were consistent in stating the contribution of obesity as a risk factor to increase the requirement for advanced medical care.

SIMONNET et al (April 9 2020) High Prevalence of Obesity in Severe Acute Respiratory Syndrome coronavirus-2 (SARS-CoV-2) Requiring Invasive Mechanical Ventilation[18]

A retrospective cohort study of 124 patients in France where the authors looked at clinical characteristics including BMI and the need for Invasive Mechanical Ventilation.
Results showed Obesity (BMI >30 kg/m2) and severe obesity (BMI >35 kg/m2) were present in 47.6% and 28.2% of cases, respectively. Overall, 85 patients (68.6%) required IMV. The proportion of patients who required IMV increased with BMI categories (p<0.01, Chi square test for trend), and it was greatest in patients with BMI >35 kg/m2 (85.7%).

KALLIGEROS et al (30 April 2020) Association of Obesity With Disease Severity Among Patients With COVID-19[19]

A retrospective cohort study of 103 patients hospitalized in Rhode Island, USA with COVID-19. Among them, 41 patients (39.8%) were admitted to the ICU and 29 (70.7%) required (IMV). The prevalence of obesity was 47.5% (49/103). In a multivariate analysis, severe obesity (BMI ≥35 kg/m2) was associated with ICU admission (aOR 5.39; 95% CI:1.13- 25.64). Moreover, patients who required IMV, were more likely to have had heart disease (aOR 3.41; 95% CI:1.05- 11.06), obesity (BMI=30- 34.9 kg/m2) (aOR 6.85; 95% CI: 1.05- 44.82) or severe obesity (BMI≥35 kg/m2) (aOR 9.99; 95% CI:1.39- 71.69). Severe obesity (BMI ≥35 kg/m2) was associated with ICU admission, while history of heart disease and obesity (BMI ≥30 kg/m2) were independently associated with the use of IMV.

LIGHTER et al (9 April 2020) Obesity in Patients Younger Than 60 Years Is a Risk Factor for COVID-19 Hospital Admission[20]

In an analysis of 3,615 patients with COVID-19 in New York, 775 (21%) had a body mass index (BMI) 30-34, and 595 (16% of the total cohort) had a BMI >35. There were 1,853 (51%) patients discharged from the ED, 1,331 (37%) were admitted to the hospital in acute care and 431 (12%) were either directly admitted or transferred to the ICU during admission.

Patients aged <60 years with a BMI between 30-34 were 2.0 (95% 1.6-2.6, p<0.0001) and 1.8 (95% CI 1.2-2.7, p=0.006) times more likely to be admitted to acute and critical care, respectively, compared to individuals with a BMI <30.

DRUCKER (2020) Coronavirus Infections and Type 2 Diabetes-Shared Pathways with Therapeutic Implications[21]

Drucker's article includes a section on rates of diabetes and obesity in patients with coronavirus infections. Analysis of 124 consecutive ICU admissions in a single center in Lille, France from February 27-April 5 2020 revealed greater rates of obesity and severe obesity among SARS-CoV-2 patients, relative to historical non-SARS-CoV-2 controls. The frequency of obesity was 47.5% in this observational study, compared to 25.8% in a historical control group of ICU subjects with non-SARS-CoV-2 illness, and the requirement for intubation and mechanical ventilation was higher in subjects with obesity.

WATANABE et al (21 April 2020) Obesity and SARS-CoV-2: a population to safeguard[22]

The authors hypothesize that obesity could play a role in predisposing to serious COVID-19 complications through several mechanisms: systemic chronic inflammation, related comorbidities such as diabetes, increased complement system activation and IL-6 secretion. Ultimately, excess fat could also lead to the possible presence of ectopic adipocytes within the alveolar interstitial space that may suffer direct viral infection and in turn aggravate the inflammatory infiltrate, therefore contributing to the massive interstitial edema being observed.

SORIANO et al (8 May 2020) Body Mass Index (BMI) and Coronavirus Disease 2019 (COVID-19): A Living Systematic Review[23]

This review focuses on the BMI value as a tool to evaluate the risk of development and/or aggravation of this disease. The mean BMI value of severe COVID-19 patients ranged from 24.5 to 33.4 kg/m^2, versus 22.0 to 24.3 kg/m^2 for non-severe patients.

BELLO-CHAVOLLA et al (5 May 2020) Predicting mortality due to SARS-CoV-2: A mechanistic score 2 relating obesity and diabetes to COVID-19 outcomes in Mexico[24]

The authors looked at data of confirmed and negative COVID-19 cases and their 30 demographic and health characteristics from the General Directorate of Epidemiology Mexican Ministry of Health. "Among 71,103 subjects at April 27th, 2020, we observed 15,529 subjects with SARS-CoV-2 and 1,434 deaths. Risk factors for lethality in COVID-19 includes early-onset diabetes obesity, COPD, advanced age, immunosuppression, and CKD; we observed that obesity mediates 45.5% of the effect of diabetes on COVID-19 lethality."

THOMAS (2020) A primer on COVID- 19 Mathematical Models[25]

"Obesity investigators can use mathematical model projections to test prevention and reduction of COVID-19 cases affected by obesity." COVID-19 symptoms and mortality are disproportionately more severe in people with obesity and obesity related comorbidities. This is of concern for the United States, where ~42% have obesity and of these, 85% have type 2 diabetes.

ROTTOLI et al (12 May 2020) Obesity is one of the strongest risk factor for respiratory failure and death in COVID-19 patients: a retrospective multicentric cohort study[26]

Rottoli et al present a retrospective multicentric cohort study of 296 COVID-19 patients admitted to an Italian hospital between February 28 and March 28, 2020. Demographic characteristics, laboratory findings and clinical scores were compared in obese and non-obese patients. Multivariable analysis was carried out to identify the risk factors for respiratory failure and mortality. Obesity remained the strongest risk factor when analysing respiratory failure (OR 2·98, p =0·001) and death (OR 2·29, p=0·045).The comparison between obese and non-obese patients, not surprisingly, showed a significantly higher distribution of comorbidities in the obese group. Obesity has been widely recognized as a risk factor for major comorbidities, including type 2 diabetes, hypertension and cardiovascular disease. The comparison between obese patients who developed respiratory failure and those who did not confirmed the aforementioned findings. No difference in the distribution of comorbidities was detected between the two groups. Interestingly, the BMI was similar between the two groups (32·4 vs. 32·3 kg/m2), suggesting that even grade I obesity is a strong risk factor for fatal outcomes.

DIETZ (2020) [Letter] Obesity and its Implications for COVID-19 Mortality[27]

"The disproportionate impact of H1N1 influenza and now COVID- 19 in patients with obesity and severe obesity is not surprising given the impact of obesity on pulmonary function. Obesity is associated with decreased expiratory reserve volume, functional capacity, and respiratory system compliance. In patients with increased abdominal obesity, pulmonary function is further compromised in supine patients by decreased diaphragmatic excursion, making ventilation more difficult. Furthermore, increased inflammatory cytokines associated with obesity may contribute to the increased morbidity associated with COVID-19 infections.

DE LUCENA (2020) Mechanism of inflammatory response in associated comorbidities in COVID-19[28]

Studies indicate that obese individuals are more likely to develop infections, and that adipose tissue serves as a pathogen reservoir. In diabetic individuals, higher rate of inflammatory processes is seen due to constant glucose recognition by C type lectin receptors. Hypertensive individuals, usually grouped with other conditions, are treated with drugs to reduce blood pressure mostly through ACEi and ARB, that leads to increased ACE2 expression, used by SARS-CoV-2 for human's cell entry. Until now, the studies have shown that individuals with those conditions and affected by COVID-19 present an uncontrolled release of pro-inflammatory cytokines and an unbalanced immune response, leading to the cytokine storm phenomenon. Vitamin D is highlighted as a potential therapeutic target, because in addition to acting on the immune system, it plays an important role in the control of cardiometabolic diseases.

STEFAN et al (2020) Obesity and impaired metabolic health in patients with COVID-19[29]

Preliminary data suggest that people with obesity are at increased risk of severe COVID-19. However, as data on metabolic parameters such as BMI and levels of glucose and insulin in patients with COVID-19 are scarce, increased reporting is needed to improve our understanding of COVID-19 and the care of affected patients.

RICHARDSON et al (2020) Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area[30]

A case series of patients with COVID-19 admitted to 12 hospitals in New York, between March 1, 2020, and April 4, 2020. The most common comorbidities

were hypertension (3026; 56.6%), obesity (1737; 41.7%), and diabetes (1808; 33.8%).

HU et al (2020) Risk Factors Associated with Clinical Outcomes in 323 COVID-19 Hospitalized Patients in Wuhan, China[31]

A retrospective review of 323 hospitalized patients with COVID-19 in Wuhan. Patients were classified into three disease severity groups [non-severe, severe, and critical], based on initial clinical presentation. Obesity (BMI ≥30), hyperglycemia and diabetes, and cardiovascular disease were distinct risk factors for unfavorable clinical outcomes. Patients with diabetes and body mass index (BMI) of ≥30 were more likely to have unfavorable outcomes.

BHASKER (2020) [Letter] Are Patients Suffering from Severe Obesity Getting a Raw Deal During COVID-19 Pandemic?[32]

Obesity is an underlying factor for type 2 diabetes, hypertension, cardiovascular disease, renal disease, and venous thromboembolism and has a detrimental effect on lung function. A pro-inflammatory state coupled with malnutrition may lead to impaired immune response in patients suffering from obesity and increased susceptibility to all influenza viruses including COVID-19. Even though the evidence regarding this is still inadequate, this hypothesis has been one of the biggest deterrents for advising against bariatric surgery to patients suffering from obesity during COVID-19 pandemic.

FLINT (2020) COVID-19 and obesity-lack of clarity, guidance, and implications for care[33]

The authors discuss the fact that people with a high BMI of over 40kg/m^2 may be more vulnerable to contracting a more severe form of COVID-19, but they also talk about the lack of information compared to other risks like diabetes or hypertension.

"Although it is recognised that a higher BMI has been associated with greater risk of type 2 diabetes, cardiovascular disease and hypertension, all of which are predictors of poor outcomes in COVID-19, to date, no available data show adverse COVID-19 outcomes specifically in people with a BMI of 40kg/m^2 or higher. This absence of data might explain why, unlike with other factors identified as reasons for a higher-risk status, there is a paucity of information to explain the reason why people with a BMI of 40kg/m^2 or higher, as an independent risk factor, are included as a high-risk group."

BUSCEMI et al (2020) [Letter to the Editor] There is a relationship between obesity and COVID-19 but more information is needed[34]

Few studies describing COVID-19 with rates of obesity exist and most are based on heterogeneous populations. In cohort studies with COVID- 19 disease, obesity rates are generally reported as no higher than population-based estimates; in contrast, subgroups of critically ill patients report higher prevalence rates of obesity.

QINGXIAN et al (2020) Obesity and COVID-19 Severity in a Designated Hospital in Shenzhen, China[35]

In a review of 383 patients, 11 January – 16 February, hospitalized in Shenzhan, China, after adjusting for potential confounders, compared to normal weight, overweight showed 86% higher, and obesity group showed 2·42-fold higher odds of developing severe pneumonia.

TIBIRIÇÁ (2020) [Letter to the Editor] Increased severity of COVID-19 in people with obesity: are we overlooking plausible biological mechanisms?[36]

The authors discuss the role of endothelial dysfunction in obesity. "We believe that, among several possible pathophysiologic mechanisms leading to adverse prognosis in people with obesity and COVID-19, endothelial dysfunction is a central one, as it combines the effects of obesity and its associated comorbidities with the acute effect of SARS-CoV-2."

KRUGLIKOV et al (2020) The role of adipocytes and adipocyte-like cells in the severity of COVID-19 infections[37]

The authors argue that "adipocytes and adipocyte- like cells, such as pulmonary lipofibroblasts, may play an important role in the pathogenic response to COVID- 19. Expression of angiotensin-converting enzyme 2 (ACE2), the functional receptor for SARS- CoV, is upregulated in adipocytes of obese and diabetic patients, which turns adipose tissue into a potential target and viral reservoir. This may explain why obesity and diabetes are potential comorbidities for COVID- 19 infections."

HUANG et al (2020) Obesity hypoventilation syndrome and severe COVID-19[38]

A case study of a 23-year old man who attended hospital in Wenzhou, China on January 21st and was given a positive diagnosis of COVID-19. The patient had a BMI of 37.3 kg/m^2 "obese hypoventilation syndrome (BMI ≥ 30 kg/m^2

and $PaCO_2$ > 45 mm Hg) was observed, possibly the result of combined severe pulmonary viral and bacterial infection; this can progress to malignant hypoventilation syndrome, a condition typically characterized by a poor prognosis. The current practice guidance for treatment of COVID-19 suggests non-invasive oxygenation management targeting dyspnoeic individuals with PaO_2/FiO_2 levels below 300 mm Hg or primarily in those with type I acute respiratory failure. However, no strategies exist for managing COVID-19 patients with obesity, chronic obstructive pulmonary disease or other diseases that may cause type II acute respiratory failure.

GOYAL et al (2020) Clinical Characteristics of COVID-19 in New York City[39]
A retrospective case study of 393 consecutive patients admitted to two hospitals in New York City between March 3 – March 27. Median age 62 years, 35.8% had obesity. Obesity was common and may be a risk factor for respiratory failure leading to invasive mechanical ventilation.

GOLD et al (2020) Characteristics and Clinical Outcomes of Adult Patients Hospitalized with COVID-19 — Georgia[40]
A cohort study of 305 patients hospitalised in Georgia. Median age was 60 yrs. Severe obesity (BMI ≥40), present in 12.7% of patients, was most common in those aged 18–49 years (21.8%; p<0.001).

GARG et al (2020) Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019 - COVID-NET, 14 States[41]
MMWR Report of 1,482 US patients hospitalised with COVID-19 March 2020. 89.3% had one or more underlying conditions; the most common were hypertension (49.7%), obesity (48.3%), chronic lung disease (34.6%), diabetes mellitus (28.3%), and cardiovascular disease (27.8%). Among patients aged 18–49 years, obesity was the most prevalent underlying condition, followed by chronic lung disease [primarily, asthma] and diabetes mellitus. Among patients aged 50–64 years, obesity was most prevalent, followed by hypertension and diabetes mellitus.

MUSCOGIURI et al (2020) Obesity: The "Achilles heel" for COVID-19?[42]
A retrospective cohort study, French centre with 124 patients admitted to intensive care for SARS-CoV-2. Obesity (BMI >30 kg/m2) and severe obesity (BMI >35 kg/m2) were present in 47.6% and 28.2% of cases, respectively, patients who required invasive mechanical ventilation (IMV) increased with

BMI categories ($p < .01$) and it was greatest in patients with BMI >35 kg/m (85.7%). The authors also discuss inflammation, the pathophysiological mechanisms linking obesity and COVID-19. Whereas, considering that subjects with obesity have a proinflammatory milieu, it is expected that COVID-19 could further exacerbate inflammation exposing them to higher levels of circulating inflammatory molecules compared to lean human subjects. This could explain the increased risk of severe complications of COVID-19 for subjects with obesity.

PETRILLI et al (2020) [Preprint Not Yet Peer Reviewed] Factors associated with hospitalization and critical illness among 4,103 patients with COVID-19 disease in New York City[43]

A cross-sectional analysis of 4,103 patients diagnosed with COVID-19 in New York March 1st-April 2nd 2020. Hospitalized patients were more likely to be male (62.6% vs 39.0%) and had substantially more comorbidities than non-hospitalized patients, particularly with regard to cardiovascular disease (44.6% vs. 16.4%), diabetes (31.8% vs 5.4%) and obesity (39.8% vs. 14.5%). More striking were our findings about the importance of inflammatory markers in distinguishing future critical from non-critical illness. Among these, early elevations in c-reactive protein and d-dimer had the strongest association with mechanical ventilation or mortality. Some emerging case reports suggest that patients with critical COVID-19 disease are developing complications from hypercoagulability, including both pulmonary emboli and microscopic thrombi. In this regard it is notable that the chronic condition with the strongest association with critical illness was obesity, with a substantially higher odds ratio than any cardiovascular or pulmonary disease.

SAMUELS (2020) [Letter] Obesity and severe COVID-19 disease: a strong association[44]

A letter to the Editor by an Anaesthesiologist from Weill Cornell Medical College, New York- Presbyterian Hospital, who was also Director of the Bariatric Anesthesia Division, and an airway expert. He was assigned to the COVID Airway Team in March. "I began to field calls from other physicians, "Could you help out. We have a 150-kg patient." Upon closer inspection, I noted that most of my patients were male, over age 60, had extensive medical comorbidities, and obesity."

CAUSSY et al (2020) Obesity is associated with severe forms of COVID-19[45]

Caussy et al suggest that the prevalence of obesity varies across geographical location. The authors argue that the prevalence of obese patients in ICU units may also depend on the local level of obesity. The authors report on a patient population from Lyon Hospital, as compared to one examined in the Simonnet et al study from Lille University Centre in France. In the Lyon population, patient obesity was lower >35kg/m2, 11.3% than in Lille 28.2%, as well as the requirement for IMV 58.4% compared to 68.6%.

CHIAPPETTA et al (2020) [Brief Communication] COVID-19 and the role of chronic inflammation in patients with obesity[46]

The authors discuss low grade chronic inflammation, a common condition in obesity, associated with type 2 diabetes and hypertension, comorbidities which have had an adverse effect on patients with COVID-19. They discuss the Edmonton Obesity Staging System (EOSS). Risk stratification based on EOSS which classifies obesity based on the presence of medical, mental, and/or functional complications rather than on body mass index (BMI), has been shown to be a better predictor of all-cause mortality and it may well be that EOSS stages may better describe the risk of hyperinflammation in patients with COVID-19 infection.

COSTA et al (2020) [Letter] COVID-19 ventilatory phenotypes and obesity: is there a relationship?[47]

Obesity has been recognized as an independent risk factor in other viral infections such as H1N1(1). Although data are scarce at this stage, there is also an unexplained increased prevalence of obesity in patients infected with SARS-CoV-2 admitted to the intensive care units.

MALAVAZOS et al (2020) Targeting the Adipose Tissue in COVID-19[48]

The role of the adipose tissue during infectious diseases such as COVID-19 could be important. If obesity represents a predictor of poor prognosis or higher rate complications in SARS-Cov2 patients, it is still a modifiable risk factor. Therapeutic actions targeting the adipose issue may be considered to reduce the burden of the COVID-19 disease.

ICNARC report on COVID-19 in critical care 08 May 2020[49]

The Intensive Care National Audit and Research Centre (UK) reports COVID-19 patients in critical care 8th May 2020. Total number of 5,868 patients. Patient characteristics: demographics by receipt of respiratory support, includes BMI:

- Receiving Basic Respiratory Support: N= 1584: BMI 25-<30 509; BMI 30-<40 424; BMI 40+ 136
- Receiving Advanced Respiratory Support: N=4287: BMI 25-<30 1449 BMI 30-<40 1258; BMI 40+ 314

ZHAO (4 May 2020) [Letter] Obesity accompanying COVID-19: the role of epicardial fat[50]

Although clinically very relevant, it remains difficult to determine how SARS-CoV-2 severity is increased in the context of obesity. As presented by Katz et al 28% of hospitalised patients presented with cardiac problems. Considering that myocardial response is closely linked with COVID-19 mortality, local biological effects on myocardial tissue from EAT warrants further discussion.

LUZI et al (2020) Influenza and obesity: its odd relationship and the lessons for COVID-19 pandemic[51]

Basal hormone milieu, defective response of both innate and adaptive immune system and sedentariness are major determinants in the severity of influenza viral infection in obese patients. Being obese not only increases the risk of infection and of complications for the single obese person, but recent evidence indicates that a large obese population increases the chance of appearance of more virulent viral strain, prolongs the virus shedding throughout the total population and eventually may increase overall mortality rate of an influenza pandemic. Waiting for the development of a vaccination against COVID-19, isolation of positive cases and social distancing are the primary interventions. Evidence from previous influenza pandemics suggests the following for our obese and obese-diabetic patients: 1. lose weight with a mild caloric restriction. In addition to the obvious positive effect of weight loss, caloric restriction activates AMP-kinase, potentiating the immunomodulatory effect of physical exercise; 2. include metformin and pioglitazone [when not contraindicated] in the drug treatment for type 2 diabetes; and 3. practice mild-to-moderate physical exercise in order to potentiate positive immunomodulation. Finally, present

evidence suggests a prolongation of quarantine period in adult and adolescent obese patients.

De LUSIGNAN et al (15 May 2020) Risk factors for SARS-CoV-2 among patients in the Oxford Royal College of General Practitioners Research and Surveillance Centre primary care network: a cross-sectional study[52]

We aimed to identify demographic and clinical risk factors for testing positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) within the Oxford Royal College of General Practitioners (RCGP) Research and Surveillance Centre primary care network.

We analysed routinely collected, pseudonymised data for patients in the RCGP Research and Surveillance Centre primary care sentinel network who were tested for SARS-CoV-2 between Jan 28 and April 4, 2020. We found increased odds of a positive test among people who are obese (142 [20·9%] of 680 people with obesity vs 171 [13·2%] of 1296 normal-weight people; adjusted OR 1·41, 95% CI 1·04–1·91). We provide evidence of potential sociodemographic factors associated with a positive test, including deprivation, population density, ethnicity, and chronic kidney disease.

ENGIN et al (15 May 2020) Two important controversial risk factors in SARS-CoV-2 infection: Obesity and smoking[53]

The effects of obesity and smoking in the coronavirus disease 2019 (COVID-19) pandemic remain controversial. Angiotensin converting enzyme 2 (ACE2), a component of the renin-angiotensin system (RAS), is the human cell receptor of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of COVID-19. ACE2 expression increases on lung alveolar epithelial cells and adipose tissue due to obesity, smoking and air pollution. A significant relationship exists between air pollution and SARS-CoV-2 infection, as more severe COVID-19 symptoms occur in smokers; comorbid conditions due to obesity or excess ectopic fat accumulation as underlying risk factors for severe COVID-19 strongly encourage the virus/ACE2 receptor-ligand interaction concept. Indeed, obesity, air pollution and smoking associated risk factors share underlying pathophysiologies that are related to the Renin-Angiotensin-System in SARS-CoV-2 infection. The aim of this review is to emphasize the mechanism of receptor-ligand interaction and its impact on the enhanced risk of death due to SARS-CoV-2 infection.

RCPCH (2020) COVID-19 - research evidence summaries[54]

Data on COVID-19 and children with underlying medical conditions is sparse and limited to case reports/series. Immunosuppression does not appear to significantly increase the risk of severe disease. Contact tracing on a dialysis unit who had contact with a member of staff who tested positive found three children to be positive, but only one had symptoms. A case report of a child with cystic fibrosis who contracted COVID-19 from his grandfather, identified through contact tracing, also remained asymptomatic. There is a case report of COVID-19 pneumonia triggering acute chest syndrome in an adolescent with known sickle cell disease on daily hydroxyurea. On screening patients and caregivers with cancer in one of the largest paediatric cancer centres in the US, 20 of 178 paediatric patients tested positive. Only one (5%) required hospitalisation for symptoms of COVID-19, with none requiring critical care.

Comorbidities identified among adults as increasing the risk of severe COVID-19 may not apply to children. However, it is reasonable to expect that children with significant respiratory or cardiac conditions, or those who are immunocompromised due to disease or treatment, may be more vulnerable. CDC data from the USA reports that a high proportion of cases needing admission had at least one co-morbidity, most commonly respiratory. Data from Italy also finds that children with co-morbidities are overrepresented in those admitted to hospital, though most were reported to have mild illness. Notably there is no apparent difference in severity according to age in the Italian data, whereas CDC data noted increased hospitalisation in infants.

SHEKERDEMIAN et al (2020) Characteristics and Outcomes of Children With Coronavirus Disease 2019 (COVID-19) Infection Admitted to US and Canadian Pediatric Intensive Care Units[55]

A retrospective medical record review of pediatric patients admitted to 46 participating North American PICUs with confirmed COVID-19 infection between March 14 and April 3, 2020, and with outcome follow-up through April 10, 2020. Patient data included age and sex, pre-existing comorbidities [heart disease, developmental delay, diabetes, immune compromise, malignancy, medical complexity, obesity, post-transplant, and tracheostomy] and mode of presentation [asymptomatic, respiratory, gastrointestinal, neurological, or circulatory].

In our series, obesity was notable as a comorbidity, particularly in older children, although our rates were significantly lower (20.5% of children 6

years or older had obesity). We found the severity of illness in infants and children with COVID-19 to be far less than that documented in adults, with most PICUs across North America reporting no children admitted with this disease during the study period. Of the critically ill children with COVID-19, more than 80% had significant long-term underlying medical conditions. Overall survival and outcomes from critical illness in infants and children with COVID-19 in this series was far better than reported for adult patients. At the present time, our data indicate that children are at far greater risk of critical illness from influenza than from COVID-19.

BRAMBILLA et al (2020) Special Issues for COVID-19 in Children and Adolescents[56]

A high prevalence of obesity in patients with severe COVID-19 requiring invasive mechanical ventilation was recently reported. We wish to remind readers that children and adolescents can have COVID-19 disease and that the disease may be extra-pulmonary.Patients with obesity and COVID-19, even young patients, require attentive care because of their risk for complications. Moreover, subjects with obesity should rigorously comply with preventive measures, including mask, glove, handwashing, and social distancing.

CHAO et al (2020) Clinical Characteristics and Outcomes of Hospitalized and Critically Ill Children and Adolescents with Coronavirus Disease 2019 (COVID-19) at a Tertiary Care Medical Center in New York City[57]

Study of 67 children and young people (1 month – 21years) admitted to a single tertiary care children's hospital in New York, between March 15th – April 13th 2020. 67 children tested positive for COVID-19; 21 (31.3%) were managed as outpatients. Of 46 admitted patients, 33 (72%) were admitted to the general pediatric medical unit and 13 (28%) to the pediatric intensive care unit (PICU). Obesity and asthma were highly prevalent but not significantly associated with PICU admission (p=0.99). Admission to the PICU was significantly associated with higher C-reactive protein, procalcitonin, and pro-B type natriuretic peptide levels and platelet counts (p<0.05 for all). Patients in the PICU were more likely to require high-flow nasal cannula (p=0.0001) and were more likely to have received Remdesivir through compassionate release (p<0.05). Severe sepsis and septic shock syndromes were observed in 7 (53.8%) PICU patients. Acute respiratory distress syndrome (ARDS) was observed in 10 (77%) PICU patients, 6 of whom (46.2%) required invasive mechanical ventilation for a median of 9 days.

DHOCHAK et al (2020) Pathophysiology of COVID-19: Why Children Fare Better than Adults?[58]

In adults with COVID-19, co-morbidities like heart diseases, cerebrovascular diseases, and obesity are associated with increased mortality. Upregulation of ACE-2 in smokers may contribute to poor outcomes of respiratory infections in them; the same will be applicable to elderly smokers. As most of these morbidities are not commonly seen in children, children are placed in a favourable position. Second-hand smoking could be a risk factor for children. Pending detailed reports, young infants and children with similar co-morbidities should be considered as a high-risk population for COVID-19.

CDC (2020) Coronavirus Disease 2019 in Children — United States, MMWR February 12–April 2, 2020[59]

Report on 2,572 COVID-19 positive cases which occurred in patients aged <18 years. Among 345 pediatric cases with information on underlying conditions, 80 (23%) had at least one underlying condition. The most common underlying conditions were chronic lung disease, including asthma (40), cardiovascular disease (25), and immunosuppression (10). Among the 295 pediatric cases for which information on both hospitalization status and

underlying medical conditions was available, 28 of 37 (77%) hospitalized patients, including all six patients admitted to an ICU, had one or more underlying medical condition; among 258 patients who were not hospitalized, 30 (12%) patients had underlying conditions. Three deaths were reported among the pediatric cases included in this analysis; however, review of these cases is ongoing to confirm COVID-19 as the likely cause of death. Weight or BMI is not specifically mentioned.

WOO et al (2020) Zooming Towards a Telehealth Solution for Vulnerable Children with Obesity During COVID-19[60]

Health inequities exist throughout the life course, resulting in racial/ethnic and socioeconomic disparities in obesity and obesity-related health complications. Obesity and its co-morbidities appear linked to COVID-19 mortality. Approaches to reduce obesity in the time of COVID-19 closures are urgently needed and should start early in life. In New York City, we developed a telehealth pediatric weight management collaborative spanning New York-Presbyterian, Columbia University Vagelos College of Physicians and Surgeons, and Weill Cornell Medicine during COVID-19 with show rates 76-89%. To stave off the impending exacerbation of health disparities related to obesity risk factors in the aftermath of the COVID-19 pandemic, effective interventions that can be delivered remotely are urgently needed among vulnerable children with obesity. Challenges in digital technology access, social and linguistic differences, privacy security, and reimbursement must be overcome to realize the full potential of telehealth for pediatric weight management among low-income and racial/ethnic minority children.

PIETROBELLI et al (2020) Effects of COVID-19 Lockdown on Lifestyle Behaviors in Children with Obesity Living in Verona, Italy: A Longitudinal Study[61]

A study to test the hypothesis that youths with obesity, when removed from structured school activities and confined to their homes during the COVID-19 pandemic, will display unfavorable trends in lifestyle behaviors. The study included 41 children and adolescents with obesity participating in a longitudinal observational study located in Verona, Italy. Lifestyle information including diet, activity, and sleep behaviors were collected at baseline and three weeks into the national lockdown during which home confinement was mandatory. Changes in outcomes over the two study time points were evaluated for significance using paired t-tests.

There were no changes in reported vegetable intake; fruit intake increased (p=0.055) during the lockdown. By contrast, potato chip, red meat, and sugary drink intakes increased significantly during the lockdown (p-value range, 0.005 to 0.001). Time spent in sports activities decreased (X±SD) by 2.30±4.60 hours/week (p=0.003) and sleep time increased by 0.65±1.29 hours/day (p=0.003). Screen time increased by 4.85±2.40 hours/day (p=0.001). Recognizing these adverse collateral effects of the COVID-19 pandemic lockdown is critical in avoiding depreciation of weight control efforts among youths afflicted with excess adiposity. Depending on duration, these untoward lockdown effects may have a lasting impact on a child or adolescent adult adiposity level.

NATIONAL INSTITUTE FOR PUBLIC HEALTH AND THE ENVIRONMENT, NETHERLANDS (2020) Questions and Answers about COVID-19 (novel coronavirus)[62]

Children with underlying health conditions do not seem to run a greater risk of a severe course of COVID-19 than healthy children, with the possible exception of children with severe obesity and or diabetes.

POST-COVID-19 REHABILITATION IN OBESE PATIENTS

ZHAO et al (2020) Recommendations for respiratory rehabilitation in adults with COVID-19[63]

The authors give recommendations for respiratory rehabilitation in adults with COVID-19, based on a review of the existing literature and input from frontline clinical experts.
Their recommendations are as follows:

- For inpatients with COVID-19, respiratory rehabilitation would relieve the symptoms of dyspnea, anxiety, and depression and eventually improve physical functions and the quality of life.
- For severe/critical inpatients, early respiratory rehabilitation is not suggested.
- For patients in isolation, respiratory rehabilitation guidance should be conducted through educational videos, instruction manuals, or remote consultation.
- Assessment and monitoring should be performed throughout the respiratory rehabilitation process.

— Proper grade protection should be used following the present guidelines.

These recommendations can guide clinical practice and form the basis for respiratory rehabilitation in COVID-19 patients. For patients with severe/critical condition, older adults, obesity patients, patients with multiple comorbidity and patients with one or more organ failure, the respiratory rehabilitation team should customize a respiratory rehabilitation plan based on the unique problems of each patient.

SEVERIN et al (2020) Respiratory Muscle Performance Screening for Infectious Disease Management Following COVID-19: A Highly Pressurized Situation[64]

We hypothesize that impaired respiratory muscle performance is an underappreciated factor contributing to poor outcomes unfolding during the coronavirus pandemic. While impaired respiratory muscle performance is considered to be rare, it is more frequently encountered in patients with poorer health, in particular obesity. However, measures of respiratory muscle performance are not routinely performed in clinical practice, including those with symptoms such as dyspnea.
The purpose of this perspective paper is to discuss the potential role of respiratory muscle performance from the perspective of the coronavirus pandemic. We also provide a theoretical patient management model to screen for impaired respiratory muscle performance and intervene if identified with the goal of unburdening healthcare systems during future pandemic crises.

BRUGLIERA et al (20 May 2020) Nutritional Management of COVID-19 Patients in a Rehabilitation Unit[65]

This study focuses on the COVID-19 Rehabilitation Unit at the San Raffaele Scientific Institute (Milan, Italy) at the end of March 2020, where 50 patients had been admitted. Criteria for admission were positive nasopharyngeal swab test and functional independence measure (FIM) values showing dependence for motor or respiratory functions. The authors detail how malnutrition delays healing times and increases hospitalization periods. Therefore, the prevention, diagnosis, and treatment of malnutrition must be regularly included in the management of hospitalized COVID-19 patients in a rehabilitation department, to improve both short and long-term prognosis. Malnutrition must be considered as the inability to preserve a correct body

composition and muscle mass, and not necessarily related to a low body mass index. For this reason, obese patients have to be considered according to the same criteria. Moreover, it is noteworthy that a personalized swallowing rehabilitation targeting the recovery of normal feeding should be provided during the hospitalization, in order to reduce the duration of admissions.

BRUGLIERA et al (2020) [Letter] Rehabilitation of COVID-19 patients[66]

The recent SARS-CoV-2 experience has revealed the need for a multidisciplinary rehabilitative approach, especially for those patients with serious COVID-19 illness, advanced age, obesity, multiple chronic diseases and organ failure. Every patient needs a neuromotor and respiratory rehabilitation program. Recovery of COVID-19 patients aims to improve respiratory function, counteract immobilization, reduce the rate of long-term complications/ disability and to improve cognitive/emotional domains in order to promote a quality of life and facilitate the discharge home.

DE SIRE et al (2020) Systematic rapid living review on rehabilitation needs due to COVID-19: update to April 30th 2020[67]

A systematic rapid living review on rehabilitation needs due COVID-19 which presents the first appearance of epidemiological data on the likely high incidence of neurological complications/disabling sequelae in patients hospitalized for COVID-19. Rapid guidelines on the management of chronically disabled patients in the COVID-19 era are included. The authors advise to provide COVID-19 patients with early respiratory rehabilitation in the acute phase, and with telemonitoring and telerehabilitation in the post-acute phase.

VITACCA et al (2020) Joint statement on the role of respiratory rehabilitation in the COVID-19 crisis: the Italian position paper[68]

Respiratory Rehabilitation is structured non-pharmacological therapy with a process delivered in three phases: assessment, intervention and re-assessment; the assessment is above all of a functional nature, with particular attention paid to the state of consciousness, respiratory, cardiological, motor function, and quality of life. Regardless of the type of intervention, the intensity, timing and modality must be tailored to the individual patient's needs, in particular for those with severe/critical illness, elderly patients, obesity, comorbidity and other complications.

SHEEHY (2020) Considerations for Postacute Rehabilitation for Survivors of COVID-19[69]

The objective of this report is to answer the question "What rehabilitation services do survivors of COVID-19 require?" The question was asked within the context of a subacute hospital delivering geriatric inpatient and outpatient rehabilitation services. Three areas relevant to rehabilitation after COVID-19 were identified:

- Details of how patients may present have been summarized, including comorbidities, complications from an intensive care unit stay with or without intubation and the effects of the virus on multiple body systems, including those pertaining to cardiac, neurological, cognitive and mental health.
- Suggested procedures regarding the design of inpatient rehabilitation units for COVID-19 survivors, staffing issues and considerations for outpatient rehabilitation.
- Guidelines for rehabilitation including physiotherapy, occupational therapy and speech-language pathology following COVID-19 have been proposed with respect to recovery of the respiratory system as well as recovery of mobility and function.

A thorough assessment and an individualized, progressive treatment plan which focuses on function, disability, and return to participation in society will help each patient to maximize their function and quality of life. Careful consideration of the rehabilitation environment will ensure that all patients recover as completely as possible.

SLIM et al (2020) The quintuple penalty of obese patients in the COVID-19 pandemic.[70]

Patients with obesity are clearly at a severe disadvantage compared with other patients affected by COVID-19. If they are not infected, they suffer harmful effects of confinement. If they are infected, they are exposed to a greater risk of admission to prolonged intensive care, with sarcopenia, care provision ill-suited to their specific needs, and possible postcritical complications. The impact of the COVID-19 pandemic in the setting of a global syndemic that includes obesity, thus deserves urgent consideration.

LIANG (2020) Handbook of COVID-19 Prevention and Treatment Compiled According to Clinical Experience. The First Affiliated Hospital, Zhejiang University School of Medicine[71]

Rehabilitation Therapy for COVID-19 Patients: Severe and critically ill patients suffer from different degrees of dysfunction, especially respiratory insufficiency, dyskinesia and cognitive impairment, during both acute and recovery stages. The goal of early rehabilitation intervention is to reduce breathing difficulties, relieve symptoms, ease anxiety and depression and lower the incidence of complications. Rehabilitation assessment: Based on general clinical assessment, especially functional evaluation, including respiration, cardiac status, motion and ADL should be emphasized. Focus on respiratory rehabilitation assessment, which includes the evaluation of thoracic activity, diaphragm activity amplitude, respiratory pattern and frequency. The rehabilitation therapy of severe or critically ill COVID-19 patients mainly includes position management, respiratory training and physical therapy.

OTHER

THOMAS et al (2020) Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations[72]

Recommendations for physiotherapy management for COVID-19 in the acute hospital setting including:

- physiotherapy workforce planning and preparation
- a screening tool for determining requirement for physiotherapy
- the selection of physiotherapy treatments
- personal protective equipment

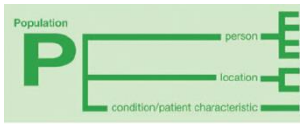
CSP (2020) Rehabilitation of adults who are hospitalised due to COVID-19: physiotherapy service delivery[73]

This set of standards covers rehabilitation in hospital critical and acute care settings through to step-down rehabilitation facilities and/or ongoing rehabilitation in the community. Further guidance will be developed for the end of life and community rehabilitation pathways. There are 6 quality standards:

— assessment and goal setting
— timing and intensity of rehabilitation
— continuity of care and communication
— ongoing rehabilitation in the community
— personal protective equipment
— infection control during rehabilitation

Produced by the members of the National Health Library and Knowledge Service Evidence Team†. Current as at 10 June 2020. This evidence summary collates the best available evidence at the time of writing and **does not replace clinical judgement or guidance**. Emerging literature or subsequent developments in respect of COVID-19 may require amendment to the information or sources listed in the document. Although all reasonable care has been taken in the compilation of content, the National Health Library and Knowledge Service Evidence Team makes no representations or warranties expressed or implied as to the accuracy or suitability of the information or sources listed in the document. This evidence summary is the property of the National Health Library and Knowledge Service and subsequent re-use or distribution in whole or in part should include acknowledgement of the service.

The following PICO(T) was used as a basis for the evidence summary:

	OBESITY
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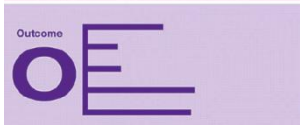	

The following search strategy was used:

COVID-19 OR CORONAVIRUS OR CORONA VIRUS OR WUHAN N2 VIRUS OR "2019 N-COV" OR "2019 NCOV" OR "SEVERE ACUTE RESIRATORY SYNDROME CORONAVIRUS 2" OR "SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS 2" OR SARS-COV-2 OR (2019 AND (NEW OR NOVEL) AND CORONAVIRUS)
AND
OBESITY OR OBESE OR OVERWEIGHT OR HIGH BMI

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