



## Association of Obesity with Covid-19 and Nutrition Perspective

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**ABSTRACT:** *COVID-19 is a disease that cause respiratory illness due to novel corona virus. It was reported by WHO on December 31,2019 for the first time. The outbreak of this disease started from Wuhan city, China. Now COVID-19 has been declared as a universal pandemic. The epidemiological outcomes of COVID-2019 have not been completely understood yet. The present review tried to find association between obesity and COVID-19, also the extent of severity it may cause in the disease.*

**Keyword:** *Universal pandemic, COVID-19, Nutritional needs, Obesity.*

### INTRODUCTION

BMI that is equal to 30 Kg/m<sup>2</sup> or above is classified as obese or overweight. 26% grown-ups and 46% young ones are affected by obesity globally. A complex relationship between genetics, socioeconomic and cultural impacts together constitute obesity. Dietary patterns and lifestyle choices have a great impact on the prevalence of obesity. Urban development also plays its role in it. Obesity increases a person's chances of developing comorbid conditions e.g.

high blood pressure, respiratory problems, dyslipidaemia, sleep disturbances and some type of cancers (Apovian, 2016). In China, city Wuhan, an outbreak of pneumonia of unknown aetiology appeared at the end of 2019. WHO termed this new and unusual coronavirus that was its causing agent as COVID-19 (Coronavirus disease of 2019). This virus was correlative to MERS and SARS. It is a beta-coronavirus affecting lower respiratory tract of humans and is noticeable as pneumonia in them (Sohrabiet al.,

2020). It is shown by research that transmission of COVID-19 can take place during incubation period before the appearance of symptoms in those patients. Moreover, phlegm was present in a patient of recovery phase from SARS-CoV-2 (Rothe et al., 2020). COVID-19 can roughly be divided into 3 stages; first is asymptomatic (carrying virus but no symptoms evident); second is symptomatic (virus symptoms present and also it is non-severe) and finally third severe (respiratory problems and symptoms evident (Wang et al., 2020). This virus is similar to flu in a way that it spreads from one individual to another through drops, like when coughing or sneezing or talking, if it makes contact with the mucosa. Infection can also spread through infected surfaces if a

person touches any surface and afterwards touches the mouth, eyes or nose. Droplets are not able to travel far from 2m of distance and they also don't remain in the air (Zou et al., 2020).

### Types

Coronaviruses that affect humans are of six types causing disease in them. Two of them MERS coronavirus and SARS coronavirus are the severe types. These two types have caused epidemics with high death rates. Whereas the other four types of coronavirus are mild causing general respiratory problems (Kooraki et al.,2020). According to the clinical findings about COVID-19, infected patients are divided into the following types as shown in table 1:

**Table 1: Types of COVID-19 (Zu et al., 2020)**

TYPES	CLINICAL FINDINGS
<b>Mild</b>	➤ Fever less than 38°C (can end without treatment)
	➤ Cough may be present or not
	➤ No shortness of breath, no gasping
	➤ Pneumonia not present
<b>Moderate</b>	➤ Fever
	➤ Respiratory problems
	➤ Pneumonia
<b>Severe</b>	➤ Respiratory rate higher or equal to 30 per minute
	➤ Oxygen saturation that is less than 93% in rest state

**Critical**

- Partial pressure of oxygen /Flow rate of oxygen less than 300 mmHg
- Rapid progression of COVID-19
- Lung failure
- Trauma
- Organ failure, ICU is needed

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**METHODOLOGY**

The current review material was searched from Google Scholar, Wiley library and PubMed library for authentic literature from December 2019 to September 2021. In this review 90 articles including case reports and case series were selected. Out of 90, 72 articles were related to current topic. All unpublished data were excluded.

**Prevalence of COVID-19 in Obese Patients**

The Covid-19 pandemic is rapidly spreading the world over, strikingly in Europe and North America, where weight is extraordinarily normal. Weight (BMI >30 Kg/m<sup>2</sup>) and genuine heftiness (BMI >35 Kg/m<sup>2</sup>) were accessible in 47.6% and 28.2% of cases, independently. When all is said in done, 85 patients (68.6%) required Invasive Mechanical Ventillation (IMV). The degree of patients who required IMV extended with BMI classes (p<0.01), and it was generally critical in patients with BMI >35 Kg/m<sup>2</sup> (85.7%). The odds

extent for IMV in patients with BMI >35 Kg/m<sup>2</sup> versus patients with BMI <25 Kg/m<sup>2</sup> was 7.36 (Simonnet et al., 2020). Besides, the rising regularity of obesity in the United States and related information on the impact of weight on mortality from H1N1 influenza should fabricate the affectability of clinicians pondering patients with chunkiness and COVID-19 to the prerequisite for compelling cure of such patients (Dietz and Santos-Burgoa, 2020). Americans have higher BMI than those from China—the ordinariness of obesity in the US was 42.4% in 2017-2018—yet Americans in like manner have a high weight of class III strength, with 9.2% of the masses with BMI >40 Kg/m<sup>2</sup>. This has certifiable repercussions for our human administrations system. Individuals with genuine rotundity who become debilitated and require heightened care (5% of defilements) present challenges in calm organization—more bariatric crisis center beds, all the all the more testing intubations, progressively difficult to get

an imaging examination (there are weight confines on imaging machines), dynamically difficult to position and transport by nursing staff (Ryan et al., 2020). From February seventeenth to April fifth, 103 patients were hospitalized with COVID-19. Among them, 41 patients (39.8%) were admitted to the ICU and 29 (70.7%) required IMV. The regularity of weight was 47.5% (49/103). In a multivariate assessment, outrageous robustness (BMI  $\geq 35$  Kg/m<sup>2</sup>) was connected with ICU assertion (Kalligeros et al., 2020). In a dataset of 265 patients (58% male patients), a colossal banter relationship was found among's age and BMI, in which progressively young individuals admitted to clinical facility will undoubtedly be fat. There was no differentiation by sex (p=0.9). The average BMI was 29.3 Kg/m<sup>2</sup>, with only 25% of individuals having a BMI of under 26 Kg/m<sup>2</sup>, and 25% outperforming a BMI of 34.7 Kg/m<sup>2</sup> (Kass et al., 2020). Similar results were observed by Cai and coworkers in a study conducted among 383 patients, (Cai et al., 2020).

In another study 200 patients were enrolled (female sex: 102, African American: 102), with an average BMI was 30 Kg/m<sup>2</sup>. The middle age was 64 years In this acquaintance of

hospitalized patients with COVID-19 of each a minority-pervasive commonalities, weight, extending age, and male sex were self-rulingly associated with higher in-crisis facility mortality and when everything is said in accomplished increasingly horrible in-clinical center results (Palaiodimos et al., 2020). A study was conducted to explore the relationship between obesity and COVID-19, both are pandemic worldwide. Statistical analysis showed that more patients with severe COVID were overweight and obese as compare to others and obese patients had more worst outcomes than non-obese. This study indicated that obesity aggravates COVID-19 (Yang et al., 2021).

### **Association of COVID-19 with Obesity**

The COVID-19 pandemic, includes in getting the consideration worldwide and it is presented by the extreme intense respiratory disorder coronavirus 2 (SARS-CoV-2) (Gao et al., 2020). In the pathogenesis of COVID-19 disease, obesity assumes a significant job. The insusceptible framework, which is official in the pathogenesis of COVID19, assumes a significant job in weight instigated fat tissue aggravation. In the fat tissue the irritation brings about metabolic brokenness conceivably prompting

dyslipidemia, type 2 diabetes mellitus, insulin obstruction, hypertension and cardiovascular sickness. Obesity has been expanded the vulnerability to contaminations (Kassir, 2020). Coronaviruses (CoVs), wrapped positive-sense RNA infections and there are gathering of infections in the human respiratory tract that can cause contaminations, which can be described clinically from delicate to untreatable. The extreme intense respiratory condition coronavirus 2 (SARS-CoV-2) is the infection capable. COVID-19 the worldwide spread can be portrayed the most exceedingly awful pandemic in humankind in the earlier century. Until this point in time, the infection COVID-19 has contaminated in excess of 3,000,000 individuals comprehensively and killed in excess of 200,000 individuals. This infection can be contaminated all the age gatherings, however progressively genuine sign that can likely bring about death are distinguished in more seasoned individuals and those with key ailments, for example, cardiovascular and aspiratory ailment. New information report progressively extreme side effects and even an unsafe expectation for the large patients. A developing assemblage of exhibit associate corpulence with COVID-19 and from invulnerable

framework movement the quantity of instrument decline to incessant aggravation are included. Lipid peroxidation makes responsive lipid aldehydes which in a patient with metabolic turmoil and COVID-19 will influence its expectation. At long last, pregnancy-related stoutness should be contemplated extra in connecting to COVID-19 as this disease could present high peril both to pregnant ladies and the baby. The relationship of corpulence with raised passing rates contrasted with non-fat individuals who have a common infection (H1N1) has been expressed. Another examination in 30 individuals with COVID-19 gave that patients BMI  $27.0 \pm 2.5$  show with increasingly serious indications when contrasted with patients with BMI  $22.0 \pm 1.3$  (Petrakis et al., 2020). It is turning out to be certain that few reasons put individuals living with higher weight at higher danger of the sickness. On April 17, 2020 the World Health Organization confirmed that those living with obesity has higher threat in danger of the illness (Finer et al., 2020). Utilization of large number of calories by the body leads to being overweight. This happens because of high sugar and fat enriched meals and decline in physical action. A few people may get discouraged, or not competent to do any type of activity and others

eating more nourishments with no exercises because of terrible updates on degree COVID-19, which might be the explanation of weight gain and getting corpulent (Abbas et al., 2020).

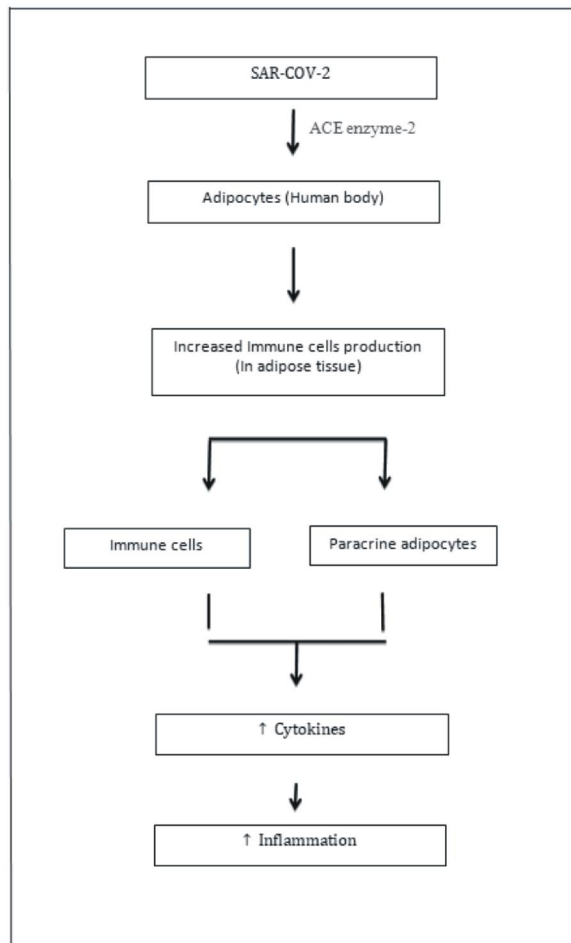
Individuals who have diabetes with obesity should ensure that they keep up great glycemic control, as it can help lessen disease hazard and seriousness. Individuals who are living with both obesity and type 2 diabetes may likewise require progressively ordinary blood glucose observing (using self-checking blood glucose gadgets, for instance) and medicine acclimation to keep up standard glycaemia to adjust to the new vitality necessities of diminished action and vitality consumption. Moreover, old people (>65 years) with type 2 diabetes were likewise bound to be influenced by COVID-19. The latest information from New York City shows that the variables most connected with hospitalization hazard were age and heftiness (BMI >40 Kg/m<sup>2</sup>), trailed by cardiovascular breakdown and ceaseless kidney malady. This investigation likewise found that increased weight was the most grounded chance factor for creating intense respiratory misery disorder and requiring intubation (Frühbeck et al., 2020). To characterize the relationship of obesity on COVID-

19, national or global review enormous scope clinical investigations of emergency clinic confirmations should be guided. A few such littler, or provincial, contemplates are on-going, showed that the most normal comorbidities spoke to in the extreme COVID-19 contaminated population are hypertension, obesity and diabetes (Samuels, 2020). The human angiotensin-converting enzyme 2 (ACE2) is reputed receptor for corona virus. ACE2 facilitates corona virus to enter the host body. ACE2 receptors are abundantly present in adipose tissues. Obese individuals with increased amount of adipose tissues contain significantly high number of ACE2. Increased ACE2 levels mean increased susceptibility to infection (Covid-19) (Bolourian and Mojtahedi, 2020). Certain pathways / molecules, hyper activated in obese hosts and shared with those in coronaviruses, could further rationalize the association of obesity with COVID-19.

A study was designed to find out the association between COVID-19 and BMI. Literature was searched from Embase database and Pubmed. Articles were searched on the basis of BMI, covid severity and mortality. Total sixteen studies were selected, out of which 9 studies showed a great

association between higher BMI and Covid-19 outcomes. Meta-analysis showed that patients with BMI greater than normal had severe covid-19 outcomes with p-value less than 0.001 (Soeroto et al., 2020). It has been studied that Coronavirus triggers an incommensurate immune response which leads towards a destructive systemic injury. This systemic injury causes more inflammation in obese as compare to others. The mechanism behind this

phenomenon is that immune cells produced as a result of injury accumulate in adipose tissues where these immune cells combine with paracrine adipocytes and produce a huge range of cytokines (Bhattacharya et al., 2020). Increased cytokines production in visceral adipose tissues cause systemic and pulmonary inflammation, as shown in Fig. 1 (Almerie and Kerrigan, 2020).



**Fig. 1: Mechanism of inflammation caused by SAR-COV-2s**

Mechanisms behind the association between obesity and COVID-19 are increased cytokines production (Dugail et al., 2020), altered mammalian target of rapamycin (mTOR) pathway, increased ACE2 receptors and destructive immune response. Obesity has been associated with poor pulmonary function and mechanical ventilation in patients with COVID-19. Along with COVID-19 obesity may lead toward other complications such as hypertension, CVD, diabetes and renal failure. That's why mortality rate in COVID patients is more among obese (Caci et al., 2020).

A study was conducted to find out effect of obesity on the progression of COVID-19. In this study total 95 patients were divided into two equal groups obese and non-obese group depending upon their Body mass index. Blood tests, clinical characteristics and chest computed tomography were collected for prognosis of disease. Statistical analysis showed that mortality rate was higher in COVID-19 patients with obesity. It was also observed that the rate of pulmonary changes were more common in obese group. Total lymphocytes, CRP, triglycerides, alanine aminotransferase (ALT), ESR and IL-6 levels were also increased in obese group as compare to

non-obese. Findings of this study indicated that obesity is a risk factor of Covid-19 and its progression (Kang et al., 2020).

### **Obesity and Immunity**

Coronavirus sickness 2019 (COVID-19) is most exceedingly terrible pandemic, has asserted >125,000 lives worldwide to date. Developing investigators for poor results incorporate propelled age, male sex, prior cardiovascular sickness, and the hazard factors, which are including hypertension, diabetes, and, all the more as of late, obesity is included the rundown. (Skalny et al., 2020). Considering the current pandemic of COVID-19 where no compelling preventive and helpful medication is accessible, the most significant weapon is a sound safe framework. There are a few nutrients and follow components which are vital for the typical working of the resistant framework. Supplementation of nutrients and follow components have demonstrated positive effect on upgrading insusceptibility in viral diseases. Supplementation has expanded the humeral insusceptibility of pediatric patients. When there is no pharmacological systems for counteraction or treatment are by and by accessible, for a viral sickness like COVID-19 and where the specific time

of the completion of this circumstance is obscure, nourishing approaches for improving insusceptibility is something to be investigated. In the current worldwide setting with constrained developments, it is hard to accomplish a reasonable and shifted diet. Accordingly, having suggested measures of calories and micronutrient will be a test and elective micronutrient supplementations might be useful particularly for vulnerable populaces, for example, the old (Ryan and Caplice, 2020). Late reports have introduced a solid relationship among obesity and the seriousness of COVID-19 disease, even without other co-morbidities. Subsequent to tainting the host cells, SARS-CoV-2 may cause a hyper-fieri response through the over the top arrival of cytokines, a condition perceived as "cytokine storm", while instigating lymphopenia and a disturbed insusceptible reaction. Heftiness is connected with interminable second rate irritation and insusceptible dysregulation, yet the specific systems through which it fuels COVID-19 contamination are not completely clarified, expanded measures of cytokines are created, for example, TNF- $\alpha$ , IL-1, IL-6 and MCP-1 lead to oxidative pressure and inadequate capacity of natural and versatile

insusceptibility, while the actuation of NLRP3 inflammasome appears to assume a basic job in the pathogenesis of the disease. The calming specialists are effectively utilized, for example, IL-1 and IL-6 blocker in comparable hyper-fieri settings like that of rheumatoid joint pain has set off the conversation of whether such operators could be administrated in chosen patients with COVID-19 ailment (Jayawardena et al., 2020).

Various nutrients (A, B6, B12, folate, C, D and E) and follow components (zinc, copper, selenium, iron) have been uncovered to have key jobs in supporting the human invulnerable framework and diminishing danger of diseases. Other basic supplements are additionally significant including different nutrients and follow components, amino acids and unsaturated fats. Every one of the supplements named above has jobs in supporting antibacterial and antiviral assurance, however zinc and selenium appear to be especially significant for the last mentioned. It would appear to be reasonable for people to devour satisfactory measures of fundamental supplements to help their invulnerable framework to assist them with managing pathogens should they become tainted. The gut miniaturized scale biota

assumes a significant job in instructing and controlling the safe framework, the element of sickness gut dysbiosis, including numerous irresistible maladies and has been portrayed in COVID-19. Dietary ways to deal with achieve a solid smaller scale biota can likewise profit the invulnerable framework. Serious disease of the respiratory epithelium can prompt intense respiratory misery disorder (ARDS), described by extreme and harming host irritation, and titled as cytokine storm (Korakas et al., 2020). Intense and constant respiratory sicknesses cause broad grimness and mortality, and this class of ailment presently incorporates the novel coronavirus serious intense respiratory disorder that is causing coronavirus ailment 2019 (COVID-19). The world is confronting a significant segment move toward a more established, hefty, and genuinely inert masses. Hazard factor appraisals dependent on pandemic information indicate that those at higher hazard for serious sickness from COVID-19 incorporate more seasoned guys, and individuals of any age with heftiness and related comorbidities, for example, hypertension and type 2 diabetes. Maturing all by itself prompts negative changes in natural and versatile resistance, a procedure called

immunosenescence. Stoutness causes foundational irritation and hurtfully impacts resistant capacity and host safeguard such that designs immunosenescence. The investigation of creature and human help the possibility that as opposed to high exercise remaining burdens, ordinary moderate-power physical action improves resistant reconnaissance against pathogens and diminishes dismalness and mortality from viral contamination and respiratory ailments including the normal cold, pneumonia, and flu. COVID-19 is certainly a reminder, a tocsin, to the world that essential avoidance countermeasures concentrated on wellbeing practices and cleanliness request our complete consideration and backing (Calder, 2020). Disappointedly, the specific pathophysiology and treatment, particularly for the extreme COVID-19, is as yet questionable. The consequences of beginning examinations have demonstrated that safe modulatory or insusceptible suppressive medicines, for example, hydroxychloroquine, interleukin (IL)-6 and IL-1 adversaries, generally utilized in rheumatology, may be considered as treatment decisions for COVID-19, especially in extreme illness. The expansion of better data about proper mitigating medicines, generally utilized

in rheumatology for COVID-19, concentrated on the auxiliary highlights of SARS-CoV-2, the host insusceptible reaction against SARS-CoV-2 and its relationship with the cytokine storm (Nieman, 2020). Obesity is a hazard and prognostic factor for the ailment seriousness and the prerequisite of cutting edge clinical consideration in COVID-19. Obesity has been associated with impeded invulnerable framework, expanding the vulnerability for 2019-nCoV disease (Nieman, 2020). Obesity is connected with metabolic unsettling influences that cause tissue pressure and brokenness. Large people are at a more serious hazard for incessant infection and regularly present with clinical parameters of metabolic disorder (MetS), insulin opposition, and foundational markers of constant poor quality irritation (Tamara and Tahapary, 2020). Typically, leptin is one of most suitable adipokines, in the focal control of vitality digestion and in the guideline of digestion resistant framework relationship assumes significant physiological jobs, being a foundation of the developing field of immune metabolism. Without a doubt, leptin receptor is communicated all through the safe framework and leptin has been shown to control both natural and versatile safe reactions (Andersen *et al.*,

2016). Leptin is truly one of most appropriate adipokines, with significant physiological jobs in the focal control of vitality digestion and in the guideline of digestion resistant framework transaction, being a foundation of the rising field of immune metabolism. Without a doubt, leptin receptor is communicated all through the resistant framework and leptin has been uncovered to manage both inborn and versatile invulnerable reactions (Francisco *et al.*, 2018).

### **Obesity and Inflammation**

Immunologically, weight is showed as a serious illness - of a ceaseless clinical condition that can influence the invulnerable reaction to irresistible ailments through immediate, circuitous and epigenetic systems. There are numerous follower cytokines and tissues (adipokines) that are delivered and discharged with respect to the quantity of instinctive fat tissue in the body. Serum amyloid-an is an adipokine discharged by adipocytes, which can act straightforwardly on macrophages to expand their creation of provocative cytokines, for example, tumor rot factor (TnF) -  $\alpha$ , interleukin (il) - 1, and il-6, nor do they stand up to. In fact, this article announced in detail that the vast majority of the adipokines included are non-fieri middle people. The creation of

obesity incised adipokine, for example, leptin/adiponectin builds insulin opposition in type 2 diabetes, which brings about powerlessness to distinguish and identify satiety leptin in the flawless core of the Mediobasal nerve center. Moreover, unfavorable impacts are seen, regardless of high-vitality stores, hunger, vitality consumption, exercise and vitality parity and focal insufficiency in the hippocampus - likewise, delayed iFn reactions during constant aggravation and obesogenesis incorporate compromise between the infection and weight. (Zhou et al., 2020). Coronavirus sickness (COVID-19) is a pandemic brought about by the most extreme coronavirus 2 (SARS-CoV-2) pestilence that has inundated the world, influencing more than 180 nations. Terrifically, there are a couple of significant hazard factors for genuine COVID-19 contamination. These incorporate the nearness of poor sustenance and non-transferable sicknesses (NCDs, for example, diabetes, interminable lung malady, cardiovascular ailment (CVD), stoutness, and different diseases that shield the patient from getting inoculated. These illnesses are described by fundamental aggravation, which might be a typical component of these

NCDs, influencing quiet results against COVID-19 (Zabetakis et al., 2020).

Several underlying alterations were observed in Covid-19 patients with obesity. Obesity causes alteration in pulmonary function (Popkin et al., 2020), sleep apnea, difficult mechanical ventilation and increases need of intensive care (Caussy et al., 2020). So obese individuals with covid-19 need more attention for treatment and prevention (Finelli, 2020). As per the World Obesity Federation, "weight related conditions seem to exacerbate the impacts of Covid-19 (SARS-CoV-2)"; moreover, the Centres for Disease Control and Prevention detailed that "individuals with coronary illness and diabetes are at higher hazard for SARS-CoV-2 issues and that heftiness puts them at higher danger of genuine sickness". Ongoing reports have demonstrated an expansion in cytokines because of expanded irritation in patients with SARS-CoV-2. Weight, then again, speaks to a condition of low-level injury, with an assortment of fiery items straightforwardly discharged by fat tissue (Michalakis and Ilias, 2020). A huge populace was put together examination with respect to the significance of wellbeing hazard factors (smoking, physical inertia, stoutness, and liquor addiction) COVID-19

utilizing companion information on the national clinic confirmation register. Members were 387,109 people ( $56.4 \pm 8.8$  yr; 55.1% ladies) living in England from a UK Bio bank study. Exercise, smoking, and liquor utilization, were evaluated by pattern poll (2006-2010). The weight record, from normal stature and weight, was utilized for the marker of all out corpulence. It was stated that an undesirable way of life related with a higher danger of non-transferable malady is additionally a hazard factor for admission to COVID-19, which may mostly be clarified by lower grade aggravation. Permitting a basic way of life change can lessen the danger of genuine contamination (Hamer et al., 2020). Continual aggravation, related with obesity and metabolic disorder, prompts anomalous cytokine creation and an expansion in antagonistic stage responses. Large patients have raised atomic transcript factor kappa B and high ribonucleic corrosive articulation of incendiary cytokines, for example, tumor corruption factor- $\alpha$ , interleukin-1, and interleukin-6 (IL-6), substances which are significant in the pathogenesis of metabolic disorder (Hotamisligil, 2006). The inborn safe reaction in patients with weight is modified and prompts a first line of guard, an expanded incendiary reaction, and a

strange T-cell reaction (Frydrych et al., 2018). Patients with high weight frequently have respiratory brokenness, described by changes in breathing examples, expanded protection from oxygen, poor gas trade and lower lung limit and muscle quality. Weight is additionally connected with an expanded danger of diabetes, coronary illness and kidney ailment, comorbidities that are considered to cause an expanded danger of renal disappointment. In any case, even without comorbidities of obesity, the immediacy of hypertension, dyslipidemia, prediabetes and insulin opposition may take a few people to cardiovascular occasions and increment the frequency of atherosclerosis, cardiovascular brokenness and disabled invulnerable capacity (Stefan et al., 2017). It is broadly realized that comorbidities, for example, hypertension, diabetes mellitus and CVD is related with a bigger COVID-19 course; weight has not been examined at this point. Obesity is a significant hazard factor for these comorbidities and particularly for the wellbeing of metabolic issue, (for example, dyslipidemia and insulin obstruction) and is connected to an expanded danger of lung infection. The estimation of anthropometric markers and metabolic

parameters is imperative to all the more likely evaluate the danger of inconveniences in patients with COVID-19 (Murugan and Sharma, 2008).

Corpulence along with lymphopenia, particularly whether specially influences to CD8 T-lymphocytes, are factors that can anticipate a poor visualization in patients with COVID-19 (Urrea et al., 2020). Aging appears to deliver a wide range of types of examples and various arrangements of obesity and age-related ailments among more seasoned grown-ups, free of their BMI, hypertension and lipid focus, an abatement in body work is obvious (known as safe senescence) prompting an expansion in speculation and shows progressively serious challenges contrasted and more youthful individuals; it shows a decay of capacity in both the obtained and inside insusceptible frameworks. In the older, numerous cells that produce cytokines / chemokines / adipokines and master incendiary go between because of irritation related harm are items inferred by ROS enhanced by lipid oxidation and development of lipid pontoons inside monocytes/macrophages. Aging is related with diminished T cell volume and number, T-cell capacity and all out number, less credulous T cells, more memory cells available for use,

thymicuterution and decreased thymic yield and inoculated T cells. The World Health Organization (World) has recognized COVID-19 episodes and corpulence as a 'worldwide wellbeing infection'. Clinical and clinical perceptions around the globe affirm that CoVs can cause increasingly serious indications and issues in individuals with corpulence related conditions (Bastard et al., 2006; Salanitro et al., 2012).

Obesity is viewed as an unfavorable factor in the negative impacts of COVID - 19. In any case, until this point, fat tissue has not yet been completely perceived as a significant COVID infection - 19. Intense respiratory disorder coronavirus (SARS - CoV) ties with angiotensin changing over chemical 2 (ACE2) receptor of intracellular intrusion, and the instrument of intense lung injury during contamination has been hypothesized to be transmitted inside through the renin - angiotensin framework (RAS). RAS barricade has been proposed as a potential treatment for COVID - 19 (Gurwitz, 2020). Surprisingly, ACE2 is communicated in human tumors. The ACE / angiotensin II/type 1 angiotensin 2 receptor RAS pivot of activity assumes a significant job in the pathophysiology of heftiness

and the instinctive adiposity hazard related with cardiovascular infection. Association between the ACE2 - RAS framework, fat tissue, and COVID - 19 may, at any rate, clarify the generally safe of injury and mortality hazard for COVID - 19 patients with corpulence. Be that as it may, the job of ACE2 - RAS in COVID - 19 stays to be explained (Malavazos et al., 2020). Obesity can limit oxygenation by intruding on the progression of the stomach, meddling with the invulnerable reaction to expert insusceptible maladies (Honce and Schultz-Cherry, 2019) causing diabetes and oxidant stress antagonistically influencing cardiovascular capacity. In people with the most elevated prevalence of weight, COVID-19 will influence a more prominent extent of the more youthful age than recently announced. Openly sending messages to youthful grown-ups, diminishing the boundary to viral screening in obese individuals, and keeping up a more prominent familiarity with these in danger populaces ought to decrease the spread of COVID-19 (Kass et al., 2020). Proof has risen as of late with respect to the expanded danger of genuine SARS - CoV - 2 disease in corpulent patients, particularly among youngsters. Obesity is a hazard factor for entrenched

respiratory illness, and the recently announced affiliation isn't unexpected. Seeing a portion of the linkages among weight and SARS - CoV - 2 is significant, as this can help the correct administration of immunomodulatory treatment, just as improve the qualification between the individuals who need basic consideration (Watanabe et al., 2020). Increased sodium intake is directly associated with Cardiovascular diseases. High-salts consumption also increases the production of free radicals in body and reduces ACE2 expression in kidneys. Reduced ACE2 expression is directly linked with progression of infection covid-19 and its severity (Bhattacharya et al., 2020).

### **Nutrition Management and Precautions**

In COVID-19, overweight and hefty patients have high danger of metabolic difficulties and ceaseless infections that stoutness works. More sustenance care is required for such patients (Ryan et al., 2020). Tolerant with COVID-19 create contamination from slight to serious indications bound to the dietary status. Consequently, assessing wholesome status of individuals with contamination turns out to be increasingly significant. Through dietary help, we can bring down the

danger of oxidative pressure, infection contamination and expands invulnerability framework (Laviano et al., 2020). Malnutrition is directly linked with prognosis and progression of Covid-19 and pneumonia. Both under-nourished and over-nourished individuals have equal chance of infection and its progression. Malnutrition basically causes alteration in immune function (Richter et al., 2021) which increases susceptibility to infection (Lidoriki et al., 2020). Poor dietary patterns can make worldwide weight of corpulence and diminishes physical exercises. This can be explained by: (1) increment admission of sugar, sodium, and fat. (2) More admission of high caloric eating regimen of a person. (3) Increase admission of ultra-handled food, for example, refined sugars causing change in insulin reaction, overabundance supplements stockpiling in muscle to fat ratio. (4) Ultra-handled food can changes in the cerebrum reward framework which causing addictive-like practices and overconsumption (Lidoriki et al., 2020). In addition, western eating routine (which contain bad fats that are high in cholesterol, more sugar content, salt content and diet decreased in good carbohydrates or starches, anti-oxidants containing foods, fiber and

micronutrients etc) can lead to intricacies. Wholesome administration for these patients turns out to be progressively basic in COVID-19 (Petraakis et al., 2020).

### **Nutrition Recommendations**

Patient nutritional needs are evaluating on the basis of body weight or BMI, physiological or psychological needs and severity of infection.

### **Energy**

As in COVID-19 more vitality required than ordinary. Keeping up vitality adjusted for heftiness and constant sicknesses is basic. As their metabolic burden is upset so low caloric can decreased the metabolic burden. Persistent with mellow to direct disease MNT includes the helpful job of essential, optional and early tertiary degrees of avoidance with the suggested measure of vitality target is 25-30 kcal/Kg/day while for fundamentally sick patients, MNT involves the gainful job generally tertiary degrees of counteraction for patients conceded in basic are with the suggested measure of vitality target will be reached to 30 kcal/Kg/day arranged in a perfect world. Standard ICU takes care of are arranged hypocaloric (0.8kcal/mL) for inception, advancing to iso-caloric (1kcal/mL) and hypercaloric (up to 1.5kcal/mL).

## **Fats**

For mellow to extreme and basically sick patients the suggested measure of fat are 25-30% of the all-out vitality, undeniably arranged thinking about fat ingestion and digestion. It is suggested that the day by day intravenous lipid (counting non-healthy lipid wellsprings) of fat is 1g/Kg, and the most extreme isn't more than 1.5 g/Kg, and it should be balanced by singular resilience for such patients which have imbalanced of intravenous infusion of fat can prompt lipid overburden and harmfulness causing hypertriglyceridemia and unusual liver capacity. To improve oxidative use of unsaturated fats utilization of medium and long chain unsaturated fats is liked. Utilize monounsaturated unsaturated fats and for the most part omega-3 unsaturated fats are utilized for basic sick patients. It can diminish the danger of disease and make quick recuperation. Omega-9 unsaturated fats ought to be suggested (olive oil) in light of the fact that have elements of safe unbiased impacts and furthermore less obstruction with haemo-elements, endothelial cell work, safe capacity and liver capacity.

## **Fluid and electrolyte balance**

To keep up liquid and electrolyte adjusted (Sodium, calcium, potassium,

chloride, phosphate, and magnesium), the "Four-Anti and Two-Balance" technique characterized as antivirus, hostile to stun, against hypoxaemia, against optional disease, and keeping up of water, electrolyte and corrosive base equalization and microecological balance is a powerful treatment methodology. Suggested measure of liquid treatment are 30 to 40 mL/Kg/day balanced regarding internal heat level, aspiratory oedema, renal brokenness and liquid aggregation. For stable patients in ICU: 30 mL/Kg/day of liquid for grown-up and 28 mL/Kg/day for older (Gupta et al., 2020).

## **Protein**

It is suggested 1.3 g/Kg/day expanding the gracefully of stretched chain amino acids to half. Tolerant with ceaseless entanglements, for example, corpulence or renal issue properly lessen protein admission to 0.8-1.0 g/Kg/day. Great protein quality with expanded chain amino acids (BCAA) supplements, whey protein and other creature proteins ought to be incorporated. In serious conditions supplemental intravenous amino corrosive imbuelements required and furthermore withstand positive protein balance.

## **Carbohydrates**

Fat and sugars are acclimated with vitality requirements although seeing a vitality proportion through fat and starches among 30:70 (without breathing insufficiency) to 50:50 % (critical condition patients) with nonstop unique observing and upgrading blood glucose levels. Constrained organization of sugars in basic sick patients the starch prerequisite is 2 g/Kg/day and must not surpass 150 g for each day (Romano et al., 2020).

## **Micronutrients**

For all degrees of anticipation in COVID-19 patient different micronutrient supplementation, other than vitamin A, B, C and D and omega-3 polyunsaturated fats, just as selenium, zinc and iron are suggested.

## **Vitamin D**

Patient with stoutness and furthermore have COVID-19 may add to vitamin D lack (<20 ng/mL) and additionally connected with number of various viral sicknesses and end of the week safe framework also. The organically dynamic type of vitamin D (1,25-dihydroxyvitamin D/calcitriol) has been related in different fiery, irresistible, and pneumonic maladies. Nutrient D through daylight presentation, certain eating bases may

give a specific measure of vitamin D, containing the sustained grains and dairy products. The objective ought to be to increase the groupings of 25(OH)D over 40–60 ng/mL (100–150 nmol/l) by thinking about taking 10,000 IU/d of vitamin D3 for half a month to quickly increase 25(OH)D focuses, trailed by 5000 IU/d for individuals in danger of COVID-19.

## **Vitamin A**

Vitamin A is hostile to infective nutrient and capacity to have body resistances against disease. The advancement of mucins and keratins, lymphopoiesis, apoptosis, cytokine articulation, counter acting agent creation, and the upgraded elements of neutrophils, regular executioner cells, monocytes or macrophages, T cells, and B cells are the insusceptible supporting jobs of vitamin A.

## **Vitamin C**

Vitamin C has insusceptible tweaking impact and it can diminish complexities. In basic sick patients constrained proof shows that high-portion vitamin C (3~10 g/d) intravenous infusion might be helpful to lessen mortality, cut the utilization of promoter drugs and mechanical ventilation time, and incorporate intense respiratory trouble.

## **Selenium**

Selenium has cancer prevention agent property and through cell reinforcement it can assume a basic job in the barrier against viral disease, redox flagging, and redox homeostatic commitments. A few selenoproteins are glutathione peroxidases and thioredoxin reductases decline the pathogenicity of a few infection contaminations.

## **Zinc**

For typical capacity and improvement of cells controlling vague invulnerability, including characteristic executioner cells and neutrophils zinc is a basic micronutrient with enzymatic and the translation guidelines capacities acted in the human body. Advancement of gained invulnerability by restricting together the definite and development elements of T lymphocytes containing the creation as well as actuation of Th1 cytokine adjusts by zinc lack. Zinc has hostile to viral property and improves invulnerable reactions. In this way, the utilization of 50 mg zinc daily might give a defensive job in contradiction of the COVID-19 pandemic (Gasmi et al., 2020).

## **Supplements**

Oral wholesome enhancements (ONS) ought to be utilized if there is patient need raised. ONS will give in

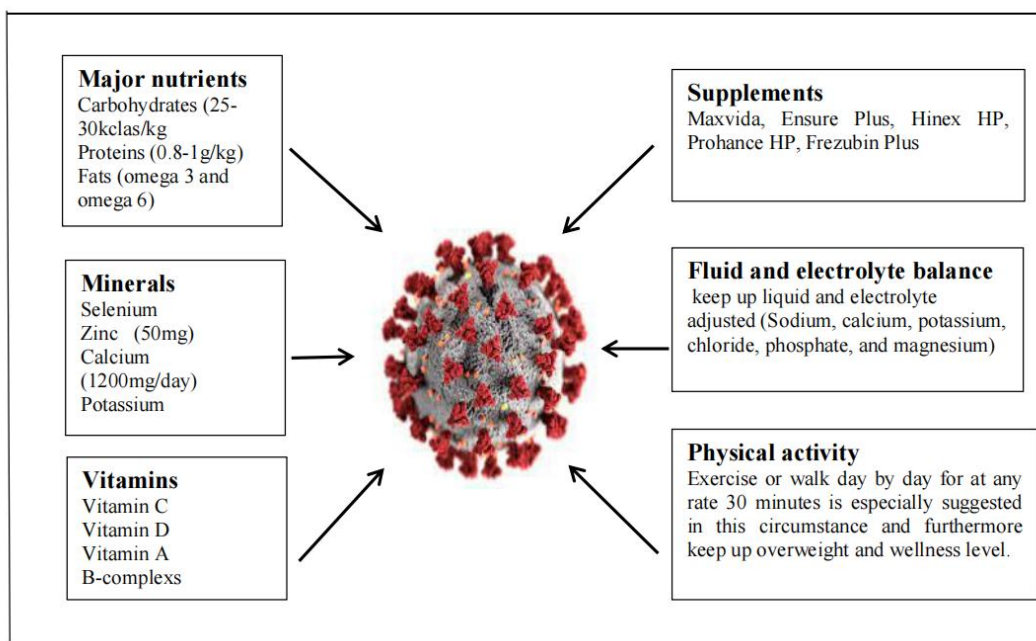
any event 400 kcal/day containing 30 gram or else a greater amount of protein per day and will be there proceeded on behalf of in any event one month (Barazzoni et al., 2020). Maxvida, Ensure Plus, Hinx HP, Prohance HP, Frezubin Plus are different healthful enhancements with fatty, high protein and wealthy in micronutrients joined with oral eating routine just as utilized in EN. These enhancements are all calorie-supplement thick details, planned explicitly for addressing nourishing requirements of fundamentally sick patients. Additionally probiotics and prebiotics with wholesome help supplemented may assist with improving gastrointestinal capacity, manage the parity of intestinal miniaturized scale biota, and defeat the danger of auxiliary contamination in light of bacterial translocation in this way boosting resistance.

## **Physical activity**

Being genuinely dynamic and should exercise or walk day by day for at any rate 30 minutes is especially suggested in this circumstance and furthermore keep up overweight and wellness level. Expansion of dietary fiber and supplements in your eating routine controlling the vitality digestion can help in weight the board just as decrease of glycaemic spikes.

- During shopping for food keep up a separation of in any event 1 meter from others.
- Don't touch face in the wake of interacting with outside articles.
- Wash products of the soil, milk parcels before use.
- Limit exceptionally prepared nourishments.
- Ensure safe cooking rehearses at home.
- Wash hands oftentimes with cleanser and water extraordinarily before giving crude, cooked.
- Always wash utensils and plates before use
- Avoid giving food on the off chance that you are sick.
- Refrigerate left-over food right away.
- Keep sanitation as a main priority while putting away food (Gupta et al., 2020).

Obesity and covid-19 epidemics can also be reduced by improving food industry. As it has been explored that food industry is one of the main reasons behind obesity pandemic (Robinson et al., 2021). During this covid-19 pandemic, food industries promoted the production of unhealthy ready to eat foods for their own profit. Food industries promote processed foods consumption, loaded with sugar, salts and empty calories (Roganović, 2021). These processed foods also increase obesity and susceptibility to infection. Food industries should prohibit the production of unhealthy foods and drinks. Governments around the world must stop the unhealthy foods productions at industry level and must ensure food security/food availability for all (Tan et al., 2020).



**Fig. 2: Medical nutrition therapy for COVID-19**

## CONCLUSION

The effect of obesity on COVID-19 is not yet clearly visible but severity of disease is noticed in the patients with obesity or severe obesity. Infection spreads rapidly in obese patients as compared to the one with healthy weight. Obesity along with other metabolic disease increase inflammation and cause hindrance in recovery. Presence of fat tissues in obese person also reduces the immunity level. Studies show that the disease get severe with the increase in BMI. Obesity can be counted as a risk factor for COVID-19 and obese patient needs extra care, attention and preventive measure to fight with this pandemic.

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