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Nutrition Crisis in COVID-19

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Abstract

Ever since the new corona virus pandemic outbreak, a plethora of research studies on nutritional aspect have been conducted and published. This review considers how malnutrition across all its forms of undernutrition, micronutrient deficiencies and overnutrition may influence both susceptibility and progression of, COVID-19. Relevant Papers were identified from Science Direct, Google Scholar and pubmed by using all combinations of the search terms related to COVID-19 and immunonutrients.

Key-words: COVID-19; Malnutrition; Immunonutrients.

Key Messages (Provide appropriate messages of about 35-50 words to be printed in centre box): The elderly are considered one of the most heterogeneous and vulnerable groups, with an increased risk of imbalances, deficiencies and nutritional problems. The consequences of malnutrition in the group result in an increase in the prevalence of infections, longer-stay hospitalizations and increased morbidity and mortality.

Introduction

The Covid 19 pandemic has largely affected the survival rate, health and nutrition of many due to the breakdown in economic machinery worldwide. COVID19 has led to many nutrition-related theories, some of them backed by a biased interpretation of evidence. Areas of interest include the role of macronutrient intake, gut microbiota, dietary fibre, B vitamins, other minerals, phytochemicals, and carotenoids.[1]

Malnutrition

Body composition, decrease in lean body mass and high fat, are consistently linked to decrease in prognosis rate in many different diseases. Malnutrition results in an increase in the prevalence of infections, longer-stay in hospital and increased morbidity and mortality.[1] Elderly individuals and patients with comorbidities like obesity, diabetes, and hypertension show a higher risk of hospitalization, severe disease, and mortality due to acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. There are many standards for assessing nutritional status in the elderly population, though the method recommended by the European Society of Parenteral and Enteral Nutrition (ESPEN) is the Mini Nutritional Assessment (MNA). The MNA is the method most commonly used for assessing the nutritional status of older people.

There are 2 major forms of PEM—kwashiorkor and marasmus. Even with an adequate caloric intake protein inadequacy in the diet, is the major cause of kwashiorkor, Where as consumption of insufficient protein and calories are known to be responsible for marasmus. Few studies, however, have linked these 2 major forms of PEM to higher incidence of infection and mortality.[2]

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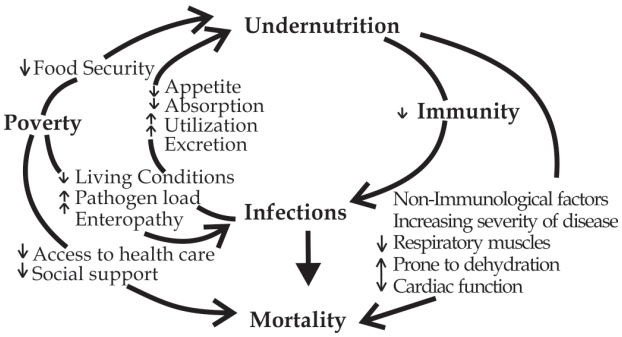

Fig. 1: Viscious cycle of Under Nutrition.

Even though there is no current published data on the effect of PEM on the susceptibility and disease progression of SARS-CoV-2 infection in children, studies on other RNA viral infections suggests that undernourished children (Fig-1)are likely to have more severe respiratory and gastrointestinal disease. Protein energy malnutrition is an important cause of immune deficiency through out the world. and resuls in vicious cycle of infection (clinical and sub-clinical).

A hospital in China recruited 182 elderly inpatients with COVID-19 for study to evaluate the nutritional status using the Mini Nutritional Assessment (MNA). Based on MNA scores the study found that the prevalence of malnutrition was high in elderly patients with COVID-19. The study concluded that nutritional support to be strengthened during treatment, especially for those with diabetes mellitus, low calf circumference, or low albumin.[3]

Body weight and diabetes

The role of overweight (body mass index (BMI) = 25.0–29.9 kg/m2) as in particular obesity (BMI ≥ 30 kg/m2) in predisposition to respiratory tract infections (RTIs) constitute an important morbidity factor in our society and also leads to considerable cost in economic terms. The study confirmed association between obesity and RTI.

A continuous low-degree inflammation occurs in obesity .It is considered as the major reason towards the progression to insulin resistance and type 2 diabetes. In lean subjects the immune environment is non-inflammatory. The adipose tissue is infiltrated by pro-inflammatory macrophages and T-cells, leading to the accumulation of pro-inflammatory cytokines like interleukins and TNF-α. A decrease in plasma vitamin C levels has been observed in type 2 diabetes by many studies. This may be reason behind major cause of increased need for vitamin C in type 2 diabetes and reason behind high level of oxidative stress caused by hyperglycemia.[4]

Genetic evidence in line with cardiovascular perspective trial studies has proved obesity (and excess fat mass) as an important cause for hypertension, diabetes mellitus, coronary heart disease, stroke, atrial fibrillation, renal disease, and heart failure. It is considered as single most and important risk factor for severe COVID-19

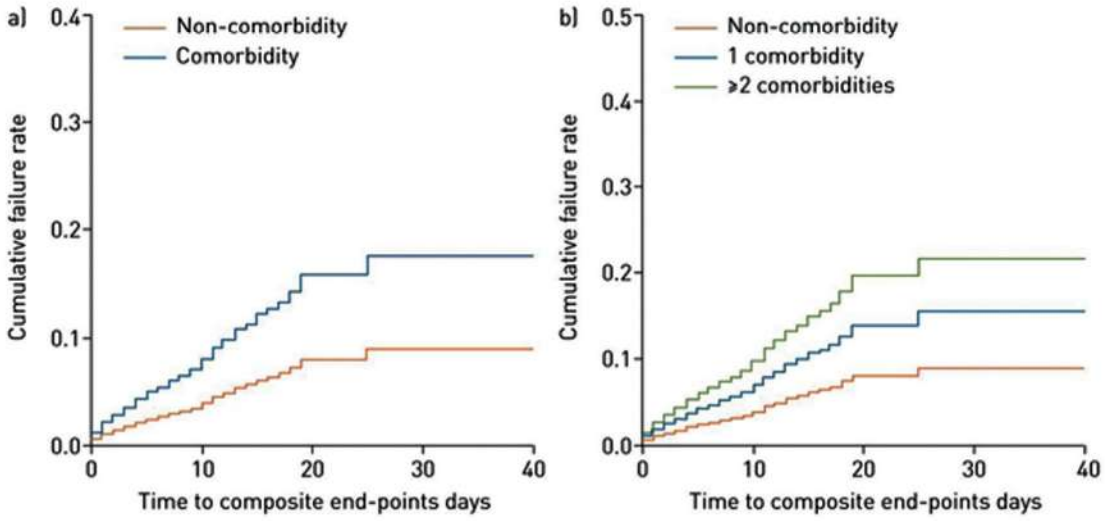

Fig. 2: Comorbidity among COVID-19 patients.

Source-Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis.Wei-jie Guan, Wen-hua Liang, Yi Zhao, Heng-rui Liang, Zi-sheng Chen,et.al. European Respiratory Journal May 2020, 55 (5) 2000547; DOI: 10.1183/13993003.00547-2020

infection, Obesity reduces protective cardio respiratory reserve and initiates the dysregulation of the immune system. In general the integrated metabolic regulation required for complex cellular interactions, and host defense mechanism is lost thus leading to immune deficit.

Diabetes is supposed to be a common comorbid condition (Fig. 2) among COVID-19 patients with poor outcomes. Hyperglycaemia in patients with and without a history of diabetes can indicate a poor recovery rate. A retrospective study by Wang et al on COVID-19 patients who underwent an HbA1c test during admission found High HbA1c level and associated with inflammation, hypercoagulability, and low SaO2.[5]

Antioxidants

During severe COVID-19, the SARS-CoV2 virus can induce a strong host immune response. This can result in the production of high levels of free radicals by both macrophages and neutrophils and induces severe oxidative stress leading to protein and lipid oxidation . Increased levels of oxidative stress pre-exist in individuals with co-morbidities such as obesity, diabetes and cardiovascular disease,and may play a role in increasing the risk of severe COVID-19.

Antioxidants decrease oxidative stress.They are present in the form of Endogenous antioxidants as glutathione, Vitamin A, C, and E. Dietary antioxidants of enzymatic co factors are selenium and zinc. Nutritional supplements are fruits, vegetables, green tea, olive oil etc.

Epidemiological studies and in vitro evidence suggest that levels of endogenous antioxidants and increased consumption of dietary antioxidants may decrease inflammation and oxidative stress, particularly in patients with co morbid conditions.[6]

Vitamin C

Vitamin C has a number of activities that contributes to its immune-modulating effects. It is a highly effective antioxidant, because of its ability to readily donate electrons, It helps protect important biomolecules (proteins, lipids, carbohydrates, and nucleic acids) from damage by oxidants produced during normal cell metabolism and during exposure to toxins and pollutants (e.g., cigarette smoke).

Vitamin C stimulates neutrophil migration to the site of infection, enhances phagocytosis and oxidant generation, and microbial killing. It protects host tissue from excessive damage by increasing neutrophil apoptosis and clearance by macrophages, and decreasing neutrophil necrosis. Thus, vitamin C is necessary for the immune system to provide adequate response against pathogens, while reducing excessive damage to the host.[7]

Vitamin A

It is essential in maintaining epithelial tissue integrity, when they are severely damaged in viral infections such as measles. Vitamin A is recommended mainly to reduce mortality and risk of complications from pneumonia, and ocular problems.. This can be done by correcting the low or depleted retinol levels that usually occurs in measles infection. Serious COVID-19 caused by SARS-CoV-2 infection has some similar manifestations to measles with symptoms of e fever, cough and pneumonia.

The reason for using anti-inflammatory or antioxidant nutrients in COVID-19 patients in this trial is to modulate the cytokine storm associated with the disease on the lungs.[8]

Vitamin E

Vitamin E is the overall term for four tocopherols (α-, β-, γ-, and δ-tocopherols) and four tocotrienols (α-, β-, γ-, and δ-tocotrienols) found in food. All these forms have antioxidant activities, but they cannot be interconverted, The. α-tocopherol form of vitamin E can only meet the human vitamin E requirement .

Dietary interventions of vitamin E has proved to enhance cell-mediated and humoral immune responses in various species of animals. Many of the following improvements as increased lymphocyte proliferation, immunoglobulin levels, antibody responses, natural killer (NK) cell activity, and interleukin (IL)-2 production have been reported with vitamin E supplementation.[9]

Vitamin D

Vitamin D can reduce risk of infections by inducing cathelicidins and defensins that can lower viral replication rates and reduces concentrations of pro-inflammatory cytokines that produce the inflammation . They may injure the lining of the lungs, leading to pneumonia, and increase the concentrations of anti-inflammatory cytokines.[10]

Zinc is the second-most abundant trace metal in the human body after iron, and an essential component of protein structure and function. Importantly, zinc is a structural constituent of ~750 zinc-finger transcription factors enabling gene transcription,

and is a catalytic component of approximately 2000 enzymes, comprising of 6 classes (hydrolase, transferase, oxido-reductase, ligase, lyase, and isomerase). Hence, zinc is biologically essential for cellular processes, including growth and development, zinc is important in DNA synthesis and RNA transcription . Aged individuals are also significantly more susceptible to zinc deficiency, increasing their likelihood of acquiring life-threatening viral infections.[11]

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