

A Presentation on the COVID-19 Pandemic: Diet as an Adjunctive Therapy for Critical Ill Patients

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Abstract

Corona virus going globally affected a large population mostly with compromised immune systems including elder peoples or people with chronic medical conditions along with poor nutrition status. This study highlights the importance of nutritional therapy to improve the effectiveness of treatment and promotion of rehabilitation of sick patients along with reduction in mortality. Recommendations in this paper help to improve the nutrition management among the critical ill patients based on the individual's nutritional screening, metabolism, nutritional choices and approaches to healthy nutritious diets to boost up their immunity.

Keywords: Corona virus • COVID-19 • Diet • Nutrition • Immunity

Introduction

Corona viruses are a large family of viruses that cause respiratory infections [1]. These can range from the common cold to more serious diseases such as severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). Coronaviruses are also said to be zoonotic, meaning they are transmitted between animals and people. Coronavirus disease 2019 (COVID-19) is a respiratory illness that can spread from person to person [2]. The virus is large so it does not settle in the air but on surfaces. On a metal surface, it will live for 12 hours on fabrics, 9 hours on the hands, 2 hours. The virus cannot survive when exposed to a temperature of 26-27°C having incubation period of 2-14 days [3].

Coronavirus affects all ages and gender but common in older people, probably because of decreased immunologic response to infection and the metabolic alterations associated with aging. The virus that causes COVID-19 is a novel coronavirus that was first identified during an investigation into an outbreak in Wuhan, China. Coronaviruses were first identified in the 1960s. People most at risk of getting the virus are those who have: recently travelled overseas, particularly to high risk countries, been in close contact with someone who has a confirmed case of COVID-19 [4].

Mode of transmission

Direct transmission: respiratory droplets produced when an infected

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person coughs or sneezes. Indirect transmission: by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly their eyes, but this is not the main way the virus spreads. By touching an infected person's hands/face or by touching things such as doorknobs that infected people have touched [5].

Clinical features

Signs and symptoms include; fever, shortness of breath, sore throat, muscle ache and fatigue while with less common symptoms of headache, diarrhea and coughing of blood [6].

Behavioral preventive strategies includes; avoid close contact with people who are sick, avoid touching your eyes, nose, and mouth with unwashed hands, wash your hands often with soap and water for at least 20 seconds [6].

Natural ways of boosting immunity by self-care, use an alcohol-based hand sanitizer that contains at least 60% alcohol if soap and water are not available, thoroughly cook meat and eggs, avoid close contact with anyone showing symptoms of respiratory illness such as coughing and sneezing, disinfection and regular cleaning of surfaces, regular washing of dirty clothing, exposure to the sun for at least 2 hours, put sanitizer in your pocket or bag always, drink hot water regularly, gargle of warm and salt water, avoid clouded places, leave one step or 1 meter from a person with the signs of the condition, avoid hand shake, wipe and disinfect your phone with sanitizer, avoid contact with live animals and pets, avoid traveling to corona virus infected places or countries [7].

Lifestyle modifications include stress reduction therapies because stress indirectly changes the immune system and make you sicker [8]. Take proper sleep-turn of your gadget screens, check that room is quiet and cool because these healthy habits having a great influence on person immune system [9]. Do moderate physical activity on daily basis to improve the physical and cognitive resilience. Multiples studies show that daily intake of round about 10 servings of brightly color fruits and vegetables in your diet boost your immunity better than supplements [6].

Specific metabolic changes occurs in the COVID-19 patient including rapid glucose breakdown, increase in blood plasma glucose, insulin resistance, slower energy supply, higher production of energy from the non-carbohydrate sources. Increased protein breakdown, decreased muscle protein synthesis, and altered amino acid profile: including decreased branched chain amino acid (BCAA) concentrations while the higher rate of fat metabolism and higher the consumption of vitamin and minerals including trace minerals [10].

Patient energy requirements increases due to higher energy consumption due to some factors like breathing, mechanical ventilation, and fever. Presence of metabolic disorders, impaired glucose utilization, increase fat and protein catabolism result in negative energy metabolism [11].

There is also poor enteral intake due to poor appetite, shortness of breath, diarrhoea, nausea, vomiting and other gastrointestinal dysfunction that is more common in the bedridden patient which leads to loss of nutrients and cause malnutrition [12].

Nutritional assessment of patient

By using NUTRIC score (NRS 2002); grading show the patient status either they are at low or higher risk of malnutrition. Grading ≤ 2 ; stable and remain isolate and continue balance, small and frequent meals, grading ≥ 3 ; patient is at risk of malnutrition; grading ≥ 5 or NUTRIC score ≥ 5 , patient is at high risk of malnutrition, early nutrition intervention is required; for those patients which are at higher risk their nutrition assessment advised to be repeated for every 3 days [2,13].

Nutrition intervention for COVID-19

In the early stage we should not exceed feeding requirements of the patients from the 70% due to stress such infection for that must try to allow low calories (<50% of the required feeding amount that is 10-15 kcal/kg/day) [14]. Within 3-7 days there should be gradually increase in person energy intake after the patient stabilized [15-17].

Caloric requirements for group of obese people are 25-30 kcal/kg (ideal body weight). Estimation of ideal body weight for male; male ideal weight, kg=height, cm-105 while for female; female weight, kg= (height, cm-100) \times 0.85. Obese group (BMI 30-50), morbid obese (>50 BMI) were having to 11-14 kcal/kg and 22-25 kcal/kg of their body weight [18,19]. For glucose; 3.4 kcal/g, glycerol/glycerol; 4.3 kcal/g while for fatty acid propofol 1.1 kcal/ml [14,18].

Protein intake should be must 25-30% of total energy requirements. Non-obese, obese, morbid obese were having to 1.2-2.0 g/kg (ideal body weight), 2 g/kg (ideal body weight), 2.5 g/kg (ideal body weight) of protein daily intake [19]. For kidney patient protein intake must be reduced it should be 1.2-2.0 g/kg (ideal body weight). To reduce muscle wasting, improve strength of respiratory muscles and promotion of cough and expectoration there should be increase in HBV protein intake branch chain amino acids (50% from the animal source). Up to 35% of supplemental intake of branch chain amino acid not only improve the insulin resistance but also appreciably inhibit the muscle breakdown and enhance the efficiency of interferon [17].

Fat intake should be 25-30% of total energy requirement [20]. Due to some changes in the fat absorption, fat metabolism, excessive intravenous injection of fat can leads overloading and toxicity of lipid that cause hypertriglyceridemia in the critical ill patients on parental nutrition. It is recommended that intravenous lipid should be 1g/g and not exceed more than 1.5 g/kg, adjust the dose accord to the tolerate level of the patient [20].

Patients on enteral nutrition must have to increase the intake of essential fatty acid through a variety of cooking vegetables oils, especially monounsaturated fatty acid vegetables oils. Patient on parental nutrition must have to increase the intake of medium and long chain fatty acids. The usage of soybeans oil intravenously fat emulsion should not be recommended while the omega 3 fatty acids has lower risk of infection in the critically ill patients, so it is recommended that increase the intake of fish oil (omega 3 fatty acids). It is also recommended to increase the intake of olive oil that contain omega 9 fatty acids that having immune boosting effect, also improve the endothelial function, immune function and liver function [17].

Glucose-lipid ratio; too much glucose in the blood cause hyperglycaemia that results in higher production of CO₂, increase fat synthesis and increase the insulin requirements. For critically ill COVID-19 patients; actively monitor the blood glucose level and should be controlled between 7.8-10.0mmol/L [17]. For this purpose carbohydrates intake should be 2 g/kg in the form of glucose and it is suggested to reduce the glucose-lipid ratio to (50-70):(50-30) [20]. To decrease the patient complication, mortality and infection complication normoglycemia is required, if the blood glucose is consciously <20mmol/L, insulin infusion pump is recommended till the normal blood glucose level is achieved [21].

Fluid requirements

Fluid requirements should be 30-40 mL/kg for stable patient. There is supplemental fluid intake 3-5 mL/kg is required when there is rise in 1°C in the body temperature. Minimum fluid intake should be given on the base of nutritional requirements and fluid output from the boy of the individual [17].

Vitamins and trace minerals: Intake should be based on RNI [18]. Multiples studies shows that higher dose of intravenously vitamin C (3-10 g/day) reduce the patients stress and infection, refuse the drug used and mechanical ventilation period and found as effective in acute respiratory distress disorder caused viral infection [17,22]. In the critical ill patients along with adverse clinical outcomes including higher mortality and infection rate were found vitamin D deficient [15]. Intake of Vitamin D (500000 UI) can be given at one time after one week of the admission in the intensive care that result in improvement in the ventilation and decrease the patient stay in the hospital. In the hospitalized critically ill patients due to refeeding syndrome, development of hypophosphatemia (blood phosphorus ≤ 0.5 mmol/L) occurs [19]. Therefore it is recommended to closely monitor the patient's serum phosphate concentration and give appropriate amount of phosphate supplements till the need (Table 1) [13,19,23,24].

Table 1. Micronutrients recommended amount for parental nutrition.

	Name	Recommendations
Vitamins	Vitamin B1	6 mg
	Vitamin B2	3.6 mg
	Vitamin B3	40 mg
	Folate	600 mcg
	Vitamin B5	15 mg
	Vitamin B6	6 mg
	Vitamin B12	5 mcg
	Biotin	60 mcg
	Vitamin B6	6 mg
	Vitamin C	200 mg
	Vitamin A	990 mcg
	Vitamin D	5 mcg
	Vitamin E	10 mg
	Vitamin K	150 mcg
Minerals	Sodium/potassium	1-2 mmol/kg
	Calcium	10-15 mEq
	Magnesium	8-20 mEq
	Phosphate	20-40 mmol
Trace elements	Chromium	<1 mg
	Copper	0.3-0.5 mg
	Manganese	55 mcg
	Selenium	60-100 mcg
	Zinc	3-5 mg

Frequency and specific monitoring program recommendations: Effects of nutritional approaches and other adverse reaction should be closely monitored during the patient admission by; achievement of enteral/parenteral nutrition program, completion of biochemical indicators such as routine blood test, anthropometric measurements, gastrointestinal symptoms like nausea, vomiting, diarrhoea as mention in Table 2 [11,25].

Immune system has a vital role. It protects your body from harmful substances, germs and cell changes that could make you ill". Immunity booster foods support your body's greatest defence against most of the Viruses and bacteria. As per WHO, the virus is more likely to affect people with less immune system [26].

Nutrients recommendations for critically ill patient to support immune system

- Get plenty of sleep. Our immune system does the heavy lifting when we are sleeping. Get a minimum of 7 & 1/2 hours of sleep [27].
- Zinc - If you are even minimally deficient your immune system is at risk for not being able to clear pathogen. Mushroom is a major source of immune system boosting mineral Zinc. If you don't have enough zinc in your diet tends to have fewer white blood cells to keep fight off disease, which can lead to a reduced immune response [28].
- Vitamin A is highly antiviral and many cases can prevent entry of viruses into the cells. (Be careful if you are pregnant or at risk of becoming pregnant; supplementing with Vitamin A can cause birth defects if the dose is too high). Coconut is a great source of beta carotene which supports the body's mucus membrane, which lines the respiratory and intestinal tract, making harder for bacteria it enters the blood stream [6].
- Vitamin D - It's highly utilized in making the nasty enzymes that the

neutrophils make to liquefy the pathogens once it eats them. It is good to be reminded about the critical role of good bacteria in immunity-building. Get your daily dose from dahi, lassi, buttermilk, raita and fermented foods [29,30].

- Reishi mushroom, also known as Ganoderma can really boost your immune system to protect you against invaders without causing an increased risk of autoimmunity [6].
- Vitamin C can help fight a viral infection by causing oxidative bursts to kill the pathogen in the blood (Sangani et al., 2015). The citrus fruits of the season, figs, dates, pear, apple, pomegranate and raisins, should be included on the menu whenever possible. Gooseberry (Amla) contains Vitamin C that helps to boost the immune system. The amount of Vitamin C in amla is equal to that of 20 oranges. Kale contains high levels of Vitamin C, which helps to fight off infection and regenerate other antioxidants in the body [31,32].
- Eating soluble fiber boosts the production of a protein (interleukin-4), which in turn stimulates the infection-fighting cells (T-cells) in the body. In the digestive tract, soluble fiber undergoes fermentation, and upon reaching the large intestine, it is broken down by the gut bacteria into short-chain fatty acids (SCFA), which enable the movement of immune cells. Fruits, veggies, seeds, dals, etc. are good sources of soluble fiber. Legumes and dals, particularly those with the outer covering intact, such as channa, mash, lobia, soy, beans and peas, are of great value [33].
- The tulsi, neem and curry leaves are valuable additions. Other leafy vegetables are also of great value. Black pepper, cinnamon and fenugreek are other spices of immense value [34].
- Black cumin seeds (kalonji) and its oil have been described by scientists as nourishment for the immune system. Cinnamon- It is

Table 2. Approaches to monitor the critically ill patients.

Monitoring category	Point description	Recommended frequency
Nutrition program completion (oral eating, enteral nutrition, parenteral nutrition)	Assess actual nutrient intake, adjust unreasonable nutrition plans in time, and promote a smooth transition between the five steps.	1 time daily.
Biochemical Indicators	Blood routine, liver and kidney function	Albumin and pre-albumin in liver function are commonly used nutritional indicators, and conditions can be monitored such as transferrin, retinol binding protein and other indicators. Routine can be 1 to 2 times a week, and those with liver and kidney failure will increase the frequency accordingly.
	Electrolyte	Including blood phosphorus, blood potassium, blood calcium, blood sodium, blood magnesium, blood chlorine, etc.; electrolytes need to be monitored before and during nutritional support to prevent refeeding syndrome; PN support and CRRT treatment need to strengthen monitoring. Monitor once every 1-2 days.
	blood sugar	Both hypoglycemia and hyperglycemia are associated with poor prognosis and mortality, and patients with diabetes need to be monitored especially. Feeding starts every 4-6 hours within 24 hours of feeding, and at least twice daily during the later period. People with unstable blood sugar should be more frequent.
	Blood lipids	Including triacylglycerol, cholesterol and so on. 2 times a week.
	Body mass measurement	It is used to help judge the effect of nutrition intervention; BMI<18.5 kg/m ² , indicating the presence of malnutrition. Once a week.
Gastrointestinal Symptoms	Bowel sounds, diarrhea, bloating, abdominal pain, nausea, vomiting, reflux, etc.	Reflect EN-supported gastrointestinal tolerance. 1 time daily.
	Gastric residue (GRV)	Used to assess gastrointestinal dysfunction and tolerance to EN support, to prevent reflux and aspiration. For short term drainage (such as 15 min), GRV>250 mL is considered to have a high residual amount. Patients with High-risk patients are advised to monitor GRV>500 mL/6 h are recommended to give prokinetic drugs or consider nasal jejunal tube feeding. Delayed enteral nutrition is used for those who do not improve. every 4-6 hours.
Other	Intra-abdominal pressure (IAP)	Intra-abdominal pressure is related to EN tolerance, and the use of enteral nutrition with IAP greater than 20 mmHg will be limited. EN speed and dosage should be adjusted according to intra-abdominal pressure. For patients with ARDS mechanical ventilation, it is recommended to use it every 4-6 hours.
	Volume of liquid in/out (24 hrs. volume of liquid in/out, 3-5 dynamic volume of liquid in/out)	Understand fluid balance in the body and guide fluid replacement and nutrition programs. 24 hr in/out volume: 1 time per day; 3-5 d dynamic in/out volume balance: 1 time every 3-5 d.

Table 3. NRS 2002 Nutrition risk screening form.

Disease severity score	General malignant tumors; Hip fractures; Long-term hemodialysis; Diabetes; Chronic diseases (such as liver cirrhosis, chronic obstructive pulmonary disease)	1 point
	Malignant blood tumor; Severe pneumonia; Big abdominal surgery; Stroke	2 point
	Cranial brain injury; Bone marrow transplantation; Intensive care patients (APACHE II > 10)	3 point
Scoring of impaired nutrition	The body weight has decreased by more than 5% in the last 3 months, or the food intake has decreased by 1/4 to 1/2 in the past 1 week.	1 point
	The body weight has decreased by more than 5% in the last 2 months, or the food intake has decreased by 1/2 to 3/4 in the last 1 week, or the BMI is less than 20.5 kg/m ² and the general situation is poor	2 point
	The body weight has decreased by > 5% in the last month, or the food intake has decreased by more than 3/4 in the last week, or the BMI is <18.5 kg/m ² and the general situation is poor	3 point
Age score	Age > 70 years old	1 point
Total score = Disease severity score + Nutritional impairment score + Age score		

Table 4. Improved nutritive score table.

Project	Range	Score
Age (Years)	<50	0
	50-74	1
	≥75	2
APACHE II score (Points)	<15	0
	15-19	1
	20-27	2
SOFA score (Points)	≥28	3
	<6	0
	6-9	1
Number of organs causing insufficiency (Number)	≥10	2
	0-1	0
	≥2	1
Length of hospital stay before admission to the ICU (d)	0-1	0
	>2	1

APACHE II Score: Acute Physiology and Chronic Health Assessment II score; SOFA Score: Sequential Organ Failure Score; Total score is the sum of all score.

anti-viral, antifungal and antibacterial properties and also an immune system booster [30].

- Ginger is a very good immune booster and also has detoxifying properties.
- Garlic is another powerful agent, but the beneficial properties of garlic are destroyed upon cooking, so adding garlic to salads, chutneys and dip, are the best way to consume it [35,36].
- Fenugreek seeds can be soaked, sprouted and added to salads, in addition to its regular use in cooking.
- Tea is also a leaf and plays a role in disease prevention. Green tea, black tea is good options [37].
- Nuts and seeds like walnuts, almonds, pumpkin flaxseed, sesame, chia seeds, poppy seeds, sunflower and mustard are worthwhile additions to the diet also boost your immunity [38].
- Andrographis and elderberry are herbals that worked as a antiviral against high viral burden and low innate immune response. Herbs-Basil, thyme, parsley, Rosemary, oregano, dill boosts your immune system [39].

Testing and diagnosis

Your doctor will decide if you need testing, based on the following criteria-

- You have returned from overseas in the 14 days before you feel unwell,
- You have been a close or casual contact of a confirmed COVID-19 case in the 14 days before you feel unwell,
- You have a fever or acute respiratory infection (e.g. Shortness of breath, cough, and sore throat) with or without fever,

- You have a severe community-acquired pneumonia and no other cause of it is clear to your doctor, with or without recent international travel,
- If you are a healthcare worker with direct patient contact and have a fever (≥37.5) and an acute respiratory infection (e.g. Shortness of breath, cough, sore throat) [40].

There is no treatment and vaccine for coronavirus, but medical care can treat most of the symptoms. Antibiotics do not work on viruses. If you have been diagnosed with coronavirus, isolate yourself in your home [11].

Precautions for infected person includes report at health facility for treatment, take your medications as prescribed, eat nutritious diet to improve your immune system, stay home when you are sick, cover your cough or sneeze with a tissue, then throw the tissue in a dust bin, clean and disinfect frequently touched objects and surfaces [5].

Nutrition screening tool for critical patients

For critically ill patients with new crowns, dynamic nutritional risk screening is recommended. NRS 2002 can be used for nutritional risk screening (Table 3). Combined with the actual situation of the front line of anti-epidemic, some critically ill patients' body weight and diet history may be difficult to obtain, and the application of NRS 2002 is limited. In this case, a modified NUTRIC score (Table 4) is recommended for screening [41,42].

Discussion and Conclusion

After hospital discharge, probably very high-dose protein and calorie feeding for prolonged duration is necessary to optimize the outcomes. High-protein oral nutrition supplements are likely essential in this period. Several pharmacological options are available to combine with nutrition therapy to enhance the immune response and stimulate muscle protein synthesis. During

and after ICU care, optimal nutrition therapy is essential to improve the long-term outcome to reduce the likelihood of the patient to becoming a "victim" of critical illness again. Frequently, nutrition targets are not achieved in any phase of recovery. Personalized nutrition therapy, while respecting different targets during the phases of the patient journey after critical illness, should be prescribed and monitored.

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Conflict of Interest

There is no conflict of interest between authors.

Ethical Approval

The study was approved by the Institutional Ethics Committee.

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