

## Nutrition in coronavirus infection (COVID -19)

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### Abstract

Insufficient, irrational nutrition is the most widely spread reason of immunodeficiency. Few is known on nutrition in COVID-19 that caused pandemics worldwide.

In this review, we summarized key points of nutrition in COVID patients, including macronutrients and micronutrients.

**Key words:** nutrition, viral infection, COVID-19, macronutrients, micronutrients

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Balanced nutrition is the main factor of environment, influencing quality of life, depends on normal physical development and health condition. Insufficient, irrational nutrition is the most widely spread reason of immunodeficiency. Few is known on nutrition in COVID-19 that caused pandemics worldwide (1).

Disturbances of cell immunity, complement system and immunoglobulin sections are linked to protein-energetic deficiency. Fat-soluble vitamins – A, E, D, as well as water-soluble vitamins C, B6, B2 and folates; microelements – zinc, ferrum, selenium, magnesium, copper play an important role in regulation of immune system. Deficiency of microelements may reduce the resistivity of organism to infection (2-4). In addition, omega-3-fatty acids effectively support immune system (5, 6).

Many chronic diseases, as diabetes, cardiovascular diseases, older age (6, 7), obesity, irrational nutrition are the factors of high risk in coronavirus infection (8, 9).

Correct functioning of immune system depends on adequate consumption of proteins, fat, carbohydrates vitamins and mineral nutrients. Irrational nutrition leads to deficiency of nutritional elements that impairs function of immune system (8, 10). Deficiency of polyunsaturated fatty acids as omega-3 fatty acids influences immune cells.

Vitamin C also influences several aspects of immunity – growth and functioning of immune cells, migration of leucocytes, and also production of antibodies in infection, organocytosis. People with vitamin deficiency are prone to have severe respiratory diseases such as pneumonia (11, 12). Older adults who received vitamin C had lower severity of the disease and risk of mortality (13).

In China, a high dose of vitamin C, 24 grams per day for 7 days, was introduced into the treatment algorithm for a new coronavirus infection (14).

Prophylactic intake of vitamin C in population may reduce the duration and severity of cold (15). Moreover, it can reduce risk of pneumonia development (16). The morbidity was lower in patients with high vitamin C concentration as compared with those with reduced one (17).

Patients with sepsis and acute respiratory distress in intensive care receive high doses of intravenous vitamin C to restore balance (18). Patients with sepsis and acute respiratory distress, who received 200 mg/kg per day intravenous injection of vitamin C in ICU, had reduced mortality and hospitalization days (19).

Vitamin D deficiency increases respiratory infections (20, 21). It is established that daily intake of vitamin D protected against respiratory infections and was generally safe. Based on the analysis of the course, it was proposed to prescribe vitamin D in doses of 2000-5000 IU per day for hospitalized with a new coronavirus infection (22). To reduce risk in those in contact with patients, increase the dose to 10,000 IU per day for up to 8 weeks (23).

Vitamin D deficiency is the public health problem in the world as many people suffer from it. Vitamin D is responsible for normal function of bones, promotes entrance of calcium in cells, sustains the levels of calcium and phosphates in blood serum, and plays fundamental role in prevention of development of osteomalation in children and osteoporosis in adults (24).

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It has also different functions including modulation of cells growth, neuro-muscular function, immune function, and reduction of inflammation (24). It is well soluble in fat and has maximum effect in sunlight (25). Diet is the main factor that defines the vitamin D concentration, it was higher in people who consume meat, and fish products as compared to vegetarians (26). Increase in concentration for Vitamin D with prescription of 35 ng/ml per day in patients with COVID 19 reduced the mortality (27) and hospitalization to ICU (28).

Vitamin A deficiency may be more prone to viral infections, and therapy improves the condition of patients with pneumonia (29, 30). Vitamin A plays a big role in maintaining the immune system.

Vitamin E-vitamin E deficiency leads to decreased lymphocyte proliferation and reduced phagocytosis of neutrophils, and its regular intake increases overall resistance to infection, especially in elderly and senile individuals (31). Regular intake of 200 IU per day reduces the risk of upper respiratory infections in older adults (31).

Studies using the omega-3-PUFA eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have shown significant improvements in blood oxygenation, reduced need for mechanical ventilation, and decreased lung inflammation (31).

**Energy and macronutrient requirements**

Based on energy expenditure and macronutrients status, recommended energy requirements for patients with severe disease - 27-30 kcal/kg.

Daily protein requirement is 1.2-2 g/kg, daily consumption of products must be of high -energy density, high protein content and high bioavailability of macronutrients.

The need for fats and carbohydrates in patients without respiratory failure is a percentage ratio of 30:70, and in patients with acute respiratory distress - 50:50.

Therefore, the assessment and correction of nutritional status at all stages of patient care should be considered as an integral part of the clinical approach to managing a COVID-19 patient as recommended by WHO (3):

1. Assessment of malnutrition - by physical examination
2. Optimizing nutritional status through dietary modification
3. Enrichment of the diet with vitamins, minerals, PUFAs (omega-3, omega-6)
4. Specialized food products) - in case of insufficiency 2.3. step - correction and enrichment of the diet
5. Enteral nutrition in case of ineffectiveness of oral nutritional support
6. Regular dosing of physical activity in the absence of contraindications

Optimal nutrient intake can be achieved through a quantitative, qualitative, balanced, varied diet. To support and strengthen the immune system, you should consume nutrients above the recommended daily allowance.

<b>Table 1. Recommended micronutrients to supplement immune system</b>		
<b>Nutrient</b>	<b>Rationale</b>	<b>Recommended doses</b>
Vitamin C	Dose more than 200 mg/day maintains the normal levels of vitamin C in blood serum Reduces risk, severity and duration of upper respiratory tract infections	For healthy people 200 mg/day For patients with severe COVID-19 – 15-25 mg/kg daily intravenous
Vitamin D	Daily consumption (2000 ME daily or 50 mcg/ daily) reduces risk of acute respiratory tract infections	For patients with COVID-19 2000-5000 ME daily, may be increased up to 10000 ME daily for 8 weeks.
Omega-3 PUFA (EPA, DHA)	Omega 3 PUFA supports immune system and promotes regression of inflammation – 250 mg/ daily	Daily dose 250 mg/day

### Recommended micronutrients to support immune system

The recommended nutrients, their doses to protect from infection and support immune system are summarized in Table 1.

To limit the spread of infection, including acute respiratory viruses, vaccination and hygiene measures are necessary, however, the situation with COVID-19 with severe outcomes requires effective safe strategies to maintain the immune system - this is to ensure sufficient nutritional support for the immune status. Optimal intake of macro- and micronutrients improves immune defenses and can limit the emergence of new strains of viruses.

#### We recommend:

1. Protein of animal source in amount of 50% of total protein (milk, cottage cheese, cheese, dairy products, poultry, fish, meat of young animals, eggs).
2. Fat rich in omega-3 PUFA and omega-6 PUFA and fat-soluble vitamins A, E, D (fish, fish products, milk fat, liver pates, liver pancakes, butter, vegetable oil, linseed, sunflower).
3. Carbohydrates - limit simple carbohydrates - 5% of daily energy (6 teaspoons of sugar), limit strong coffee, strong tea, and consume more fiber with vegetables, fruits rich in vitamins, whole grains, sea buckthorn berries, sweet-brier, black currants.
4. Use of sweet-brier, black currants, sea buckthorn rich in vitamins C and  $\beta$ -carotenes - distilled liquids in the form of drinks up to 2-2.5 liters / day.
5. Limit salt to 5.0 grams/day. Limit saturated fat - beef, lamb fat.
6. Eating 5-6 times a day in small portions, mainly in liquid form as soup or food prepared on steam.

#### Conclusions

The main preventive measures for coronavirus infection, including acute respiratory viruses, are: 1) vaccination and hygiene measures, 2) for people with severe consequences of COVID-19, the immune system should be supported by optimal intake of micro- and macronutrients, 3) a full, varied diet will improve the immune protection against new strains of the virus.

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