

REVIEW ARTICLE

Nutritional Support for Rehabilitation of Survived COVID-19 Patients: A Review

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ABSTRACT

COVID-19 caused by SARS-COV-2 has spread in late 2019, and later, was announced as a pandemic disease. COVID-19 affects various organs of the body. Thus, patients are affected by a spectrum of disease severity and show a variety of symptoms such as fever, respiratory dysfunctions, and gastrointestinal complications. Nutritional treatment of patients consists of adequate intake of liquids, macro-and micro-nutrients to enhance the immune system and fulfill vital requirements. In addition to nutritional support during the treatment period, proper nutritional follow-up and support are needed to rehabilitate and regain optimal health status for survived COVID-19 patients. Thus, in this study, a review was done to present a guideline to provide nutritional support for COVID-19 survivors, to meet the needs, food purchase, and preparation.

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Introduction

For years, the critical role of nutrition in enhancing the ability of the immune system against infections threatening human health has been established. Nutrients can boost the immune system in a variety of ways. Hence, having a healthy dietary pattern, in addition to improving the healing process, can accelerate the recovery process, restore the immune system, repair the damaged tissues, normalize the body physiology, and prevent a recurrence (1, 2). Due to the emergence of Coronavirus 2019 (COVID-19), studies of other similar diseases such as Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) have shown that the capacity of the respiratory and immune systems does not return to normal even after one year, as well as the defects in the liver function up to six months and the neuropsychological problems caused by the disease up to three months post-recovery; all these may affect the quality of life of people (3-10). Therefore, it is necessary to provide expert nutritional advice to the survived COVID-19 patients at discharge by the dietitians, also follow-up them for six months to one year. To provide a proper nutrition plan, it is necessary to collect data and evaluate the patients' physical and nutritional status based on the following information (2):

1. Assessment of Survived COVID-19 Patients

1.1. Personal Information and Medical Records

Personal information such as age, sex, occupation, marital and economic status, educational level, and access to food are recorded. The status of the underlying diseases including diabetes, cardiovascular and autoimmune diseases, cancer, kidney and liver disease, hypertension, etc. are clarified (2-11).

1.2. Evaluation of Nutritional Status and Anthropometric

The dietary intake, appetite, swallowing status, body hydration condition, and muscle catabolism are monitored (12). Assessment of weight, height, body mass index (BMI), and arm circumference are carried out.

1.3. Clinical Evaluation

The presence of any diarrhea, nausea, vomiting, and hypertension are checked. Malnutrition after treatment due to a lack of awareness of how to care for surviving patients at home can weaken their immune system again. Serum albumin levels were shown in Table 1 that can play an essential role in patients' nutritional status (12).

1.4. Investigation of Medications to Prevent Drug-food Interactions

Due to chloroquine administration for 5-day, it is necessary to pay attention to food-drug interactions. Hydroxychloroquine sulfate inhibits thiamine uptake, so thiamine (100 mg tablets) is recommended three times daily. Taking hydroxychloroquine sulfate with food to reduce drug stimulation and not taking antibiotics with dairy products are suggested. Vitamin C supplements can interfere with antiviral drugs (protease inhibitors) such as lopinavir, ritonavir, and nelfinavir, which are prescribed to treat COVID-19 patients. Also supplementation with vitamin C for possible interactions with warfarin, statins, and niacin, as well as aluminum-containing drugs like phosphate bands, and chemotherapy should be considered (13, 14).

2. Para-clinical Evaluation

Para-clinical evaluation of the patient being discharged will greatly assist the dietitian/therapist in setting appropriate dietary plans or prescribing dietary supplements. The dietitian/therapist should request the following factors: Complete blood count (CBC), fasting plasma glucose (FPG), serum iron, ferritin, total iron-binding capacity, calcium, phosphorus, magnesium, sodium, potassium, creatinine, blood urea nitrogen (BUN), albumin, total protein, zinc, lipid profile, alanine aminotransferase (ALT), aspartate aminotransferase (AST), bilirubin, high-sensitivity C-reactive protein, erythrocyte sedimentation rate, 25(OH)vitamin D3, urine analysis, prothrombin time (PT), and partial thromboplastin time (PTT) (15).

3. Nutritional Requirements

Nutritional interventions performed by dietitians

Table 1: Diagnostic criteria for protein-energy malnutrition in adult patients (12).

| Diagnosis | BMI | Weight loss in three to six months | Serum albumin level | Others |
|-----------------------|----------------|------------------------------------|---------------------|---------------------------------------|
| Marginal malnutrition | Less than 20 | Less than 5% | Over 3.5 g/dL | |
| Moderate malnutrition | 18.5-20 | Between 5 to 10% | 3-3.5 g/dL | |
| Severe malnutrition | Less than 18.5 | More than 10% | 3 g/dL | Not taking food for over 5 days (NPO) |

BMI: body mass index; NPO: nil per os (nothing by mouth).

can influence the nutritional status of the patient at every stage of the disease. Formulating an exclusive diet for each survived patient based on the clinical conditions, underlying disease, and drug regimen is important (2-11). It reduces catabolism and muscle loss and improves the patient's physical and mental performance. A balanced diet and weight loss in overweight and obese participants should also be considered after the complete recovery of the patients. Following the Mediterranean diet pattern can improve respiratory function (16).

3.1. Energy

A total of 25-30 Kcal/kg body weight (BW) is recommended to meet energy needs. If the patient is overweight or obese, use the adjusted weight in the formula (17, 18). Calorie calculation for the elderly should be adjusted based on maintaining a BMI >23 (18). To provide adequate energy for cancer patients suffering from cancer-related complications such as anorexia, difficult swallow, mouth ulcers, malnutrition, weight loss, digestive disorders, nausea, and vomiting; the commercial and protein formulas can be used (18, 19). Calories needed for pregnant women based on the BW before pregnancy plus 340 and 452 kcal for the second and third trimester should be calculated, respectively (20, 21).

3.2. Dietary Fat

To prevent a decline in the immune system in these patients, the optimal percentage of dietary fat between 25 to 30% of the total calories should be determined. In patients with hypercholesterolemia (especially total cholesterol >260 and low-density lipoprotein (LDL) >160), it is recommended that the intake of total fat, saturated fatty acids (SFA), polyunsaturated fatty acids (PUFA), monounsaturated fatty acids (MUFA), and trans-fatty acids (TFA) to be in the range of 25-30%, <7%, ≤10%, ≤20%, and <1% of total calories, respectively (22, 23). Main sources of SFA and cholesterol are fried foods, pizza and fast foods, biscuits, and cookies containing high amounts of TFA, butter, cream, high-fat yogurt, red meat,

egg yolk, sausages, and dairy products with 2% or more fat. Also, the main sources of unsaturated fats are fish, avocado, kernels, and vegetable oils such as soybean, canola, olives, corn, and sunflower (24). Targets for controlling blood lipids in individuals without any history of CVDs have been proposed by the American Diabetes Association. Accordingly, optimal levels of triglycerides <150 mg/dL, LDL <100 mg/dL, and HDL >40 mg/dL in men and >50 mg/dL in women are considered (25).

3.2.1. Fish Fatty Acids (Omega-3)

Since, patients with viral diseases have generally low plasma levels of omega-3 fatty acids (FAs), and concerning the effect of fish oil on viral diseases, as well as the role that omega-3 FAs mediators have in attenuating influenza and hepatitis viruses and reducing the inflammation; therefore, intake or supplementation of omega-3 FAs is important in survived patients after recovery (18, 26-29). It is recommended to consume food sources of omega-3 FAs including fatty fish (such as salmon) twice weekly, two walnuts daily, and olives and canola daily. Due to neuropsychiatric problems, age of patients, and positive effects of omega-3 FAs in survived patients, they should receive 250-500 mg/d of docosahexaenoic acid (DHA) plus eicosapentaenoic acid (EPA) through diet, or if they are unavailable through food, supplements can be taken. When supplemented, it is recommended to consume 250-500 mg/d of DHA+EPA, which can be achieved from a capsule of one g fish oil supplement depending on the formulation (30). Liver failure has been reported in some survived patients; thus, omega-3 supplementation should be carefully considered and liver enzymes (ALT and AST) should be checked. Also, LDL levels in recovering patients, and FPG levels and PT in diabetics should be monitored for supplementation. We should be careful of interactions between omega-3 supplements and vitamin E, ginger, ginseng, and medications. Finally, pregnant women should be cautious about eating seafood (26, 29).

Table 2: Few examples of dietary sources of fibers (32).

| Variable | Amount (g) | Variable | Amount (g) | Variable | Amount (g) | Variable | Amount (g) |
|-----------------------------|------------|-----------------------------------|------------|---|------------|------------------------|------------|
| Cooked lentils (Half a cup) | 8 | Whole-grain bread (One slice) | 2 | Cooked barley or oatmeal (Half a cup) | 4 | Peanut (1/4 cup) | 3 |
| Dried plum (5 numbers) | 4 | Pear with skin (One medium-size) | 5 | Cooked spinach or Carrot (Half a cup) | 3 | Pasta (One cup) | 2 |
| White bread (One slice) | 1 | Apple with skin (One medium-size) | 4 | Bananas or oranges (One medium-size) | 3 | Tomato (One) | 1 |
| Cooked beans (Half a cup) | 7 | Cooked potato (One medium-size) | 3 | Wheat bran (1/4 cup) Beans (Half a cup) | 6 | Strawberries (One cup) | 4 |

3.3. Protein

The protein requirement in these patients should be in the range of 1.2-2 g/kg BW; at least 50% should be from a high biological value. For overweight subjects, BW should be adjusted (19, 31). If the patient suffers from acute or chronic kidney failure, the range of protein can be changed to 0.8-1 g/kg BW. For the elderly, it is recommended to consume 1-1.25 g/kg BW (men about 56 g, and women about 46 g) (18).

3.4. Carbohydrates

After determining the amount of protein and fat, the remaining energy should be allocated to carbohydrates. Include 20-30 grams of fiber in the diet. If one does not get enough fiber from the food sources, standard fiber supplements can be used for survived COVID-19 patients. Also, consider other diseases when prescribing fiber. Table 2 shows some examples of dietary sources of fibers.

4. Fluid Requirement

A self-assessment method is used. To do so, a half-liter container is used and the urine output is estimated. If the urine is collected up to a volume of 500 to 800 mL in a bright color, it indicates a good condition (19). In the elderly, it is recommended to take 30 mL/kg/day of fluid to prevent constipation and dehydration (33). The recommendation is 1-1.5 ml per Kcal energy consumption (30-40 ml/kg BW).

5. Monitoring (Follow-up)

Monitoring should be done through anthropometric, clinical, and laboratory evaluations, and if necessary, dietary modification must be undertaken. The survived patients have to be monitored by a dietitian for a 3-6 months period (34).

Conclusion

A healthy diet from all food groups including daily consumption of at least 5-6 units of fruits and vegetables (at least one unit containing vitamin C, vitamin A), one whole egg, 2-3 units of probiotic dairy products (in the absence of underlying diseases), adequate daily protein intake (meats, poultry, legumes, and nuts), and fatty fish twice a week are recommended for the survived patients. It is also recommended to drink 2 to 3 L/day of fluid to prevent constipation and dehydration. In survived patients suffering from hypercholesterolemia, to reduce LDL level, a restricted diet of SFA, TFA, and cholesterol below 200 mg/d is suggested. Up to 30% of the total calorie can be provided from fat (20% from MUFA (olive oil) and 10% from PUFA and median-chain triglyceride). Finally,

the survived patient should be monitored by the dietitian for periods of three and six months.

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Conflict of Interest

None declared.

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