

REVIEW ARTICLE

Practical Recommendations of Micronutrients and Food Hygiene for Rehabilitation of Survived COVID-19 Patients: A Review

Jalaleddin Mirzay Razaz¹, Mohammad Nosrati-Oskouie^{2,3*}, Majid Hassan Qomi^{4,5}, Marjan Behzadi-Moghaddam⁵, Nazanin Sadat Aghili-Moghadam⁶, Mohammad Ali Mohsenpour⁷, Maryam Elham-Kia⁸, Zahra Ahadi⁵, Maryam Javadi⁹, Razieh Khaloofard¹⁰, Maryam Saboktakin⁵, Azadeh Nadjarzadeh¹¹, Mehrnaz Ghanizadeh¹², Gisoo Sharifi⁵, Arezoo Haeri-Ardakani¹³, Ebrahim Parvin⁵

1. Department of Community Nutrition, Faculty of Nutrition and Food Technology, National Nutrition and Food Technology Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran

2. Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran

3. Nutrition Research Center, Department of Clinical Nutrition, Faculty of Nutrition and Food Sciences, Tabriz University of Medical Sciences, Tabriz, Iran

4. Tehran Medical System Organization, Tehran, Iran

5. Iranian Nutrition Society, Tehran, Iran

6. Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran

7. Department of Clinical Nutrition, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

8. Department of Nutrition and Diet Therapy, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran

9. Department of Nutrition, School of Health, Qazvin University of Medical Science, Qazvin, Iran

10. Department of Clinical Nutrition and Dietetics, Faculty of Nutrition Sciences and Food Technology, National Nutrition and Food Technology Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran

11. Department of Nutrition, School of Public Health, Shahid Sadoughi University of Medical Sciences and Health Services, Yazd, Iran

12. Department of Sport Physiology, Faculty of Physical Education and Sport Sciences, Islamic Azad University, Tehran, Iran

13. Department of Nutrition & Diet Therapy, Ardakan Ziaei Hospital, Yazd, Iran

ARTICLE INFO

Keywords:

COVID-19
SARS-CoV-2
Coronavirus
Nutrition
Vitamin

*Corresponding author:

Mohammad Nosrati-Oskouie, PhD
Candidate;

Department of Clinical Nutrition,
Faculty of Nutrition and Food
Sciences, Tabriz University of
Medical Sciences, Tabriz, Iran.

Tel: +98-9365790841

Email:

Mohammad_nosrati_o@yahoo.com

Received: March 1, 2021

Revised: May 5, 2021

Accepted: May 11, 2021

ABSTRACT

The outbreak of COVID-19 and a large number of infected people led to this viral disease of varying severity and hospitalization of patients. During periods of illness and recovery, the body uses its reservoirs and resources to fight the disease. In the post-recovery period, the body may experience nutritional insufficiency and deficiency. Therefore, adequate intake of micronutrients, such as water-soluble and fat-soluble vitamins, minerals, polyunsaturated fatty acids, and phytochemicals, as well as the preparation of safe food is of great importance for the recovery of the immune system and strengthening rehabilitation for survived COVID-19 patients. In this work, we aim to review the literature and present a guide for nutritional needs and food hygiene practices for survived COVID-19 patients.

Please cite this article as: Mirzay Razaz J, Nosrati-Oskouie M, Hassan Qomi M, Behzadi-Moghaddam M, Aghili-Moghadam NS, Mohsenpour MA, Elham-Kia M, Ahadi Z, Javadi M, Khaloofard R, Saboktakin M, Nadjarzadeh A, Ghanizadeh M, Sharifi G, Haeri-Ardakani A, Parvin E. Practical Recommendations of Micronutrients and Food Hygiene for Rehabilitation of Survived COVID-19 Patients: A Review. Int J Nutr Sci. 2021;6(2):59-64. doi: 10.30476/IJNS.2021.88587.1099.

Introduction

Severe acute respiratory symptoms coronavirus 2 (SARS-CoV-2) as a novel coronavirus that has infected both humans and animals, was first identified at the end of 2019 (1, 2). Among the six types of coronaviruses that have been reported, SARS-CoV-2 is well-known for its high rate of transmission and has caused significant global health concerns (3). The World Health Organization has now declared coronavirus disease-2019 (COVID-19) as a pandemic (4). Symptoms mainly include fever, cough, and shortness of breath, which usually begin 2 to 14 days after infection (5). Mechanical respiratory support, antiviral therapy, and corticosteroid therapy are currently used in the care of patients with COVID-19, however, no specific treatment has been suggested (6). Home quarantine, maintaining social distance and the immune system are some of the best ways to prevent and reduce the spread of the virus (7, 8).

Nutrition is one of the most important factors affecting the human immune system (9). Subjects with nutrient deficiencies have attenuated immune systems and are more prone to viral infections such as COVID-19 as well as post-disease exacerbations (9). Supplementation with some nutrients may support the body's natural defense system by antibody production, cellular immunity, epithelial barriers, and increasing immunity (10). A balanced diet, especially adequate in terms of immune-boosting components such as proteins and micronutrients, increases resistance to infections (11). On the other hand, quarantine is related to boredom and stress due to hearing and reading about the pandemic. Consequently, boredom and stress cause subjects to consume higher energy, fat, protein, and carbohydrate (12). Thus, providing a proper diet to maintain a healthy individual and correcting immune-related nutrient deficiencies may be essential for the prevention, treatment, and recovery of viral infections (13). Therefore, this study aimed to summarize the latest findings on the effect of micronutrients on accelerating COVID-19 recovery as well as expert nutritional recommendations on micronutrients and food hygiene.

1. Vitamins

During the illness, treatment, and recovery, due to the involvement of certain organs of the body followed by the comprehensive response of the immune system, patients may experience a reduction or depletion of the body's reserves of certain micronutrients after recovery in survived COVID-19 patients. Also, given that the characteristics of the coronavirus are still unknown, studies have shown that survived patients may be at risk for re-infection. So strengthening the immune system after recovery is also very important. In the following, we investigated some of the vitamins and minerals that

are involved in the structure and strengthening of the immune system (14-17).

1.1. Vitamin A

Many of the immune system activities depend on adequate vitamin A levels and its precursor. Researchers have shown that people who receive less vitamin A through food are more likely to be affected by respiratory tract viruses such as coronaviruses (17). Therefore, it is recommended that patients consume vitamin A-rich foods and supplements after recovery. Mineral multivitamin supplementation with vitamin A can also be recommended by a dietitian's prescription.

1.2. Group B Vitamins

It seems that deficiency of group B vitamins may weaken the immune system's response to the virus. It has been shown that B vitamins, especially B2 are deficient in the elderly (one of the high-risk groups for COVID-19 disease). It has also been observed that B vitamins have been able to reduce coronavirus titers in human plasma and effectively eliminate *Staphylococcus aureus*, which is a major pathogen causing nosocomial infection and is abundantly found in the upper respiratory tract. Finally, due to the prescription of a high-protein and high-calorie diet during the treatment and, if necessary, after recovery, the need for B vitamins especially B2, B3 (involved in energy metabolism), and B6 (involved in protein metabolism) increases (16). Hence, it is recommended to consume group B vitamins through dietary intake, if necessary, through multivitamin supplementation as high as Dietary Reference Intakes (DRI) recommendation. Food source of B vitamins listed as follows: vitamin B2 (dairy milk, yogurt, cheese, eggs, chicken breast, salmon, spinach, and almonds), vitamin B3 (red meat, poultry, fish, brown rice, nuts and seeds, legumes, and bananas), and vitamin B6 (salmon, poultry, chickpeas, and some vegetables and fruits, especially dark leafy greens, bananas, papayas, oranges, and cantaloupe)

1.3. Vitamin C

Vitamin C can improve performance and prevent infection of the lower respiratory tract. It can also be used as a weak antihistamine to improve symptoms. Hence, it is advisable to consume at least one exchange of fruits and one exchange of vitamin C-rich vegetables per day (16). The main dietary source includes green, red, and bell peppers, kiwi, strawberries, cabbage (broccoli, cauliflower, kale, etc.), cantaloupe, tomato, potato, oranges, and other citrus fruits. Supplements should be used with caution in diabetes, hemochromatosis, kidney diseases especially oxalate stones, and in the elderly (18).

1.4. Vitamin D

Considering that it is recommended to stay-at-home,

Table 1: Recommendations in vitamin D deficiency.

Serum level of 25(OH)VitD ₃	Recommendation
<12 ng/mL (<30 nmol/L)	50000 IU (1250 mcg) weekly orally for 6 to 8 weeks followed by 800-1000 IU (20 to 25 mcg) daily to reach the optimal levels (above 30 ng/mL)
12-20 ng/mL (30-50 nmol/L)	800 to 1000 IU (20 to 25 mcg) daily for 3 months
20-30 ng/mL (50-75 nmol/L)	600 to 800 IU (15 to 20 mcg) daily to reach the optimal levels
>30 ng/mL (>75 nmol/L)	800 IU (20 mcg) daily

IU: international units.

using a mask, gloves, etc., which limits access to sunlight, and also the fact that the disease mainly occurs in winter and in the elderly who usually are vitamin D deficient, so levels of 25(OH)VitD₃ should be checked and a dietitian should provide recommendations for treatment of vitamin D deficiency (16, 19) (Table 1).

Higher doses of vitamin D may be needed to achieve optimal levels. In COVID-19 patients, it is better not to supplement vitamin D through injection. Furthermore, during vitamin D deficiency treatment, it is essential to consume at least 1000 mg/d of calcium for men and premenopausal women, and 1200 mg/d for postmenopausal women through diet (supplied by three dairy units). It is recommended that during the stay-at-home period, children for approximately 15 minutes daily, and adults for 20-30 minutes be exposed to sunlight with wrists, feet, and foreheads uncovered (at 11 am or 3 pm, from behind an open window without any intermediate). Food sources of vitamin D include cheese and egg yolk (small amounts), mushroom (small amounts), fish liver oil, and fatty fish such as salmon, trout, tuna, and mackerel.

2. Minerals

2.1. Selenium

Higher prevalence of viral diseases such as swine flu, bird flu, SARS (another coronavirus), Ebola, and HIV have been reported in selenium (Se)-deficient areas of China and Sub-Saharan Africa. This may be due to a selenium deficiency that causes mutation and stability in the virus (16). Coronavirus and similar viruses have been reported to have spread to Se-deficient areas of China; this is due to the rapid mutation in the virus as a result of oxidative stress caused by Se deficiency. Thus, it is recommended to take a multi-mineral containing 100 mcg/d of Se along with a diet rich in Se and other antioxidants such as vitamins E and C. Food sources are beef, chicken, saltwater fish, tuna and sardines, eggs, nuts, and cereals. It is advisable to take fish twice a week, and a whole egg daily (in participants without underlying disease).

2.2. Zinc

Since zinc (Zn) can prevent the spread of coronavirus and reducing the lower respiratory tract infections and diarrhea-related complications (in 30% of people), and it is recommended to take it from food sources up to

the DRI level. For patients with prolonged diarrhea, it is recommended to have a zinc supplement in the DRI range (20). Children with diarrhea should take a 20 mg/d dose of zinc supplement for 10-14 days after recovery (20). Plasma zinc level <60 mcg/dL is considered as low level (Note that plasma levels are not an accurate measure of reserves) and should be checked with alkaline phosphatase and clinical symptoms (20, 21). Zinc levels in patients with hypoalbuminemia may display false reduction. Short-term supplementation in the DRI range or doses of 20-25 mg daily can be recommended for the elderly who do not have a good appetite (20). Note that each Zinc acetate (25 mg) contains about 7.5 mg of elemental zinc. Main food sources of zinc include milk, eggs, sunflower seeds, and chicken (white meat).

2.3. Iron

Although pathogens need iron (Fe), iron deficiency can impair the immune system and increase the risk of respiratory tract re-infection. Also, iron overload can cause oxidative stress and mutation in the virus (22). Therefore, iron supplements should only be considered, when there is a proven iron deficiency. In addition to cell blood count (CBC) and clinical findings, the existence of each of the following can be proof of iron deficiency. Serum ferritin <15 ng/mL (in pregnant mothers <30 ng/mL) and percentage of transferrin saturation <16% (in people with inflammatory conditions where ferritin is not reliable <20%) (23). It should be noted that the diagnostic percentages are different for kidney patients. According to The National Institute for Health and Care Excellence (NICE) guidelines, red blood cell markers are better for diagnosis in these patients; However, if these tests are not available, a combination of ferritin (<100 ng/mL) and transferrin (<20%) evaluation is recommended (24).

It is recommended to treat iron deficiency orally in adults after complete recovery from Covid-19 infection with 150-200 mg of elemental iron per day for up to 3-6 months after test normalization. For greater efficacy and reducing the complications, this dose may be recommended every other day for a more extended period. Note that each 325 mg ferrous sulfate, 324 mg ferrous fumarate, and 300 mg ferrous gluconate tablet contains about 65, 106, and 34 mg elemental iron, respectively. Food source of heme iron includes red meat, fatty fish, poultry, and egg; and non-heme iron include beans,

lentils, and dark green leafy vegetables.

3. Probiotics

Two clinical trials reported the effect of probiotics on respiratory illnesses where critically ill patients on mechanical ventilation who received probiotics had significantly less ventilator-associated pneumonia than placebo (25, 26). Also, a meta-analysis of the effect of probiotics on the duration of respiratory infection has been shown to shorten the length of recovery time (27). However, there is no study examining the effects of probiotics on the management of the covid-19 disease. An ongoing Phase 2 multicenter, randomized, double-blind, placebo-controlled trial to assess the effect of *Lactobacillus rhamnosus* GG (20 billion CFU) to decrease infections and improve outcomes (28). Although the use of probiotics as a promising therapeutic approach can be considered to alleviate COVID-19 and its inflammatory complications through modulation of the gut microbiome, and the recommendation for its use requires further studies. Therefore, consumption of prebiotic and probiotic food sources such as pasteurized probiotic dairy products, fiber-rich sources like barley and legumes can be recommended.

4. Monitoring (Follow-up)

Monitoring should be done through anthropometric, clinical, and laboratory evaluations, and if necessary, dietary modification. The survived patients should be monitored by a dietitian for a 3-6 months period (29).

5. Recommendations for Food Hygiene

For enjoying proper and balanced nutrition, paying due attention to food hygiene is essential, especially in times of outbreaks and crises. Foods can be contaminated with chemicals or microorganisms at every stage from production to consumption (30-32).

In the event of outbreaks, the transmission ways of pathogens must be identified and prevented through hygienically monitoring at all stages, including purchasing, bringing home, refrigerating, storage, and consumption. In the current situation, given the longevity of the viruses on different surfaces, and since we purchase food from various stores, we always need to be careful and follow the related protocols (30, 33, 34). Chin *et al.* reported that the virus survived in infections of the hard surface including plastic, stainless, and surgical masks (35). Also, another study found that the virus can remain in infections of the skin for 4 days (36). Although the above-mentioned studies demonstrated that the virus can survive on the surface, but it cannot be concluded that it is a major way of transmitting for COVID-19, because many of these studies have not been evaluated outside the laboratory (37). In this regard, a study stated that surfaces have a relatively low risk of virus transmission (38). It

was also demonstrated by the US Centers for Disease Control and Prevention that surfaces are not thought to be a common route of virus transmission and spread for the COVID-19 (37). Viral diseases, by decreasing the immunity level, may reduce the body's resistance to conditions such as food poisoning. Therefore, it is necessary to consider hygiene tips in buying, washing, storing, preparing, and consuming food (33, 39).

5.1. Prevention of Coronavirus Transmission through Food

5.1.1. How to Buy Food?

Food must be prepared and purchased from safe places. Avoid buying uncovered foods (e.g. olives, pickles, ready herbs, dried vegetables, and nuts). Regarding nuts, you can disinfect them before using them in a microwave. It is recommended to buy pasteurized or sterilized dairy products and pay attention to their production and expiration dates. Since the virus survives on different surfaces (metal surfaces up to 20 h, steel surfaces for several days), so it is likely that the shopping cart or basket might be infected (33). Thus, the surfaces of all shopping stuff on the wheels should be disinfected at home.

Bread is not contaminated after baking, but the way removing it from the oven, packing it out, and carrying it to home are among the things that can cause infection (39). Bread is probably one of the most important way of transmitting coronavirus into the home, thus it is vital to stick to the related protocols to provide the household with healthy bread (40). Packaged bread include all kinds of toast and baguette that are entirely produced industrially. After purchasing bread, simply rinse the container and then consume the bread. You can also return the edge of the bag containing bread and put the bread on the table without touching the edge of the bag or your hand. Traditional bread includes Lavash, Barbary, Sangak, and Taftoon as typical Iranian traditional bread. For these bread, two tablecloths or bags should be considered, one for bakeries and the other for storing at home.

5.1.2. Preparation, Storage, and Consumption of Food

Quickly clean and prepare fish, red meat, and raw chicken; then thoroughly wash the used table and board (33). Kitchen sinks are one of the most polluted places and should be washed after washing fruits, vegetables, and meat products (32). The virus survives at low temperatures (refrigerator), so meat, poultry, vegetables, and fruits must be kept in the refrigerator or freezer after proper washing. It is better to store different foods on different fridge floors depending on the type of food. Foods that are more likely to rot, such as cooked meat should be stored in the coldest part of the fridge. Finally, cook different types of meat, including red meat, turkey, poultry, fish, as well as eggs, and avoid eating them half-cooked (baking temperature

at least 70°C or 158°F).

Recommendations (in Summary)

(i) Recommend daily consumption of phytochemicals (lycopene sources such as tomato and resveratrol's sources such as grapes and blueberries) that are helpful in the recovering period. (ii) To get more flavonoids and polyphenols, focus on the daily consumption of vegetables and fruits like apples and onion. If supplemented, the recommended dosage is 500 to 1000 mg per day. Daily intake of one multivitamin tablet containing vitamins A, E, C, and group B vitamins, omega-3, selenium, zinc, and magnesium for three months is helpful on a dietitian's diagnosis. (iii) Be careful about group B and fat-soluble vitamins, especially D, K, and dietary antioxidants in the survived hepatic patients. Check vitamin D and iron levels and start supplementation, if needed. (iv) A gynecologist should recommend the consumption of vitamins and minerals in the survived pregnant women.

Acknowledgment

We would like to thank all members of the present study group for their ideas, suggestions, participation, and support.

Conflict of Interest

None declared.

References

- 1 Helmy YA, Fawzy M, Elasad A, et al. The COVID-19 Pandemic: A comprehensive review of taxonomy, genetics, epidemiology, diagnosis, treatment, and control. *J Clin Med*. 2020;9:1225. DOI:10.3390/jcm9041225. PMID:32344679.
- 2 Cui J, Li F, Shi ZL. Origin and evolution of pathogenic coronaviruses. *Nat Rev Microbiol*. 2019;17:181-92. DOI:10.1038/s41579-018-0118-9. PMID:30531947.
- 3 Helmy YA, Fawzy M, Elasad A, et al. The COVID-19 Pandemic: A comprehensive review of taxonomy, genetics, epidemiology, diagnosis, treatment, and Control. *J Clin Med*. 2020;9:1225. DOI:10.3390/jcm9041225. PMID:32344679.
- 4 Muscogiuri G, Barrea L, Savastano S, et al. Nutritional recommendations for CoVID-19 quarantine. *Eur J Clin Nutr*. 2020;74:850-51. DOI:10.1038/s41430-020-0635-2. PMID:32286533.
- 5 Lake MA. What we know so far: COVID-19 current clinical knowledge and research. *Clin Med (London)*. 2020;20:124-27. DOI:10.7861/clinmed.2019-coron. PMID:32139372.
- 6 Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395:497-506. DOI:10.1016/S0140-6736(20)30183-5. PMID:31986264.
- 7 Derwand R, Scholz M. Does zinc supplementation enhance the clinical efficacy of chloroquine/hydroxychloroquine to win today's battle against COVID-19? *Med Hypotheses*. 2020;142:109815. DOI:10.1016/j.mehy.2020.109815. PMID:32408070.
- 8 Jayawardena R, Sooriyaarachchi P, Chourdakis M, et al. Enhancing immunity in viral infections, with special emphasis on COVID-19: A review. *Diabetes Metab Syndr*. 2020;14:367-82. DOI:10.1016/j.dsx.2020.04.015. PMID:32334392.
- 9 López Plaza B, Bermejo López LM. Nutrition and immune system disorders. *Nutr Hosp*. 2017;34:68-71. DOI:10.20960/nh.1575. PMID:29156936.
- 10 Homayoun M, Mehrabani D, Edalatmanesh MA, et al. The role of lithium chloride in nutrition and stem cell growth kinetics: A review. *Int J Nutr Sci*. 2021;6:6-13. DOI:10.30476/IJNS.2021.88801.1104.
- 11 Cotter SC, Reavey CE, Tummala Y, et al. Diet modulates the relationship between immune gene expression and functional immune responses. *Insect Biochem Mol Biol*. 2019;109:128-41. DOI:10.1016/j.ibmb.2019.04.009. PMID:30954680.
- 12 Moynihan AB, Van Tilburg WA, Igou ER, et al. Eaten up by boredom: Consuming food to escape awareness of the bored self. *Front Psychol*. 2015;6:369. DOI:10.3389/fpsyg.2015.00369. PMID:25883579.
- 13 Pae M, Meydani SN, Wu D. The role of nutrition in enhancing immunity in aging. *Aging Dis*. 2012;3:91-129. PMID:22500273.
- 14 Fan YY, Huang ZT, Li L, et al. Characterization of SARS-CoV-specific memory T cells from recovered individuals 4 years after infection. *Arch Virol*. 2009;154:1093-9. DOI:10.1007/s00705-009-0409-6. PMID:19526193.
- 15 Berthon BS, Wood LG. Nutrition and respiratory health--feature review. *Nutrients*. 2015;7:1618-43. DOI:10.3390/nu7031618. PMID:25751820.
- 16 Saul AW. Nutritional treatment of coronavirus. *Orthomolecular Med News Service*. 2020;16:22.
- 17 Zhang L, Liu Y. Potential interventions for novel coronavirus in China: A systematic review. *J Med Virol*. 2020;92:479-490. DOI:10.1002/jmv.25707. PMID:32052466.
- 18 Hemila H, Chalker E. Vitamin C for preventing and treating the common cold. *Cochrane Database Syst Rev*. 2013;Cd000980. DOI:10.1002/14651858.CD000980.pub4. PMID:23440782.
- 19 Sizar O, Khare S, Goyal A, et al. Vitamin D Deficiency. 2021. In: StatPearls [Internet].

- Treasure Island (FL): StatPearls Publishing; 2021. PMID:30335299.
- 20 Abrams S, Motil K, Hoppin A. Zinc deficiency and supplementation in children and adolescents. UpToDate [Online][cited 2018 May 11]. 2007.
 - 21 Hambidge K. Zinc in trace elements in human th and animal nutrition. Mertz “W. Ed. 5 Vol”, P1-137 Orlando. Florida academic press inc; 1987.
 - 22 Auerbach M, Means Jr RT, Kunins L. Treatment of iron deficiency anemia in adults. *Nutritional Anemia*. 2019;85-95. DOI:10.1017/9781139023993.008.
 - 23 Elstrott B, Khan L, Olson S, et al. The role of iron repletion in adult iron deficiency anemia and other diseases. *Eur J Haematol*. 2020;104:153-161. DOI:10.1111/ejh.13345. PMID:31715055.
 - 24 National Clinical Guideline Centre. Anaemia management in chronic kidney disease: update 2015. NICE guideline 8. National Institute for Health and Care Excellence (NICE). Updated 2015. <http://www.nice.org.uk/guidance/ng8>. Accessed June 3, 2015.
 - 25 Morrow LE, Kollef MH, Casale TB. Probiotic prophylaxis of ventilator-associated pneumonia: a blinded, randomized, controlled trial. *Am J Respir Crit Care Med*. 2010;182:1058-64. DOI: 10.1164/rccm.200912-1853OC. PMID:20522788.
 - 26 Zeng J, Wang CT, Zhang FS, et al. Effect of probiotics on the incidence of ventilator-associated pneumonia in critically ill patients: a randomized controlled multicenter trial. *Intensive Care Med*. 2016 42:1018-28. DOI:10.1007/s00134-016-4303-x. PMID:27043237.
 - 27 Hao Q, Dong BR, Wu T. Probiotics for preventing acute upper respiratory tract infections. *Cochrane Database Syst Rev*. 2015;CD006895. DOI:10.1002/14651858.CD006895.pub3. PMID: 25927096.
 - 28 Akour A. Probiotics and COVID-19: is there any link? *Lett Appl Microbiol*. 2020;71:229-34. DOI:10.1111/lam.13334. PMID:32495940.
 - 29 Yang PH, Lin MC, Liu YY, et al. Effect of nutritional intervention programs on nutritional status and readmission rate in malnourished older adults with pneumonia: a randomized control trial. *Int J Environ Res Public Health*. 2019;16:4758. DOI: 10.3390/ijerph16234758. PMID: 31783672
 - 30 Patel U, Malik P, Mehta D, et al. Early epidemiological indicators, outcomes, and interventions of COVID-19 pandemic: A systematic review. *J Glob Health*. 2020;10:020506. DOI:10.7189/jogh.10.020506. PMID:33110589.
 - 31 World Health Organization. Enhancing Developing Country Participation in FAO/WHO Scientific Advice Activities: Report of a Joint FAO/WHO Meeting, Belgrade, Serbia and Montenegro, 12-15 December 2005. Food and Agriculture Org; 2006.
 - 32 Mehrabani D, Vahedi M, Eftekhari MH, et al. Food avoidance in patients with ulcerative colitis: A review. *Int J Nutr Sci*. 2017;2:189-195.
 - 33 Tailgating Food Safety (Q & A) United States Department of Agriculture. Food Safety and Inspection Service. http://www.fsis.usda.gov/news_&_events/Food_Safety_at_Home_Podcasts/index.asp. Access May 10, 2020
 - 34 van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N Engl J Med*. 2020;382:1564-1567. DOI:10.1056/NEJMc2004973. PMID:32182409.
 - 35 Chin AWH, Chu JTS, Perera MRA, et al. Stability of SARS-CoV-2 in different environmental conditions. *Lancet Microbe*. 2020;1:e10. DOI:10.1016/S2666-5247(20)30003-3. PMID:32835322.
 - 36 Harbourt DE, Haddow AD, Piper AE, et al. Modeling the stability of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on skin, currency, and clothing. *PLoS Negl Trop Dis*. 2020;14:e0008831. DOI:10.1371/journal.pntd.0008831. PMID:33166294.
 - 37 Lewis D. COVID-19 rarely spreads through surfaces. So why are we still deep cleaning? *Nature*. 2021;590:26-28. DOI:10.1038/d41586-021-00251-4. PMID:33514939.
 - 38 Goldman E. Exaggerated risk of transmission of COVID-19 by fomites. *Lancet Infect Dis*. 2020;20:892-93. DOI:10.1016/S1473-3099(20)30561-2. PMID:32628907.
 - 39 Food hygiene: practical guidelines (2019). <http://app2.nea.gov.sg/public-health/food-hygiene/foodhygiene-practices-guidelines>. Access 2 May, 2020.
 - 40 Ouabdesselam L, Sayad A. Impact of COVID-19 on Food Safety. *Eur J Basic Med Sci*. 2020;10:27-32. DOI:10.21601/ejbms/10820.