

Systematic Review on Novel Corona Virus: Origin, Transmission, Role of Immunity and Ayurveda as Therapeutic Potential in Treating COVID-19

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Abstract: The new coronavirus named COV-2 has contributed to the outbreak of a respiratory disease known as COVID-19 at the end of 2019. More than a million people around the world have been infected by this outbreak. Corona is a particularly transmitted viral illness caused by one of the viruses that started to get people sick of flu-like symptoms. The condition is called SARS-CoV-2 or Severe Acute Respiratory Syndrome. Coronaviruses are a wide family of viruses believed to cause diseases ranging from mild cold diseases to serious diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). The infection spreads quickly and has infected individuals around the world. More than 55 million individuals have been contaminated with COVID-19 worldwide so far. In some individuals, the infection can be more extreme and some patients show no effects, since it depends on the individual's immunity. High levels of social trauma and a major effect on emotional and physical wellbeing, such as health staff, have contributed to the COVID-19 crisis. The elevated risk of acute respiratory infections is more closely associated with deteriorating mental health problems, including fatigue, depression, and anxiety. Our immune system needs to be effective enough to prevent disease before a potential vaccine is available. The promising effects have been seen by Ayurveda and various natural methods to improve the immune system and keep it safe to stop viral attack. In this review article we have addressed the sources of the corona virus and also how it is transmitted from animals to humans. In the current review, the viral life cycle and role immunity and Ayurveda in the prevention of corona virus were also addressed.

Key words: COVID-19, Corona virus, Pandemic, Respiratory illness, Immune system, Ayurveda, Transmission, Immune boosting food.

1. Introduction

Due to the novel corona virus that is called the COVID-19 pandemic, the planet is facing lockdown for the first time. It has contributed to major global economic instability and human wellbeing due to this lockout [1]. In December 2019, a number of acute respiratory infections occurred in Wuhan City, Hubei Province of China. A new Corona virus, belonging to the Coronaviridae family, has been found to be the pathogen responsible for these infections. The outbreak was considered to have been initiated by zoonotic distribution from the seafood markets in

Wuhan, China [2, 3]. Transmission from human to human was accepted as responsible for the transmission of the disease by the government and was documented in around 185 countries worldwide [1, 4, 5]. The virus infection travels from the nasal passage and throat to the lungs in extreme situations, where it can lead to pneumonia and prove fatal. The virus circulates by coughing, sneezing droplets and reaches the body through the lips, eyes, and nose. It can remain viable on surfaces for hours to days, and when inhaled, it can reach the lungs directly [3]. As there is no clear therapy for this disease to date, it is concluded that a variety of diagnostic and treatment techniques are required for controlling COVID-19 per hour. The immediate use of chloroquine and hydroxychloroquine has been licensed by the United

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States Food and Drug Administration for emergency care of affected persons [4]. There are many Ayurveda therapies present in the current scenario to strengthen

the body's immune system and also help to be mentally and physically and provide courage to defeat corona virus [6].

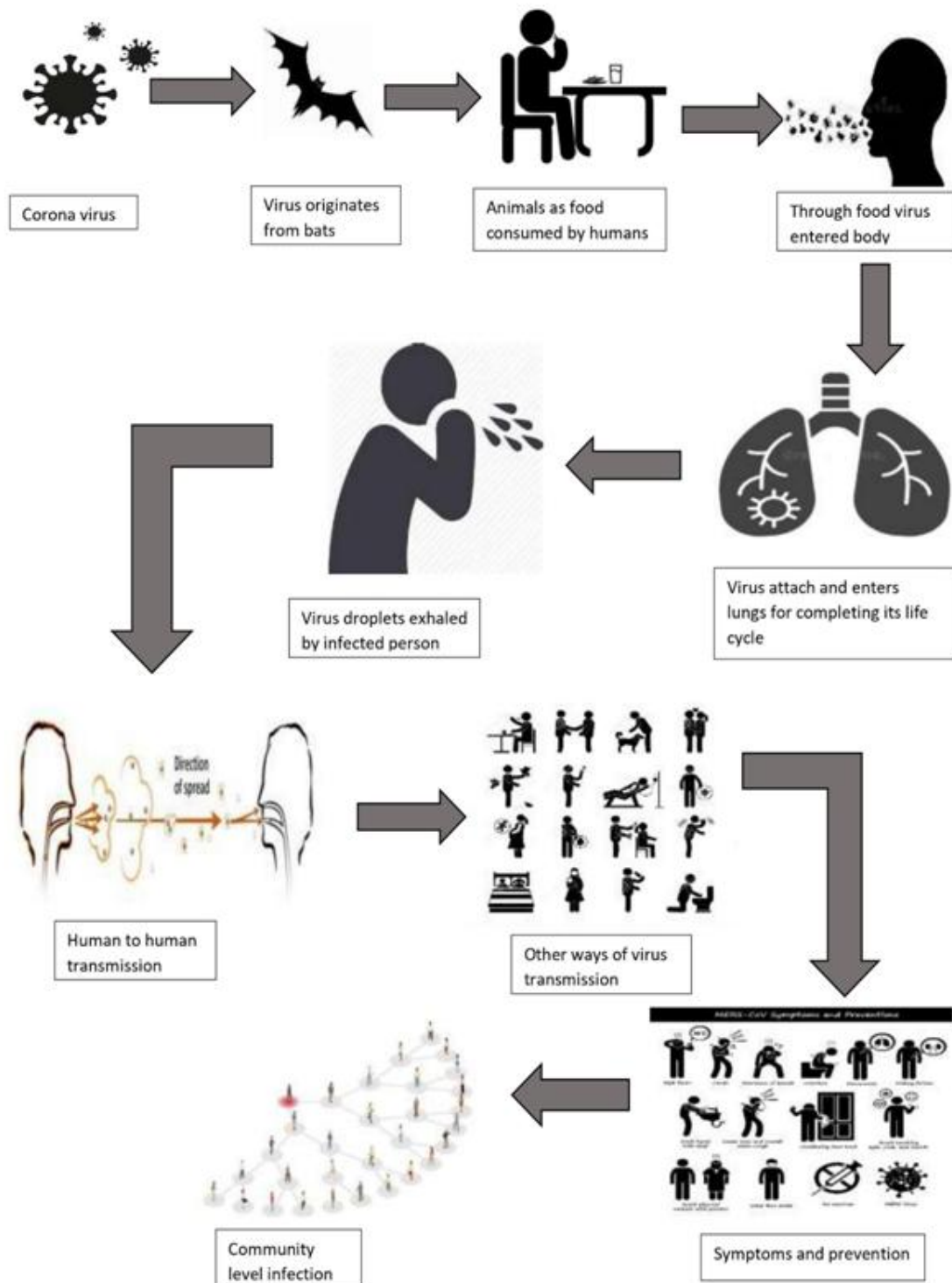


Fig. 1 Origin, sources and transmission of novel corona virus from animals to human to community level.

1.1 Origin

Most health practitioners suspect that the current form of corona virus came from the Bats or Pangolins. Wuhan, China, has confirmed the first human transmission. This type of virus will infect both humans and animals, as the virus spreads by interaction with individuals. In significant numbers of countries where COVID-19 was declared a pandemic by the World Health Organisation (WHO) on March 11, 2020, novel corona virus cases have been confirmed. When it is present in an entire nation or planet, every illness is said to be a pandemic. The pandemic alarm system of the WHO varies from Phase 1 (low risk) to Phase 6 (full pandemic) [1, 7, 8]:

- Phase 1: No reported human diseases were caused by the virus in animals.
- Phase 2: Human contamination was caused by the animal virus.
- Phase 3: In human beings, there are scattered occurrences or small groups of illness. It's not large enough to cause community-level diseases if the disease spreads from humans to humans.
- Phase 4: The infection is occurring at the population level from person to person with reported outbreaks.
- Phase 5: The disease is circulating among humans in one of the WHO regions in more than one area.
- Phase 6: There are community-level outbreaks in at least one more nation in a particular region from Phase 5 [7, 8].

1.2 Modes of Transmission

COVID-19 spreads by droplets produced by a COVID-19 infected individual as a result of coughing or sneezing (Fig. 1). In two respects, this can happen [9, 10].

1.2.1 Transmission of touch.

Direct close contact: By being in close contact with COVID-19 patients (within one meter of the infected

person), one can get the infection, especially when they do not cover their face with a mask while coughing and sneezing.

Indirect contact: For several days, the droplets of the infected person hang off the surfaces or clothing. The infection may then be spread to healthy people by rubbing all other surfaces or clothes and then touching one's nose, eyes and mouth.

1.2.2 Transmission droplets

Corona virus transmission by droplets depends on the size of the droplet and the distance from the infected person to the healthy person [9, 10].

Respiratory droplets: Respiratory droplets have a diameter of $> 5-10 \mu\text{m}$. When a person is in direct contact with an infected person who has respiratory symptoms such as coughing and sneezing, this form of transmission may occur. Viruses can penetrate the body through the nose, eyes, and mouth through respiratory droplets, which can contribute to infection.

Airborne transmission: Droplets with a diameter of $< 5 \mu\text{m}$ are known as aerosols and droplet nuclei. In the case of airborne infection, the infectious agent is exhaled by the affected person via the dissemination of aerosols that remain trapped for a long time in the air [8-10].

1.3 Pathophysiology

This viral infection spreads from the nasal passage and throat to the lungs, where it is lethal and can cause pneumonia. Via coughing and sneezing, the infection circulates through the droplets of the sick person and reaches the bloodstream through the lips, eyes and nose. Infection causes inflammation of their mucous membrane upon hitting the lungs and destroys air sacs. Because of this inflammation, the lungs' ability to oxygenate the blood and remove carbon dioxide from the bloodstream is diminished. Lung inflammation and its decreased effectiveness can cause fluids, pus, and dead cells to fill them, causing an infection, and leading to pneumonia. Viruses may also penetrate the bloodstream, inducing symptoms such as diarrhoea

and indigestion, and infecting the gastrointestinal tract [11-13].

1.3.1 Viral Life Cycle and Penetration into Host Cells

The infection is spread from an infected person to a normal person by respiratory droplets. The virus binds to the host receptors and reaches the host cells by membrane fusion until the virus enters the normal person's body. In an envelope embedded with a variety of protein molecules, the corona virus is encased [11, 12]. When it is outside the host cell, the lipid bilayer envelope, membrane proteins, and nucleocapsid revolt against the virus. The viral envelope consists of four structural proteins, namely the spike (S), membrane (M), envelope (E) and nucleocapsid (N) proteins, and the lipid bilayer.

For host attachment and penetration, the S protein protrudes from the viral surface and reaches the host body. Two functional subunits compose the S protein (S1 and S2). ACE-2 is the SARS-CoV functional receptor and is shown to be highly prevalent in pulmonary epithelial cells. The S-protein binds initially to initiate the host cell invasion by the virus via these ACE-2 receptors of the host. After the corona virus has been bound to the ACE-2 receptors, the S-protein is activated by a two-step cleavage process: the first for priming at the S1/S2 cleavage site and the second for activation at the fusion peptide adjacent site within the S2 subunit. This S-protein induces confirmatory modifications that contribute to fusion of viral and host cell membranes. The virus reaches the pulmonary alveolar epithelial cells after the virus is merged with the membrane and the viral material is released inside the host. The virus now undergoes replication and development of negative strand RNA inside the host cell through transcription via the pre-existing single strand positive RNA. This newly shaped negative RNA strand serves to create new positive RNA strands that translate to synthesize new proteins in the cell cytoplasm [11, 12]. The new genomic RNA is bound by the viral N protein and the

M protein enables the incorporation of the cellular endoplasmic reticulum. In the endoplasmic reticulum membrane, these newly formed nucleocapsids are then enclosed and transferred to the lumen, from which they are transported to the cell membrane via the Golgi vesicles and then to the extracellular space via exocytosis. As these particles are now fresh material for group dissemination through respiratory droplets, the new viral particles are now ready to invade the neighbouring epithelial cells [11-13].

1.3.2 Symptoms

Severity-based complaints in patients

Mild: Symptoms of acute respiratory tract infection (fever, cough, sore throat, running nose, sneezing, fatigue) or digestive symptoms (vomiting, abdominal pain and diarrhoea).

Moderate: Pneumonia (frequent fever and cough)

Severe: Pneumonia with hypoxemia

Critical: Acute respiratory distress syndrome (ARDS) [11, 14].

1.4 Immune System and Immunity

The immune system is a complicated cell and protein network that protects the body from infection. The immune system functions by maintaining a database of any microbe it has ever vanquished, so that once it reaches the body again, it will easily detect and kill the microbe [15, 16].

In the Covid-19 pandemic situation, immune enhancement is the trending issue. In order to combat corona infection, people follow different ways to improve their immunity. For this effect, certain individuals may be infected by Covid-19 infection, but because of their inbuilt innate immunity, their signs are not shown [4, 17].

In order to defend off illness or other foreign particle, the immune system is still involved, but its function is only intensified when a human is sick. This activity is followed by a rise in the rate of metabolism, which in turn allows its activity to generate energy sources. Ultimately, these types of nutrition are

derived from nutritious diets. A proper consumption of all necessary nutrients and a healthy diet allows the immune system to function properly [15-17].

The power of our body to protect against microorganism-causing diseases is known as immunity. Two kinds of immunity are available, including: Innate immunity and Adaptive immunity [16]:

1. Innate immunity: Innate immunity is the first line of defence for our body against viruses and microbes that provide protection during the initial crucial hours of exposure to a pathogen. Any of the elements of inherent immunity include physical defences such as eyes, eyelashes, body hair, saliva, tears, etc [18].

2. Adaptive immunity: When innate immunity is not adequate to combat the pathogen, adaptive or acquired immunity is enabled. When the human is exposed to diseases or when vaccinated, this form of immunity grows [18].

The immune system's functions that allow an efficient host defence mechanism are [15]:

- Creating a membrane to avoid the entry into the body of pathogens.
- Identifying the pathogens once the boundary is crossed.
- Removing pathogens.
- Immunologic reaction generation [15].

1.5 Role of Immunity in COVID-19

As it stands, no vaccine has been found to fight coronavirus infection, and only immunization plays an important role in the fight. The role of the immunity and immune system in fighting corona infection has been called to attention by the COVID-19 pandemic situation [15]. Several health professionals and physicians have recommended strengthening the immune system so that the body can react to the virus itself and battle it without any antibodies. Covid-19 attacks people with a poor immune system, especially infants, older people and individuals with diabetes,

cardiovascular disease, etc. There is no specific medication or vaccine available to date for corona infection that has preserved a stable immune system to be protected from any virus invasion [4, 15, 19]. A healthy person's vulnerability to being infected with the virus depends on many factors, including [20]:

- I The existence of pre-existing virus-fighting antibodies;
- II Any individual's innate cellular immunity;
- III The involvement of virus entry receptors in the body;
- IV Presence of infection-fighting B-cells and T-cells (20).

Ageing and other diseases also play an important part in the normal functioning of the immune system. A correlation between diet and immunity in the elderly appears to be present. A form of malnutrition known as "micronutrient" in which a person is deficient in certain necessary dietary vitamins and minerals, and this can occur in the elderly as the elderly consume less [21, 22]. Loss in immune integrity, a phenomenon termed immunosenescence, may be associated with aging [15]. Because of this immunosenescence, older people are more vulnerable than younger people to diseases and inadequate vaccine responses [21].

1.6 Natural Ways to Strengthen the Immune System

There should be a compromise between the different parts of the immune system for the proper functioning of the body. Apart from maintaining a healthy lifestyle and taking supplements, the Indian ministry is also suggesting few organic and natural ways to practise as preventive measure to fight COVID-19. There are a variety of ways to improve immunity and counter the pandemic situation [23, 24].

To be physically active: Most health providers agree that health and exercise help patients fight off any sickness. As the corona virus primarily damages the respiratory system, yoga, pranayama and breathing exercise promote the proper functioning of the lungs

and improve the capacity to pump all the body's cells with oxygen rich blood. Exercise also increases blood supply, improving the immune system in turn. Staying physically strong and fit strengthens the individual's emotional health and helps to cope with fatigue, anxiety and depression. The use of physical activity in routine life tends to overcome weight, blood pressure and cardiovascular wellbeing, because one has a smaller chance of being affected by illness by improving health and immunity. It has been shown that chronic exercise over a span of 6 months reduces age-related immune deficiency [23].

Do not smoke: Scientists have demonstrated that smoking can reduce the immune system and thereby raise the risk of infection. There are thousands of free radicals emitted when a human smoke a cigarette, and many dangerous ingredients, including nicotine and nicotine. This results in a drop in the amount of anti-oxidants in smokers [25].

Get some sunshine: By energizing the T-cells responsible for combating pathogens, sunlight plays an important role in immunity. Sunlight does not stop the COVID-19 virus, but preserves the state of health of patients with COVID-19 in order to recover from the illness. Sunlight enhances the immune system, which speeds down the human body's production of viruses. Sunlight activates the development of vitamin D, which acts to improve the immune system. Studies have demonstrated that exposure to sunshine leads greatly to the healing of respiratory diseases, including tuberculosis and pulmonary disease [26].

Eat a healthy diet: Dietary nutrient shortages weaken natural immunity and make it more vulnerable to bacteria and viruses, and harmful health effects are linked with inadequate nutrition. Therefore, a healthy diet must be consumed so that the body receives all the necessary proteins, vitamins and minerals that help improve the immunity and have the ability to combat the disease. Vegetables, fruit, seeds, grains and nuts are used in the healthy diet [15, 27].

Steaming: A successful therapy for COVID-19 positive treatment may be steam inhalation. The heat waves of steam have also been observed to denature proteins that contribute to loss of SARS-CoV-2 infectivity, according to the researchers. Inhalation of steam with mint leaves and caraway seeds is shown to be effective in corona-positive patients [28].

1.7 Ayurveda's Role in Enhancing Immunity

There is no medication for COVID-19 therapy, but we need to protect ourselves against this disease by boosting our own immunity. Immunity under the heading of Vyadhikshamatwa was clarified by Ayurveda [29]. Several treatment options for improving immunity to respiratory diseases are available in Ayurveda, including some immunomodulators, local and systemic treatments, herbal decoctions, hot water, medicated water gargling and steam inhalation listed in Ayurveda for respiratory diseases

There are multiple variables that have a negative effect on immunity [30]:

- Unbalanced diet
- Excessive use of alcohol
- Erratic sleep
- Heavy burden
- Chronic drugs
- Dehydration [30]

There are many ways to boost immunity by Ayurveda, including [31]:

- ✓ Manage the metabolism and digestion and stop piling up the body's toxins

Stop consuming cold, processed, fried and junk foods that damage your immunity. Eat easy-to-digest, new and balanced foods at frequent intervals. Minimize red meat consumption and prohibit some refined meats such as pork, sausage and nuggets from being used. Staying hydrated is really important; drink warm water, Tulsi herbal and ginger tea [31].

- ✓ Maintain the three nutritional, sleep and lifestyle

pillars

Eat a balanced diet on a daily basis to get all the necessary nutrients for the body. Adequate sleep is also important in addition to good soil. Daily yoga and movement keep the body safe and fit. Breath work increases strength and boosts the circulation of the blood as well. When engaging with individuals, holding hands and embraces are discouraged to retain mutual distance so that the risks of transmitting diseases are minimized [31].

✓ Meditation

Meditation is a mind-management technique and there are researches that explain how meditation strengthens the immune system and enhances health. It would help to keep the mind relaxed and clear of tension and boost an individual's thinking capacity with a good mindset [31].

✓ Support your health with herbs

A natural antibacterial herb that can be added to food preparations is turmeric. It is used to improve immunity and therefore reduce the body's toxins. Tulsi Arka has anti-viral characteristics. Twice every day, 5-10 drops of Tulsi arka is healthy in skin, enhances digestion, and cleanses the upper respiratory tract. Using chyawanprash everyday with warm water or milk to get the vital nutrients that improves immunity. Eat seasonal fruits and vegetables and stay stress-free to improve optimal immunity and boost the respiratory system. Also ensure proper hygiene [31].

✓ Immunity boosting foods

Covid-19 attacks people with a poor immune system, especially people below and above the age level. It becomes more vulnerable to infections such as corona virus and other diseases when the immune system is small or weakened. Real foods dependent on plants improve and support the intestinal beneficial bacteria and optimal gut health, which stimulates the immune system of the general body. We should keep ourselves well and protected before we get a

preventive cure and a corona virus vaccine. In order to improve immunity and enhance the immune system, different food products should be taken [32].

Turmeric: Turmeric has a curcumin compound that has anti-inflammatory, anti-oxidant and anti-bacterial effects that also aid in wound healing. It helps to heal the cough when combined with milk and even battles the viruses in the respiratory tract. Turmeric is also known as golden herb, helps in removing toxins from the body and its anti-bacterial properties helps to fight against infections [32, 33].

Citrus fruits: Fruits enriched with vitamin C tend to enhance immunity to corona virus infection and help to keep healthy. As it is a potent antioxidant, vitamin C is a necessary food for the body, so it can neutralize the free radicals present in the body and help reduce cellular damage caused by radicals. Oranges, kiwi, tomatoes, bananas, grapefruit, lemon and amla are the best suppliers of vitamin C foods [32]

Root Vegetables and Greens: Vegetables containing β -carotene and vitamin A found to possess anti-inflammatory properties that can help the body's antibodies to respond to toxins, such as virus. Vitamin A is also involved in the production, growth and differentiation of red cells, lymph cells and antibodies. Food rich in vitamin A found to reduce the severity and prevent against subsequent episodes of acute lower respiratory tract infections. Food rich in β -carotenes and vitamin A includes carrot, spinach, apricots, kale etc [32, 33].

Yoghurt: Yoghurt and some varieties of cheese contain live cultures known as "probiotics" that are supposed to activate the disease-fighting immune system. These probiotics are "good bacteria" in the digestive system that are normally present. In the yogurt, live stains of these healthy bacteria are also found. In order to improve the immune system and support a balanced digestive system, probiotics can

benefit [32, 33].

Natural anti-virus foods: Tulsi leaves, garlic, ginger and honey are some of the natural anti-virus foods that protect against flu like symptoms:

- ☆ Tulsi leaves: Basil leaves are rich in phytonutrients, vitamins, minerals, and Eugenol, a bioactive compound with anti-microbial and anti-bacterial properties, which also helps reduce the level of stress and plasma glucose. Tulsi combats the respiratory ailments;
- ☆ Garlic: It's got powerful antioxidant properties. Garlic helps increase the production of T-cell-fighting viruses and reduces the amount of stress hormones produced by the body that can help keep the immune system functioning properly [32, 33];
- ☆ Ginger: Used for the treatment of cough, colds, nausea and gastrointestinal problems.

Zinc: Cells of the immune system need zinc for proper functioning and immune cell production. Zinc is a mineral which is not produced by the body. Red meat and shell fish include food containing zinc. Zinc is also necessary for the metabolism to function properly [32].

Water: Corona virus patients should drink plenty of water, as this will keep the mucous membrane moist, reducing the risk of cold and flu. Water helps to generate lymph that carries white blood cells throughout the body and other immune cells. Hydration is the way the nutrients in each cell of the body can be boosted. Eat food containing water, watermelon, cucumbers and celery [32].

Pomegranate: The healthiest fruit with anti-oxidant, anti-viral and anti-tumor effects is the pomegranate. It is also claimed that vitamins such as vitamin A, C, E and folic acid are safe sources. Pomegranate intake decreases the risk of certain illnesses [33].

2. Conclusions

People with poor immunity are more vulnerable to this COVID-19 world pandemic. Therefore, it is vital that Ayurveda and plant-based foods improve immunity so that the body gets all the beneficial nutrients that boost the immune system and sustain the body's beneficial bacteria. With increasing immunity, good grooming, social distance, wearing face masks, the use of sanitisers and daily hand washing should also be maintained to avoid infection. The novel coronavirus, which also increases the immunity of all aged classes, includes a nutritious diet and a healthy lifestyle.

References

- [1] Jamshaid, H., Zahid, F., Din, I, et al. 2020. "Diagnostic and Treatment Strategies for COVID-19." *AAPS PharmaSciTech* 21 (6): 222.
- [2] Shereen, M. A., Khan, S., Kazmi, A., et al. 2020. "COVID-19 Infection: Origin, Transmission and Characteristics of Human Corona Virus." *J Adv Res* 24: 91-98.
- [3] Liu, Y-C., Kuo, R-L., & Shih, S-R. 2020. "COVID-19: The First Documented Coronavirus Pandemic in History." *Biomed J* 43 (4): 328-33.
- [4] Chowdhury, M. A., Hossain, N., Kashem, M. A., et al. 2020. "Immune Response in COVID-19: A Review." *J Infect Public Health* 13 (11): 1619-29.
- [5] Pal, R., and Yadav, U. 2020. "COVID-19 Pandemic in India: Present Scenario and a Steep Climb Ahead." *J Prim Care Community Health* doi: 10.1177/2150132720939402.
- [6] Golechha, M. 2020. "Time to Realise the True Potential of Ayurveda against COVID-19." *Brain Behav Immun* 87: 130-1.
- [7] Current WHO phase of pandemic alert for Pandemic; Available on: www.who.int (Access on 10/2/2020).
- [8] Corona virus cause: Origin and how it spreads; Medical News Today; Available on: www.medicalnewstoday.com (Access on 12/2/2020).
- [9] Jayaweera, M., Perera, H., Gunawardana, B., & Manatunge, J. 2020. "Transmission of COVID-19 Virus by Droplets and Aerosols: A Critical Review on the

- Unresolved Dichotomy.” *Environ Res* doi: 10.1016/j.envres.2020.109819.
- [10] Transmission of SARS-CoV-2: implications for infection prevention precautions; World Health Organization; Available on: <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions> (Access on 15/2/2020).
- [11] Cascella, M., Rajnik, M., Aleem, A., et al. 2022. “Features, Evaluation and Treatment of Coronavirus (COVID-19).” In: StatPearls [Internet]. PMID: 32150360.
- [12] Ouassou, H., Kharchoufa, L., Bouhrim, M., et al. 2020. “The Pathogenesis of Corona Virus Disease 2019 (COVID-19): Evaluation and Prevention.” *J Immunol Res* doi: 10.1155/2020/1357983.
- [13] Yuki, K., Fujiogi, M., & Koutsogiannaki, S. 2020. “COVID-19 Pathophysiology: A Review.” *Clin Immunol* doi: 10.1016/j.clim.2020.108427.
- [14] Liu, Y., Yan, L-M., Wan, L., et al. 2020. “Viral Dynamics in Mild and Severe Cases of COVID-19.” *Lancet Infect Dis* 20 (6): 656-7.
- [15] Calder, P. C. 2020. “Nutrition, Immunity and COVID-19.” *BMJ Nutr Prev Health* 3 (1): 74-92.
- [16] Marshall, J. S., Warrington, R., Watson, W., & Kim, H. L. 2018. “An Introduction to Immunology and Immunopathology.” *Allergy Asthma Clin Immunol* 14 (Suppl 2): 49.
- [17] Wagner, D. N., Marcon, A. R., & Caulfield, T. 2020. “‘Immune Boosting’ in the Time of COVID: Selling Immunity on Instagram.” *Allergy Asthma Clin Immunol* 16: 76.
- [18] How the immune system works; Medical News Today. Available on: www.medicalnewstoday.com (Access on 16/2/2020).
- [19] Boosting your immune system against coronavirus: How to minimize the risk of infection? Available on: www.narayanahealth.org.
- [20] Schlom, J., and Donahue, R. N. 2020. “The Importance of Cellular Immunity in the Development of Vaccines and Therapeutics for COVID-19.” *J Infect Dis* 222 (9): 1435-8.
- [21] Oh, S-J., Lee, J. K., & Shin, O. S. 2019. “Aging and the Immune System: the Impact of Immuneosenesence on Viral Infection, Immunity and Vaccine Immunogenicity.” *Immune Netw* 19 (6): e37.
- [22] How to Boost Your Immunity, Helpful Ways to Strengthen your Immune System and Fight off Disease; Harvard Health Publishing. Available on: www.health.harvard.edu; September 2014 (Access on 18/2/2020).
- [23] da Silveira, M. P., da Silva Fagundes, K. K., Bizuti, M. R., et al. 2021. “Physical Exercise as a Tool to Help the Immune System against COVID-19: An Integrative Review of the Current Literature.” *Clin Exp Med* 21 (1): 15-28.
- [24] K Srinivasa Rao. 2020. “Yoga Improves Immunity, Helps Fight COVID-19.” *The Hindu Times* Available on: <https://www.thehindu.com/news/national/andhra-pradesh/yoga-improves-immunity-helps-fight-covid-19/article31879286.ece>.
- [25] Sopori, M. 2002. “Effects of Cigarette Smoke on the Immune System.” *Nat Rev Immunol* 2 (5): 372-7.
- [26] Leavy, O. 2020. “Immune-boosting Sunshine.” *Nat Rev Immunol* doi: 10.1038/nri2759.
- [27] Davison, G., Kehaya, C., & Jones, A. W. 2014. “Nutritional and Physical Activity Interventions to Improve Immunity.” *Am J Lifestyle Med* 10 (3): 152-169.
- [28] Steam inhalation: What are the benefits? Available on: www.healthline.com (Access on 20/2/2020).
- [29] Gautam, S., Gautam, A., Chhetri, S., & Bhattarai, U. 2020. “Immunity against COVID-19: Potential Role of Ayush Kwath.” *J Ayurveda Integr Med* doi: 10.1016/j.jaim.2020.08.003.
- [30] Improving immunity with Ayurveda. Available on: www.anandaspa.com (Access on 21/2/2020).
- [31] Ayurveda for Building Immunity against COVID-19. Available on: www.artofliving.org (Access on 21/2/2020).
- [32] Arshad, M. S., Khan, U., Sadiq, A., et al. 2020. “Coronavirus Disease (COVID-19) and Immunity Booster Green Foods: A Mini Review.” *Food Sci Nutr* 8 (8): 3971-6.
- [33] Immune Boosting Foods: Fruits, Veggies, Proteins and More. Available on: www.mindbodygreen.com (Access on 23/2/2020).