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Review Article

Post Pandemic Food Trends

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1. Introduction

“Pandemic” is a term which is there in everyone’s life for some years back. The world has seen numerous pandemics since the 6th century. But the most significant effects were made by the Covid-19 pandemic. The global crisis and two consecutive lockdowns have necessitated a rethinking of food options. Health and well-being have become a priority, and there has been a significant rethinking of what people eat and how it affects the environment.

2. Pandemic – Definition

The American Lung Association^[1] (2022) refers pandemic as a disease event in which there are more cases of a disease than expected spread over several countries or continents, usually involving transmission from person to person and affecting a large number of people.

2.1. Difference between endemic, pandemic and epidemic diseases

Table 1: Difference between endemic, pandemic and epidemic diseases

Endemic diseases	Epidemic diseases	Pandemic diseases
It is constantly present in a certain population or region, with a relatively low spread. Eg: Nipah virus, Ebola virus, Malaria <i>etc.</i>	It is happening when there is a sudden increase in cases spreading through a large population like a country. Eg: Measles, Dengue <i>etc</i>	It is happening when there is a sudden increase in cases spreading through several countries, continents or the whole world. Eg: Plague, Cholera, Influenza, Covid-19 ^[2]

**Endemic****Epidemic****Pandemic**

2.2. History of pandemics

The emergence and spread of infectious diseases with pandemic potential occurred regularly throughout history. Some of the pandemics that happened around the world are mentioning below:

- a) **Plague of Justinian:** It is also called “Black death” during the 6th century in the Mediterranean region. It is caused by *Yersinia pestis* with the symptoms like fever, cough and dyspnea. The plague of Justinian is estimated to have killed 60 per cent of the Mediterranean world and is still spreading as an epidemic.
- b) **Plague:** This pandemic occurred from 1346 to 1353 in Europe, Asia, and Africa. It is considered to be the most fatal pandemic recorded in human history with a death toll of around 200 million people. Some estimates suggest that it managed to kill as much as 60 per cent of Europe’s population.
- c) **The Seven Cholera pandemics:** The first cholera pandemic, also known as Asiatic cholera, began in 1817. It started in India and extended to Nepal, Indonesia, China, Japan, the Middle East, and parts of Russia. It was followed by six other pandemics, which happened in the period between 1827 to 1923 and spread to different continents. It is transmitted *Vibrio cholerae* through contaminated water. It now becomes endemic in several world regions. It is approximated that the first six cholera pandemics claimed about 1 million lives. The seventh cholera pandemic is estimated to cause around 2.86 million cholera cases globally every year. About 1.3 billion people are currently at risk of infection from cholera.
- d) **Influenza:** This includes Russian flu, Spanish flu, Asian flu, Hong Kong flu and Swine flu. Starting from 1889, it spreads all over continents from time to time. The patients presented with fever, chills, or myalgia. By the time April 1958, it had claimed more than 1 million lives globally. Even in the 21st century, influenza is still present as an endemic disease in many countries.

- e) **SARS Covid-19:** It is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-COV2), with the symptoms like fever, fatigue, productive cough, breathlessness, headache, anosmia, dysgeusia, and sore throat. Severe cases presented with complications such as respiratory failure, cardiac failure, and septic shock. The first case was reported to WHO from Wuhan on December 31, 2019, and it was declared as a global pandemic on March 11, 2020. Globally, as of July 2021, WHO reported that there have been >190 million confirmed cases of Covid-19, including >4 million deaths.

3. Effects of pandemic

The pandemic had created numerous effects and a great threat to the world economy, lives and livelihood. It arises as a health shock but later it leads to a global crisis. Some of the important effects of the pandemic are socio-economic and cultural effects, environmental effects and health effects.

a) *Socio-economic and cultural effects*

The pandemic has created global inflation, decline in economic growth by 3%, and employment losses. It causes labour displacement, business closures and stock crashes. The pandemic had also created an economic decline in the travel, tourism and restaurant sectors^[3]. It impacted many of the social relationships, social interactions and social norms^[4].

b) *Environmental effects*

The quarantine measures followed during the pandemic have created a huge increase in online shopping sectors and led to an increase in domestic waste. The online food deliveries also increased the amount of inorganic waste from food packaging and containers. As the pandemic has increased the number of health related problems and thus it increases hospital admissions. This leads to an increase in the amount of medical waste and impacts the environment. Wuhan hospitals produced an average of 240 metric tonnes of medical waste during the outbreak compared to their previous average of fewer than 50 tonnes^[5].

c) *Health effects*

The pandemic has also created numerous health effects. It created numerous psychological effects like acute panic anxiety, obsessive behaviours, paranoia, depression and post-traumatic stress disorder^[6]. The pandemic had also increased the incidence of respiratory and related issues like pneumonia, cardiovascular diseases, weakened immune system etc.^[7].



4. Food trends

The pandemic had created an immunity loss to large group of people over the world. Thus, it causes a change in food consumption patterns among people and leads to new and adopted trend in eating behaviour, habits and food choices.

The food trends adopted by people can be explained in three classifications. They are:

- 4.1. Pre-pandemic food trends
- 4.2. Pandemic food trends
- 4.3. Post pandemic food trends

4.1. Pre-pandemic food trends

Before the pandemic, many people, especially working professionals, had habits of dining out frequently. They rely more on restaurant meals due to their lack of free time and their hectic work schedules. At the same time many people made their meals at home for both family and personal demands.

It is important to note that pre-pandemic usage of online food delivery (OFD) applications was far lower than in the later stages of pandemic.

4.2. Pandemic food trends

By resuming many of the traditional customs, people during the pandemic period had adjusted to a new way of lifestyle. The practice of preparing meals at home had grown more popular, with many people beginning to bake bread and cakes in their kitchens. It was observed that the use of online food delivery applications had increased to a large number during the pandemic. During the pandemic time, people's knowledge of food, health, quality, and safety had also been increased^[8].

4.3. Post pandemic food trends

Adapting to healthy eating habits is the one thing that the pandemic helped people realise. They keep us healthy for a longer period of time in addition to giving the body good nutrition. The pandemic has made adopting healthy lifestyle choices possible all across the world. However, there have been some shifts seen in the pattern of food consumption across the post-pandemic period. Times of India^[9] reported that there are five post pandemic emerging food trends in India. They are:

- a) Adapting to healthy eating habits
- b) Increasing use of plant-based diets
- c) Increasing nutritional awareness of foods
- d) Increasing preference for healthier snacks
- e) Increasing popularity in baked goods and food blogging



The pandemic had created more space for people to enjoy home cooked meals. A study conducted by a US based survey platform called Acosta^[10] (2021) revealed that among post-pandemic eating trends, 20% increase was found in people eating together with their family, 19% increase seen in people cooking their meals at home, 15% increase was seen in the amount of food purchased by people. Usually, people took 2-3 meals per day but during the post pandemic time, it was seen that a 14% increase in consumption of a greater number of meals prepared per day (Table 2).

Table 2: Post pandemic meals at home

Food consumption trend	Percentage increase
Eating together with family	20%
Cooking meals at home	19%
Amount of food purchased	15%
No. of meals prepared per day	14%

Saxena and Limbad^[11] (2021) had conducted a research study on consumption change of household food habits pre and post lockdown during Covid-19 in the states of Gujarat and Maharashtra. The results indicate that there was a paradigm shift of the consumption of food items like fast foods, organic foods, vegetarian, and non-vegetarian food products. Most people are relying more on online services to order foods at home rather than consuming outside. It was found that the consumption of milk, milk products, fresh fruits and vegetables, nuts, organic cereals and organic tea were increased. It was because of the increased remote working strategies, as well as people became more conscious to maintain a healthy. It was also observed that the consumption of fast foods was increased so as to reduce the cooking time in between the household chores.

It was also found that there was a change in buying behaviour of the people when purchasing food commodities during the post lockdown period. 87.5% of the respondents preferred more home cooked meals, 65% of the respondents increased the practice of online ordering of foods and groceries and 59.9% respondents used to buy food commodities from local shops rather than going to supermarkets.

5. Post pandemic food trends

The food trends that are more prevalent during the pandemic are continuing in the post pandemic time as a trend. These trends can be explained under 4 headings. They are:



5.1. Increased use of food delivery applications

5.2. Change in food handling habits

5.3. Increased use of immune boosting foods

5.4. Increased use of supplements

5.1. Increased use of food delivery applications

There was a significant shift seen in people going to restaurants to have food to ordering food online. Financial Express^[12] (2021) reported that the global installation of food delivery applications increased from 21% to 25% pandemic and post pandemic time. Several applications like Swiggy, Zomato, UberEats, Swiggy Instamart, Jiomart, Amazon *etc.* were used by consumers for ordering food and groceries online. In Kerala, applications like Potafo, Pesito, and Rezoy were popular for online food delivery.

Many new applications were made during the pandemic time for food delivery, especially from Kerala. For example, Kerala Startup Mission with Lasper Technologies developed a food delivery application called "Foaps" which accepts online food delivery orders made through multiple applications. This application is still available in Kochi, Thiruvananthapuram and Kozhikode.

The concept of cloud kitchen has evolved as the use of online food delivery grows. This megatrend was observed at the time of pandemic and post pandemic time. Cloud kitchen is the concept of delivery only restaurant with no physical space and dine-in space. It is a restaurant kitchen that accepts delivery only orders without a traditional restaurant or dining in facility. The reason why they are popular is simply the contactless food option available without direct customer interaction with no extra staff such as waiters, cashiers or alike. With this minimum staff, the cloud kitchens will incur less expenditure and the same can be reflected in the form of discounts or some other monetary concessions^[13].

A study done by Sunil^[14] (2021) on the factors affecting Indian consumer's use of food delivery applications during the Covid-19 pandemic. He found that Swiggy was the most used application among other food delivery applications. The concerns over hygienic factors make the highest factor for purchasing food online. He also found that the offers like free delivery, combos, coupon discounts, complimentary items *etc.*, provided by the restaurants make customers more like to buy food online.

5.2. Change in food handling habits

One of the most important trends observed during post pandemic time is that the change in food handling habits among people. People around the world have been much more vigilant and health conscious during the pandemic time. Many people had adopted numerous



methods for sanitation and food handling to ensure safety.

The use of vegetable washes, vinegar wash, saline water, baking soda *etc.* and organic washes like turmeric water and tamarind water had increased to a large hike during the pandemic and many of these practices are still following by many people. During the pandemic period Food and Drug Administration (FDA) recommends four steps for safe dealing with food that is, **Clean, Separate, Cook and Chill**. They had recommended to:

- Rinse fruits and vegetables under running water without soap, bleach, or commercial produce washes.
- Use separate cutting boards and plates for produce, meat, poultry, seafood, and eggs
- Cook food safely when the internal temperature is high enough to kill germs
- Refrigerate and freeze food properly

FDA also recommends the usage of different fruits and vegetable washes and their soaking time to remove dirt and germs from the outer surface. It is briefly explained in Table 3.

Table 3: Composition and soaking time of different washes

Composition	Soaking time
1 tbsp mild detergents in a bucket of water (20 L)	1 minute
Vinegar in 3 parts of water	5 minutes
One large lemon juice in 5 litres of water	15-20 minutes
1/2 cup salt + 3 tbsp baking soda	15-20 minutes
Food grade hypochlorite solution (100ppm)	2-5 minutes

It was also observed that the use of packaged and canned goods had seen a rising preference among the general public during the pandemic and post pandemic period^[15].

5.3. Increased use of immune boosting foods

It has been familiar with the use of many immune boosting foods and beverages during pandemic. Many people are still using those immunity drinks like lime water, turmeric drink, ginger-garlic tea, *chukku kappi*, amla juice, aloe vera juice and other immunity drinks to boost the body's immune system so as to fight many infectious diseases.

It is important to note that the majority of households had witnessed some practices of using traditional or herbal medicines so as to prevent the pandemic. People had used many spices and condiments as immunity boosters in many of its forms.

The use of food as a medicine is there in our society for ages back. The consumption of functional foods and immuno nutrients like macro and micronutrients had facilitated in



providing immunity against many diseases^[16].

5.3.1. Immune boosting beverages and other products

Experts had advised to drink immunity boosting drinks to give a natural boost to the immune system and stay protected. The widely used immunity boosting drink during the pandemic was turmeric milk. Many health institutes, universities, food manufacturing and nutraceutical companies developed many immunity boosters in the form of drinks, mixes, gummies, etc.

The Indian Institute of Spice Research (IISER), Kozhikode has developed a novel spice mix formulation using turmeric, ginger and cinnamon as adjuvants in milk and milk products. This technology was then transferred to MILMA and they made a product called ‘Golden milk mix’ and ‘Golden milk’ as a beverage and make it available in the market.

Kerala Agricultural University had also developed some immunity boosting products such as ‘Jeevani’ – an immunity boosting drink, Lozenges from Holy basil and candy, gummies from turmeric extract.



Golden milk and mix – IISR with Milma



Candy and gummy from turmeric extract – KAU, Vellanikkara



Jeevani – KAU, Vellanikkara



Tulsi Lozenges – KAU, Vellanikkara

Plate 1: Immunity boosting products

5.3.2. Spices and herbs

Spices and herbs were used from ancient times as a traditional medicine in many Asian countries. Especially, in the Ayurvedic medicine they form a major ingredient. Due to their high potential, these spices and herbs are used for many pharmacological purposes mainly as immunity boosters. Phytochemical metabolites, such as tannins, terpenoids, alkaloids, coumarins, flavonoids and polyphenols, have shown efficacy against pathogenic microorganisms. Accordingly, quite a lot of reports have recommended the efficacy of herbal



bioactive compounds in reducing and managing the risk of SARS-CoV-2.

The Ayurveda Department of AYUSH, Ministry of Health and Family Welfare, Government of India has released the National Clinical Management Protocol which includes the use of spices such as turmeric, cumin, coriander, and garlic that are recommended in cooking. They have also advised taking drink herbal tea/decoction made from basil, cinnamon, black pepper, ginger, and raisin once or twice in a day. It was proved that these spices and herbs have antiviral activity against viruses which can prevent Covid-19 and declared those as immunity modulators.

Some of the spices and herbs that are commonly used commonly during pandemic period are turmeric, cinnamon, garlic, black pepper, ginger, cloves and basil.

a) Turmeric

The use of turmeric as an antimicrobial agent is familiar with everyone even from ancient times. The yellow pigment extracted from the turmeric rhizome called curcumin which possess that property and it also exhibits some other pharmacological properties like anti-inflammatory, and antifibrotic properties.

Pastor *et al.* (2021) ^[17] found that the curcumin has a strong therapeutic potential against SARS-CoV-2. It can inhibit the production of pro-inflammatory cytokines in lipopolysaccharide and thus provide a better immune system to fight against infections.

b) Cinnamon

Another spice which has a pharmacological effect is cinnamon. The major phytochemical found in cinnamon called cinnamaldehyde has anti-inflammatory properties. It can inhibit the TNF- α -induced inflammation through suppression of NF- κ B pathway activation. It was found that cinnamaldehyde is useful in the mitigation of SARS-CoV-2-induced hyper inflammation happened in lungs ^[18].

c) Garlic

Garlic is an important spice that is still being used for culinary and medicinal purposes. The predominant thiosulfinates in fresh garlic extract identified as allicin have the anti-inflammatory, antioxidant and antiviral properties. Fresh samples of garlic with no processing induces most of its biological activities. It can inhibit the TNF- α induced expression levels of IL-1 β , IL-8, IP-10, and IFN- γ pro-inflammatory cytokines.

Allicin exhibits strong viricidal activity against a wide range of viruses including parainfluenza virus type 3, human rhinovirus, herpes simplex virus (HSV)-1, HSV-2 and vesicular stomatitis virus (VSV). It inhibits nitric oxide synthase expression in activated macrophages and provides immunity against infectious agents ^[18].



d) Black pepper

Black pepper is a common spice which is being used in herbal medicine for a very long time. The bioactive compound present in black pepper is called piperin. It possesses anti-inflammatory functions and is therefore used to treat respiratory tract related diseases caused by viral infections. It is a strong antioxidant and promotes innate immunity and phagocytic activity in the body. It was found that black pepper can protect the body from hyper inflammation induced during the Covid-19 infection^[18].

e) Ginger

Ginger is one of the most popular spices worldwide, known since ancient times, and used both as a spice and a medicinal plant. Gingerols are the major phenolic compounds found in fresh ginger which possess a wide array of bioactivities, such as antioxidant, anticancer and anti-inflammatory properties.

Gingerols can alleviate inflammation given their ability to inhibit the activation of protein kinase B (Akt) and nuclear factor kappa B (NF- κ B) signalling pathways, causing a decrease in proinflammatory and an increase in anti-inflammatory cytokines^[19].

f) Clove

Clove is an important spice typically used for a variety of its health purposes. Scientific studies have evaluated its antimicrobial, antifungal, antiviral, antioxidant, anti-inflammatory and anticancer properties in a variety of models. The bioactive compound present in clove is called eugenol. It can strongly suppress the entry of pseudo typed SARS-CoV-2 into human ACE2-expressing HEK293 cells. It can reduce the SARS-CoV-2 spike S1-induced activation of NF- κ B pathway and the expression of IL-6, IL-1 β and TNF α cytokines in human A549 lung cells.

Paidi *et al.* (2021)^[20] found that the oral treatment with eugenol can reduced lung inflammation, decreased fever, improved heart function and enhanced locomotor activities in SARS-CoV-2 spike S1-intoxicated mice. Therefore, selective targeting of SARS-CoV-2 spike S1, but not ACE2, by eugenol may be beneficial for Covid-19 treatment.

g) Basil

Basil is a medicinal herb, which is commonly known as Tulsi. It contains a bioactive compound called quercetin. It is a powerful antioxidant with anti-inflammatory and antiviral activities. It helps in inhibiting TNF- α production and inhibits virus entry and viral cell fusion. Quercetin is found to reduces expression of pro-inflammatory cytokines and lung inflammation induced by rhinovirus^[21] (Glinsky, 2020).



A study conducted Gayathri (2022)^[22] found that basil have 38 bioactive compounds and out of which 14 compounds were identified with antiviral activity against Covid-19.

Gonella et al. (2022)^[23] conducted a study to assess the consumption of immune-boosting foods commonly consumed in India, including spices and gooseberries and a comparison of the frequency of consumption of these foods before and during the first wave of the COVID-19 pandemic.

It was found that there was an increase in awareness with respect to dietary habits, specifically in terms of consumption of immune boosting foods observed during the Covid-19 pandemic across the age groups. A significantly higher number of respondents consumed herbal juice/concoctions during the pandemic compared to earlier times. There was a significant increase in the consumption of condiments, fruit, gooseberries, honey, neem, and spices during COVID-19 times.

Nuertey et al. (2022)^[24] conducted a study to determine various types of home-based remedies, mode of administration, prevalence of use and relevance in reducing risk of infection, hospital admissions, severe diseases and death.

It was observed that the participants used home based remedies in various forms. The main methods of application of home-based remedies were mainly immune boosting drinks (34.1%), eating healthy food (33.8%), engaging in physical exercises (18.8%), steam inhalation with and without herbal decoction (9.9%), herbal baths (2.7%), and gargling (0.6%).

Neem tree leaves were the main ingredient in inhalation therapy and baths. These warm baths and steam inhalation were based on the general belief that heat kills SARS-CoV-2. Various drinks and herbal concoctions were imbibed to boost the natural immunity to fight any strain of SARS-CoV-2 that might have invaded the human body. Ginger has been the dominant ingredient in most of the drinks. Ginger with or without sweeteners or ginger in combination with other fruits, herbs, or seeds was commonly practiced as a preventive drink against Covid-19. Citrus fruits with sour properties such as lemon and lime were also believed to prevent Covid-19 and as such were active ingredients in many drinks taken to prevent Covid-19. Cloves were also common in some of the drinks.

The temperature of water used for drinks was important. Warm temperature of the drinks is preferred due to the widely held belief that SARS-CoV-2 survives best in a cold environment and is destroyed by heat.

Dietary changes such as adopting the habit of eating fruits and vegetables at a level not previously done, with the aim of preventing Covid-19, were common. Warm saline gargling were also identified in the qualitative analysis as other approaches to prevent Covid-19.



5.3.3. Macronutrients

Nutrition is critical to maintaining the health and vitality of all living organisms. Nutrients ingested in the diet are essential for growth, cellular function and tissue development, energy supply and immune defense. Macronutrients, including proteins, carbohydrates, and fatty acids, provide tissues with the energy necessary for their development and function. Immunomodulation by macronutrients has been studied in experimental animals and in human intervention studies by testing the effect of their intake on immunological outcomes.

a) Proteins

Proteins represent important macronutrients for the immune system, Protein consumed in the diet is broken down into amino acids which are then reassembled into antibodies and complement proteins which are the major players of the immune system. Amino acids play a major role in regulating the activation of macrophages, natural killer cells and B and T lymphocytes. They are important for the production of cytokines and cytotoxic substances.

It was reported by Hindustan Times (2020) ^[25] that the egg consumption during the pandemic was increased by 25% than before. It was because egg contains good amount of protein that can fight against Covid-19 virus.

b) Fatty acids

Fatty acids provide an important source of energy, are components of the cell membrane and modulate cell function. They can also influence immune cell functions by serving as precursors for the synthesis of lipid compounds involved in the regulation of innate and adaptive immune responses and inflammatory pathways. The concentration of fatty acids is a factor that may influence their effect on immune cells. Low concentrations of free fatty acids induce T cell proliferation and cytokine production and cause decreased immune functions. Metabolic derivatives of fatty acids, including alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are precursors for anti-inflammatory molecules that contribute to monocyte recruitment to sites of inflammation.

The omega-3-fatty acids helps in the production of prostaglandins, leukotrienes and resolvins which helps in reducing inflammations in the body. It helps in supporting respiratory functions, maintain body temperature, blood pressure and heart rate ^[26].

5.3.4. Micronutrients

Every stage of this immune response is reliant on the presence of certain micronutrients. The structural and functional integrity of the physical barriers requires maintenance for optimal function. Micronutrients play vital roles in these processes. The major micronutrients employed in immunity are vitamins like vitamin A, C, D, E and minerals like zinc (Zn) and



selenium (Se).

It was found that 78.1% people indicated everyday consumption of dietary supplements in the pandemic time so as to increase their immunity [27]. Micronutrients help in the management of the post-COVID syndrome. It involves in providing host immune responses to viruses by means of virus-host interaction, innate immune activation and through adaptive immune responses.

a) Vitamin A

Vitamin A forms the first line of defense in the form of Retinoic acid (RA). It enhances the serum levels of immunoglobulins like IgG, IgM and IgA. RA also helps in the production of specific antibodies and results in modulation of B lymphocyte activation, differentiation and cytokine production. Thus, it imparts a good immune modulatory activity in the body. Vitamin A deficiency alters the phagocytic and bactericidal activity of other cells of the innate immune system such as neutrophils and macrophages; this situation leads to further inflammation. In these cases, the number and activity of lymphoid cells decrease, such as natural killer cells, which can lead to an inefficient antiviral response. The major sources of vitamin A are yellow-orange-colored fruits and vegetables like carrot, papaya, mango, liver, organ meat *etc.*

b) Vitamin C

Vitamin C is a water-soluble micronutrient of high molecular importance. It possesses a wide range of biochemical and biological actions like antioxidant, phagocytosis, neutrophil chemotaxis, microbial clearance, and immunomodulatory, antiviral and anti-inflammatory effects and improves natural killer cell and T cell proliferation thus resulting in increased generation of antibodies from plasma cells and B-cells. It helps in reducing duration and severity of upper respiratory tract infections [28].

Vitamin C enhances the immune system via several pathways, such as provoking the response of T lymphocytes, augmenting the activity of lymphocytes and phagocytes, increasing interferon levels and scavenging reactive oxygen species (ROS). The supplementation of vitamin C had demonstrated a wide range of antiviral effects against several types of viral infections against Covid-19 in many studies. The important sources of vitamin C are citrus fruits like orange, cashew apple, gooseberry, kiwi, lemon, guava *etc.*

Kim *et al.* (2016) [29] found that the combination of Vitamin C with red ginseng can reduce the influenza virus-induced lung inflammation and increased the survival rate in mice. It was also found that Vitamin C in combination with quercetin provides synergistic antiviral, antioxidant and immunomodulatory effects in human body [30].



c) Vitamin D

Vitamin D is an important micronutrient for bone and mineral metabolism. But it also exerts its role by binding to its receptor (VDR), which is expressed in many cell types including B and T cells. In activated and proliferating B and T cells, the expression of VDR is increased indicating an important involvement of vitamin D in adaptive immune responses.

Vitamin D receptor can be found in cells like monocytes and macrophages which can increase the differentiation of monocytes to macrophages. Calcitriol, which is the active form of vitamin D, promotes movement and phagocytic ability of macrophages.

Vitamin D also involved in a wide range of immunomodulatory activities like:

- Maintain immune barrier integrity
- Produce antimicrobial peptides
- Modulate oxidative burst potential
- Support monocytes, macrophages and dendritic cell functions
- Promote anti-inflammatory cytokine production

The sources of vitamin D are milk and milk products, mushrooms, fishes *etc.*

d) Vitamin E

Vitamin E is a fat-soluble compound found in the cell membrane where it scavenges peroxy radicals and prevents oxidative damage to the cells. Vitamin E exerts an important role in modulating membrane integrity, signal transduction, and oxidative stress in immune cells. It helps in maintaining or enhancing Nk-cell cytotoxic activity and inhibits PGE2 production by macrophages. Thus, it indirectly protects T-cell function.

Vitamin E can enhance the cytotoxic activity, supports lymphocyte proliferation and T-cell-mediated functions, decreases prostaglandin E2 production by macrophages and can also reduce respiratory tract infection and virus load. The sources of vitamin E are avocado, nuts and oil seeds, coconut oil *etc.*

e) Zinc (Zn)

Zinc is an important mineral which possesses immune modulatory activity. It helps to maintain the integrity of immune barriers and enhances cytotoxic activity. Zinc supports cellular functions, growth and differentiation of innate immune cells and possesses anti-inflammatory properties. It also helps in production of antibodies, especially the immunoglobulin IgG. The main sources of zinc are garlic and dark green leafy vegetables.

f) Selenium (Se)

Selenium in the form of the amino acid (called selenoproteins) selenocysteine forms



part of the catalytic active site of peroxidases that catalyze oxygen-reactive species and may regulate metabolic reactions that induce the synthesis of lipoxygenases, enzymes involved in the synthesis of inflammatory mediators and thus exhibits anti-inflammatory properties.

Selenium can modulate innate and adaptive immunity and produce antibodies. The deficiency of selenium will increase the risk and virulence of virus-induced pulmonary infections. The major sources of selenium are brazil nuts, egg, chicken, oysters, clams *etc.*

5.4. Increased use of supplements

When the SARS-CoV-2 virus infection spreads over the world, people's interest in vitamin and mineral supplement use has increased to a large hike. Aysin and Urhan (2021)^[31] found that supplement use before and during the pandemic in Asia increased 29.5% to 71.9%. Most of the individuals stated that they took supplements to strengthen the immune system, as they know that supplements do not prevent Covid-19. However, it has been stated that the use of vitamin D, C, Zinc and selenium supplements may be beneficial, especially in those with diagnosed nutritional deficiencies and those with upper respiratory tract infections. Healthy individuals should be made aware of supplements and usage conditions.

Some of the commonly used supplements during the pandemic and post pandemic time are Evion, Supradyn, Lycomet, Celin tablets, Zincovit, Neurobion, S-Cal, Selenium *etc.*

6. Other practices commonly seen during the pandemic.

During the pandemic period, people are forced to maintain home quarantine for a long time. But it made a possibility of spending good time with family and helps many people to begin good lifestyle changes.

Many people had started the practice of making kitchen gardens, in the homesteads. It is a small-scale approach to growing fruits and vegetables for the needs of one's own. It is a sustainable approach of making gardening. On the other side, kitchen gardens help in providing a great psychological wellness for the people.

Next one practice which was emerged as a part of pandemic is food blogging. Many people resumed their art of cooking and increased their practice of baking cakes, breads *etc.* Through food blogging many people got familiarized with homemade snacks, foods and other cuisine.

Another practice which was seen during was the use of warm food and water. It is important to note that the use of warm food helps in maintain an internal temperature in the food makes it safer for consumption. The use steam inhalation using different herbs were also common during pandemic. Herbs like basil, neem leaves *etc.*^[32].



7. Post pandemic – A new world of health and opportunities

The pandemic had caused a change in the course of lifestyle and habits. The transient alteration of concerns and behaviours, but a deeply entrenched metamorphosis that prioritizes mental and physical health, with food and dietary supplements used as agents of change.

This has exerted enormous pressure on society and forced a host of changes to how to live and work. The adaptations have accelerated already existing trends in health care and lifestyle management.

According to a study done by Sloan and Hutt (2022)^[33], it was reported that nearly half (46%) of global consumers had taken greater control of their health, 38% improved their diet and 28% of consumers increased their activity level since the pandemic. So, it is so evident that many trends observed during the pandemic is still in practice by a major number of people.

8. Conclusion

As the epidemic had many detrimental impacts on people, it also brought about certain modifications in the general way of life and customs of people all over the world. Due to the pandemic's significant impact on the bottom of the income pyramid and the population's decreased nutritional intake, people had to deal with some societal difficulties. Contextual factors, such as lockdown situations, and individual factors, such as anxiety connected to Covid-19, loss of income, household composition, and gender, induced changes in eating behaviour during the initial wave of the pandemic. The results assist in identifying populations that are particularly susceptible to nutritional changes during the pandemic and suggest prospective directions that could be pursued to reduce the pandemic's detrimental effects on food intake. The changes in lifestyle and habits during the pandemic had created a rethinking in people and it made people to continue the changes for a better life in the post pandemic period also.

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