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Role of Indian Diet and Pranayama during Covid Pandemic

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Abstract: ***COVID pandemic adversities had diverted our inclination towards the remedial compounds which inhibit the potency of inflammatory markers during COVID-19 infection and reduce the severity of disease. Precisely, the Indian diet had played major role to combat the disease during COVID pandemic. The uptake of immune booster's phyto-compounds in form of daily diet had reduced the rate of severity during COVID infection, thus lower the burden of emergencies in medical crises. This review takes insight to those health benefitting dietary compounds that are used at a large scale, in almost every household due to their better affordability and easy access.***

Keywords: Covid pandemic, diet, nutrition, medicinal plants, life style changes

1. Introduction

The Coronavirus-2 or SARS-CoV-2, caused severe acute respiratory syndrome due to novel COVID-19 infection. The disease was first reported in November 2019which spread very fast by 30th January 2020 and has extended till date with different strains. The SARS-CoV-2 genome virus has been reported as zoonotic transmission, it showed 96% similarity with bat coronavirus and91% similarity with Pangolin CoV-2, coronavirus which could be an intermediate host for virus transmission [1, 2]. The World Health Organization (WHO) declared on 11th March 2020a global health emergency pandemic to COVID-19infection [3]. The countries everywhere started to set boundaries, making containment zones, banned mass gathering and events and declared a National Lockdown, governments and agencies worked on this health emergency when the covid infection cases showed toll rise. The WHO states COVID-19 infection for all age groups, specially the elderly leading to highest mortality rate, also those having compromised health conditions and comorbidities like hypertension, type-2 diabetes and obesity also faced severe adversities [4]. Since thenCOVID-19 infection has become a challenge to mankind. The whole medical fraternity doctors, nurses, health workers working day and night are fighting against the pandemic like real soldiers to save human lives.

The clinical symptoms of COVID-19 infection are asymptomatic to mild and severs pneumonia resulting in acute respiratory distress syndrome (ARDS), which sometimes leads to multi organ dis-failure (MOF). Recently some patients with covid infection faced dyspnea and hypoxemia, changes to respiratory syndrome having shortening of breath and oxygen supply. The other infection symptom observed in COVID-19 were seen in patients where ARDS progressing to septic shock, metabolic acidosis, coagulation dysfunction with disseminated intravascular coagulation (DIC), and multiple organ dysfunction syndrome (MODS), few other symptoms reported for Covid infections were diarrhea and gastrointestinal manifestations [5].

The SARS-CoV-2 infects human cells through the binding of its spike protein (S) to Angiotensin-Converting-Enzyme-2 (ACE-2). The ACE-2 is expressed in lung cells, esophagus epithelium and enterocytes of GI tract. The host protein named TMPRSS2, primes the viral protein which further replicates in host cells [6]. The covid infection shoots the inflammation where cytokine storm is induced, increasing the plasma levels of cytokines like IL-6, IL-1, IP-10, MCP-1, MiP-1A and TNFα as the progression of disease [7]. Later there is accumulation of pathogenic cells and inflammatory monocytes in the lungs causing respiratory disability and mortality in the disease. The cytokine release syndrome (CRS) created cytokines storm activates the endothelial cells and vascular dysfunction to thrombotic disease both in venous and arterial circulations. The pathophysiology of CRS also include oxidative stress, NADPH oxidase 2 (Nox2)-derived reactive oxygen species (ROS) induce clotting and platelet activation, thrombin generation and impairing artery dilation [7 & 8]. The pharmacological research and trial studies so far have considered remidesiver, as lifesaving drug in the COVID-19 infection. The use of chloroquine and hydrachloroquine showed little benefits but were not so successful due to cardiac toxicity occurring while treatment. The COVID-19 infection period has turned our interest beside pharmacological therapy to some non-pharmacological resources included in our diet and lifestyle which could strengthen our immune system and can be useful in COVID-19 pandemic [8].

Impact of COVID-19 in India

The impact of Covid on huge Indian population fall in various dimensions, where the laborers and factory workers risked their lives immigrated to the villages in large numbers without maintaining social distance, on the other side staying at home and online working, digital education, limitation of outside physical activities lead to food craving and binge over eating. These situation where storage of food items in full capacity due to outside restrictions and hearing stressful media news on Covid-19, had major influence on diet and lifestyle of millions of people. Foods rich in carbohydrates such as chocolates, ice cream and sweets comforts stress by inducing production of serotonin, a happy hormone and elevates depressed moods. However sudden

shoot in sugar levels raises one's glycemic index developing high risk of obesity, cardiovascular diseases leading to other severe complications due to Covid-19 [9].

Role of Indian Diet in COVID-19

The prospect of healthy diet and fitness in human life is universal. The pathology and mortality rate, health complications affected all age groups in COVID-19. The most severe damage was seen among the elderly, underrepresented minorities and those underlying comorbidities. The high prevalence of the risk factors in India were lifestyle disease like hypertension and type 2 diabetes and obesity can be kept at control by selection of diet and diet pattern. The maximum consumption of saturated fats (HFD), unsaturated fat, refined sugar and carbohydrates plays underlie role in the severity of covid infection conditions. In this chapter we will discuss different dietary components its effect on our health and lifestyle changes in covid-19 [10]. There are seven major classes of nutrients macronutrient such as proteins, carbohydrates and lipids, micronutrients like vitamins and minerals which completes a balanced diet.

***Proteins* (Dal, Pulses)**

The recommended dietary allowance (RDA) has recommended the daily protein intake for an adult 0.8g/Kg body weight, but in general the daily protein intake is much less than it. This changes the efficiency of body to develop its own defense system properly and lowers one's immunity. The risk of infection in this case increases many folds due to lesser active immunoglobins present in our body [11]. The low rate of immunoglobins increases persistence infection rate in lungs to hyper inflammation and other complications [12]. The intake of different forms of protein show different results, the processed meat, cheese and other frozen animal protein include high calories due to saturated fats along with them, further it changes the post prandial effects and increases lipogenesis which increases the inflammation in our body. Other sources such plant based protein diet containing anti-inflammatory properties can also not be helpful [13]. Thus it is important to select right type of protein sources which is essential for our body defense system, like eggs, fish, lean meat and non-fat dairy proteins like whey protein [14]. The studies have reported that proteins which have high biological value, lowers the glycemic index after meals and increases the gastric retention and gastro intestinal transit time [15]. The production of antibodies should be maintained through right choices of protein diet consumed daily [16]. It has been reported that many branched amino acids increases the intestinal immunoglobulin levels, an arginine supplementation was seen to increase the T-lymphocytes and T-helper cells functions during repeated infections [17]. Other amino acid which play important role in immune system is Glutamine which elevates the macrophages, neutrophils and lymphocytes and various cytokines levels such as IL-6, IFN-β and TNF-α through signal transduction needed for proliferation of immune cells and tissue repair [18]. A study based on cellular immunity and antibody response stated that protein deficiency, increases susceptibility to viral infection such as Zika virus or influenza virus [19]. It is clear from previous studies that diets low in protein content is not strong enough to encounter infections.

Lipids (Desi Ghee, White Butter, Nondairy products)

The lipids include fatty acids (FAs) which is important part of diet and needs to be regulated efficiently. The polyunsaturated omega-3, omega-6 and omega-9 fatty acids are essential fatty acids our body cannot make so it has to be consumed through in diet. The source of omega-3 fatty acids are sea food, fish and flaxseeds and walnuts, while sources of omega-6 fatty acids are vegetable oils. The ratio of both the fatty acids needs to be maintained in a ratio of 1: 1-4: 1, but recently it has been found that this ratio is 10: 1. The studies showed that fatty acids affects immune responses changing the organization of nuclear receptors [20]. Immune cells like epithelial cells, macrophages, dendritic cells, lymphoid cells, neutrophils, T and B cells are affected by lipid alterations in our body [21]. Theomega-3 fatty acids include linolenic acids (ALA), eicosapentaenoic acids (EPA) and docosahexaenoic acids (DHA) while omega-6 fatty acids produces arachidonic acids which are primarily pro-inflammatory mediators responsible for blood clotting and constriction of blood vessels, but body also converts this arachidonic acid into eicosanoids which are subsets of compound like oxylipins that can be part of cytokine signaling and innate immune response [22]. The omega-3 released oxylipins are also helpful in removing bacterial infections with the help of cytokines and apoptotic neutrophils [23]. Certainly these findings add the benefits of omega-3 fatty acids consumption in our diet. The balance between FAs, omega-3 and omega-6 fatty acids is essential for immune system homeostasis which if disturbed initiates allergens, autoimmune and other metabolic dysfunctions [24].

Dietary Fiber (Green leafy Vegetables, High Fiber Grains, Millets)

The role of dietary fibers in undoubtedly significant in our diets, it is recommended that 25g to 35g dietary fiber is should be included in our diet [25]. The good sources of dietary fibers are vegetables, fruits, nuts, seeds and whole grains, these foods unlike their contemporary processed carbohydrates like white flour, refined sugar. These diet component are most important health choices we make in daily diets. The high glycemic index induced by processed foods increases the free radicals and immediately increases the inflammatory cytokines and C-reactive protein in our body [26]. The dietary fiber included in our diet lowers the shoot of post prandial high glycemic index load and do not triggers the any adverse inflammatory response in our body [27]. Dietary fibers are complex carbohydrates and are slower in digestion as compared to processed carbohydrates intakes and inhibits the chances of sudden shoot of glycemic load in our system [28]. This type of change in food pattern have resulted in reduced C-reactive protein (CRP) concentrations in blood when tested indicating reduction in inflammation [29]. A study reported low carbohydrate diet increased gamma delta T cells in the lungs against influenza virus [30]. Since these are important but nascent more research is needed to understand the role of dietary fibers in immune responses among human subjects. The other important studies showed that dietary fiber improves our gut microbiome compositions which reduces the chances of gut

and systemic inflammation and reduces the risk of other inflammatory diseases such as CVD, T2D, cancer and obesity [31].

Role of vitamin supplementation in COVID infection

These days nutrition supplements has taken a new talk in COVID-19, from several decades' importance of nutritional supplements with Vitamins and minerals have been proved. There are twelve vitamins and essential minerals which encompasses the micronutrients taken in our diet. Here we will discuss few vitamins which nowadays are taken as supplementation in pre to post covid infections and recovery.

Vitamin C

A water soluble vitamin which provides antioxidants useful in production of cortisol and catecholamine. Its function to maintain epithelial and endothelial barrier, helps in vasodilation and reduces certain inflammatory modulators also [32, 33]. It works in reducing ROS, decreases necrosis and improving phagocytosis and chemo taxis to builds overall strong immunity. Many randomized trials conducted indicate that Vitamin C supplementation supports respiratory tract infections. Some of the studies have also reported an intravenous supplementation immediately reduces inflammation and speeds the recovery of vascular injuries during severe conditions of sepsis and acute respiratory distress syndrome (ARDS). It has also been reported that Vitamin C helps in reducing proinflammatory and procoagulant changes occurring in Lung damage [34], and 8]. Other reports related to Covid studies on Vitamin C showed a combination of Vitamin C with hydro cortisone and thiamin are effective against sepsis, pneumonia [35]. The combination of corticosteroids and Vitamin C improves the glucocorticoid receptor functions and increases the sodium –Vitamin C transporter 2 preventing the damage in endothelial layer [36]. Overall various studies have observed it undoubtedly that Vitamin C increases the body resistance capacity over corona virus and may reduce the lower respiratory tract infections at various conditions [37].

Vitamin D

The good sources of Vitamin D in diet are milk, eggs, fish and mushrooms, other than these an important source is sunlight through which we can synthesize calcitriol (1, 25 dihydroxyvitamin D) underneath skin from cholesterol [38]. The most important function of Vitamin D is regulating calcium homeostasis in bone metabolism. Over the years it has been studied that beside bone health, Vitamin D has significant role in immune system and certain inflammatory responses in our body [39]. Some studies have explained that T cell binds with calcitriol (an active component of calcidiol) to conduct its physiological functions, other inflammatory cells also bind to Vitamin D receptor thus explaining the role of vitamin D in our immune system [40]. Other important studies related to Vitamin D showed that in the presence of 1, 25 (OH) 2D3, macrophages production of catelicidine is increased which prevents infections of respiratory human cells [41]. There are studies which shows that bio-signaling pathways associated to Vitamin D may modulate the inflammatory responses. The nuclear factor NF-kB (**Nuclear Factor** kappa-light-chain-enhancer of activated B cells) bioactivity changes via upregulation and triggers the production of many molecules which increases the inflammatory response (IL-6, IL-β. TNF-α). The production of iNOS, COX-2 and PLA2 enzymes is increased and reduce the production of free radicles and cell degradation [42]. The Vitamin D stabilizes our immune system and metabolic system certainly it also plays important role neurodegenration. The supplementation of Vitamin D in our diet is very important. The study done on 14, 108 subjects showed that Vitamin D levels were inversely proportionate to acute respiratory disease infection [43]. Recently this type of studies where daily or weekly administration of Vitamin D doses benefited among acute respiratory disease infection in patients [44]. However much studies are needed to test the hypothesis of intake of Vitamin D reduces the Covid infection rate and be mandatory supplement along with defined dosage and method of administration in covid infection.

Vitamin A

The Vitamin A supplement has been known to improve the infection, protection mucous and epithelium and eye sight [45]. The sources of Vitamin A can be found very easily all the orange and red vegetables, dark green leafy vegetables, cheese, eggs, fish and cod liver oil. The Pro vitamin A, α carotene and β carotene present in different food sources are important for our diet [46]. The role of Vitamin A is keratinization, stratification, differentiation and maturation of the epithelium layer of skin, our first line of defense against pathogen. The other function Vitamin A modulates as ligands, by its active forms retinal, retinol and retinoic acid which activates the receptor (RAR) nuclear retinoic acid receptor. These forms of (Cis and Trans) retinoic acid regulates immune functions on cells like macrophages, neutrophils, phagocytes and natural killer T-cells. Also it is seen that deficiency of Vitamin A, changes in histopathology of pulmonary epithelium causing lung dysfunction and other respiratory diseases [47]. These studies show the importance of Vitamin A in our diet during COVID-19, where lung infection is major cause of morbidities.

Vitamin B

Vitamin B is good source of many enzymatic processes, the constituent of Vitamin complex include riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid and cobalamin. The food resources milk, cheese, eggs, liver and kidney, meat, fish, such as tuna, mackerel, and salmon, shellfish, such as oysters and clams, dark green vegetables, such as spinach and kale, such as beets, avocados, and potatoes, whole grains and cereals, beans, such as kidney beans, black beans, and chickpeas, nuts and seeds, fruits, such as citrus, banana, and watermelon, soy products and yeast. Overall for good health Vitamin B is requires for many vital functions of human physiology. The administration of Vitamin B3 (nioctinamide) had shown the decreased inflammation and neutrophil infiltrations, in lung injury in mice [48]. The PLP (pyridoxal 50 phosphate) an active coenzyme of Vitamin B6 is involved in humoral and cell mediated immunity [49]. During treatment of infected patients the supplementation of Vitamin B increased total lymphocyte cells, including T helper cells and T–suppressor cells. Certain other reports also found folate (Vitamin B9), to lower the cytotoxicity of NK cells, while cobalamine

(Vitamin B12) was significant in immunomodulatory functions. The Vitamin B complex is recommended supplementation by the doctors during any kind of subdued inflammation and the changes are seen in total plasma homocysteine, an oxidative stress marker [50].

Role of Indian local herbs

Nutraceutical are nutrients, dietary supplements and herbal products thatcan consumed by anyone to increase the immunity and to protect from various ailments such as viral and bacterial infections cold, flu, diarrhea etc. The anti-inflammatory and antioxidant properties of nutraceutical are beneficial in preventing inflammatory changes and coagulation. The polyphenols (flavonoids, phenolic acids, stilbenes, and lignans) reduces the oxidative stress and maintain a redox homeostasis. Some studies have reported the compounds like cucurmin, glycyrrhizic acid and Vitamin C in combination may support immune response towards covid infection [55]. A Chinese herbal compound Lianhuaqingwen (LH) is also helpful in protection against covid infection by increasing the cytokine levels [56]. Addition of nutraceuticals to our diet and lifestyle may be useful in COVID-19 pandemic. Further, the herbal components which were considered useful during COVID-19 infection were;

- Indian gooseberry or*Amla* (*Emblicaofficinalis*)
- Turmeric or *Haldi (Curcuma longa*)
- Ginger or *Adrak* (*Zingiberofficinalis*)
- Giloy or *Guduchi* (*Tinosporacordifolia*)
- *Tulsi* (*Ocimum sanctum*)
- Clove or *Laung* (*Syzygiumaromaticum*)
- *Ashwagandha* (*Withaniasomnifera*)
- *Kalonji* (*Nigella sativa*)
- *Neem* (*Azadirachtaindica*)

The herbal plants have significant importance as stated by Ayurveda and also reported in many scientific studies. The medicinal plants each has its own ethanopharmacology and properties to fight against diseases acute as well as chronic. Traditional Indian medicines like Indian gooseberry, turmeric and ginger, clove, neem and Tulsi are well known for their benefits globally. The other medicinal plants like Giloy and Ashwagandha were not very common names until COVID-19 struck the infections. Giloy or Guduchiis scientifically known as *Tinospora Cordifolia.* The plant stem, root and leaves are considered important for its medicinal value. It contains alkanoids, glycosides, steroids and many phytochemicals. It taste bitter and Ayurveda consider it best for doshas like Vata and Kaph. It is used as decoction prepared along with other spices. Nowadays Giloy tablets and juice are available in market for easy to use purpose. The properties of Giloy which has drawn attention are strong immunity booster, antipyretic and antioxidant. In Ayurveda Giloy is mention with another name *"Madhunashini"*, which represents its properties to control blood sugar by production of insulin [61]. Some recent *in silico* studies based on molecular docking, network pharmacology and molecular dynamics on phytoconstituents of Giloy, has reported berberine ($C_{20}H_{18}NO_4$), β-sitosterol ($C_{29}H_{50}O$), coline ($C_5H_{14}NO$), tetrahydropalmatine ($C_{21}H_{25}NO_4$) and octacosanol ($C_{28}H_{58}O$) may control the $3CL^{pro}$ protein function of CoV enzyme responsible for transcription and viral replication in COVID-19virus. Another therapeutic drug which showed significant results against COVID-19 was *Ashwgaandha* scientific name. *Withaniasomnifera*, this herbal drug which is commonly used in sleep problems, showed two proteins Withanoside V [10.32 kcal/mol, Somniferine [9.62 kcal/mol as inhibitors against SARS-Cov-$2M^{pro}$ (main protease enzyme) [62]. Although there are many related results from different herbal components but to produce promising drug leads MDS analyses and drug receptor regulation studies are needed to be performed. In future the excellent immunomodulatory and anti-inflammatory properties of herbal plants will be emphasized for increasing the immunity profile without any adverse effects against the infectious diseases.

Probiotics

The symptoms of COVID-19 infections include diarrhea, nausea, vomiting and abdominal discomfort had shown chances of corona infection had significant role gut micro biota alterations. Probiotics contain beneficial oraganism that improve the gut microbiota during any type of pathologic conditions. The randomized studies on administration of probiotics in cold and flu infections were evident from the research. Still many studies are needed to know the exact role of probiotics in antiviral activity. Although the research suggest that probiotic intake improves the mucosal innate immunity, reduced intestinal permeability and helps in developing systemic acquired immune response. Some other studies done on vesicular stomatitis virus shows that bacterial strains like *Lactobacillus paracasei, Lactobacillus rhamnosus, as well as Lactobacillus plantarum*, can evade the virus [51], the other reports on probiotic bacterial strain *Lactobacillus brevis* CD2 strain shows the bacterial cell wall inhibits herpes simplex virus type2 [52]. The Lactobacilli has properties of immunomodulation and increase cytokine level in viral infection [53]. Some clinical studies on *L rhamnoosus* GG strains have shown positive results during infections [54]. No studies have been conducted so far to depict the role of probiotics in COVID-19 infections directly but it may be seen as promising supplement to counter the cytokine level increased during infection and lessen the severity of conditions.

Pranayama practices and its effect during COVID-19 pandemic

During lockdown when people have to stay inside their home and frequency of consuming junk food increased many folds. The lifestyle of many has changed, and few are struggling to new normal. As the time passes the urban socio economic population has increased the screen time and lessened the physical activities due to unavailability of gyms, parks and swimming pools. Beside this less sleep has also contributed to the manifestation of various metabolic complications like obesity, type 2 diabetes and cardio-vascular diseases. Some online surveys and related studies have indicated the before and after COVID-19 condition and its adverse consequences on the health. To maintain mental and physical health a regular meal pattern including balanced diet, disciplined sleep patterns are important. Reducing screen time or taking short breaks during screen

time are preventive measures to keep the pace of healthy lifestyle. The changes in the psycho-social behavior cannot be neglected, the stress and anxiety had taken a toll due to monotonous routine, and COVID-19 news, the effect of stress and anxiety on the hormonal imbalances is seen in previous studies [56]. Recently many surveys had been conducted to analyses the effect of COVID-19, the fear of unknown disease the panic created due to lockdown and quarantine zones had depleted the mental strength significantly among the Indian population and worldwide [57, 58, 59]. The interventions for precautions and safety measure guidelines given by WHO (World Health Organization) like wearing face mask, eye protection and maintain social distancing from person to person in public places needs to be followed [60]. This type of change had delivered an impact on social lifestyle of population. Further studies will be needed to identify future outcomes of post covid-19 affects.

2. Conclusion

The dietary components discussed in this chapter are in context to Covid-19 crises. The dietary constituent fulfill our requirement for growth and development, In future this needs to adhere the role of diet on metabolites, oxidative stress, inflammations and immune system. However healthy diet should be followed by healthy lifestyle habits to attain the strong defense system regulated to combat infectious disease and microbes.

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