

# Yoga as an Integrative Approach for Prevention and Treatment of Oral Cancer

## Abstract

Despite tremendous advancements in medicine, the number of oral cancer cases continues to increase, and the need for integrating alternate medicine or adopting an integrative approach has become a compelling cost-effective requirement for the management and treatment of diseases. Conventional treatment of oral cancer involves surgery followed by radiotherapy with or without chemotherapy which causes several complications including poor quality of life and high chances of recurrence of cancer. Oral cancer is often linked with obesity which is major risk factors in other cancers. Apart from obesity, oral cancer is thought to have an inverse relation with neurodegenerative disorders presumably because cell death decreases in the former case and increases in the latter. Ancient mind-body techniques such as yoga have not been adequately tested as a tool to synergize the cellular equilibrium pertaining to the treatment of oral cancer. Nerve growth factor (NGF), tumor necrosis factor-alpha (TNF- $\alpha$ ), and interleukin-6 (IL-6) are among the early experimental cellular biomarkers that may be used to probe the modulation of oral cancer, obesity, and neurodegenerative disorders. Yoga has been reported to influence these molecules in healthy individuals but whether their expression can be altered in patients of oral cancer by yoga intervention is the subject of this research being discussed in this review article. Therefore, the present article not only reviews the current status of research studies in oral cancer, obesity, and neurodegenerative disorders but also how these are linked to each other and why the investigations of the putative NGF pathway, involving TNF- $\alpha$  and IL-6, could provide useful clues to understand the molecular effects brought about by yoga intervention in such patients.

**Keywords:** Integrative medicine, oral cancer, prevention, treatment, yoga

## Introduction

Cancer is the major silent epidemic which affects the public health and is increasing across the world.<sup>[1]</sup> Oral cancer, ranked as the sixth most common cancer across the globe,<sup>[2]</sup> is increasing remarkably<sup>[3]</sup> in southern countries of Asia including India.<sup>[4]</sup> In India, oral cancer is more common among males when compared to females.<sup>[5]</sup> Recent study at Chandigarh Government Medical College and Hospital (GMCH) revealed that among total patients who visited hospital, around 1.6% patients had mouth cancer.<sup>[6]</sup> Oral cancer can easily be detected at advanced stages (Stage III and IV).<sup>[5]</sup> Delayed diagnosis complicates the treatment process,<sup>[7]</sup> and therefore, early detection is of paramount importance. Regular self-examination of the oral mucosa can help in early detection,<sup>[8]</sup> and for this, individuals must be made aware about how to examine buccal cavity for sign of oral cancer. Surgery, radiotherapy,

and chemotherapy are commonly used for oral cancer treatment, either in combination or as singular modality depending on the stages of cancer progression.<sup>[9]</sup> Dietary factors such as low intake of fresh vegetables and fruits, and poor oral hygiene contributes in oral cancer progression,<sup>[10]</sup> and therefore, the disease can be partly prevented by creating awareness about risk factors and imparting good feeding habits. Recent neuroepidemiological studies in India have revealed that neurodegenerative disorders in a country are increasing as compared to the past few years, and approximately 30 million individuals are suffering from neurological disorders.<sup>[11]</sup> Another most common and yet most neglected public health problem around the globe is obesity.<sup>[12]</sup> Around 5% of the Indian population has been affected by obesity,<sup>[13]</sup> and recent studies have shown that the prevalence of generalized and abdominal obesity was found to be greatest

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in Chandigarh followed by other states.<sup>[12]</sup> Interestingly, obesity has been accepted as a major risk factor for cancer<sup>[2]</sup> and other lifestyle disorders such as stroke,<sup>[14]</sup> diabetes, and hypertension.<sup>[15]</sup>

Although oral cancer, neurodegenerative disorders and obesity are usually seen as unrelated entities and treated independently but may have an underlying common link. Nerve growth factor (NGF) is found to be increased during oral cancer progression<sup>[16]</sup> and in obese women,<sup>[17]</sup> and involved in neurodegenerative disorders, making it a promising experimental molecular marker as an underlying link between the above cited three diseases. None of these diseases have a permanent cure or an established method of prevention. Yoga has an Indian origin<sup>[18]</sup> and currently classified as Complementary and Alternative Medicine by the National Institutes of Health.<sup>[19]</sup> Recent studies have shown that yogic breathing produces theta waves in brain which may potentially regulate the molecular expression of neurotrophic NGF<sup>[20]</sup> [Figure 1]. Natural therapies such as yoga have not been adequately tested as a tool to synergize the cancer treatment involving radiotherapy and chemotherapy and in prevention of precancerous to malignant transformation. Moreover, after surgery, there are considerable chances of recurrence of oral cancer. Yoga can be an effective method, not only to improve lifestyle but also to test whether it may reduce the chances of recurrence of oral cancer [Figure 1] mediated by molecular mechanisms hitherto undeciphered.

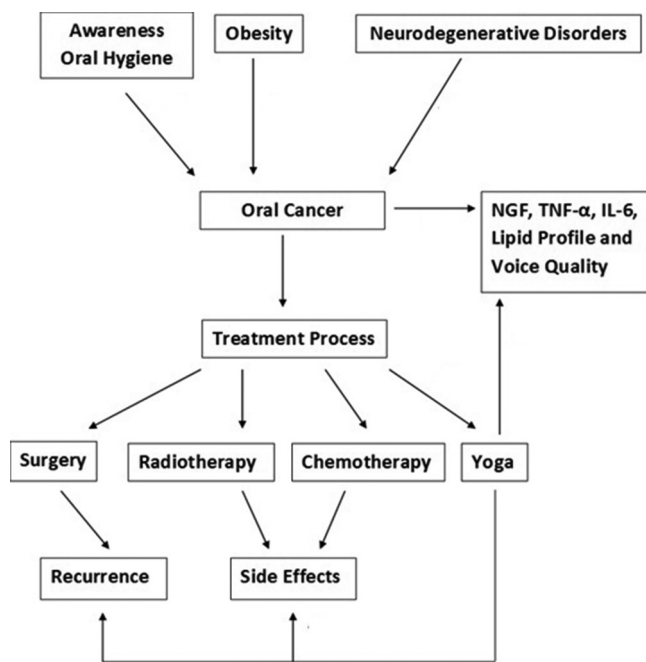


Figure 1: Existing information and research questions related to oral cancer and yoga: relation of oral hygiene, obesity, and neurodegenerative disorders with oral cancer is unknown. How the lipid profile, voice quality, cytokines level are altered affected by oral cancer and whether yoga shows any beneficial effect also need to be investigated. Yoga also needs to be tested as a tool to reduce cancer recurrence and side effects associated with radiotherapy and chemotherapy

Yoga might, therefore, constitute as a potential economic and promising lifestyle-based therapeutic and palliative modality for oral cancer. Oral cancer can also affect the speech characters such as precision, speed, voice quality, hoarseness, and pitch.<sup>[21]</sup> Since speech is very important for social interaction, reduced speech quality, in particular, may affect patients' quality of life to a great extent, and therefore, the effect of oral cancer on voice quality needs to be investigated.<sup>[21]</sup> There are no existing data available on the effect of yoga on voice quality which has been evaluated [Figure 1]. As regular exercise has been found to enhance learning and memory.<sup>[22]</sup> Yoga can, therefore, be reasonably hypothesized to have a homeostatic impact on neurodegenerative diseases and thus positively affect memory, attention, verbal fluency, and cognitive flexibility.<sup>[23]</sup> Yoga and other nonpharmacological behavioral interventions that aim at the prevention of cognitive decline require extensive comparative evaluation. This is not possible until evidence is generated through head-to-head clinical trials in an integrated fashion. It is believed that there is an inverse relationship between frequency of yoga practice and obesity-related parameters.<sup>[24,25]</sup> A recent study at Patanjali Research Foundation has shown that yoga is able to reduce the obesity.<sup>[26]</sup> The molecular mechanisms underlying yoga effectiveness at improving obesity-related parameters remains unclear and needs to be investigated urgently, not only because of its preventive role in cancer but also to understand its crosstalk with neurodegenerative disorders. Ideally, such longitudinal studies with strict follow-up can reveal how successfully can yoga alter the lifestyle-related disorders.

Prevention of disease has always gained the primary and preferred option for promoting health and decreasing disease rates. Some recent reports have claimed that investment in effective prevention programs would save the nation billions of rupees, while others have varying opinion and predictions.<sup>[27]</sup> In developing countries like India, investment in disease prevention could be of paramount importance.

### Prevalence and Global Burden

In the developed and developing countries, increasing cases of cancer are considered as major public health-related issue, for which public health administrators and health policymakers keep planning new strategies to deal with the problem. In recent WHO resolution on "Diet, Physical Activities and Health and Convention on Tobacco Control," major concern was on how to prevent cancer and other diseases that share high-risk factors. World Health Assembly resolution in 2005 on cancer prevention and control highlights prevention being on primary component.<sup>[1]</sup>

Oral cancer, in the global context, is the sixth most common cancer and its pathogenesis is believed to be associated with lifestyle, genetic, and epigenetic factors.<sup>[2]</sup> Oral and lung cancer ranks as the top two prevalent cancers

in humans.<sup>[4]</sup> Global burden of oral cancer increased markedly by an average of 45.6% from 1990 to 2010.<sup>[3]</sup> The southern countries of Asia (India, Pakistan, Sri Lanka, Afghanistan, Nepal, Bangladesh, Bhutan, Maldives, Burma, and Tibet) have about comparable oncologic impact.<sup>[4]</sup> According to World Health Organization, 40% of the oral cancers diagnosed worldwide occur in India, Pakistan, Bangladesh, and Sri Lanka.<sup>[28]</sup> Oral cancer among males is more prominent in India when compared to females.<sup>[5]</sup> In India, oral cancer involves 83,000 new cases and 46,000 deaths per year<sup>[29]</sup> which accounts for about 30%–40% of all types of cancer and are much higher as compared to the Western world.<sup>[28]</sup> According to a study carried out at GMCH Sector 32, Chandigarh, 1.6% patients presented with mouth cancer.<sup>[6]</sup> More specific data on awareness and knowledge of oral cancer and the effectiveness of nonpharmacological measures in general population can be helpful to plan a cost-effective strategy for prevention and treatment of diseases in the city.

### Diagnosis and Treatment

Oral cancer represents the abnormal growth of any tissue located in oral cavity.<sup>[30]</sup> Oral cavity includes the lips, buccal mucosa, retromolar trigone, alveolar ridges, hard palate, mouth floor, and tongue. Oral cancers include squamous cell carcinomas, basal cell carcinomas, malignant melanoma, ameloblastoma, verrucous carcinomas, nasopharyngeal carcinomas, and mucoepidermoid carcinoma. About 90% of cancer originating in the mouth and lips are squamous cell carcinomas. Oral cancer involves the tongue and can occur in the floor of the mouth, maxilla or mandible, palate (roof of the mouth), gingiva (gums), cheek lining, and lips. Most oral cancers show similar phenotypes under the microscope, and these are malignant and tend to spread rapidly.<sup>[31]</sup>

Oral cancers are generally detected at Stage III and IV.<sup>[5]</sup> Visual detection of precancerous lesions is problematic because they do not show induration, ulceration, pain, or associated cervical lymphadenopathy. Precancerous lesions in oral cavity including leukoplakia, submucous fibrosis, and erythroplakia are considered to have high malignant transformation rate.<sup>[32]</sup> Early detection at precancerous stage is important because that can potentially help in the prevention of disease. Conventional oral examination can detect red patch and white patch lesions, whereas advanced diagnostics make early detection more feasible.<sup>[33]</sup> A cytological study of oral cells can be used for the early diagnosis.<sup>[34]</sup> Molecular methods of disease diagnosis have been gaining importance because molecular changes occur before the histological symptoms. The analysis of molecular alterations and identification of specific genetic anomalies are the hot spots of oral cancer studies.<sup>[34]</sup>

Surgery and radiotherapy are commonly used for the treatment of oral cancer at early stages. Preference of treatment method depends on the tumor location, patient age, cosmetic and functional outcomes, associated illnesses,

and the availability of expertise [Figure 1]. Early-stage oral cancers are generally operated by surgery.<sup>[9]</sup> Tumors at Stage III and IV have high treatment failure rates, and combined modality approach including surgery, radiotherapy, and chemotherapy is preferred.<sup>[35]</sup>

Delay in the diagnosis of oral cancer is considered as a significant factor in the recent past years which compromises the treatment outcome, thus worsening the survival.<sup>[7]</sup> An effective method of detection at precancerous stage is the regular self-examination of the oral mucosa<sup>[8]</sup> and has the potential to prevent at least 37,000 deaths occurring worldwide every year from oral cancer.<sup>[29]</sup> However, an adequate amount of literature is available on the effects of poverty and inequality on health, but limited data are available to show the relationship between oral cancer and sociodemographic inequalities because little importance is given to research and prevention in a predominant medical model approach.<sup>[28]</sup> Therefore, the public awareness on oral cancer risk factors is crucial for early detection and consequent prevention, which can be the most effective means to improve survival and to reduce treatment duration, morbidity, disfigurement, and associated costs.<sup>[36]</sup>

### Lifestyle Risk Factors

In the past days, treatments for most of diseases were being sought, including herbs from various sources. The news of unfamiliar herbs, with reputed therapeutic efficacy, was creating much enthusiasm. Tobacco is produced by pharma companies throughout Europe by physicians, missionaries, botanists, explorers, and historians, it became popular because of its therapeutic applications in fevers, general bodily illness, catarrh, colds, and also as an aid to digest and prevent hunger and thirst.<sup>[37]</sup> However, today as estimated by the WHO, 90% cases of oral cancer among Indian men are attributed by tobacco consumption<sup>[28]</sup> which increases the risk by 3–15 folds and are responsible for 90% of oral cancers.<sup>[10]</sup> After the tobacco, diet is considered as second factor which has potential to prevent oral cancer.<sup>[11]</sup> Additional causes of oral cancer include low intake of fresh vegetables, fruits, aging, lower socioeconomic status, and poor oral hygiene.<sup>[10]</sup> Thus, the disease is largely preventable by avoiding risk factors such as tobacco or alcohol use and by imparting good habits of food, for which public awareness is much needed. Public awareness about the right knowledge of oral cancer can be useful. However, yoga as a preventable tool is rarely prescribed, either due to lack of research in the field or practice of integrative medicine in hospitals and communities.

### Associated Diseases

In 1960s, neuroepidemiological studies in India were restricted to single disorders such as epilepsy and stroke, and it was only two decades later that community-based studies for a spectrum of neurological disorders were initiated in Bangalore, Bombay, Delhi, and Kashmir which

provided the estimate that of the current population of 1.27 billion, approximately 30 million people suffer from neurological disorders.<sup>[11]</sup>

Today, people tend to consume high calorie fast food including snacks, cold drink, and large portion of meal which gives more energy than body needs making them more vulnerable to obesity.<sup>[38]</sup> Worldwide, obesity is another common public health problem in many countries. According to the WHO report of 2012, nearly 2.8 million individuals die due to overweight or obesity each year globally and one in six adults is obese.<sup>[12]</sup> Obesity and overweight is the fifth leading global risk factor for mortality.<sup>[39]</sup> Over 300,000 bariatric surgeries were performed worldwide to treat obesity in 2011, but to date, no solution for reducing obesity exists without side effects.<sup>[24]</sup> It is estimated that around 5% of the Indian population has been affected by obesity.<sup>[13]</sup> Food intake is thought to be regulated through neural circuits which are in the hypothalamus. Absence of circulating and functionally active hormone, leptin, is known to result in massive obesity in mice. Leptin acts by inhibiting food intake as well as increases energy expenditure through an interaction with certain specific leptin receptors which are located in the hypothalamus.<sup>[40]</sup> Low leptin level leads to elevated lipid profile,<sup>[41]</sup> i.e., the level of total cholesterol, low-density lipoprotein (LDL), triglyceride, and reduced high-density lipoprotein (HDL) in obese individuals<sup>[42]</sup> and whether yoga intervention affects its levels has not been sufficiently examined. Recent studies have indicated an alarming situation of obesity in Chandigarh. Highest prevalence of generalized and abdominal obesity was found in Chandigarh followed by Maharashtra, Tamil Nadu, and Jharkhand.<sup>[12]</sup> As mentioned above, in most of the cases of cancer, obesity has been identified as a major risk factor for cancer.<sup>[2]</sup> Obesity leads to increased deposition of fat in the body tissue that stores harmful toxins which later serve as a continuous source of carcinogens.<sup>[13]</sup> Strategic investment is needed to create awareness-based obesity prevention programs which are effective way to reduce not only the related lethal consequences such as cancer but also many lifestyle disorders such as stroke,<sup>[14]</sup> diabetes, and hypertension.<sup>[15]</sup>

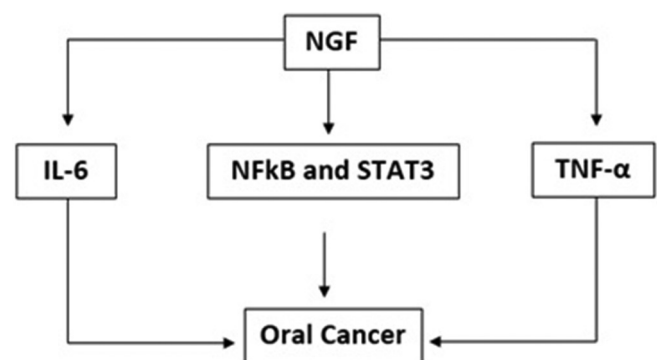
Systemic changes associated with obesity, such as metabolism dysregulation and the release of signaling molecules, including inflammatory mediators, growth factors, and endocrine factors, can contribute to the growth of various types of cancers.<sup>[2]</sup> The imbalance in-between energy metabolism caused by high fat in the diet affects synaptic plasticity, learning, and cognition of the brain.<sup>[22]</sup> It is, therefore, important to investigate the biological mechanism that link obesity, cancer, and neurodegeneration so that new molecular targets for the development of better and more effective therapeutic strategies for treatment can be assessed vis-a-vis the intervention of mind-body techniques.

## Putative Molecular Mechanisms

At molecular level, NGF may act as a vital underlying link to the mechanisms responsible for clinically distinctive cancer progression, obesity, and neurodegenerative disorders [Figure 2].<sup>[43]</sup> NGF induces changes in cellular microenvironment which contributes to pain.<sup>[44]</sup>

NGF has also been found to promote oral cancer progression through mechanisms that involve interleukin-6 (IL-6) which is believed to be positively correlated with tumor size. Furthermore, IL-6 activates the transcription factor nuclear factor-kappa B and STAT3 signal transduction pathway, which in turn regulates the expression of genes controlling cell proliferation and apoptosis in oral cancer.<sup>[16]</sup> NGF is involved in survival, regeneration, and death of nerve cells during aging and in neurodegenerative disorders. In recent studies, NGF has been documented to be related to mechanisms and symptoms of neurodegenerative disorders.<sup>[45]</sup> Anti-NGF has been reported to reduce tumor proliferation in a tongue cancer mouse model which indicates its effectiveness as a potential marker for oral cancer,<sup>[16]</sup> however, epidemiological evidence does not exist in the field.

Neurodegeneration and cancer are thought to have an inverse relation as cell death increases in one case and decreases in another case. Recently, many studies have demonstrated the link between two disparate processes. Genetic studies also suggest that individuals who are affected with neurodegenerative disorders have reduced incidence for cancer<sup>[46]</sup> or vice versa.<sup>[43]</sup> Circulating level of the NGF has been found to be increased in overweight, obese, and morbidly obese women.<sup>[17]</sup> It was found in recent studies that the NGF level is upregulated to about 1.4-fold in obese patients when compared to healthy subjects. Recent findings suggest a possible positive relationship between NGF and waist circumference.<sup>[17]</sup> BDNF gene expression is mediated by the NGF and elevated level of BDNF was found in obese peoples.<sup>[47]</sup>



**Figure 2: Putative molecular mechanism involved in oral cancer. Nerve growth factor is thought to promote oral cancer progression through cytokines (interleukin-6 and tumor necrosis factor-alpha) and transcription factors (nuclear factor NF-kappa B and STAT3). However direct molecular basis needs to be established**

## Yoga as Integrative Medicine

Yoga originated in India thousands of years ago and is practised in present age and day. Yoga and its effects have increased health awareness in the society, and natural remedies have gained acceptance among people for the management of diseases.<sup>[18]</sup> This is due to its benefits on physiology and functions. Yoga, 3000-year old tradition, is classified as Complementary and Alternative Medicine by the National Institutes of Health and is now regarded in the Western world as a holistic approach to health.<sup>[19]</sup> Indian yoga association has recently initiated a nationwide effort of standardizing the yoga protocols and its quality of adherence.

The greatest limitation in today's medical system is that physicians do not take the psychosocial or psychosomatic experience into account for therapy. This is evident by the fact that such studies correlating psychosomatic scores with clinical symptoms are rarely cited. Ironically, it resonates with Bhagavad Gita teachings that dates back to 5000 years, i.e., shifting from body consciousness to spiritual conscious is the way to get relief from the pain and sufferings in life. In spiritual experience, mind stabilized in peaceful *satvik* consciousness. Indian Patanjali yoga has eight components - *Yama, Niyama, Asana, Pranayam, Dhyana, Dharana, Pratyahar,* and *Samadhi*. However, school of Brahma Kumaris Rajyoga propagates mindfulness meditation which combines *Dhyana, Dharana,* and *Pratyahar* of Patanjali Kriya. Yoga is one of the six schools of Indian philosophy and is also part of Indian traditional medical system, *Ayurveda*.<sup>[48]</sup> Many herbal plants mentioned in *Ayurveda* known to have medical importance.<sup>[49-53]</sup> *Ayurveda* is the oldest Indian indigenous medicine system of plant drugs known for preventing or suppressing tumors using herbal drugs and even various research studies are ongoing to that indirectly validate their role in the management of cancer.<sup>[54]</sup> In a developing country like India, where more numbers of homeopathy and *Ayurveda* practitioners are available relied upon by the 70% of the population that inhabit the rural India. Effectiveness of synergistic cancer therapies has been reported in a recent patent filed which shows one chemotherapeutic drug or agent, obtained from the *Arum* plant extract, when administered orally to patients, along with routinely used chemotherapy drugs, in the form of aqueous dispersions, gels, ampules, powders, capsules, pills, or tablets, which shows greater effects than the sum of the individual therapeutic effects.<sup>[55]</sup> Yoga, with its slow breathing, progressive exercise, which encompasses meditation and relaxation, is an integrated system that balances the body, energy, mind, and emotions synergistically, enabling each individual to reach its potential, regardless of the age, sex, and phenotype.<sup>[56]</sup> Prevention or treatment of illness or disease by yoga intervention is an attractive strategy worth testing, especially in health-care delivery systems in the developing economies.

Recent studies on the effect of yogic breathing (also called *Pranayama*) have shown NGF regulation. Yogic breathing involved methods to regulate breathing voluntarily, making strong relaxation response. This stimulates the parasympathetic and vagal system which in turn causes modulation in genes expression related to stress, metabolism, and inflammation. Yoga and relaxation stimulate salivation which contains good amount of NGF. Breathing exercises increase parasympathetic dominance, vagal tone, and decreases sympathetic discharges which in turn creates theta waves in brain which ultimately influence the NGF expression.<sup>[20]</sup>

Despite so much advancements in surgical techniques and technology, the survival rates of patients have not improved significantly in decades.<sup>[57]</sup> Unfortunately, the rationale behind such therapies requires healthy cells to be damaged or destroyed permanently.<sup>[58]</sup> Prevention is, therefore, always thought to be better than cure, thus saving nation's efforts in disease management. Natural therapies such as yoga could be a good substitute that has not been adequately tested as a tool to prevent precancerous to malignant transformation and to synergize the treatment involving radiotherapy and chemotherapy. Furthermore, after surgery, there are chances of recurrence of oral cancer which is main factor of treatment failure. Recent studies have shown that main cause of tumor recurrence is proximity to midline whereas tumor size and invasion depth were found to be unrelated with recurrence.<sup>[59]</sup> Major lifestyle factor which was found to cause recurrence is reuse of tobacco products.<sup>[60]</sup>

Yoga as an effective method to not only improve lifestyle but also to test whether it may reduce the chances of recurrence of oral cancer needs more investigations. Whether yoga can reverse epigenetic changes and prevent the spread of emerging cancerous cells. Therefore, whether it may constitute as an economic, promising therapeutic modality for oral cancer management, will be determined more research projects.

Genes and environment interaction such as food, metals, pollutants, microorganisms, and lifestyle play a crucial role not only in brain health but also in susceptibility to diseases.<sup>[61]</sup> Regular exercise has been found to balance homeostasis and repair brain damage. Along with modulation on neurogenesis, it also enhances memory and learning. Moreover, exercise can synergize the functional recovery of the brain which attributes to aging effects.<sup>[22]</sup> There is an increasing trend in literature suggesting a positive impact of yoga on neurodegenerative diseases. The results imply a positive effect of yoga, especially on memory, attention, verbal fluency, and cognitive flexibility.<sup>[23]</sup> Many of the ongoing lifestyle and diet interventions in developing countries are relatively recent, and a few of them have been documented which can reduce the risk of major diseases. However, the success of Singapore, Finland, and other developed countries in

reducing rates of neurodegenerative and cancer strongly suggest that similar benefits will emerge in the developing countries.<sup>[62]</sup> Yoga, therefore, has its future as an appropriate nonpharmacological behavioral intervention aiming to prevent the cognitive decline provided scientific analysis is carried out without any cognitive bias.

There is an inverse relationship between frequency of yoga practice and obesity-related parameters such as body mass index (BMI), body weight, body fat, waist circumference,<sup>[24]</sup> total cholesterol, LDL, triglycerides, and very LDL.<sup>[25]</sup> Recent study at Patanjali has shown that 6 day yoga practice and vegetarian diet can reduce the BMI, mid-arm circumference, waist-hip circumference, and the total cholesterol in 47 obese persons. However, HDL along with serum leptin values found to be decrease which may be due to vegetarian diet. Addition to that postural stability and the bilateral hand grip strength increased.<sup>[26]</sup> The molecular mechanism underlying yoga effectiveness at improving obesity-related parameters remains unclear and needs to be investigated.

As yoga popularity is increasing as a potential integrative medicine, the quality of methodology has been frequently questioned.<sup>[63]</sup> Specifically, recent research on yoga was unable to draw quality conclusions because biasness involved in randomized controlled trials.<sup>[64]</sup> Compared to complementary therapies, yoga has been shown more positive when a study conducted in India,<sup>[65]</sup> potentially representing location-based publication bias. Research conducted in India on yoga is found to be more positive in conclusions as compared to those conducted in other countries.<sup>[65]</sup> Therefore, Indian trials need to be more standardize, data blinding, data validation, and quality assurance should be kept in mind. The factor that might influence the bias and also need to be investigated.

Yoga has often been considered as integrative approach without side effects but whether this thought has changed needs comprehensive review and analysis.<sup>[66]</sup> Musculoskeletal, nervous, and visual system are believed to be affected by yoga<sup>[66]</sup> due to excessive effort than required, improper teacher training, and unknown medical complications.<sup>[67]</sup> Therefore, standardization of yoga protocol, backup by scientific data, is important to establish yoga as integrative approach.

### Voice Quality

Oral cancer and its surgical treatment impair patients' speech due to alteration of oral cavity musculature, jaw structure, and vocal tract. Brain controls the speech, and cranial nerves control the movements of the lip, the tongue, the pharynx, the velum, and jaw. Velopharyngeal closure leads to the separation of nasal and oral air stream during speech and its opening results in the formation of nasal phonemes. To make the speech level audible, a voice signal is generated in the larynx by vibrations from vocal

fold. Speech depends on fast and exact movements of the structures of the vocal tract. Oral cancer can affect the speech characters such as precision, speed, voice quality, hoarseness, and pitch.<sup>[21]</sup> Moreover, risk factors such as smoking might influence voice quality due to chronic inflammation of the vocal cords and diminished vibratory function.<sup>[58]</sup> This often leads to a hoarse and rough voice. Since speech is required for social interaction, reduced speech quality, in particular, may affect patients' quality of life to a great extent, and therefore, the effect of oral cancer on voice quality requires attention.<sup>[21]</sup> Furthermore, surgery of anterior portion of tongue can be associated with altered speech quality. The functional complexity of the oral cavity structures is main constrain during restoration to presurgical status.<sup>[68]</sup> There are no existing data available to describe the effect of yoga on voice quality which makes any future study of paramount importance.

### Palliative Care

Terminally ill patients of oral cancer face both the adverse effects of treatments and recurrence of disease which makes oral cancer as a complex course of illness that requires palliative care. Palliative care is a specialized area of health care focusing on prevention and management of patients' suffering.<sup>[69]</sup> Although the treatment and management of the diseases is important, it is equally important to alleviate the sufferings and symptoms in a terminally ill patient. This requires a multivariate approach which allows the palliative care team to address physical, spiritual, emotional, and social concerns.<sup>[69]</sup> The experience of a patient undergoing cancer chemotherapy and radiotherapy is often characterized by symptoms of sleep disturbance, anxiety, stress, pain, fatigue, and impaired quality of life that affect them socially and psychologically.<sup>[70]</sup> The growth of cancer and tumors is promoted by stress making stress management important for cancer patients.<sup>[19]</sup> Despite numerous advances in treatment methods, effective symptom management, and interventions have not provided satisfactory results in the field except palliative care. Pharmacologic interventions focus on cancer-related fatigue, and these drugs are invariably ineffective, expensive, and often associated with side effects. Behavioral interventions such as yoga could be a nonpharmacological, inexpensive, and effective form of palliative care. Yoga intervention has already shown beneficial results in managing cancer-associated symptoms in breast cancer patients.<sup>[71]</sup> It is currently not established as cure for cancer, nor has any definitive way of preventing it; however, yoga can increase physical, spiritual, and emotional wellness, which many cancer patients might require.<sup>[19]</sup> Recent studies on yoga's effect on cancer patients have shown significant effectiveness in postchemotherapy-induced nausea intensity, nausea frequency, intensity of anticipatory nausea, anticipatory vomiting, decreased depression, anxiety, and distressful symptoms.<sup>[19]</sup>

## Social Security

Medical processes do not just include prevention, cure, and treatment of disease but also involve issues related to quality of life, privacy, and security of patient data. Healthcare-related issues such as research trials are gaining attention by media as the number of corporate hospitals increases. Various agencies such as scientific review committees, regulatory bodies, ethics committees, and NGOs are working toward patient protection and their rights. There is a need to constitute a separate body which will work explicitly to deal such problems.<sup>[72]</sup> Another aspect is to provide the rehabilitation for cancer patients who are physically and psychosocially impaired.<sup>[73]</sup> Rehabilitation for cancer patients is not been well recognized as cancer care is generally practised in clinical settings. With advances in palliative care and increased survival rate of patients, interest has turned toward establishing cancer rehabilitation in recent years. Rehabilitation flexibly can be applied from the time of diagnosis to the terminal stage. The entire phase of rehabilitation involves physical as well as psychosocial aspects. Although its effectiveness has not been completely demonstrated in the area of palliative care, rehabilitation for cancer patients can be an important means of supporting the patient and their families leading to improvement of patients' quality of life.<sup>[74]</sup>

Disease prevention has always gained primacy for promoting health and reducing disease rates. For many people in the country, this health argument is enough reason to invest in prevention, economics aside. However, in starting, it costs more to deliver preventive services, but later on with stages, the savings on health benefits could be large. Some recent reports claim that investment in effective prevention programs would save the nation's billions of rupees, while others have different opinion and predict the opposite.<sup>[27]</sup> In developing countries like India, investment in disease prevention could be of paramount importance.

## Future Aspects

As India shares the prominent burden of oral cancers, the incidence of disease can be greatly reduced by making the people aware about the risk factors and tools for early detection. The awareness about oral cancer, obesity, and neurodegenerative disorders is needed to facilitate prevention, early detection, and treatment of diseases. A study which has reported the relationship between oral cancer and the neurodegenerative disorders and obesity will help in unifying the public health intervention strategies. Besides, such study can also help in establishing the true relationship between two disorders, if any with respect to NGF. Larger yoga intervention studies can help in the development of a method to secure relief without any side effects, thus promoting immunity and wellness. The benefits obtained by the yoga are not limited to disease

management alone, if applied for oral cancer, it will also provide benefits in managing other physiological and psychological problems. Furthermore, the health benefits gained by the yoga will have long-term rehabilitation effects unlike the conventional medicine. As treatment cost is an important consideration among the economically backward individuals, such evidence-based yoga intervention might provide important clues for wellness and prevention of oral cancers among poor. Countries with poor health budgets like India, can invest in yoga for preventive health measures to save health resources.

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## Conflicts of interest

There are no conflicts of interest.

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