

Climate Change & Oral Health: Current Challenges & Future Scope

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Abstract—The impact of climate change on oral health is of significant importance. Certain facets of climate change have culminated in the emergence of epidemics, destruction of forests, flooding of coastal areas and other fatalities. Impact of climate change on the lives of natives of a particular geographical region influences the overall health status of an individual. Global repercussions have an effect on the ecosystem. Oral precancer and cancer is increasing amongst the younger generation in the Indian sub-continent. This can be attributed to rampant usage of tobacco, associated products and exposure to various amounts of solar radiation. Epidemiological assessment & readiness to tackle health burden arising due to change in climatic condition needs to be strengthened. Health sector investment should be channelized towards patient care largely in the public sector. Health education and preventive programmes need to be targeted towards the vulnerable population. The public health infrastructure needs to be strengthened to adapt to the rapidly changing disease profile. Therefore, concerted efforts have to be made in order to understand these modifying factors. This can be achieved by upgrading health care facilities and research support. This would facilitate a harmonious balance to enable sustainable development and optimum overall health.

Index Terms—Climate change, Oral health, public health, oral precancer, oral cancer, socio-economic factors

Climate change is now recognized as a global threat and actions of mankind are largely accountable for this. Climate sensitive infections, natural disasters, wide spread malnutrition, air pollution related morbidity and mortality has emerged as the global predicament. Damage to our planet due to environmental degradation and the enormity of the challenge and consequences of global warming are the burning issues today. The latter part of the 20th century saw a transformation in both general & oral health unmatched in history. Yet, despite the remarkable achievements in recent decades millions of people worldwide have been excluded from benefits of socio-economic developments and scientific advances which improved healthcare and quality of life. Though the past decade has witnessed substantial improvement in international health the environmental concern needs to be emphasized.¹

Climate change is likely to impact all the natural ecosystems, as shown by the National Communications Report of India to the United Nations Framework Convention on Climate change (UNFCCC).² Major concerns over health, water, social & cultural life are incorporated with the issue of global warming and climatic change. The relationship between climate change and human health is multidimensional. It is imperative to assess

climate change induced health burden and distribution of the health impact. Effects of climate change on human health are both direct and indirect. People are exposed directly to changing weather pattern (temperature & sea-level rise) and more frequent extreme events. Indirectly, it affects changes in the quality of water, air, food, changes in ecosystem, agriculture, industry, human settlements & the economy. Health problems increase vulnerability and reduce the capacity of groups to adapt to climate change. Therefore, the social, economic, political & cultural determinants of health have a vital role to play.

For instance, between 1994 and 1996, India experienced a sudden rise in the malaria problem, resulting in epidemics and death due to malaria in states of Rajasthan, Manipur, Nagaland and Haryana. The transmission window for Malaria are predicted to increase with climate change from 4 - 6 months to 7 - 9 months in Jammu & Kashmir and Madhya Pradesh and from 7 - 9 months to 10 - 12 months in Uttar Pradesh.^{3, 4} The rural Indian Population (approximately seven hundred million of one billion) directly depends on climate sensitive sectors (agriculture, forests and fisheries) and national resources (such as water, biodiversity mangroves, coastal zones, grasslands) for their subsistence and livelihoods. Further, the adaptive capacity of dry land farmers, forest dwellers, fisher folk and nomadic shepherds is very low. Moreover, public health to a large extent, depends on safe drinking water, sufficient food, secure shelter and good social conditions. A changing climate is likely to affect all these conditions.

The projections for India as specified by the Hadley Centre using the Regional Climate modelling system known as PRECIS indicates a rise in the annual mean surface temperature by up to 3 to 5 degree Celsius under A2 scenario and 2.5 to 4 degree Celsius under B2 scenario by the end of the century particularly in the northern parts of India. Extremes in maximum and minimum temperature are also expected to increase. Current climate shocks and stresses already have a devastating impact on the vulnerability of the poor. This is increasing due to number of trends, including HIV/AIDS, conflict and pressures associated with globalization. Increasing frequency and intensity of weather related extremes and gradual changes in the average temperature will exacerbate these impacts. According to national family health survey conducted by Ministry of Health and Family Welfare, one third of India's household are in urban areas and two third in rural areas. The Indian health care system is still affected by infrastructural deficiency and variation in the quality of the care delivered. Health care provision is based on an integral network starting from sub-centres and progressively stepping to upper levels that is referral centres.⁵

As the government expenditure on health remains low private public partnership could boost investment in the sector to provide better facilities. The total expenditure from both union budget and state budget for health stands at 1.04 percent of the GDP for 2008-09. The government's allocation for healthcare remains an insignificant 0.36 percent of GDP in the 2010-11 budget. This is still very far from the three percent of GDP that needs to be allocated to the healthcare system to provide quality basic healthcare. Research indicates that reverse health impacts are greatest in low income countries. The urban poor, geriatric population, children, coastal populations and ethnic groups are predisposed to high risk. Reduced economic productivity and socio-economic status are important parameters for health risk assessment. The total number of people at risk, age structure of the population and the density of the segments are important variables in any projection of the effects of climate change.

Oral health is an essential component of general health as poor oral health effects growth, development and learning for children, communication, nutrition, self-esteem and various systemic conditions. Because of its effects on daily living, oral health is considered a determinant of quality of life. Post independence India never had oral health related epidemiological data based on uniform assessment criteria. Therefore, for policy makers' assessment of required services emerged as a major challenge.

Oral Cancer has emerged as a public health concern with over two hundred thousand new cases reported annually worldwide.⁶ The consumption of betel quid and tobacco previously a cultural challenge in Southeast Asia is a global public health concern. Oral leukoplakia and oral submucous fibrosis largely constitutes oral precancer in India. Areca nut and betel quid chewing are known risk factors for the causation of oral precancer & cancer.² Rapid urbanization leading to an unhealthy lifestyle, such as increased access to tobacco in various forms leads to an increase in the incidence of oral cancer.⁸ The International Agency for Research on Cancer has classified betel quid without tobacco as human carcinogen.⁹

In most regions of India, oral cancer is the most common cancer in men and the third most common cancer in women.¹⁰ In South Central Asia, 80% of the head and neck cancers are found in the oral cavity and oropharynx. Most oral malignancies begin as leukoplakia, erythroplasia and erythroleukoplakia which are inflammatory lesions.^{11, 12} Detection of aero-digestive tract cancers remain a diagnostic challenge due to limitations of visual and manual examination.

The recognized etiological agents and risk factors for oral cancer include tobacco use, frequent alcohol consumption, a compromised immune system, the use of areca nut, history of cancer, dietary habits and such less well established factors as infection with certain types of human papilloma viruses.^{13, 14} Evaluation of circulating immune complexes and trace elements in oral pre cancer & cancer has paved a way towards knowing the immunological and biochemical basis of carcinogenesis.¹⁵

Oral precancer (oral leukoplakia & oral submucous fibrosis) and cancer are complex multi-factorial diseases arising from the interplay between the genetic components

and the environmental determinants. Almost 90% of the oral cancers are Squamous Cell Carcinomas. The most common sites of occurrence are buccal mucosa, tongue and labial mucosa (lower lip). Environmental exposures in farmers can be explained by solar (ultra violet) exposure. Mutation of the p53 gene characteristic of the DNA damaged induced by ultra violet light is implicated. Climate change induced dietary transition, contamination; impacts on food chain ecosystem & food security have increased the vulnerability of the population at risk.

Oral cancer screening, early detection and proactive intervention would lead to improvement of survivorship and quality of life of population at risk. Therefore, efforts should be channelized towards discovering more effective therapeutic and preventive strategies. Tobacco legislation policies targeted at the growing market and health promotion strategies affect developing countries like India where the human resource is considered an asset. On the contrary, disease burden and treatment costs play a pivotal role in converting this asset to liability.

Climate change has led to an increase in viral infections caused by herpes group of viruses, human papilloma virus, cytomegalovirus etc. Herpes labialis and herpes zoster are commonly occurring ulcerative lesions. Incidence of oral aphthous ulcers are also exacerbated by stress. These manifest in the oral cavity and lead to systemic debilitation.

The connection between oral & systemic health is believed to be specifically strong when considering the geriatric population. Increasing life expectancy in the developing countries has shifted the emphasis of dental public health from a restorative to a preventive approach. The explosion in size of the elderly population in this country and throughout the world's developing countries is a phenomenon that is now widely recognized as being in its infancy. The average life expectancy at birth in India was 32 years in 1947, 62 years in 1994 and will be an estimated 75 years in 2015. With the increased life expectancy, the demand on health professionals is to improve quality of life for the geriatric population. A holistic and multi-disciplinary approach is therefore the need of the hour.

Poor oral health leads to masticatory inefficacy leading to malnutrition, anaemia, involuntary weight loss and disturbed systemic health. Some of the oral manifestations of systemic diseases in geriatric patients are oral lichen planus, autoimmune diseases, connective tissue disorders, HIV/AIDS lesions etc. Stress related mucosal & musculo-skeletal diseases are a substantial part of growing health concern due to their affect on respiratory system, gastrointestinal organ system and aero-digestive tract disorders.

Climatic variability and change also causes oxidative stress in allergic reactions. Oxidative stress occurs not only as a result of inflammation but also from environmental exposure to air pollution and cigarette smoke. Therapeutic approaches that reduce exposure to environmental reactive oxygen species or enhance endogenous antioxidant defences might be beneficial for treatment of allergic disorders of aero-digestive tract. Allergic reactions exacerbate immune complex formation and inflammation of the temporomandibular joint. Drug interactions due to prolonged medication in medically compromised patients' results in oral mucosal diseases. This often manifests as

hypo salivation or dry mouth, increased incidence of dental caries, amputation caries, periodontal disease and salivary gland disorders. This results in premature loss of teeth and associated nutritional deficiencies. The salivary pH, buffers and consistency have a characteristic role to play in determining the quality and quantity of saliva. The need to emphasize the connection between climate change and diet cannot be ignored. Low carbon diet is a healthy lifestyle modification which can be brought about by decrease in meat consumption of the population. Moreover, animal farming increases the green house gas production and life stock sector is also a major player in affecting climate change.

Various oral diseases like dental caries, fluorosis are influenced by the food and water quality in a particular topographic area. Deteriorating systemic health of geriatric patients due to climate change has a psycho-social impact in developing countries like India. The challenges to society of managing the services and well being of older adults will consume an increasingly larger proportion of human and financial resources. Consequently, safe and comprehensive care will demand team work. Collaboration and communication between dentist, patient and other health care workers is essential to meet this challenge effectively. Combined with the above, a holistic and humane approach in interaction with the geriatric population is imperative.¹⁶The empathetic approach targeted towards the weaker and marginalized sections of society should be the key to reducing the health disparities.

Given the clear evidence that many health outcomes are highly sensitive to climate variations it is inevitable that long term climatic change would have an effect on the health of global population. Health promotion, disease management, public health threats and health services development in the rural and the semi-urban sectors are of immense importance in developing countries. Rapid urbanization, unemployment and stress related health effects (tobacco addiction) are rising public health problems. Climate change is dependent on the exposure, sensitivity and adaptive capacity of the population. In India health effects of climate related disorders may further weaken the existent inadequate public health infrastructure.^{17, 18}

Research should be targeted to understand the complex interplay of gene-environment interactions and oxidant mediated aero-digestive tract diseases. Identification of specific bio- markers, trace elements in oral precancer & cancer will indicate the molecular basis of disease to provide quality care for patients with confronting new threats from climate sensitive diseases. The rate and magnitude of climate change in future will be influenced by how effectively and rapidly global mitigation and adaptation strategies are deployed. Sustained development and mitigation will be influenced by newer technologies addressing climate change. This would largely depend on the role of civil society and environment health interaction. Working towards mitigation of factors affecting climate change at the individual and community level should form a part of long-term commitment to safeguard public health.

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