



A glimpse on epidemiology in ancient science w.s.r to *janapada dhawmsa* and its contemporary relevance in public health practice.

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Abstract: The subject of environmental hazards to health has assumed great significance in the modern world. Knowledge about who is likely to develop a particular disease and under what circumstances they are likely to develop has been considered as central to the daily practice of medicine by wise physician as well as for administration of appropriate measure to improve the health of the public in different age & era. In earlier times the discipline of tropical medicine was of interest to the physicians largely due to contamination of air, water, soil, climate etc. subsequently the interest got focused on medical geography and geographic pathology due to occurrence of certain environment related diseases confined to geographic boundaries. Evaluation of environmental determinants of disease is not the phenomena of contemporary science but it was also broadly depicted by the ancient preceptors of Ayurveda in early age. Ayurveda is serving mankind since centuries. It has almost every answer for human race problems. The preventive aspects of pandemic situation are well stated in Ayurveda with enough details. The great preceptors of Ayurveda focused on evaluation, study & distribution of environmental determinants of disease like Vikrita Vayu, Vikrita Jala, Vikrita Desha & Kala confined to affect the health of population and spread of epidemics or any outbreak in a particular geographic region which can be analyzed and interpreted in the light of modern theories of epidemiology.. Evaluation & understanding of epidemiological determinants can be helpful in early detection, diagnosis, prognosis of prevalent diseases which afflicts the mass population as well as for administration of appropriate preventive & therapeutic measure in various endemic, outbreak & pandemic condition. Keeping this in point of view initiation is made by the author to explore the environmental determinants of epidemics as per Ayurvedic perspective and modern perspective & highlight some emerging issues like endemic, epidemic or pandemics related to environment & biodiversity and create awareness for restoration of environmental health for the welfare of today's society.

Key words: epidemics, JanapadaDhawmsa, Vikrit Vayu, Vikriti Desha, environmental health, Prajnapradha.

1. INTRODUCTION:

The fundamental pillars of 'Vasudhaiva Kutumbakam' based on love, harmony, cooperation & mutual support are meant for maintaining the world as one family^[1]. Our great Indian Philosophy of 'Vasudhaiva Kutumbakam' and our great Mantra 'Sarve Bhavantu Sukhinah' has now come to the forefront for challenging global health issues related to various endemic & pandemic situations. We are seemingly locked into a downward spiral of ecological degradation, biodiversity loss and climate emergency. An ecosystem decline threatens human health system worldwide and raises the global burden of disease. Knowledge about who is likely to develop a particular disease and under what circumstances they are likely to develop has been considered as central to the daily practice of medicine by wise physician as well as for administration of appropriate measure to improve the health of the public in different age & era. In earlier times the discipline of tropical medicine was of interest to the physicians largely due to contamination of air, water, soil, climate etc. subsequently the interest got focused on medical geography, geographic pathology, environmental epidemiology etc due to occurrence of certain environment related disease confined to geographic boundaries. Currently the field of environmental pathology encompasses all such diseases caused by progressive deterioration in the environment and environmental epidemiology an emerging branch of contemporary science focuses



on evaluation of physical, chemical and biologic agents in the environment as disease risk factors which often affecting large population and also concern itself with the incidence, distribution, cause, control & prevention of disease. Evaluation of environmental determinants of disease is not the phenomena of contemporary science but it was also broadly depicted by the ancient preceptors of Ayurveda and in treatise of Hippocrates in early age. Historically epidemiology has focused on population level factors regarding communicable infectious diseases, chronic diseases, infant health and other environmental & behavioral health in Hippocrates's era ^[2]. The great preceptors of Ayurveda focused on evaluation, study & distribution of environmental determinants of disease like *Vikrita Vayu*, *Vikrita Jala*, *Vikrita Desha* & *Kala* confined to affect the health of population and spread of epidemics or any outbreak in a particular geographic region ^[3]. Today it is a wide-encapsulating umbrella that encompasses any health related issues that may influence the overall health of a population. Currently the field of environmental pathology encompasses all such diseases caused by progressive deterioration in the environment and environmental epidemiology an emerging branch of contemporary science focuses on evaluation of physical, chemical and biologic agents in the environment as disease risk factors which often affecting large population and also concern itself with the incidence, distribution, cause, control & prevention of disease. The cumulative impact of prolonged drought, catastrophic, bush fire and devastating extreme weather events have shaken the people worldwide not only over the last few years but also even in early ages. This year global spread of SARS-CoV-2 and the resulting covid-19 pandemic is a poignant example of how the degradation of ecosystem can contribute to the emergence of novel disease. Synergistic consequences of climate change and ecological degradation are raising the global public consciousness. Rising public health issues costs of the global burden of disease must incentivize society to push towards a restorative culture and away from a culture of ecological degradation. Initiation for ecosystem restoration as a public health intervention due to links between environmental quality and human health is still remained unexplored.

2. AIMS & OBJECTIVES:

- 1) Exploration of environmental determinants of disease and their impact for onset of various endemic or pandemic situations.
- 2) Creating awareness for understanding the silent role of environmental or ecological determinants on disease prevalence as well as early detection of epidemiological health issues & implementation of appropriate preventive & therapeutic measures accordingly.

3. LITERATURE REVIEW:

The climate crisis and its consequences represent the greatest challenge facing human health and health care system in the 21st century. We are continuously learning about the unpredictable powers of nature. In last few decades the world has been sharply reminded time after time of the degree to which people in all countries and on all continents remain chronically vulnerable to some known or unknown diseases. It threatens to undermine the global health in last few decades. Rising temperature, flood, drought or any type of devastating weather condition can directly or indirectly cause human pathologies that have prevalent in population confined to various geographical area. More intense and frequent heat waves due to global warming impact human health and increase mortality. Further rising temperature and air pollution increase the production and allergenicity of pollens associated with high prevalence of allergic disease in different geographical region. To challenge various epidemiological issues which have been emerged as global threat in present world, the branch epidemiology used for analysis and studying risk factors for disease development as well as surveillance of the occurrences of particular illness often affecting large population. Epidemiology is the study of the patterns, cause and effects of health and disease condition. It can be considered as the corner stone of public health and informs policy decisions and evidence based medicine by identifying risk factors for disease and targets for preventive medicine. It can also be used to study the progression or natural history of a disease as well as study of prognostic factors which are determinants of the progression of a disease and evaluation of treatment accordingly. Further environmental epidemiology has been worked for the study of environmental determinants of disease and focuses on various physical, chemical and biological agents in the environment as disease risk factors which often affecting health of mass population. The branch of environmental epidemiology of contemporary science was also recognized by as an important discipline by the ancient preceptors of Ayurveda in early ages. Various environmental determinants for epidemics are described under the broad heading of *Vikrita Vayu*, *Vikrita Jala*, *Vikrita Desha* & *Vikrita Kala* by *Acharya Charaka* in *Janapadadhwansaniya Vimanadhyaya*. It has been clearly mentioned by *Acharya* that Sinful acts followed by intellectual blasphemy committed during present life and previous life directly or indirectly responsible for affliction of epidemiological factors like air, water, climate etc ^[4]. Epidemiological study also reveals that human interference with biodiversity such as deforestation, habitat degradation and fragmentation, agriculture intensification, wildlife



trade and climate change help to create the conditions for pathogens to leap from wildlife to human, spread of pollutants, environmental toxins etc.

Human activities have an adverse effect on the environment by polluting the water we drink, the air we breathe and the soil in which plant grows.

Air (Vayu) pollution & epidemics:

One of our greatest scourges is air pollution on account not only of its impact on climate change but also its impact on public & individual health due to increasing morbidity & mortality. It has been recognized that air pollution is world's single largest environmental risk, accounting for an estimated 4.2 million premature death in a year from outdoor pollution and 3.8 premature deaths from indoor pollution^[5]. Exposure to air pollution is associated with myriad adverse health outcomes in short & long term. The health of susceptible and sensitive individual can be impacted even on low air pollution days. Short term exposure to air pollutants is closely related to COPD, cough, shortness of breath, wheezing, asthma, respiratory disease, high rate of hospitalization and the long term effects associated with air pollution are chronic asthma, pulmonary insufficiency, CVD & cardiovascular mortality^[6]. Neurological effects have been observed in adults and children often extend after exposure to air pollutants. Psychological complication, autism, retinopathy, fetal growth, LBW seem to be related to long term air pollution. Air pollution mainly affects those living in large urban areas where road emissions contribute the most to the degradation of air quality. Spread of toxic fog can be fatal to those populations of surrounding areas. In developing countries also, the problem is more serious due to over population and uncontrolled urbanization along with development of industrialization. The use of fuel such as wood fuel or solid fuel for domestic needs due to low incomes exposes people to bad quality polluted air at home. Outdoor and indoor air pollution cause respiratory and other disease and has recognized as an important source of morbidity and mortality. According to WHO each year air pollution is responsible for nearly seven million deaths around the globe^[7]. Air pollution refers to release of pollutants into the air which are detrimental to human health and planet as a whole. Nitrogen dioxide, Sulphur dioxide, Carbon monoxide, depletion of Ozone layer in the outer space etc can be considered as major air pollutants affect the major systems of human health such as respiratory system, cardio vascular system, central nervous system dysfunction, various type of carcinoma^[8]. For ex Carbon Monoxide prevents uptake of oxygen by blood lead to significant reduction in the supply of Oxygen to the heart. Hence particularly where Co is predominant as major air pollutant, people in that area are prone to suffer from heart disease. Toxic effects induced by ozone are registered in urban areas all over the world causing biochemical, morphologic, functional & immunological disorders. In highly polluted cities where coal consumption and auto mobile exhaust accumulate in the atmosphere, the air pollutants become visible as smog. Some pollutants prevalent in certain industrial area like coal dust, Silica, Asbestos etc triggers particular disease. Climate change resulting from environmental pollution affects geographical distribution of much infectious disease also. *Acharya Charaka* has described the various characteristics of Air which is injurious to health of mass population in *Janapada Dhawmsaniya Vimanaadhyaya* of *Vimana Sthana* such as absence of characteristic features of *Vayu* in conformity with the season, excessive calmness or violent blow of air, excessive clashes among each other when wind blowing, association with unwholesome smell, admixture of pollutant gases, ashes or smoke and excessively cyclonic nature of *Vayu* etc^[9]. Hence it needs to detect the air pollutants and cause of affliction which will be helpful to take early measures to prevent air born diseases manifested in form of epidemics. The people expose to abundant air pollution area must be aware of air born health hazards & early recognition of air born ailments and its preventive measure.

Water (Jala) pollution and Epidemics:

The wide spread problem of water pollution is jeopardizing our health. Unsafe water kills more people each year than war where as safe water is important for public health whether it is used for drinking, domestic use, food production or recreational purposes. Water a life giving liquid can also be a life taking lethal fluid. The WHO estimates that 80% of diseases worldwide are water born. Prevalence of water born diseases are due contamination by various chemicals like pesticides, fertilizers or due to presence of micro organisms or any trace elements^[10]. Water pollution occurs when harmful substances often chemicals or micro organisms contaminate a stream, river, lake, ocean and degrading water quality and rendering toxic to humans or the environment. Contaminated water and poor sanitation are linked to transmission of diseases such as Cholera, Diarrhea, Dysentery, Hepatitis A, Typhoid etc^[11]. With dangerous level of fluoride, iron, Salinity, Arsenic etc in water prevalence of trace element related diseases are found in form of epidemics in mass population in specific geographical region. For ex about 65 million people suffer from Fluorosis, a crippling disease caused by excess fluoride commonly found in the Rajasthan states in Northern India^[12]. Poor water quality becomes inevitable when water gets polluted with industrial waste, garbage, untreated sewage, chemical effluents carry viruses such as Hepatitis A&E and bacteria like E coli. Unclean water for washing can cause skin and



infectious eye disease such as Trachoma and Trachoma can lead to premature Visual impairment. High concentration of different inorganic substances and trace metals in water due to industrial pollution or availability of specific trace element or geochemical in soil of specific geographical region also pose a serious health risk to the people^[13]. The major inorganic substances in water include Sodium, Potassium, Calcium, Magnesium, Bicarbonate, Sulphate and the trace metals include Aluminum, Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Zinc etc. High concentration of Calcium and Magnesium compounds cause hardness of water. For people suffering from diseases of heart or kidneys, it is recommended to avoid with high concentration of Sodium. Lead toxicity affects the fetal nervous system, edema or swelling of the brain etc^[14]. The consumption of water with high level of Arsenic may lead to the loss of limb, cancer even death as prevalent in most part of West Bangle^[15]. Long term exposure to Arsenic has produced widespread Arsenicosis mainly manifested as skin ailments, vascular disease, neuropathy, and also wide spread of heart & lung disease and multiple cancers^[16]. Fluorine is beneficial to human body in low concentration but is toxic in excess. Numerous studies have demonstrated that low concentration in drinking water is associated with increased dental caries. As a result fluoride is widely used in dental products. In the other way high concentration may cause mottled teeth and disturbs the growth of the bones in children^[17]. Various characteristics of polluted water has been described by *Acharya Charaka* that when excessively abnormality in smell, colour, taste or touch or excessive stickiness in water, when there will be reduction in number of aquatic animals or manifestation of unpleasantness then it indicated the toxicity of water^[18]. Evaluation of toxicity may be mild to severe range can be determined based on assessment of above points by ancient preceptors.

Affliction of specific geographical region (*Desha*) and epidemics:

Health and well being of humankind are intimately tied to the quality of air, water, soil etc. geographical or geological factors which are greatly influenced by regional or local geography where the population resides. Ecology and geographical factors under regional or local geography not only influence human health but also that of plants & animals and in broader context of all the nonliving components of the environment as well. Regional effect for prevalence of some disease in particular country. It is evident that geographic distribution of disease are always present endemic in certain location where as same disease is completely missing in other area. For ex Japanese Encephalitis is common in South, South east and East Asia closely linked to irrigated rice production occurs as endemic outbreak with high mortality rates among children^[19]. Similarly though Malaria has been considered as global threat but largest extend of Malaria & Schistosomiasis are more commonly seen in Africa^[20]. Ebola and Marburg viruses have focal distribution and cause dramatic human out breaks with high mortality. In reference to evaluation of various geological factors like water, soil, trace elements or minerals or presence of specific bacteria in soil of particular region for the onset of disease, it needs to identify geochemical anomalies in soils, sediments and water that may impact on health. The source of trace elements is varied in soil and water. Source of trace elements from food derived from soil and water in a particular region results prevalence of various diseases either due to deficiency or excess quantity. For ex Selenium deficiency (due to soil low in Selenium) has been shown to cause severe physiological impairment & organ damage such as Juvenile Cardiomyopathy and muscular abnormality^[21]. Hence this disease is prevalent in areas with low Selenium. In India entire population prone to IDD due to deficiency of Iodine in soil of the subcontinent and consequently the food derived from it. Iodine deficiency leads to a much wider spectrum of disorders commencing with the intrauterine life and extending through childhood into adult life with serious health problems like goiter, cretinism, abortion, mental retardation etc^[22]. One organism *Coccidioides Immitis* thrives in surface soil in arid and semi arid areas with alkaline soil, hot & short summer, moist winter and results Coccidioidomycosis which is endemic in South Western USA, Mexico and central & South America^[23]. Due to role of environmental and acculturation factors in the development and exacerbation of Asthma, Asthma prevalence is higher in westernized in economically developed countries than developing countries. Geographical location is also a key element that influences food habits and cultures and play a major role in health and disease outcome based on particular dietary habit & culture. For ex people in *Bahlika*, *Saurashtra*, *Sindh* and *Sauvira* are mostly languid and have loose flesh and blood as they are inhabited with excess salt in regular diet. Blindness, impotency, baldness, grey hair and heart diseases are more prevalent in Eastern side and China due to excess alkali^[24]. Immune response of the human body and prevalence of autoimmune disorders is also influenced by geographical location. Keeping this in view evaluation of *Bala Pareekshya* as per geographical location has been advocated by *Acharya Charaka* in great compendia of *Charaka Samhita* in reference to *Desha Pareekshya* which can be correlated with the concept of ecoimmunology in modern perspective^[25]. Concept of Ecoimmunology which is a rapidly expanding field in contemporary science aims to investigate the cause and consequence of variation in immunity within an ecological framework. It explores how the environment shapes immune function which in turn influences host-parasitic relationship and disease outcome. Importantly immune function can be suppressed, depressed, reconfigured or stimulated by exposure to rapidly changing environmental drivers like temperature, pollutants and food availability



in a specific geographical location. Characteristics of abnormal land has been mentioned in *Charaka Samhita* in reference to epidemics(*Janapada Dhawmsa*)such as abnormality in the natural colour, smell, taste and touch, excessive stickiness, abundance of serpents, wild animals, mosquitoses, locusts, flies, rats, owls, vulture etc, having jungles of grass and weeds, withered, dried or destroyed crops, abundance of smoke in the wind, bewilderment and painful disposition of various types of animals &birds, perversion or absence of religion, truth, modesty, manners &other qualities of the inhabitants of the land, frequent occurrence of meteorites, thunderbolts and earth quakes etc. Impairment of these factors responsible for the destruction of countries by epidemics ^[26].

Affliction of climate/season (*Kala*) and epidemics:

Understanding seasonal biology for biomedical perspective is the need of hour to prevent contemporary health issues because Epidemiologic triad consists of agent, host and environmental factors interrelate in a variety of complex ways to produce disease. *Ayurveda* broadly depicts the concept of *Kala* and its unavoidable &irreversible effect towards various physiological, pathological and immune functions. *Samyak Yoga of Kala* is meant for restoration of health where as *Hina, Ati* or *Mithya Yoga of Kala* can be considered as one of the key factor for triggering the prevalence of some diseases ^[27]. Such as heat wave in excessive hot weather accompanied by high humidity can be recognized as extreme weather in summer (*Ati Yoga of Grisma*), especially found in oceanic climate countries. During heat waves, the air becomes stagnant and traps emitted pollutants, often resulting dry out vegetation and serious medical hazards. According to the scientists, heat waves, droughts, cold waves, snow fall and flooding can be recognized as extreme condition of weather (i.e. *Ati yoga of Kala*) can affect air and water quality and manifest air and water born ailments. When the environment affects by lack of rain fall in a particular geographical region, drought conditions make life difficult for resident species those have adapted to particular environmental condition. This can be considered as the *Hina Yoga* or *Ayoga of Kala*. Certain epidemics occur at certain season. For ex Whooping cough occurs in spring where as measles produce epidemics in winter^[28]. Influenza, the common cold and other infections of the upper respiratory tract such as sore throat occur predominantly in winter ^[29]. Epidemics may be the consequence of disaster of another kind such as tropical storms, floods, earth quakes, droughts etc. Understanding the impact of climate change on disease burden through the effect of temperature, humidity and seasonality on infectious disease dynamics can prevent epidemics to some extent. Manifestation of characteristic features contrary to the normal conditions of various seasons is considered to be harmful.

Reasons for pollution of Air, water etc, lead to epidemics:

Ancient wisdom broadly accepts the sinful acts committed during the present life and the previous life followed by intellectual blasphemy can be considered as the root for the vitiation of all these factors ^[30]. From the beginning of creation, manifestation of inauspiciousness has been preceded by sinful acts. Religious duties and qualities of living beings got reduced in quarters gradually by the passage of each *Yuga*. This is how the entire universe has to face dissolution. After the passage of each *Yuga* life span of living beings get reduced also ^[31]. Sinful acts per-force makes the righteous acts to disappear. Because of the disappearance of righteous acts, even the gods desert the people living in those places. Consequently impairment in seasonal characteristics, abnormality of air, water reservoirs &land in earth takes place. Due to impairment of above factors the normal attributes of food, drug or drink found in those regions also get impaired ^[32]. Human interference directly or indirectly has been considered as the key factor is responsible for worldwide biodiversity such as deforestation, habitat degradation and fragmentation, wildlife trade and climate change etc.

Ancient vision to challenge upcoming epidemics:

Ancient preceptors broadly accepts the result of own misdeed followed by impairment if intellectual blasphemy are directly or indirectly responsible for all type of distortion in the universe as well as of destruction of mass population by epidemics. From the beginning of creation, manifestation of inauspiciousness has been preceded by sinful acts. But one should hold himself responsible for his happiness & miseries. The holistic science *Ayurveda* focuses on both non-pharmaceutical approaches i.e. prayers to the gods, good conduct etc and resorting to wholesome regimen as antidotes to the misdeeds of the individual and pharmaceutical approach i.e. administration of rejuvenation therapy and various elimination therapies as the principle of management of epidemics. Truthfulness, compassion for living beings, charity, sacrifices, prayer to the gods, adaptation of preventive measures as per geographical or geological impact on health outcome, protection of self by Mantra, observation of *Brahmacharya*, self control, residence in auspicious localities, constant association with religious scripture and religious persons etc. can nurture the deed of any individual and drive in righteous path. It may prevent individual as well as global health from the impact of epidemics and any type of natural



distortion. Therefore, irrespective of any situation, without apprehension one should follow the path of propitiousness [33]

4. MATERIALS & METHODS :

1) Review of great compendia Charaka Samhita & Sushruta Samhita has been made for contextual analysis of epidemics and environmental determinants of disease.

2) Different web journals are referred for understanding the role of emerging branches of contemporary science such as medical geography, environmental epidemiology, tropical medicine etc. for evaluation, distribution and prevention of epidemics.

5. DISCUSSION:

Behaviour that is responsive to the presence of a disease can potentially reduce the size of an epidemic outbreak. A change in behaviour can be prompted without witnessing the disease first hand. Hence there is great need of raising awareness, the exchange of information, scientific knowledge, best practices, quality education and advocacy programme on epidemics at the local, regional and global levels as effective measures to prevent and respond to epidemics. Major pandemics that have afflicted humankind throughout history such as plague Cholera, Influenza and presently Covid-19. Infectious disease still represents threats the human health as pathogens can spread rapidly through global trade and travels. Global surveillance programs are thus needed to detect and identify pathogens spill over from animals to human as well as control of water born or air born epidemics. Furthermore, effective non pharmaceutical and pharmaceutical measures for the prevention and control various endemic, epidemic or pandemic situations are required to learnt their dissemination in the human population. Epidemic management has been described as the process of anticipating, detecting, preventing, responding and controlling epidemics in order that by which the health & economic impacts are minimized. Enhancing environmental health through better air quality, water and sanitation, waste management along with efforts to safe guard biodiversity will reduce the vulnerability of communities to pandemics and thus improve overall social well-being and resilience. Limiting people's exposure to hazardous physical, chemical and biological agents in air, water, soil, food and other environmental media will reduce their vulnerability to future pandemics, increase the health and well-being and provide an important complement to public health systems. Hence the recognition of the importance of biodiversity and eco system health in daily lives of individuals is becoming widely spread now at least among scientists and policy makers.

CONCLUSION:

The value of an integrated one health approach that fosters integration of human health, animal health, planet health as well as environmental health. With this vision & mission '*Sarve Bhavantu Sukhinah & Sarve Santu Niramaya*', recognition of public health in association with restoration of ecological and environmental health instead of only individual health should be taken into consideration. Researches should be conducted on hazards of biodiversity and its prevention to meet the challenge of major global health issues which destroy the population by mass.

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