



AIR POLLUTION AND NUTRITIONAL TRANSITION AS RISK FACTORS FOR NON-COMMUNICABLE DISEASES : THE EMERGING TRENDS IN HEALTH SCENARIO OF KERALA, INDIA

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Abstract

India is confronted with the challenge of tackling the twin burden of communicable and non-communicable diseases (NCDs). Combined effects of air pollution and changes in dietary pattern have accentuated the problem of NCDs and over nutrition (obesity). The paper uses secondary data sources, National Family Health Survey, 4(2015-16), Kerala Economic Reviews, and India: Health of the Nation's states report, 2017 to review the risk factors and the incidence of major non-communicable diseases in India and Kerala. India has a disproportionately high burden of cardio vascular diseases, followed by chronic respiratory diseases, cancer and diabetes. In Kerala, the sharp rise in prevalence of NCDs were associated with gradual process of urbanization, the phenomenal reduction in the cultivated area of paddy and all pulses and the enormous increase in poultry and meat consumption, access to labour saving techniques, the rise of various non-farm sectors, and especially the emergence of service sector. Though demographic dividend provides us a window of opportunity, the same would act as a double-edged sword as both the younger and the older people are equally prone to NCDs. The problem of increased burden of NCDs will remain unresolved until and unless both behavioural modifications at micro level and environmental protection at macro level are intensively addressed.

Keywords: Non Communicable Diseases, double burden, nutritional transition, air pollution.

Introduction

Close link between environmental pollution and non-communicable disease burden is widely recognised (India: Health of the Nation's states report 2017). Rapid industrialisation and economic growth brought to the forefront the risk of environmental degradation. Environmental issues and loss of biodiversity affects agriculture, food production, health and nutrition. Now, the focus has shifted to achieve the dual objectives of growth with sustainable development. Sustainable development looks into the aspirations of the present generation, without compromising the needs of the future generations (Brundtland Report 1987). Sustainable development without environmental protection would endanger not only the ecosystem but also the health parameters of the population. The India State Level Disease Burden Initiative Report, conducted as a part of the Global Burden of Diseases, Injuries and Risk Factors Study (GBD) 2016, found that air pollution emerged as the second largest risk factor in India, the first being malnutrition (as cited in India State Level Disease Burden Initiative Air Pollution Collaborators 2019). In India, out of 1.24 million mortality in 2017, 12.5 percent of the deaths were due to air pollution (India State Level Disease Burden Initiative Air Pollution Collaborators 2019). Studies from across the globe established links between air pollution and noncommunicable diseases, particularly chronic obstructive pulmonary disease (COPD) and cardio vascular diseases (Cohen *et al.*, 2017). Improved air quality in high income countries resulting from stringent legislative measures implemented by them led to a decline in the world wide mortality rates due to PM_{2.5} as between 1990 and 2015, whereas mortality and Disability Adjusted Life Years (DALYs) due to NCDs have accentuated in India and China (Cohen *et al.* 2017).

Nutritional transition and air pollution

Epidemiological and nutritional transition along with air pollution have increased morbidity and mortality due to NCDs. Rapid revolution in health sector led to an epidemiological transition, resulting in a demographic dividend and high incidence of NCDs, namely cardiac ailments, hyper tension, diabetes and cancer (Omran 2005; McKeown 2009). NCDs have taken precedence over communicable diseases (Wahdan 1996) and it results in morbidity and premature deaths leading to a loss of productivity and human capital. More recently, across the globe there have been onslaught of new communicable diseases like SARS, Nipah, COVID 19 etc and the resurgence of diseases in mutated or drug resistant variants which had been eradicated earlier (Wahdan, 1996).

Nutritional transition refers to the shift in dietary and physical activity patterns, accompanied by demographic, and socio-economic changes (Popkin 2006). It has brought changes in the nutritional outcome, a major factor for the high incidence of obesity and a rising tide of NCDs. Globally, there has been a shift in dietary patterns-Western diet, replacing the traditional pattern of food (Kennedy 2008). Increasing urbanization, shift in consumption pattern from a higher proportion of carbohydrate based foods to one with lower carbohydrates, along with diversified foods like animal products, fat and excessive use of sugar, resulted in nutritional transition (Hawkes 2006; Popkin 2006). The role of mechanisation, labour saving device, block chain and artificial intelligence entail less physical activity, affecting the entire life styles and is precipitated by changes in energy expenditure (Popkin 2006). These emerging issues stress the need to address the problem of tackling obesity and NCDs. Countries are grappling to simultaneously address the issue of overweight and obesity on one hand and under nutrition on the other. 'South Asian enigma' is still a puzzle that economic growth did not result in improved nutritional

outcome (The World Bank in India 2009). Malnutrition is cited as one of the major causes of child mortality (The World Bank in India 2009). In the fifth assessment report of the Inter-Governmental Panel on Climate Change (IPCC), 2014, malnutrition is treated as one of the five largest adverse health impact of climate change.

Materials and Methods

The paper makes use of secondary data sources, like National Family Health Survey 4 (NFHS), Comprehensive National Nutrition Survey 2019, Kerala Economic Reviews, Global burden of disease study 1990-2016 and 2017, and India: Health of the Nation's states report to review the risk factors and the incidence of major non-communicable diseases in India and Kerala.

Non-communicable diseases in India

Non communicable diseases (NCDs) are chronic in nature, a result of genetic, physiological, environmental and behavioural factors. Air pollution was identified as a risk factor for NCDs, along with other risk factors like tobacco use, physical inactivity, harmful use of alcohol and unhealthy diets (WHO European High Level Conference on Non Communicable Diseases 2019). Globally, a healthier environment could have averted twenty three percentage of all deaths (WHO 2017). Metabolic risk factors are high blood pressure, overweight, hyperglycaemia etc. The poverty alleviation measures of less developed countries are often hampered due to increased out of pocket spending on NCDs, as most of these diseases require continuous medication and treatments.

Results and Discussion

The report 'India: Health of the Nation's states – The India State Level Disease Burden Initiative', 2017 gives a comprehensive picture of non communicable disease burden across the states of India. The Global Burden of Disease Study 2017, tried to assess the impact of air pollution on deaths, disease burden and life expectancy across states of India (India State Level Disease Burden Initiative Air Pollution Collaborators 2019).

In 2017, the annual population-weighted mean exposure to ambient particulate matter in India was 89.9 $\mu\text{g}/\text{m}^3$ and 76.8% of the population were exposed to annual population-weighted mean exposure above the limit recommended by the National Ambient Air Quality Standards in India (40 $\mu\text{g}/\text{m}^3$) (India State - Level Disease Burden Initiative Air Pollution Collaborators 2019). 1.24 million deaths in India in 2017, which were 12.5% of the total deaths, were attributable to air pollution and had 26.2% of the global air pollution DALYs in 2017.

Table 1 gives the total deaths (in absolute number and percentage) due to major NCDs in India as between 1990 and 2016 India has a disproportionately high burden of chronic respiratory diseases. In India, chronic respiratory diseases caused 10.9 per cent of the total deaths and 6.4 per cent of the total DALYs in 2016 (India State - Level Disease Burden Initiative CRD Collaborators 2018). Two prominent chronic respiratory illness were COPD and asthma and they were responsible for 75.6% and 20 per cent respectively of the total DALYs due to chronic respiratory diseases in India in 2016. Air pollution was the leading risk factor for COPD. Cardiovascular diseases contributed to 28.1% of the total deaths and 14.1% of the total DALYs in India in 2016,

compared with 15.2% and 6.9% respectively, in 1990. The overlapping risk factors for cardiovascular diseases in 2016 included dietary risks, high systolic blood pressure, air pollution, high total cholesterol, tobacco use, high fasting plasma glucose, and high bodymass index (India State - Level Disease Burden Initiative CVD Collaborators 2018).

Health loss resulting from diabetes, is the highest among major noncommunicable diseases. The number of people with diabetes in India increased from 26.0 million in 1990 to 65.0 million in 2016. Its prevalence in 2016 was highest in Tamil Nadu and Kerala (India State - Level Disease Burden Initiative Diabetes Collaborators 2018). The most important risk factor for diabetes in India was overweight. Between 1990 and 2016, number of new cases and deaths due to cancer has doubled in India. In 2016, 8.3% of the total deaths and 5.0% of the total DALYs were due to cancer. Crude cancer incidence rate in 2016 was highest in Kerala (135.3), compared to 74.1 in 1990 (India State - Level Disease Burden Initiative Cancer Collaborators 2018).

Table 1 : Total deaths (in absolute number and percentage) due to major NCDs in India as between 1990 and 2016.

NCDs	2016	1990
Cardio Vascular	54.5 Million(28.1)	25.7 Million(15.2)
COPD	55 Million(10.9)	28 Million(9.6)
Cancer	1.06 Million (8.31)	0.55 Million
Diabetes	65 Million (3.1)	26 Million

Source: India State-Level disease burden initiative CRD collaborators; India State-Level disease burden initiative CVD collaborators; India State-Level disease burden initiative cancer collaborators, India State-Level disease burden initiative diabetes collaborators

Emerging health scenario of Kerala

Kerala model of health- good health at low cost – had started to face crisis as early as 1980s (Ekbal 2017). Panikkar and Soman(1985) pointed out that while mortality was low in Kerala, the prevalence of morbidity was found to be quite high; more people perceive themselves to be sick compared to other states in India (as cited in Ramankutty 2012). Rampant modernisation and urbanisation, drastic lifestyle changes, high alcohol and tobacco consumption, affinity for white collar jobs, unhealthy eating patterns, and less physical exercise, increase in stress levels contribute to the high prevalence of non-communicable diseases in the state (Kerala Economic Review 2017). In India 42 per cent of total deaths are due to NCDs, where as in Kerala, more than 52 per cent of the total deaths in the productive age group of 30 and 59 are due to NCDs (Kerala Economic Review 2017). Twenty seven per cent of Kerala adult males have diabetes compared to 15 per cent at national level and 19 per cent of adult female population is diabetic compared to 11 per cent in India. Genetic predisposition, dietary habits and sedentary lifestyle are considered to be the reason for this phenomenon (Kerala Economic Review 2017). In spite of Kerala's striking achievements in the health parameters (NFHS 4), Kerala is the most morbid state. Morbidity in Kerala is more than three times the all India average. The percentage of persons that responded as ailing (PPRA) in a 15-day period, in India was 7.5 percentage, this was 24.5 percentage in the state. PPRA in other states ranged between 6 percentage and 9 percentage (National Sample Survey 75th Round 2019). Comprehensive National Nutrition Survey (CNNS) reports that one in every five children (20.5%) are stunted (CNNS 2019). The

corresponding figures was 15.5% in Jammu and Kashmir. Kerala is behind J&K, Goa and Tamil Nadu. Around 9.5 per cent of adolescents are overweight, compared to 4.8 per cent in all India level, 32.2 percent in the age group 10-19 years are in pre diabetic condition and the prevalence of high total cholesterol is 13.9 percent (CNNS 2019).

Risk factors of NCDs

National Family Health Survey 4 (NFHS) 2015-16, fourth in the series of NFHS surveys initiated in 1990s , provides nation wide data on maternal, child health , other health issues and provides estimates of blood glucose levels and blood pressure levels among women (aged 15-49 years) and men(15-54 years) for all India, state level and district level. Blood glucose levels and elevated blood pressure are metabolic risk factors for NCDs.

NFHS 4(2015-16) data on the percentage of underweight children and prevalence of Acute Respiratory Infection among children in the last two weeks preceding the survey, nutritional status of adults whose BMI is below normal and who are overweight, blood sugar levels and hyper tension among adults at all India and state levels are used to assess the risk factors for NCDs. A comparison of the above

said indicators, as between India and Kerala, reveal that in terms of child nutritional indicators, Kerala fares better compared to all India average. The prevalence of high levels of child under nutrition is to be viewed as an opportunity to approach this menace in a wider perspective. Apart from anthropometric failures, other indicators of child health and well being are to be looked into. Children in Kerala are doing better in terms of health parameters like infant mortality rate and child mortality rate (Kerala Economic Review 2019). The percentage of underweight children in Kerala is only 16.1 per cent compared to 35.8 per cent at all India. Anaemia incidence among children in the age group 6-59 months in Kerala(35.7 per cent) is lower than the national average (58.6 per cent), still the incidence of anaemia is worrisome. In addition to other factors, outdoor air pollution is associated with paediatric acute respiratory infection (ARI) (Romieu *et al.*, 2002). The air quality index of Kerala is better, hence the percentage of children with ARI is less compared to all India. In Kerala, the percentage of overweight or obese men and women (28.5 per cent and 32.4 per cent) far exceeds the all India average. Females are more prone to obesity compared to males in both India and Kerala. The incidence of both diabetics and hyper tension are higher in Kerala.

Table 2: Comparison of Child and Adult Nutritional Indicators and metabolic risk factors for NCDs as between India and Kerala (in percentage)

	Kerala	India
Child Nutritional indicators		
((a) Under weight	16.1	35.8
(b) Children aged 6-59 months who are anaemic	35.7	58.6
Nutritional status of adults		
(a) Women whose BMI is below normal (BMI<18.5 Kg/m ²)	9.7	22.9
(b)All women age 15-49 years who are anaemic	34.3	53.1
(c) Women who are overweight/obese	32.4	20.6
(d) Men whose BMI is below normal (BMI<18.5 Kg/m ²)	8.5	20.2
(b) Men age 15-49 years who are anaemic	11.7	22.7
(c) Men who are overweight/obese	28.5	18.9
Childhood illness		
Prevalence of ARI in the last two weeks preceding the survey	0.8	2.7
Blood sugar level among adults		
High blood sugar level(Women)	8.7	5.8
High blood sugar level(Men)	13.1	8.0
Hyper tension among adults		
Moderately high (women)	0.8	1.4
Moderately high (men)	1.3	2.3

Source : NFHS 4

The disaggregated analysis of 'Kerala: Disease Burden Profile 1990-2016' rings a wake up call to revamp the health sector of Kerala. Among the leading causes of DALYs, in 1990 ischaemic heart disease was 7.1 per cent, rose to 12.2 per cent in 2016; COPD caused DALY was 3.7 per cent in 1990, increased to 4.4 percent in 2016 (India: Health of the Nation's states report 2017). Table 3 gives the top five risk factors leading to death and disability combined as between 1990 and 2016 in Kerala. In 1990, malnutrition was the

dominant risk factor driving most death and disability combined, whereas in 2016 high blood pressure is the leading risk factor. Malnutrition resulted in 17.4 per cent of DALY, out of total DALYs in 1990. In 1990, behavioural categories were prominent compared to environmental and metabolic category. Whereas in 2016, out of five risk factors, four were from metabolic category. This clearly indicates that the risk factors for NCDs are high in Kerala.

Table 3: Risk factors of Kerala as between 1990 and 2016.

Risk factor 1990	Risk category (1990)	Risk factor 2016	Risk category (2016)
Malnutrition (17.4 %)	Behavioural	High Blood Pressure (13.4 percent)	Metabolic
Air pollution (9.3 %)	Environmental	Dietary risk (11.2 %)	Behavioural
Dietary risk (8.1 %)	Behavioural	High fasting plasma glucose (11.1 %)	Metabolic
High Blood Pressure (7.9 %)	Metabolic	High Body Mass Index (7.6 %)	Metabolic
Tobacco use (6.5 %)	Behavioural	High total cholesterol	Metabolic

Source: India: Health of the Nation's states- The India State Level Disease Burden Initiative report, 2017

Note: The percentage in bracket is DALYs from that risk out of the total DALYs.

In Kerala, the nutritional transition is associated with gradual process of urbanization, the phenomenal reduction in the cultivated area of paddy (779000 Ha in 1960-61 to 198000 Ha in 2018-19) and all pulses (44000Ha in 1960-61 to 950 Ha in 2018-19) and the enormous increase in poultry (152(in lakhs) in 1982 to 298 (in lakhs) in 2019) and meat consumption (Kerala Economic Survey 2019), access to labour saving techniques, the rise of various non-farm sectors, and emergence of service sector reduced the extent of physical activity, resulting in a sharp rise in the prevalence of NCDs. The NRI remittances to Kerala to the tune of Rs 85,092 crores (Rajan and Zachariah 2019) has made a dent in the pattern of consumption. A study by Gill *et al.* (2015) analysed the environmental impact of dietary changes due to nutritional transition in Brazil, China and India, using supply data from FAOSTAT. The increase in cereal supply in China and India had a major impact on nitrogen and phosphorous cycle and increase in beef supply had impact on green house gas emissions.

Conclusion

To tackle the problem of the rapid increase in NCDs, an imperative approach and cross cutting policies at national and regional levels are required. The assessment of the impact of dietary changes and the leading causes for high incidence of non communicable disease is a rather complex task. India still remains home to the world's largest percentage of under nourished population, along with high incidence of NCDs. The Kerala model of development is debatable, in the context of ever-increasing burden of NCDs. Nutritional transition along with lower environmental pollution is expected to have better health outcome. Similarly, changes in dietary pattern culminates in a drift in the type of foods produced, thereby impacting the environment. The shift from cereal consumption to meat, dairy products, emergence of eating out and subsequent intake of junk foods have added fuel to the burden of non communicable diseases. This situation calls for comprehensive studies and evaluation to make our population healthier and more productive.

Objectives

- (1) To review the risk factors of non communicable diseases in India
- (2) To look into the emerging health crisis of Kerala

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