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Nutrition And Cancer In India

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A common notion is that cancer is primarily a disease of affluence and industrialisation, generally occurring late in life, and is not an important problem for developing countries. However, there are good reasons why cancer deserves attention in developing countries. Cancers such as those of the oesophagus, stomach, oral cavity, liver and cervix occur mostly in poor countries — India is an example. In several middle-income countries such as China, Malaysia and Brazil, with low infant and childhood deaths the relative importance of cancer at later ages has increased. In individuals, past the hurdle of childhood disorders, cancer is one of the three major causes of death (for instance, in Africa/Asia). Tobacco consumption is increasing rapidly in developing countries and India is no exception.

From population based registries in India covering 28 million people (3.5 per cent of the total population) from different parts, the total incidence rates are lower as compared to Western countries[1] (Table 1).

The absolute number of incident cases per se is 6 to 7×10^5 cases and approximately 300,000 persons are estimated to die from cancers annually[2,3]. By the year 2000, 1 million new cancer cases are expected to be added annually. It is important to concentrate on the absolute number of cancer cases of the upper aerodigestive tract and liver in men, which are much higher in India while the incidence of colon and lung cancer is higher in the western world. While in women, cancer of the oral cavity, pharynx, oesophagus, breast and cervix are out-numbered only by those of ovary and breast in the Western countries. This finding is in tune with their patterns of diet[1,4].

From 1983 to 1989, there has been an increase in the incidence rates of cancer by about 5.5 per cent in males and 4.9 per cent in females for cancers at all sites. However, in males there is an increase of lung and colon cancers with decrease in pharynx, stomach and liver cancers while in women, breast and ovary cancers are increasing with a slight decrease in the upper aerodigestive tract, stomach and liver cancers. Uterine cervix cancers have shown no change in incidence rate during this period.

TABLE 1
Cancer Incidence in Urban Population (AAR/100,000)

Site	India 1989		USA (Connecticut White) 1983-87		UK (Oxford) 1983-87	
	Male	Female	Male	Female	Male	Female
Mouth	12.4	7.5	8.7	3.6	3.7	1.8
Pharynx	10.2	2.7	4.6	1.5	1.3	0.7
Oesophagus	9.4	7.3	5.3	1.4	3.5	2.4
Stomach	7.6	3.8	9.0	3.9	17.5	6.8
Colon	2.9	2.0	35.9	25.4	18.7	16.7
Rectum	3.8	2.3	17.2	10.1	12.4	7.8
Liver	2.8	1.3	3.2	1.1	1.4	0.7
Pancreas	2.2	1.3	8.3	6.4	7.9	5.4
Lung	12.6	2.8	62.5	29.9	59.9	19.7
Cerevix	–	27.6	–	6.9	–	10.3
Breast	–	25.9	–	88.9	–	63.6
Ovary	–	7.0	–	12.7	–	12.4
All sites	122.3	129.7	318.1	278.7	286.6	242.2

Source: 1, 5, AAR — Age Adjusted Rate

CONTENTS

TABLE 2
Food Groups and Cancer Risk

Food Groups	Comparison	Cancer Site	OR (95%CI)
Vegetables	daily vs <daily	Oral	0.4 (0.3-0.7)
		Pharynx	0.4 (0.2-0.6)
		Larynx	0.4 (0.2-0.6)
		Oesophagus	0.4 (0.2-0.7)
	>Once vs <once/wk	Oesophagus	6.0[a]
Green leafy Vegetables	Upper vs lower tertile	Oral	1.8 (0.4-8.2)
		Lung	0.3 (0.1-0.8)
Other Veg Roots & Tubers	Upper vs lower tertile	Oral	α**
Fruits	>Once vs <once/wk	Oral	1.1 (0.7-2.0)
		Pharynx	1.0 (0.6-1.7)
		Larynx	0.5 (1.2-5.2)
		Oesophagus	0.8 (0.5-1.3)
Milk	Ever vs never	Lung	8.1 (5.3-12.4)
Animal foods	Upper vs lower tertile	Oral	2.6 (0.5-13.02)
Fish	>Once vs <once/wk	Oral	0.3 (0.2-0.5)
		Pharynx	0.3 (0.1-0.6)
Eggs	>1 vs <1/week	Oral	1.2 (0.7-2.0)
		Larynx	1.6 (0.7-3.3)
Buttermilk	>daily vs <daily	Oral	0.3 (0.1-0.6)
		Larynx	0.1 (0.01-0.6)
		Oesophagus	0.4 (0.2-0.9)
	Ever vs never	Lung	2.7 (1.9-3.9)
Red chilli powder	>100 vs <100g/ cu/month	Oral	2.7 (1.6-4.5)
		Larynx	2.5 (1.2-5.2)
Groundnut oil	>1000 vs <1000g/ cu/month	Oral	0.3 (0.1-0.5)
		Larynx	0.3 (0.1-0.6)
		Oesophagus	0.5 (0.3-0.8)
Tea	>2 vs <2 cups/d	Oral	1.3 (0.8-1.9)
		Larynx	1.1 (0.6-2.0)
		Oesophagus	2.4 (1.5-3.9)
	Ever vs never	Lung	3.9 (2.6-5.9)

*a - relative risk ** P <0.01*

Source: Reference 8-10, 14-16.

There is only one rural centre in India which collects data on the incidence patterns of cancer, and these data show that there is a vast difference between the urban and rural areas in almost all types of cancers except cervical cancer in women[1].

In all four major cancer registry areas, cancer of the oral cavity, including the pharynx, is most common in men. The next common sites of cancer are the stomach and lung in Bangalore and Chennai, whereas the lung is the second common site for risk of cancer in Mumbai and Delhi. In females, uterine cervix is the leading site of cancer in Mumbai, Delhi and Chennai while cancer of the breast is somewhat similar, though rates in Mumbai are the highest. These two sites account for two-thirds of cancers in females at all the four registries. These are followed by cancers of the oral cavity and oesophagus.

ROLE OF DIET

Upper aerodigestive tract cancers: The highest rates of upper aerodigestive tract cancers are found in India, China and elsewhere in Asia. Alcoholic drinks and use of tobacco have been identified as most important risk factors for these cancers. Several studies in literature document that the use of alcohol and tobacco compromises the nutritional status of micronutrients. Very early studies of oral cancers in India document micronutrient deficiencies such as vitamins A and B-complex[6,7].

Oral cancer: More recently, detailed case control studies were undertaken to examine the role of diet in the etiology of oropharyngeal cancers[8,9] (Table 2). The odds ratio estimates were significant when the frequency of intake of several important food groups were compared between the cases and controls. It was clear from the study that those who consume vegetables, fruits or fermented foods such as buttermilk daily and fish more than once a week were protected against the development of oral cancers. Oil consumption was also a protective factor while tea, red chilli powder and consumption of eggs were found to be harmful. In fact, for the consumption of red chilli powder, dose dependant effects were noted.

In studies at the National Institute of Nutrition (NIN) on oral cancer where detailed diet histories were obtained, poor dietary intake of vegetables and fruits were noted and were found to be risk factors for oropharyngeal cancers[9]. An estimate of the nutrients intake indicates that low intake of β-carotene, riboflavin, folate, vitamin C, and copper modify the risk potentials significantly. Even though the plasma levels after the onset of the disease do not reflect causal relationships, low levels to vitamin A, E, red cell folate and plasma zinc emerged as risk factors. Since these cases were diagnosed at relatively an earlier stage, the low levels may be considered to be causally related. The risk estimates, though moderate, are of importance in a relatively homogenous population with respect to diet and nutrition.

Oesophagus: Oesophageal cancers are often found in Southern states of India such as Karnataka, Tamil Nadu and Kerala and also in Assam and Kashmir. Oesophageal cancers are common in countries such as Iran, Africa and China where diets are based on single staple cereals with virtually no fresh fruits and vegetables. A case control study at NIN also indicated a high risk association with less frequent intake of vegetables[10]. Low socio-economic status, consumption of very hot beverages, mouldy foods and pickled vegetables which contain nitroso compounds and mycotoxins have been associated with such cancers[11]. Tea drinking has been identified as a risk factor for oesophageal cancer. In Kashmir, dried smoked fish, dried and pickled vegetables,

TABLE 3
Nutrient Intervention Trails on Precancerous Oral Lesions

Group	Nutrient	Remission (%)	New Lesion (%)
Stich *et al* (1991)	Placebo	3	21.2
	β-carotene	14.8	14.8
	β-carotene and vitamin A	27.5	7.8
	Vitamin A	57.0	0.0
Krishnaswamy *et al* (1995)	Placebo	8	38
	Vitamin A, riboflavin, zinc and selenium	57	12
Mathew *et al* (1995)	Placebo	7	5
	Spirulina	45	2

Source: Reference 19,21,24

red chilli and tea have been identified as risk factors for oesophageal and stomach cancers[12].

A very recent study conducted by NIN on food substances obtained from high and low risk areas in Karnataka indicates that a large number of food substances from high risk areas contain preformed nitroso compounds as compared to those from the low risk areas. However, there is a need to have more detailed epidemiological studies in these areas.

In addition, studies at NIN show that beer samples obtained from several of these places contain N-nitrosodimethylamine in larger amounts[13]. It is interesting to observe here that beer samples collected from Tamil Nadu have a very high content of nitroso compounds.

Stomach cancer: Like oesophageal cancers, stomach cancers are more common in Southern states of India as well as in Kashmir. Though *H. pylori* infection is an important risk factor, salted foods and poor diets are also well-known risk factors. In Tamil Nadu, the consumption of salt is high and so is the incidence of stomach cancers. In Kashmir, intake of salted tea, the habit of consuming sun-dried foods which promote nitroso compound formation are associated with increased risk. In addition, vegetables such as *Brassica oleorecea (haak)* and spices considered as rich sources of nitroso compounds may modify the risk potential[12].

Nasopharyngeal: Nasopharyngeal cancers are encountered in North-eastern parts of India, especially in Nagaland. Salted foods, and salted and fermented fish consumed, especially during childhood, appear to increase the risk of this cancer and is similar to what has been observed elsewhere[14].

Lung: A recent study by Sankaranarayanan *et al* on lung cancer also shows that green leafy vegetables and allium species such as onions are protective. While a food item such as tapioca (which does not contain protective substance), dry fish, chicken and pickles, etc, emerged as risk factors[15].

Cervix: Recent studies suggest a poor intake of vitamin A, C and β-carotene in cases with severe cervical dysplasias[16]. Even plasma levels of these vitamins as well as plasma selenium were lower. In India, folate deficiency is rampant. Low folate intake may be a risk factor in India. Studies need to be done to establish the role of folate in cervical cancers.

Colon: Incidence rates of colon cancer in India are quite low (0.5-2.1/100,000) with differences between the incidence patterns in urban (2.9 in males; 2.0 in females) and rural India (2.0 in males and 0.5 in females). The risk factors identified in the Western countries are obesity with reduced physical activity associated with consumption of foods such as red meat — a rich source of animal fat — low consumption of cereals, legumes, vegetables and of antioxidants, and overall, a diet providing additional fat and calories from alcohol. Nutrients such as folate, calcium and vitamin D appear to be important[17]. Urban Indians as compared to rural are physically less active. The consumption of meat and fat is much lower in rural India, but then rural populations also consume much less vegetables and fruits. This shows that urbanisation promotes a Western type of diet and therefore we have urban and rural differences in the cancer incidence which might become much higher in the near future.

Breast: Similar comparisons can be made with respect to breast cancer. Longer reproductive life time (with fewer births), less physical activity (with obesity), rapid early growth and early menarche are important risk factors for breast cancer, with dietary factors somewhat similar to those observed for colon cancer, that is, higher meat, animal protein and total energy consumption with less vegetables and fruits. The estimated absolute figures as such are however one-fifth of that in the US (36,000/annum). A study undertaken in Mumbai on one ethnic group — the Parsis — revealed high incidence of breast cancer[18]. The Parsi community generally comes under the high income strata, and their food habits differ from other population groups. The study indicated a higher calorie intake among cancer patients than those with benign breast lesions[18].

INTERVENTION STUDIES

Intervention programmes for cancer control are developed as a systematic approach towards cancer prevention and to establish causality. Studies of this nature have been conducted in India with emphasis on oral cancers in smokers and tobacco chewers basically to get information on the causality, rather than the use of chemoprevention as a strategy for cancer prevention (Table 3). The two studies done by Stich and co-workers in Southern India on tobacco chewers clearly indicate that vitamin A and β-carotene are protective[19,20]. On vitamin A supplementation, complete regression was observed in 57 per cent vs a spontaneous regression of 3 per cent. Studies conducted by Krishnaswamy *et al* in high risk individuals of reverse smokers in Srikakulam district of Andhra Pradesh reveal that the micronutrient supplements given as a cocktail of nutrients in the form of a prescriptive approach

resulted in regression of preneoplastic lesions[21]. The complete regression was 57 per cent in the supplemented group as against just 8 per cent in the control group. The nutrients also prevented deterioration of lesions and appearance of new lesions in the non-lesion group. Intermediate end points or biomarkers such as carcinogen-DNA adducts and micronuclei in epithelial cells reduced significantly in the treated group while no such effects were found in the placebo group[22]. Similar results have been observed in China for oesophageal and stomach cancers[23].

A more recent study using spirulina, which is an important source of β-carotene, for a period of one year resulted in complete regression of leukoplakia in tabacco chewers in Kerala[24]. However, one has to be cautious in such approaches as β-carotene supplement in the ATBC study and the physician health studies were essentially negative[25,26].

CONCLUSION

Dietary preventive measures or promotion of healthy dietary habits and lifestyles, though demanding, are perhaps the right answer for cancer and chronic disease prevention.

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FOUNDATION NEWS

Study Circle Lectures

- Dr Kamala Krishnaswamy, Director National Institute of Nutrition on 'Nutrition and Cancer' on July 22.
- Dr Sunil Sazawal, Professor, Centre for Micronutrient Research, Annamalai University, on 'Zinc and Child Health: Recent Developments' on August 27.
- Dr Prema Ramachandran, Advisor (Health), Planning Commission on 'Maternal and Child Health in the Ninth Five Year Plan' on September 30.

President's Engagements

- Led the Indian delegation to the IUNS General Assembly in Montreal on July 29 and 31.
- Participated in the Centenary Celebration of Dr Ronald Ross's discovery of the malarial parasite, and the meeting of the alumni of the London School of Hygiene and Tropical Medicine in Hyderabad on August 18-20.
- Participated in the Sixth Biennial Congress of the South African Society of Parenteral and Enteral Nutrition, and visited institutions in Capetown and Durban, September 7-10, 1997.
- Will attend the launch of 'Report on Food, Nutrition and Cancer — a Global Perspective' at India International Centre on October 15.
- Will deliver the keynote address in the FAO workshop on 'Prevention and Control of Micronutrient Malnutrition through Food-based Actions in SAARC Countries' on November 17-20.
- Will participate in the Annual Meeting of the Nutrition Society of India on November 27-28.