Cancer Scenario in India with Future Perspectives

Research Article

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Summary

Among various diseases, cancer has become a big threat to human beings globally. As per Indian population census data, the rate of mortality due to cancer in India was high and alarming with about 806000 existing cases by the end of the last century. Cancer is the second most common disease in India responsible for maximum mortality with about 0.3 million deaths per year. This is owing to the poor availability of prevention, diagnosis and treatment of the disease. All types of cancers have been reported in Indian population including the cancers of skin, lungs, breast, rectum, stomach, prostate, liver, cervix, esophagus, bladder, blood, mouth etc. The causes of such high incidence rates of these cancers may be both internal (genetic, mutations, hormonal, poor immune conditions) and external or environmental factors (food habits, industrialization, over growth of population, social etc.). In view of these facts, the present article describes the status of various types of cancers in India and its comparison at global level. Besides, attempts have been made to describe the main causes of cancer along with their preventive measures. In addition to this, efforts have also been made to predict the effect of increasing number of cancer patients on the Indian economy.

I. Introduction

In spite of good advancements for diagnosis and treatment, cancer is still a big threat to our society (Kotnis et al, 2005). This is the second most common disease after cardiovascular disorders for maximum deaths in the world (Jemal et al, 2007). It accounts for about 23 and 7% deaths in USA and India, respectively. The world’s population is expected to be 7.5 billion by 2020 and approximations predict that about 15.0 million new cancer cases will be diagnosed; with deaths of about 12.0 million cancer patients (Brayand et al, 2006). The prevalence of cancer in India is estimated to be around 2.5 million, with about 8, 00,000 new cases and 5, 50,000 deaths per annum (Nandakumar, 1990-96). According to 1991 Indian census data, about 609000 cancer cases have been observed. This number had drastically increased to 806,000 by the end of the last century; with 96.4 and 88.2% age standardized rates for males and females; out of 100,000 cases analyzed (Rao et al, 1998). During last one decade, about 70% cancer cases have been diagnosed and treated with survival of a few patients (Dinshaw et al, 1999). It is believed that in near future the number of cancer patients will increase in the developing and under developed countries, which may rise up to 70%; a serious issue for all of us. The magnitude of cancer problem in the Indian Sub-continent (sheer numbers) is increasing due to poor to moderate living standards (Wynder et al, 1974) and inadequate medical facilities. Most frequently observed cancers in Indian population are of lungs, breast, colon, rectum, stomach and liver (Nandakumar, 1990-96; Rao et al, 1998; Murthy et al, 2004). Nowadays, India is growing with a good progress rate and probably will become a developed country within a few decades resulting into its participation in the world development. Therefore, it is important to study the status of cancers in India so that advance measures may be taken to control this havoc in near future. In view of these facts, attempts have been made to study the status of cancers in India including its causes, preventive measures, effect on Indian economy and comparison with global scenario.

II. Cancer scenario in India

A data of cancer patients was compiled from 2004 to 2010 in India and shown in Figure 1.
Based on the increasing trends of cancer patients during the last few decades, the numbers of cancer patients have been predicted by the end of 2015 and 2020 in India. These compiled data show that the number of male, female and the total cancer patients in 2004 were 390809, 428545 and 819354 respectively. The number of male and female cancer patients increased continuously up to 2009, with 454842, 507990 and 962832 cases for male, female and total cancer patients, respectively. Similarly, 462408 male cancer patients and 517378 female cancer patients were recorded, with a total number of 979786 patients in 2010. Thus, it is clear from this Figure that the number of cancer cases has increased gradually with time. Moreover, a prediction of cancer patients in 2015 and 2020, respectively, has also been made. The different types of cancers observed in India are discussed in the following sub-sections briefly.

![Incident cases](image)

**Figure 1:** Year wise total cancer prevalence in India [ICMR, 2006; ICMR, 2009].

### A. Lung cancer

It was observed that lung cancer was rare in the beginning of the last century (Parkin et al, 2000) but later on it was diagnosed in various patients. Banker et al. (Banker et al, 1955) reported about 9210 consecutive autopsies of lung cancer patients in 1970, which were 14.4% of all cancer types. But, nowadays, it has become almost epidemic resulting in greater number of deaths than those caused by colorectal, breast and prostate cancers (Khuri et al, 2001). The data collected by the National Cancer Registry Program of the Indian Council of Medical Research; from six different parts of the country including both rural and urban areas; showed varying degrees of incidence in different areas (ICMR, 1988-89). The most common forms of malignancies in males during 1989 in Bombay, Delhi, and Bhopal were cancers of trachea, bronchi and lungs. These cancers were also reported in other cities in the order of Madras > Bangalore > Barshi. These sorts of cancers were rare in females except in Bombay and Bhopal, where they ranked at sixth and seventh positions of malignancies, respectively. Efforts have also been made to find out the total number of cancer cases in five metro cities of India (New Delhi, Bombay, Chennai, Bhopal and Bangalore) during 2008. These data have been plotted in **Figure 2**.

It is clear from this Figure that Delhi has the highest number of total cancer cases among the five metropolitan cities studied. Total numbers of cancer patients reported in Delhi was 13920 having 6815 and 7105 males and females, respectively. Mumbai showed the second highest number of cancer patients with 8505 total cases including 4170 and 4335 males and females, respectively. Bangalore occupied the third position with 2262 and 2998 male and female patients, respectively (total patients; 5250). Chennai stood at the fourth position having 2296 and 2528 as male and female cases; with a total number of 4824 cancer patients. Total cancer patients were low in Bhopal (1255) with 701 and 554 males and females, respectively. These trends of cancer patient distribution among discussed metropolitan cities may be due to different levels of environmental pollution, food habits, living style etc. Besides, the population density in these cities may also be a contributing factor towards increasing number of cancer patients.
B. Breast cancer
Breast cancer is the most common malignancy type diagnosed in women in developed countries and the second most common type diagnosed in developing countries. Breast cancer has been described as an alarmingly health problem in India (Yeole et al, 2003). According to the reports, breast cancers have badly attacked women population in India. A survey carried out by Indian Council of Medical Research (ICMR) in the metropolitan cities viz. Delhi, Mumbai, Bangalore and Chennai; from 1982 to 2005; has shown that the incidences of breast cancer have doubled. Over the years, the incidences of breast cancer in India have steadily increased and as many as 100,000 new patients are being detected every year (Yip et al, 2006; Michael et al, 2003). A 12% increase has been registered by cancer registries from 1985 to 2001, which represented 57% rise of cancer burden in India (Yip et al, 2006; Hadjiiski et al, 2006).

C. Stomach cancer
Stomach is one of the most essential organs of human body, which frequently gets cancer and stands at fifth position (Parkin et al, 1999). South East Asian countries including India were reported to have lower rates of stomach cancers (Rao et al, 1998; WHO, 2000-01). However, the prevalence of stomach cancer was found to be quite high in Mizoram, North East India. Reports from the National Cancer Registry Programme suggested that stomach remained the leading site of cancer in males in Chennai from 1990 to 1996 with Age Adjusted Rate [(AAR) =13.6/105], followed by Bangalore (9.5/105), Mumbai (6.4/105), Delhi (3.9/105), Bhopal (3.4/105) and Barshi (1.2/105). In Mizoram, AAR of stomach cancer has been found to be high in both males (39.1/105) and females (14.4/105) as compared to other parts of India. On the basis of the prevalence of stomach cancer Mizoram occupied the first position among Indian states. Moreover, this state comprised fifth position globally (Figure 3) (Phukan et al, 2004).

D. Gall bladder cancer
Gall Bladder Cancer (GBC) was first diagnosed during laparotomy or laparoscopy procedures, which were expected to confirm the presence of benign gall bladder diseases (Misra et al, 1997). Almost 2% gall stone patients were diagnosed with GBC. Gall bladder cancer is the most common abdominal malignancy in northern parts of the country (Singh et al, 2004). An incidence rate of 4.5 and 10.1% per 100 000 population of males and females, respectively, has been reported by the Indian Council of Medical Research Cancer Registry in some northern parts of India (ICMR, 1996). The highest incidence of GBCs in India has been reported along the Ganges delta (Kaushik et al, 1997). Gallstones associated with gallbladder carcinoma have been reported in 70-90% of patients with GBC. Approximately, 0.4% of all patients with gallstones have GBC (David et al, 1997).

E. Cervical cancer
The most susceptible site of cancer in women in the developing countries is cervix (Parkin et al, 1992). During last few decades, it has been observed that the number of cervical cancer cases in women has decreased in India.
One case study of Bangalore city supported this observation. In 1982, 32.4% cervical cancer cases per 100,000 populations were reported every year in Bangalore, which decreased to 27.2, 18.2, and 17.0% in 1991, 2001, and 2005 years, respectively. Similarly, in 1988, 25.9 new cases of cervical cancer per 100,000 women population were reported in Delhi, which decreased to 19.1 and 18.9 in 1998 and 2005, respectively. Accordingly, Mumbai recorded 17.9% new cervical cancer cases per 100,000 populations in 1982 followed by 12.7% in 2005. During these 24 years (1982-2005) Chennai recorded a fall of about 50% in cervical cancer cases. According to the reports 41% cases per 100,000 populations were reported in Chennai in 1982, which decreased to 33.4 and 22.0% in 1991 and 2005.

F. Oral cancer

In 2003, Indian Council of Medical Research (ICMR) reported that oral cancer is very common in India (ICMR, 1992). There has been a substantial increase in the incidences of oral sub-mucous fibrosis; especially among youngsters; which further increased the incidence of the oral cancer (Gupta et al, 1998). Presently, oral cancer is the fourth common type of malignancy after lung, stomach and liver in males. It is the fifth common cancer after cervix, breast, stomach and lung cancer in females (Park, 1997). Regional Cancer Centre (RCC) Kerala reported about 14% oral cancer patients out of which 17.0 and 10.5% cases were in males and females, respectively (Padmakumary, 2000). A significant number of oral cancer patients have been reported in Agra, Allahabad, Mainipuri, Varanasi and Moradabad belt of Uttar Pradesh (Wahi et al, 1965).

G. Miscellaneous cancers

Besides these, some other sorts of cancers have been observed in India. The incidence of esophageal cancer in India is moderately high; associated with diets and lifestyles. According to a data from cancer registries in India, esophageal cancer is the second most common cancer among males and the fourth most common cancer among females (Gajalakshmi, 2001). Colorectal cancer is a disease that usually affects individuals of age 50 years or more (Anthony, 1998). There is a sharp increase in the incidence rate of colorectal cancer after the age of 45 years and 90% of cases are found in persons over the age of 50 years (Lawrence et al, 2004). Head and Neck Neoplasia (HNN) are major forms of cancers in India, which account for nearly 23 and 6% in males and females, respectively (ICMR, 1992). The five year survival of the disease varied from 20-90% depending on the sub-site of origin and the clinical extent of the disease (Mehrotra et al, 2005). India is known to have the world’s largest reported incidences of HNN in women (Sankaranarayanan et al, 1998). Nearly 0.2 million head and neck cancer cases are diagnosed in the country annually and approximately 4.5 million globally.

III. Indian states and cancers

The state wise distribution of different cancer patients in India is shown in Figure 3. A perusal of this Figure clearly shows that lung cancer is the most common cancer in various states. The most effected states of India due to this cancer are Jammu & Kashmir, Himachal Pradesh, Delhi, Uttaranchand, Rajasthan, Maharashtra, Jharkhand, West Bengal, Andhra Pradesh, Kerala, Tripura and Manipur. It is also clear from this Figure that cervical cancer is the second most common form of malignancy in female population of Himachal Pradesh, Haryana, Rajasthan, Goa, Tamil Nadu, West Bengal while it stands at third position in females of Punjab, Andhra Pradesh and Uttar Pradesh. Breast cancer is the most common form of cancer in the women of Himachal Pradesh, Delhi, Rajasthan, Nagaland and Goa, and the second most common form of malignancy in females of Punjab, Maharashtra and Gujarat. In Tripura, breast cancer represents the third most common form of cancer in women folks. This Figure also dictates that stomach cancer is the third commonly reported cancer in Sikkim, Arunachal Pradesh, Tamil Nadu, Mizoram and Goa sates. It is the second most common cancer in Andhra Pradesh and Nagaland and the third most common type of malignancy in Jammu & Kashmir. Oral cancer stands at second and third positions in Goa and Assam states, respectively. Head and neck cancer patients have been observed in Tripura. Oesophageal cancer is a common type of malignancy after lung cancer in Jammu & Kashmir, Assam and Karnataka. Of course, Gall bladder cancer is not frequent in India but it has been diagnosed in certain parts of Punjab, Uttar Pradesh and Bihar. Tongue cancer is the most common type of cancer in Madihya Pradesh; especially in Bhopal while it stands at second position in Goa. Oropharyngeal cancer is prevalent in Haryana and Meghalaya. This Figure also shows that some other types of cancers viz. skin, laryngeal and non-Hodgkin’s lymphoma are rare in India but some cases have been diagnosed in Chhattisgarh and Uttaranchand. Cancers of ovary, prostate and brain have been reported only at some places in Rajasthan. The prostate and brain cancers were also found in males of Rajasthan.
Figure 3: Statewise depiction of the most incident cancers in India [Koul, 2010; ICMR, 2001; Somdatta, 2008; Das, 2005; Sharma, 2009; Gaur, 2006; Prasad, 2005; Malothu, 2010; Sumathi, 2009; (b) http://].

IV. Cancer causes in India
The cancer causes in India are almost same as in other parts of the world. The chemical, biological and other environmental identities are responsible for uncontrolled and unorganized proliferation of cells (carcinogens). Basically, under special circumstances carcinogens interact with DNA of the normal cells resulting into a series of complex multistep processes responsible for uncontrolled cell proliferation or tumors (Carmaeia, 1993). The causes for cancers can be both either internal factors like inherited mutations, hormones, and immune conditions or environmental factors such as tobacco, diet, radiation, and other infectious agents. A significant variation of cancer has been reported due to life styles and food habits (Helbock et al, 1998). For example, Asians have 25 and 10 times lower incidences of prostate and breast cancers, respectively, as compared to Western countries which may be attributed to comparatively simple life styles adopted by Asians, and safe sexual practices. It is interesting to mention here that the rates of these cancer incidences increase substantially when Asians migrate to the Western countries; indicating a clear relationship of carcinogenesis with food habits and living styles. The various cancer causes have been compiled by visiting various hospitals, cancer agencies and institutes and plotted in Figure 4. Some important causes of cancer in India are discussed in the following sub-sections briefly.
A. Dietary habits

Our survey dictates us that improper diet is one of the main causes of cancer prevalence in India. About 70% colorectal cancer cases are believed to be due to imbalanced diet. The role of diet towards cancer varies greatly according to the type of cancers (Anand et al., 2008; Willett, 2000). As per the International correlation studies, overwhelming positive associations between dietary fat, red meat consumption and colorectal cancer incidence and mortality have been observed. The heavy consumption of red meat is the main cause of several cancers including gastrointestinal tract and colorectal (Bingham et al., 2002; Chao et al., 2005; Hogg, 2007), prostate (Rodriguez et al., 2006), bladder (Garcia-Closas et al., 2007), breast (Tappel, 2007), gastric (Hanlon, 2006) and oral cancers (Toporcov et al., 2004).

Most probably, it is due to the production of heterocyclic amines (most potential carcinogens) during cooking of red meat. Pyrolysates are produced by charcoal cooking or smoke curing of meat, which exert a cancerous effect on our body cells (Lauber et al., 2007). Almost 20% of total mutagenicity of fried beef is due to the presence of PhIP (2-amino-1-methyl-6-phenyl-imidazo [4, 5-b] pyridine), which is the most abundant mutagen by mass in cooked beef. Food kept in plastic containers turns out to be carcinogenic because bio-phenol from the plastic containers gets dissolved and migrates into the food; resulting into the risk of breast (Durando et al., 2007) and prostate (Ho et al., 2006)cancers. A low intake of fresh fruits and high cooking temperatures in Indian dishes may account for low levels of vitamin C; resulting into
higher risks of stomach, mouth, pharyngeal, esophageal, 2003). Recently, the case control studies carried out in Asian Indian immigrants to U.K. and U.S.A. found high levels of homocysteine as a risk factor for the breast, ovarian and pancreatic cancers (Wu et al, 2002). Vegetarianism; practiced by a large population of Indians (particularly Hindus); has been associated with lower risks of prostate cancer (Rajaram et al, 2000). A comparison of non-vegetarian and vegetarian diets and alcohol and tobacco uses in India was carried out through case control studies. It was observed that vegetarians have a lower risk of esophageal (Roa, 1997), oral (Roa et al, 1994) and breast cancers (Jain et al, 1999). Beans, chickpeas and lentils are the principal components of vegetarian diet- a rich source of proteins; and pulses have been significantly associated with reductions in cancer (Jain et al, 1999; Mills et al, 1989). An increased risk of cancer has been observed with diets with high saturated fats. Middle class people in India and some of the rural areas have a high intake of ghee, which may create an increased cancer risk (Ghafoornissa, 1998; Law, 2000). The Indian diet containing adequate quantities of vegetables, fruits, and fibre rich grains provides protection against the increased risk of colon and breast cancers (World cancer research fund, 1997). Furthermore, Figure 4 depicts that improper life style and poor dietary habits, which are the key factors for the prevalence of breast and cervical cancers in the female population of Goa. High incidences of throat and food pipe cancers in Andhra Pradesh and Assam were attributed to improper diets (Lammers et al, 1998).

B. Tobacco

The consumption of tobacco is the leading cause of cancers in India. Figure 4 shows the regular use of tobacco via smoking, chewing, sniffing etc., in some areas of the country, which is responsible for 65 to 85% cancer incidences in men and women, respectively. The various cancers produced by the use of tobacco are of oral cavity, pharynx, esophagus, larynx, lungs and urinary bladder. It has been observed that women in Bangalore are known to have the highest rates of cancers of esophagus in the world (around eight per 100,000). Contrarily, men in Bhopal have the highest rate of tongue cancer in the world (nine per 100,000) (Bobba et al, 2003). Smoking is the most notorious factor for the causation of lung cancer (Hammond et al, 1958). Approximately, 87 and 85% males and females have been found to have lung cancer due to tobacco smoking in the form of bidi (a thin South Asian cigarette type structure filled with tobacco flake and wrapped in a tendu leaf, tied with a string at one end) (Behera et al, 2004) and cigarette in India (Notani et al, 1974). The severe carcinogenic nature of bidi has been proved by the studies of Jussawalla and Jain (Jussawalla et al, 1979) and (Pakhale et al, 1985). They observed that the unrefined form of tobacco used in bidis (WHO, 1999) and the frequency with which a bidi needs to be puffed per minute may be responsible for its relatively higher carcinogenic effects as compared to cigarettes (Bano et lung, pancreas, and cervical cancers (Chandafia et al, al, 2009). Bidi smoking at two puffs per minute produces about equal amounts of carcinogens (steam volatile phenols, hydrogen cyanide and benzopyrene) as produced by one puff per minute of unfiltered cigarette (Pakhale et al, 1990). Hookah (a special cigar used in India using raw tobacco) smoking causes lung cancer; as reported by Nafae et al. (Nafae et al, 1973). Recently, Gupta et al. (Gupta et al, 2001) reported 80 and 33% lung cancers in men and women chain smokers, respectively, as compared to controlled subjects where these numbers were 60 and 20%. Besides, Figure 4 shows that cigarette smoking and Hookah are the main causes of lung cancer in Indian states; especially in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Manipur, Tripura and some parts of Sikim. Similarly, bidi and hookah smoking are responsible of oropharyngeal cancers in male population of Haryana. Bidi and cigarette smoking are thought to be etiological factors for the causation of cancers in Andhra Pradesh. In some north-eastern states of India such as Arunanchal Pradesh, Nagaland and Sikim, high incidences of stomach cancer are attributed to the consumption of smoked meat and chewing of tobacco. High incidences of stomach cancer in Mizoram are the result of the excessive use of tuibir (water filtrate of tobacco). Similarly, high incidences of oral cancers in Orissa and Madhya Pradesh are owing to the consumption of beetle leaves and tobacco in different forms. The relatively high incidences of oesophageal cancers in certain parts of Karnataka are because of heavy consumption of tobacco in various forms.

Figure 4 also depicts that the exceptionally high incidences of oral cancer in some parts of Uttar Pradesh and Gujarat are due to the consumption of Pan Masala, Dohra and Zarda. Similarly, the consumption of Beetal, Nut, Pan Masala, Opium and Bhang (leave and flower powder of female cannabis plant) has been recognized as the major cause of mouth cancer in Rajasthan. Oral cancer being the common malignancy in Allahabad is attributed to the chewing of Dohra; an indigenous preparation of tobacco and slaked lime. The daily consumption of the number of beetle leaves by an individual is about 15-25 in Allahabad and Varanasi districts, which continuously acts as an irritant to the buccal mucosa (Mehrotra et al, 2003). One of the most important factors responsible for the oropharyngeal malignancy in Agra and Mainpuri belt of Uttar Pradesh is the chewing of beetle nut (Wahi et al, 1965). Among various risk factors for the occurrence of esophageal cancer in India, betel quid chewing carries a relative risk of 1.5 to 3.5%. The salted tea made by adding sodium bicarbonate has shown to possess a high methylation activity and may lead to the endogenous formation of nitrosamine (Malkan et al, 1997).

C. Alcohol

Alcohol consumption has been considered as one of the major causes of colorectal cancer as per a recent monograph of WHO (Baan et al, 2007).
Various types of cancers are believed to be due to ill environmental contaminants. It is estimated that about 90% cancer is owing to the polluted environment. Moreover, reported in ground water of the nuclear weapon testing area. Additionally, liver and kidney cancers, as radiations have been shown to increase the risk of leukemias and lymphomas.

Non-squamous cell carcinoma and melanoma are the exposure of ultraviolet light, which is a non-ionizing radiation. The major risk factor for various types of skin cancers viz. basal cell carcinoma, squamous cell carcinoma and melanoma is the exposure to ultraviolet light, which is a non-ionizing radiation. The underground testing of nuclear weapon testing area as well as liver, pancreas, mouth and breast cancers. A 10.0 g/day intake of alcohol by a woman increases its relative risk of breast cancer by 7.1% (Doll et al, 1981). The mechanism of carcinogenesis due to alcohol consumption is not exactly known, however, it is thought that ethanol being a co-carcinogen might play a crucial role in the carcinogenesis. The metabolic products of ethanol are acetaldehyde and free radicals. The free radicals are responsible for alcohol assisted carcinogenesis through their binding to DNA and proteins, which destroy foliate leading to secondary hyper proliferation.

D. Radiation
In the developed and developing countries, the radiations are also notorious carcinogens. About 10% cancer occurrence is due to radiation effect, both ionizing and non-ionizing (Belpomme et al. 2007). The major sources of radiations are radioactive compounds, ultraviolet (UV) and pulsed electromagnetic fields. The main series of cancers induced by exposure to the adequate doses of the carcinogenic radiations include thyroid, skin, leukemia, lymphoma, lung and breast carcinomas. The most common source of ionizing radiation exposure is Radon, which is a radioactive element. Radioactive nuclei of radon, radium and uranium are found to be associated with an increased risk of gastric cancer in rats. High risk of breast cancer among girls at puberty is due to breast irradiation of X-rays used for diagnostic and therapeutic purposes. The major risk factor for various types of skin cancers viz. basal cell carcinoma, squamous cell carcinoma and melanoma is the exposure to ultraviolet light, which is a non-ionizing radiation (Anand et al, 2000). The underground testing of nuclear weapons may be the major cause of digestive system, liver and kidney cancers, as radiations have been reported in ground water of the nuclear weapon testing area. Moreover, Figure 4 clearly shows that nuclear pollution is the main cause of lung cancer in Jharkhand.

E. Miscellaneous pollutants
It is estimated that about 90% cancer is owing to the environmental contaminants (Anand et al, 2000). Various types of cancers are believed to be due to ill effects of the polluted environment. The risk of lung cancers is increased by a number of outdoor pollutants such as poly aromatic hydrocarbons. Long term exposure to PAHs (polyaromatic hydrocarbons) in air was found to increase the risk of deaths associated with lung cancer. Indoor environmental pollutants such as volatile organic compounds and pesticides increase the risk of leukemias and lymphomas, brain tumors, Wilm’s tumors, Ewing’s sarcoma and germ cell tumors. An increased risk of cancer has been observed in people using chlorinated water for drinking purposes for a long time. N-Nitroso compounds (mutagenic in nature) are formed from nitrates present in drinking water and increase the risk of lymphomas, leukemias, and colorectal cancer and bladder cancers (Belpomme et al, 2007).

Figure 4, also shows that high level of air pollution is responsible for the prevalence of lung cancers in Delhi and some other parts of West Bengal including Calcutta. The low socio-economic conditions related to poor hygiene, poor diet or infections of viral origin are also responsible for various types of cancers (Mehrotra et al, 2003).

V. Preventive measures of cancer in India
As per the proverb, “prevention is better than cure” the prevention strategies are crucial in cancer eradication. This approach offers a great public health concern and inexpensive long term method of cancer control. National Cancer Control Programme (started in 1975-1976 in India) led to the development of Regional Cancer Centers (RCCs), a number of oncology wings in Medical Colleges; supported the purchase of teletherapy machines. District Cancer Control Programme was also initiated but could not result into sustainable and productive activity (National Cancer Control Programme). The education should focus on harmful effects of tobacco and discourage its use. Besides, we should create awareness among public about physical activities, avoiding obesity, healthy dietary practices, reducing occupational and environmental exposures, reducing alcohol uses, immunization against hepatitis B virus and safe sexual practices for avoiding cancer genesis (Dinshaw et al). The same approach should be included in adult education programme. Several state wise programmes like Kerala (Ten year action plan), Tamil Nadu (Kancheepuram Cancer Screening Programme) and opportunistic programmes in social regions have been implemented by some State Governments and Regional Cancer Centers (RCCs) for an early detection of different cancers in India. The predicted results were not materialized in most of the programmes except RCC programme in Trivandrum as the health service system could not support such activities due to deficiencies in health system management and non-availability of human resources (Cytologists/Pathologists) and absence of integration with multi-sectoral groups. Unfortunately, a little population got aware of cancer havoc, which might be spread to the population of the whole country (National Cancer Control Programme).
As discussed above tobacco is the most notorious agent for cancers, which must be banned to eradicate the prevalence of tobacco related cancers. India should give the highest priority to tobacco control programme due to its acute carcinogenic nature (WHO, 2002). It has been predicted that a ban on tobacco use can prevent up to 30% cancers in India (Central Statistical Organization, 2003-04). Alcohol consumption is responsible for the occurrence of colorectal cancer. About 25% population is consuming alcohol in India, which must be minimized or avoided to eradicate this havoc. Government needs to impose a ban on the public sale of alcohol. Seminars and public health camps should be conducted to create awareness of alcoholic harmful effects among Indians. Radiations are silent and serious carcinogens that cause a number of cancers and, hence, the strategies that reduce the exposure of people to these notorious radiations should be fully practiced to reduce the incidence of cancers. India being one of the nuclear power nations needs to build safe equipped nuclear plants with greater protection from the hazardous nuclear radiations. Nuclear reactors should be well constructed with good quality shields to provide more protection to the people at work. Nuclear tests should be carried out at safe places away from human populations to avoid exposure to these radiations.

Environmental pollution is a serious issue and has become a challenge for all of us as it is responsible for the genesis of various types of cancers. Air pollution is the most notable cause of lung cancer in the metropolitan cities of India. The harmful gases such as carbon monoxide (CO) and sulphur dioxide (SO\textsubscript{2}) produced by combustion of fuels in automobiles and several industrial processes, respectively, cause lung cancer, respiratory, digestive, ocular and skin carcinomas. Automobiles that run on compressed natural gas (CNG) should be encouraged; at least in the metropolitan cities of the country to avoid air pollution. The use of chlorofluorocarbons (CFCs), methyl halides, carbon tetrachloride and carbon tetra fluoride is the main cause of the depletion of ozone layer, which protects us from the harmful UV-rays. The use of such chemicals should be minimized in order to reduce the incidence of skin cancer caused by the harmful effects of UV-rays. The sewage discharged by several industries and municipalities is polluting Indian water resources due to insufficient water treatment plants; leading to various types of cancers. Therefore, these wastes should be treated prior to their discharge to land or river.

Due to over growth of Indian population, farmers are compelled to produce more cereals and vegetables to meet out public requirements. This pressure forces farmers to use excessive fertilizers and pesticides, which are being transported into our body via food and water causing various sorts of cancers. Farmers should be encouraged to use eco-friendly organic manures and biocides to reduce cancer incidences. India is a developing country and gradually adopting modern life styles involving the use of various kinds of chemicals in terms of medicines, cosmetics, cloths, utensils, mobile phones and other luxurious items. The use of such items may cause different sorts of cancers. That is why during past few decades the incidences of cancers have increased. It is urgent to emphasize that Indians should be aware about their life styles particularly the use of synthetic products, fabric dressing, and mode of sex, abuse of drugs and excessive use of mobile phones. Besides, an increased fashion of fast food in this country is also responsible for this havoc. Indians should adopt a healthy food habit having sufficient quantities of vitamins, minerals, proteins, fibers, carbohydrates etc. The healthy and proper foods are important aspects to control different cancers. The consumption of whole grains, vegetables and fruits antagonize the development of some cancers. The effects of various foods on the prevention and eradication of different cancers are given in Table 1. Briefly, there are no uniform standardized information programs, education and communication (IEC) strategies for cancer prevention in this nation. Besides, limited diagnostic and treatment infrastructures in the country are the serious issues, which must be increased on urgent basis. The government and other NGOs should come forward to initiate the above programs for controlling this havoc so that the present and coming generation of the country may lead healthy life.

VI. Effect of cancer on Indian economy

As per nominal Gross Domestic Product (GDP), the economy of India stands on eleventh position in the world, while it is fourth largest by Purchasing Power Parity (PPP) (CIA-The World Factbook, 2009). Indians are at high risk of acquiring cancers due to high rates of smoking, tobacco use, occupational risks, and unhygienic residential living conditions. The prevalence of cancer in India is affecting the economy of the country. The data on the effect of cancer on Indian economy is not available; however, Popkin et al. (2001) assessed the impact of cancer of diet related health conditions in terms of health spending and on income losses experienced by households (Popkin et al, 2001). The estimation of expenditures of cancer patients includes both direct medical and non-medical costs. The direct costs include buying medicine, hospitalization, pathological tests, medical practitioner consultancy, travel, lodging while the indirect costs are loss of income during treatment, premature death and affect on the income of other family members etc. In 2007, Abegunde et al. calculated the effect of cancer deaths on Indian economy. Furthermore, they assessed the economic impact of mortality from chronic diseases on Gross domestic product (GDP) (Abegunde et al, 2007). Briefly, Indian economy has been affected by the alarming rise of cancers in the last decade. It is still being affected due to continuous increase of cancer patients. An estimation of the effect of cancer on the Indian economy has been carried out and the data is given in Table 2. The economical loss was calculated by considering all the factors viz., both direct medical and non-medical costs. It is clear from Table 2 that there is a steady rise in the number of cancer cases in India. This
Table also shows that the total number of cancer patients in 2004 was 819354 with a total loss of 215.16 million US $. The number of cancer patients and economic loss are continuously increasing, which have become 962832 and 274.10 million US $ by the end of 2009, respectively. Similarly, the total cancer patients in 2010 were 979786 with total economic loss of 270.06 million US$. Clearly a direct relationship between the numbers of cancer patients and the economic loss may be seen from this Table. It is interesting to mention if these cancer incidences would have been avoided; by adopting the preventive measures cited above; India would not have suffered from such a big economic loss. This amount of money would have been used somewhere else for the development of the country.

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Types of Cancers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preventions</td>
</tr>
<tr>
<td></td>
<td>Cures</td>
</tr>
<tr>
<td>Vegetables, fruits, fibers,</td>
<td>Epithelial, colorectal, bladder,</td>
</tr>
<tr>
<td>Folic acid, vitamins (C, D and E),</td>
<td>prostate, lungs, breast, esophagus,</td>
</tr>
<tr>
<td>Spices, condiments and cereals</td>
<td>non-Hodgkin’s lymphoma</td>
</tr>
<tr>
<td></td>
<td>Bladder (cruciferous)</td>
</tr>
<tr>
<td></td>
<td>Breast (brassica)</td>
</tr>
<tr>
<td></td>
<td>Colorectal (cruciferous)</td>
</tr>
<tr>
<td>Safety measures in industries</td>
<td>Lungs, leukemia, bladder, liver,</td>
</tr>
<tr>
<td></td>
<td>gall bladder and kidneys</td>
</tr>
<tr>
<td></td>
<td>Leukemia, lung, squamous cell carcinoma, gall bladder</td>
</tr>
<tr>
<td></td>
<td>and bilary tract</td>
</tr>
<tr>
<td>Non-Smoking</td>
<td>Lungs, bladder</td>
</tr>
<tr>
<td>Control on Drug Abuse</td>
<td>Lung, head and neck</td>
</tr>
<tr>
<td>Physical Exercises</td>
<td>Cervical and breast</td>
</tr>
<tr>
<td></td>
<td>Breast and cervical</td>
</tr>
<tr>
<td>Pollution control</td>
<td>Reduce overweight, Breast</td>
</tr>
<tr>
<td></td>
<td>Bladder, colon, breast,</td>
</tr>
<tr>
<td></td>
<td>(Postmenopausal), colon,</td>
</tr>
<tr>
<td></td>
<td>Endometrial, prostate, melanoma,</td>
</tr>
<tr>
<td></td>
<td>Kidneys, gastric, cardiac, liver,</td>
</tr>
<tr>
<td></td>
<td>Gabbler, ovary, pancreatic,</td>
</tr>
<tr>
<td></td>
<td>Colorectal and breast</td>
</tr>
<tr>
<td></td>
<td>Bladder, colon, breast,</td>
</tr>
<tr>
<td></td>
<td>prostate, melanoma</td>
</tr>
<tr>
<td>Water Pollution</td>
<td>Almost, all types of cancers</td>
</tr>
<tr>
<td></td>
<td>Bladder liver and colorectal</td>
</tr>
<tr>
<td>Air Pollution</td>
<td>Lungs</td>
</tr>
<tr>
<td></td>
<td>Lungs (Radon)</td>
</tr>
<tr>
<td>Ban on ozone-depleting Chemicals</td>
<td>Skin</td>
</tr>
<tr>
<td></td>
<td>Squamous cell carcinoma of lips</td>
</tr>
<tr>
<td>Adaptation of traditional values</td>
<td>Almost all types</td>
</tr>
<tr>
<td>Awareness</td>
<td>Cervical, Skin and brain</td>
</tr>
<tr>
<td></td>
<td>Almost all types</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years</th>
<th>No. of Cancer Patients</th>
<th>Total Cost in US $ (Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>819354</td>
<td>215.16</td>
</tr>
<tr>
<td>2005</td>
<td>846635</td>
<td>224.11</td>
</tr>
<tr>
<td>2006</td>
<td>863575</td>
<td>233.11</td>
</tr>
<tr>
<td>2007</td>
<td>907838</td>
<td>245.30</td>
</tr>
<tr>
<td>2008</td>
<td>846172</td>
<td>232.89</td>
</tr>
<tr>
<td>2009</td>
<td>962832</td>
<td>274.10</td>
</tr>
<tr>
<td>2010</td>
<td>979786</td>
<td>270.06</td>
</tr>
</tbody>
</table>

Data have been calculated from the available data of year 2004, by applying inflation rate for succeeding years.
VII. Comparison of cancers in India with global scenario

It is interesting to observe from the above discussion that cancer prevalence patterns have been observed to vary among different population groups within the same country (WHO, 1993). Nearly ten million new cancer cases are diagnosed annually in the world and out of these about half cases are from developing world only. It is predicted that by the end 2020, over 10 million people would die globally each year because of cancer with 70% deaths from the developing countries only (Murray et al, 1996). But it is very interesting to note that World Health Organization has reported that the current cancer incidence rates in India are considerably lower than those in developed countries including USA (Fenley et al, 2001). Lung cancer is the single most devastating cause of cancer related deaths (Khuri et al, 2001). A great variation is observed in the prevalence of lung cancer in different geographical areas. The worldwide incidences of lung cancer are 14% whereas it constitutes 6.8% of all cancers in India (Nandakumar, 2001). Some countries like USA, Canada, New Zealand (Maori population) and Europe have high incidences of cancer (>50 per 10^5 population) followed by China, Ireland, Malta, Spain, Australia and New Zealand (non-Maori population) while moderate incidences (35-50 per 10^5 population) and low incidences (<35 per 10^5 population) countries include Latin America, most Asian countries with India, Iceland, Norway and Sweden (Zeleniuch et al, 2005). Lung cancer is the most frequent tumor in males, and second or third most common in females. In US alone, there were about 1, 64,100 new cases in 2000, of which 70,000 were in the metastatic stage (stage IV) and another 70,000 were locally advanced stages (IIIA and IIIB) (Khuri et al. 2001). A high incidence of stomach cancer has been reported in countries like China, Japan, Republic of Korea, Belarus and Costa-Rica whereas the highest age adjusted rate (AAR) of 145.0/10^5 was reported among males of Changle, China and among females of Japan with age adjusted rate (AAR) of 38.9/10^5 (Parkin et al, 1999; Parkin et al, 2002). South East Asian countries including India were reported to have lower incidence rates of stomach cancer (Parkin et al, 1999; WHO, 2000-01). However, in Mizoram a North-Eastern part of India, medical practitioners observed a very high prevalence of stomach cancer (Hadjiiski et al, 2006).

A comparison of cancer cases in India with USA has been carried out for the year 2002 as shown in Figure 5. The Figure clearly shows that the incidences of oral cancer in Indian males and females were 12.8 and 7.5 persons per 100000 populations, which were quiet higher than the incidences of the same type of cancer in males and females in USA (6.3 and 3.7 persons per 100000 populations), respectively. Similarly, high incidences of oesophageal cancer in Indian populations were observed as compared to USA. It was also observed that incidence rates of 7.6 and 5.1 of oesophageal cancer (in a population of 100000 persons) of males and females were observed in India as compared to USA (4.9 and 1.4) for males and females, respectively. High incidences of these two types of cancers can be attributed to the extensive use of tobacco by Indians in the form of Pan, Masala, Gutka, Zarda etc. A slightly high incidence rate of stomach cancers was reported in USA (7.3 and 3.6 in males and females per 100000 populations) as compared to India (5.7 and 2.8 in males and female per 100000 populations), respectively. High rates of lung and colon cancers were reported in USA in comparison to India. This Figure also clearly shows that the incidences of lung cancer in USA being 58.6 and 34.0; in males and females per 100000 populations, which is much greater than India (9.0 and 2.0 for males and females per 100000 populations). Similarly, incidence rate of colon cancer (40.6 and 30.7 for males and females per 100000 populations) in USA was greater than in India i.e. 4.7 and 3.2 for males and females per 100000 populations, respectively. This Figure also depicts high incidence rates of liver, bladder, kidney and skin cancers in USA as compared to India. The incidence rates of liver, bladder, kidney cancers and melanoma of the skin in males and females in India were 2.3 and 2.0, 3.2 and 0.7, 1.2 and 0.5, 0.3 and 0.2 respectively, which were lower than the incidence rates of the same cancers in USA i.e. 4.2 and 1.7, 23.4 and 5.4, 11.2 and 6.0, 4.2 and 1.7 per 100000 populations in males and females, respectively. In United States the age specific incidence of colorectal cancer appears to rise gradually from second to ninth decade of an individual’s life. The incidence of rectal cancer in men is proportionately higher as compared to women (Parkin et al, 1999). In US, genetic and familial etiologies accounted for less than 20% of colorectal cancers while the remaining 80% of cases are random with dietary factors significantly affecting the risk (Alabaster, 1972). Contrarily, the numbers of colorectal cancer patients in India by the end of the last century were 18,427 and 13,092 in men and women, respectively (Mohandas et al, 1999).

VIII. Conclusion

A careful reading of the above discussion in this article clearly indicates an increased number of cancer patients every year in India. Various factors responsible for cancer genesis have been discussed, which need to be controlled for their eradication. India is a growing country playing a crucial role in the development of the whole world, and, hence, needs special attention on this issue. We should create awareness among public about the cancer havoc and its prevention. The different programs should be started by Government and NGOs for creating awareness among Indian public. The diet and living style are important factors to control the spreading of cancers and, hence, Indians should be careful about these facts. Briefly, cancer is disturbing the growing economy of the country, which can be saved by proper handling of this disease. In view of these facts, it is very important to eradicate this havoc. Let us hope for the best future of this country, which is playing an essential role in the development of the whole world.
Cancer Scenario in India with Future Perspectives

Figure 5: Comparison of cancer; Indian scenario with USA [Fenley et al, 2001].

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