RESEARCH COMMUNICATION

Geographic Variation in Cancer Incidence and its Patterns in Urban Maharashtra, 2001

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Abstract

In this paper an attempt has been made to study the geographic variations in cancer incidence and its pattern in Urban Maharashtra. Data collected by Mumbai, Poona, Nagpur, and Aurangabad, Population based Cancer Registries, for the year 2001 have been utilized. The incidence patterns by sex, age, and religion has been compared between these four agglomerations. Besides this childhood cancers and tobacco related cancers for each registry are also described. Age specific cancer incidence rates show increasing trend with increasing age in all the four populations. The curves for Mumbai, Poona, Nagpur are closed together with fluctuations, indicating similarities in the rise. In all the four registries, amongst males, cancers of the lung, larynx, oesophagus, tongue and prostate while in females breast, cervix, ovary, oesophagus, mouth and leukemias occupy places in ten leading sites. The praportion of childhood cancers varies from 1.9% in females in Poona to 4.5% in males in the Nagpur populations. The proportion of tobacco related cancers varies in males from 38.9% in Poona to 54.4% in Aurangabad, where as in females from 14.1% in Nagpur to 21.7% in Aurangabad. Considerable variations was observed in the incidence of cancer of various sites in both the sexes, professing different religious faiths within this populations. The findings of this paper can be used to estimate the incidence and prevalence of cancer for future for whole Maharashtra state and studies in cancer etiology and control can be planned.

Key Words: Geographic variation, Cancer incidence, Site, Patterns, Tobacco, Religion, Childhood

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Introduction

The first population based cancer registry in India was established in Mumbai (Bombay) by the Indian Cancer Society in 1963 (Jussawalla et al 1966). In order to identify the etiological factors that might be implicated in a selected population, it is essential to determine the behavioral patterns, habits, customs, and environmental background of the group under study. It is also necessary to identify the differences, if any, in the sites, patterns and incidence rates of the disease amongst various communities living in geographical areas having varying patterns of climate and physical environments by identifying dietary habits, social customs and such other factors. With this aim in mind the Indian Cancer Society established satellite Cancer Registries in different zones of Maharashtra so that the cancer problem throughout the state could be studied in depth. Thus the first satellite Registry was established for Poona City Agglomeration in 1972, the second for Aurangabad City Agglomeration in 1978 and the third for Nagpur City Agglomeration in 1980. From January 2005 the Indian Cancer Society established another three population based Cancer Registries at the district level for Satara, Sangli and Kolhapur districts (Kurkure et al 2006). In addition, in Maharashtra one rural population based cancer Registry at Barshi in Solapur district has been functioning under NCRP since 1987. As far as cancer registration is concerned the highest percentage of population is covered in Maharashtra amongst all the states of India.

Studies of the geographical distribution of cancer have long been recognized as providing clues leading to causative factors. In this paper the extent of variation in cancer incidence seen between four urban agglomerations in Maharashtra, i.e. Mumbai, Poona, Nagpur and Aurangabad for the year 2001 was studied along with the leading sites, age and the religion-dependent incidence for each Registry. Besides this, childhood cancers and tobacco related cancers are also described.

Materials and Methods

Data collected by Mumbai, Poona, Nagpur and Aurangabad Population based cancer registries for the year 2001 has been used for studying incidence patterns. The

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Table 1. Demographic Characteristics of the Four Urban Agglomerations as per the 2001 Census

Characteristics	Mumbai	Poona	Nagpur	Aurangabad
Population (x106)	11.98	3.55	2.05	0.87
Area	437.7	344.8	236.9	50.48
Sex Ratio	811	899	917	902
Density per Sq.km	27220	10330	8660	17300
Growth rate 1991-2001	20.2	54.3	26.0	52.7
Religion				
Hindu	67.4	79.7	71.4	53.2
Muslims	18.6	8.8	10.3	29.8
Christians	3.7	2.6	1.1	1.0
Neo Buddhist	5.2	5.8	15.4	13.8
Others	5.3	3.1	1.8	2.2

Table 2. Crude (CR) , Age Adjusted (AAR) and Truncated (TR) Incidence Rates per 100,000 population by Sex for 2001 by Registry

Registry	Male				Female			
	Cases	CR	AAR	TR	Cases	CR	AAR	TR
Mumbai	4520	68.1	116	156	4522	84.0	127	232
Poona	1210	67.2	87	130	1464	81.1	106	206
Nagpur	884	80.2	101.6	185.3	910	88.6	103	230
Aurangabad	177	37.7	65.2	107.5	180	42.0	59	126

incidence patterns by sex, age, basis of diagnosis and religion are compared between these four agglomerations. Besides this childhood cancers and tobacco related cancers are also described for each registry. We utilized the coding system devised by the World Health Organization (WHO)using code numbers C00.1 – C98.9 as published in the Manual of the International Classification of Diseases, Injuries and Cause of Death – 10th Revision (WHO 1992). For histology coding, the World Health Organization's International Classification of Diseases for Oncology – ICDO3 (WHO 2000) giving histogenic and malignancy codes was followed, in conjunction with primary site codes suggested by WHO.

Results

Major demographic characteristics for the four agglomerations are given in Table 1. Greater Mumbai is the industrial heart of India and has a multi-religious, multi-lingual population representing every state in the union. Poona city has been renowned for the education facilities since the early part of the last century. Nagpur city is a city of historical importance. There is mythological reference that the God Rama traversed this region in route to the Hermitage of Saint Shrutikrishna. Aurangabad is an important industrial town as well as a popular conference center.

Numbers of cancer incidence cases, crude, age-adjusted and truncated incidence rates per hundred thousand populations by sex 2001, for all four registries are given Table 2. The crude rate varies in males, from 37.7 per 100,000 in Aurangabad to 80.2 per 100,000 in Nagpur, and in females it varies from 42.0 in Aurangabad to 88.6 in Nagpur. The age adjusted incidence rate also shows variations. As expected Mumbai, the capital of Maharashtra has the highest age-adjusted incidence rate both the sexes. In all the registries Crude, Age-Adjusted, and Truncated Incidence Rates are higher in females than in males.

Figure 1 illustrates the age specific rates for all sites of cancer in the four registries by sex. This figure indicates that increasing rates of cancer with increasing age in both the sexes. The curves for Mumbai, Poona and Nagpur are close together without fluctuations, indicating similarities in the rise.

Leading sites of cancers for all registries for males are given in Table 3 and for females in Table 4. Among males cancer of the lung occupies first rank in Mumbai, second in Nagpur and fourth in Poona and Aurangabad. Cancer of the mouth occupies second rank in Poona, third in Mumbai and Aurangabad and sixth in Nagpur. Cancer of the larynx occupies first rank in Poona and Nagpur and second in the Mumbai. Cancer of the oesophagus ranks first in Aurangabad, second in Nagpur and fourth in Mumbai registry. Cancer of the tongue, prostate and lymphomas also occupy places in the ten leading sites of cancers among all four registries.

Among females breast occupies first place followed by

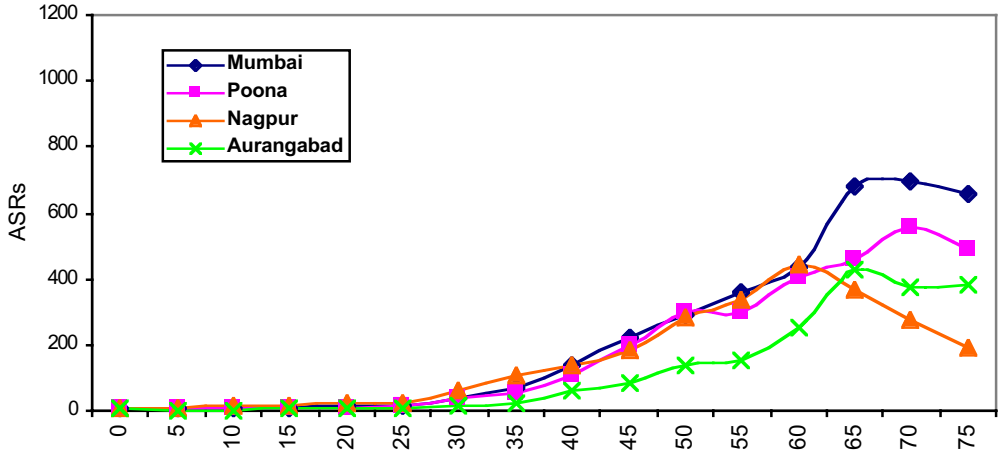

Figure 1. Annual Age-specific Cancer Morbidity Rates for All Sites

Table 3. Leading Sites of Cancer with Age Adjusted Incidence Rates for all Registries, Males

Mumbai			Poona			Nagpur			Aurangabad		
Site	Cases	AAR	Site	Cases	AAR	Site	Cases	AAR	Site	Cases	AAR
Lung	373	10.7	Larynx	90	7.5	Larynx	70	9.1	Oesophagus	21	9.0
Larynx	295	8.5	Mouth	99	6.8	Oesophagus	57	6.8	Hypopharynx	18	7.3
Mouth	255	7.7	Prostate	70	6.0	Lung	55	6.8	Mouth	18	6.0
Oesophagus	252	7.2	Lung	71	5.8	Tongue	56	6.6	Lung	15	5.7
Lymphoma	250	5.4	Oesophagus	66	5.1	Lymphoma	54	6.0	Liver	9	3.9
Prostate	247	8.3	Liver	55	3.8	Mouth	50	5.9	Tongue	10	3.5
Tongue	218	5.2	Stomach	50	3.6	Leukemia	64	5.7	Larynx	7	3.0
Liver	176	5.2	Brain	55	3.1	Stomach	32	3.8	Oropharynx	8	2.9
Bladder	176	5.0	Lymphomas	72	3.0	Brain	31	3.2	Lymphomas	9	2.6
Stomach	175	4.8	Leukemia	49	2.9	Rectum	28	3.2	Prostate	6	2.4
All Sites	4520	115.9	All Sites	1210	87.2	All Sites	884	101.6	All Sites	177	65.2

Table 4. Leading Sites of Cancer with Age Adjusted Incidence Rates for all Registries, Females

Mumbai			Poona			Nagpur			Aurangabad		
Site	Cases	AAR	Site	Cases	AAR	Site	Cases	AAR	Site	Cases	AAR
Breast	1212	33.1	Breast	352	25.0	Breast	260	29.0	Breast	48	15.6
Cervix	632	17.2	Cervix	268	19.4	Cervix	163	19.1	Cervix	34	11.6
Ovary	359	9.6	Ovary	117	8.4	Ovary	61	6.7	Mouth	12	4.3
Oesophagus	190	6.0	Mouth	67	5.0	Oesophagus	37	4.4	Oesophagus	11	4.1
Mouth	156	4.8	Lymphomas	62	4.4	Leukemia	32	3.3	Lung	8	2.8
Lymphoma	133	4.3	Oesophagus	46	3.7	Mouth	27	3.2	Leukemia	7	2.8
Brain	120	4.3	Lung	41	3.1	Brain	24	2.4	Plura	6	2.1
Leukemia	153	3.7	Colo	35	2.7	Lymphoma	24	2.4	Con.Tissue	7	2.0
Lung	121	3.7	Stomach	33	2.6	Colon	20	2.4	Ovary	6	1.7
Corp.uteri	120	3.7	Leukemia	35	2.3	Lung	20	2.2	Cor.uteri	5	1.5
All Sites	4522	127.2	All Sites	1464	106.2	All Sites	910	103.0	All Sites	180	59.0

Table 5. Number (#) and Proportion (%) of Cancers in Childhood Relative to All Cancers

Registry	Males			Females		
	All	#	%	All	#	%
Mumbai	4520	173	3.8	4522	120	2.7
Poona	1210	44	3.6	1464	28	1.9
Nagpur	884	40	4.5	910	27	3.0
Aurangabad	177	6	3.4	180	8	4.4

cervix uteri, and ovary in all four registries. Cancer of the oesophagus, lung, mouth, leukemias and lymphomas also occupy places in the ten leading sites of cancer in all four registries.

Cancers in childhood constitutes one of the most important groups of tumours not only because of age occurrence, implying a different set of etiological factors from those commonly seen in adult cancers, but also because in the past two decades with advances particularly in chemotherapy, meaning of the childhood cancer have gained markably high potency for cure. The proportion of childhood cancers relative to all sites of cancers varies from 1.9% in females in the Poona populations to 4.5% in males in the Nagpur populations (Table 5). Leukemia and Lymphomas followed closely by tumours of the central nervous system constitute the vast majority of childhood cancers.

Sites of cancer that have been associated with the use of tobacco includes lip, tongue, oral cavity, pharynx, larynx, lung and urinary bladder. The total proportions of this sites of cancers to all sites in males and females are illustrated in figure 2. In males this proportions vary from 38.9% in Poona to 54.4% in Aurangabad, where as in females they vary from 14.1% in Nagpur to 21.7% in Aurangabad. Lung, oesophagus, and oral cavity are the sites, which have major

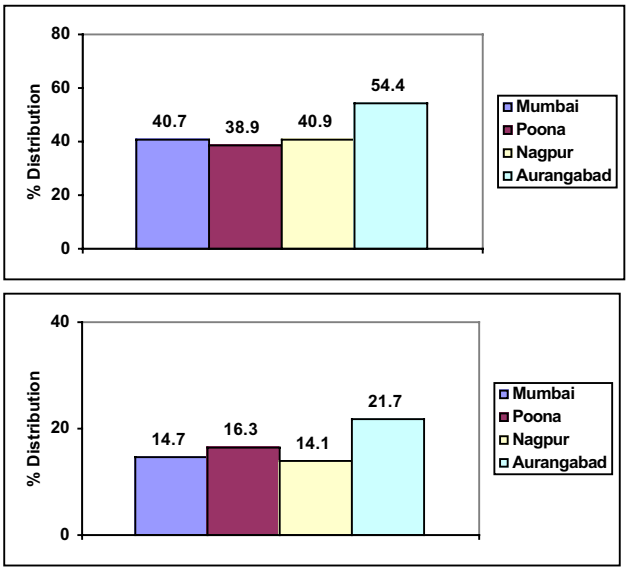

Figure 2. Proportion of Tobacco-related Cancers Relative to All Sites

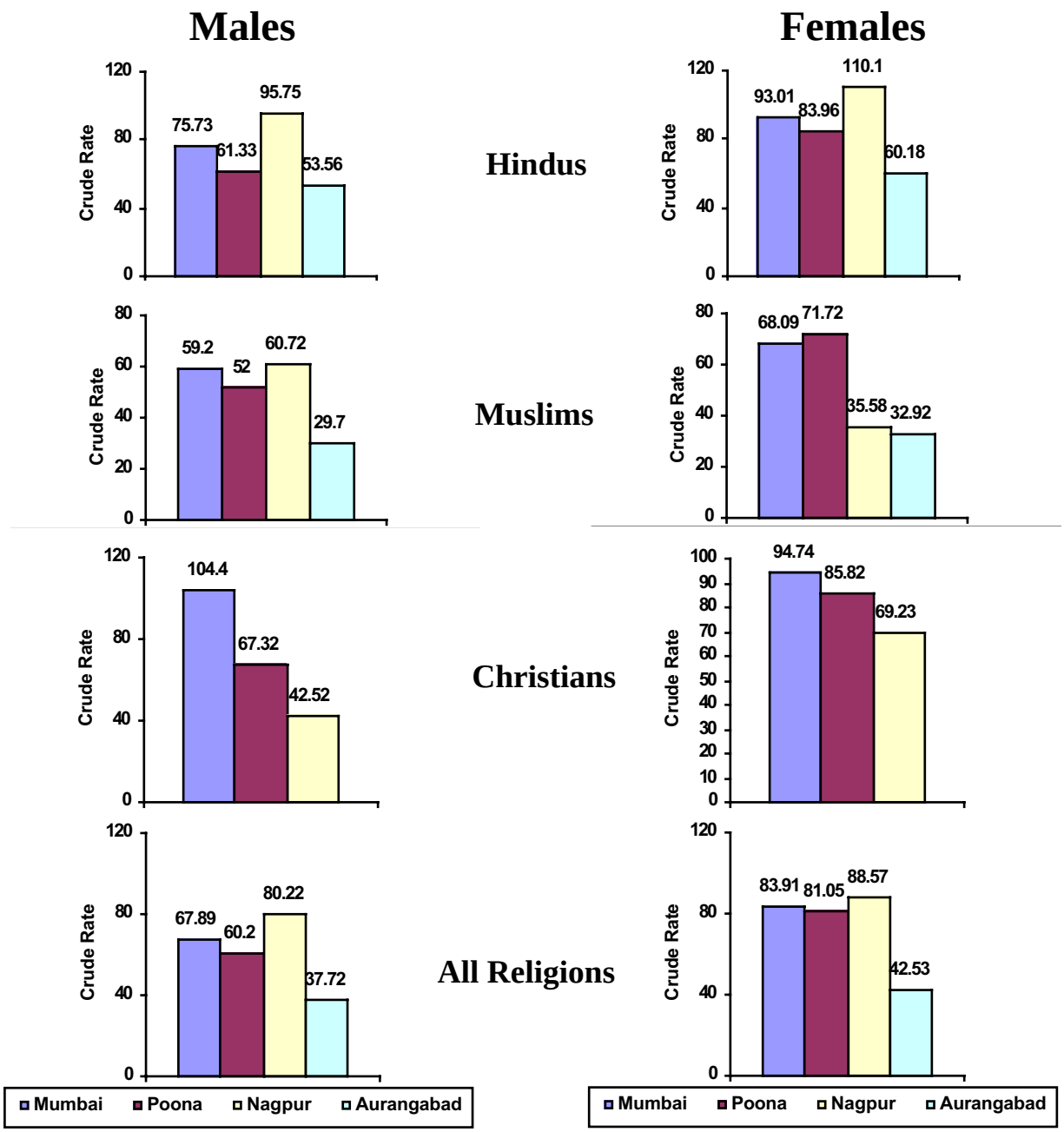

Figure 3., Crude Rates by Religion and Sex for Each Registry

contributions to tobacco related cancers in all the registries in both the sexes.

It is interesting to find that those sites where environmental factors of any value (such as excessive tobacco chewing and smoking) were noted. Particularly striking is the fact that habits known to be a etiological value in the causation of cancer are more frequently found in men than in women which may explain observed difference i.e. low incidence rates in females and wide variations in male rates in different populations.

Considerable variation was observed in the incidence of cancer of various sites in each sex, in patients, professing different religious faiths within a particular population. This was a due to a variety of causes, mainly endocrine, dietary, or environmental. Such variations called for adequate investigations to elucidate the complex etiology of the disease.

The crude incidence rates by religion and sex for each registry are given in Figure 3. In all the registries females have recorded higher incidence than males. As far as total crude incidence is concerned between the registries, Nagpur has recorded the highest and Aurangabad has recorded the lowest incidence in both the sexes. In all the registries in all religions females have recorded higher incidence than males except in Nagpur. Between the registries Hindus have recorded highest incidence rates in both the sexes in Nagpur, Muslims and Christians have recorded the highest incidence rates in both the sexes in Mumbai.

Discussion

In all the four Registries we adopt an active method of data collection on cancer patients. Staff members personally visit the wards of the co-operating hospitals regularly to interview all confirmed cancer patients and also those who are under cancer investigation. The record files maintained by the various departments of these hospitals viz. Pathology, Hematology, Radiology and the various registers in the specialized surgical and medical wards are also examined. The requisite details obtained for each patient are cross-checked with the information collected from the various departments of the collaborating hospitals to ensure completeness of records. Full information about every cancer patient registered at each and every hospital is thus obtained, irrespective of whether or not the patient is subsequently treated at the particular hospital. Additional information is obtained every time a cancer patient is re-admitted or re-examined at the Institution.

As a result of such data collected from different hospitals, the same patient is sometimes found to be registered at two or more hospitals. Care is taken to see that multiple entries of the same patient are not made in our records. On the other hand, in some instances, complete medical information on the same patient is obtained by combining the data obtained from two or more hospitals. Patients attending the clinics (out-patient departments) of various hospitals are not included in our Registry, except in the case of the Tata Memorial Cancer Hospital, because of a paucity of medical details and information on the residential status in the record files maintained in the out-patient clinics of general hospitals.

Supplementary information can often be gleaned from the death records maintained by the Vital Statistics Division of the respective Municipal Corporations. Copies are made of all death certificates, which mention cancer or tumor as the cause of death. These death certificates are then matched against the registered cases in our files. Every cancer death not traceable to an entry in our files is labeled as an "unmatched death" and the date of death is then taken as the date of the first diagnosis, and is so registered in the corresponding year's data file. Furthermore, copies of all death certificates where the term 'Cancer' or 'Tumor' is mentioned as the cause of death are individually scrutinized to confirm the statement.

General Medical Practitioners who are also family physicians are not contacted individually, but if any of them are found to have signed the death certificate of a patient dying of cancer, then they are approached personally to obtain as complete a report as possible of these patients, whether or not they have already been listed in the Registry. In many instances, the diagnosis may appear to have been based on incomplete examination, if the patient had been seen for the first time in an advanced stage of the disease. The certifying physician is then again approached personally to obtain further clarification.

For studying the completeness of the data of the registry, the indicators, proportion of deaths in period, proportion of death certificates only and stability of age incidence curves have been utilized (Yeole et al 1988 and Yeole 2001). Proportion of deaths in period for Mumbai 49%, for Poona 42%, for Nagpur 33% and for Aurangabad 23%. Except Aurangabad registry the proportions of deaths in period are at acceptable level as compare to international comparison. The proportion of cases of death certificate alone are minimum for 3% for Nagpur registry and maximum are 6.5% for Mumbai Registry, indicating that the death registration system is quite good in all the registration areas.

The indicators "Proportions of cases registered on histological verification", the proportions of cases were age is not known, the flattening of age incidence curves and proportion of other unspecified neoplasm's can throw some light on quality of data of the registry. (Jussawalla 1988). The percentage of cases registered through microscopic variations are 85.2% for Mumbai, 88.3% for Poona, 94.1% for Nagpur and 86.1% for Aurangabad registry, which are quite comparable with the registries of the developed world. The percentages of cases for age is not known is almost nil in all the registries. The percentages of primary not known cancers ranges from 7-9% between this registries. The data of all this four registries has been accepted for publications in the volumes of Cancer Incidence in Five Continents published by International Association of Cancer Registries and International Agency for Research on Cancer (Parkin et al 2002). All above facts indicates the data collected by all four registries are complete reliable and of good quality.

Even though a variation in the cancer incidence is observed between the registries in both the sexes, the age specific rates for all sites together and for major sites show increasing rates with increase in age. While studying the incidence patterns between the registries in tobacco related cancers have major contribution in males while in females breast, cervix, and ovary contributed more than 50% of total incidence. The contributions of childhood cancers is about 4% in males and about 3% in females but leukemia and lymphomas are the main contributors. The variations in cancer incidence indifferent religious group between the registries may be attributed to their different habits, customs and socio-economic status.

Geographic location is obviously not of primary interest to the epidemiologist. However, if variations relating to climate, geology and air pollution, in different countries or within one country or the occupation, socio-economic conditions and ethnic background of the people can be related to the differences in cancer incidence. Based on the finding of this paper, specific etiological hypothesis can perhaps be evolved which could be assessed by in depth epidemiological analysis (Jussawalla & Yeole 1991).

Variations in the frequency of occurrence of disease entity in different geographical regions has been recognized and epidemiological investigators have contributed in a large measure in evolving numerous hypothesis relating to the etiology of cancer. The association of a specific disease in a specific population implies either that the residents of the region possess characteristics not present in people living

in other area or that the etiologic factors concerned, are present in the biological, chemical or social environments of the affected population. (Yeole and Jussawalla 1990).

This paper described the variations in cancer incidence patterns by site, age, and religion between the four urban agglomerations in both the sexes. The differences in childhood, tobacco related cancers are also studied. The findings of this paper can be used to estimate the incidence and prevalence of cancer for future for whole Maharashtra state and studies in cancer etiology and cancer control can be planned.

References

Jussawalla DJ, Deshpande VA, Natekar MV (1966). Cancer in Greater Bombay, 1964, Indian Cancer Society, Mumbai.

Jussawalla DJ, Yeole BB (1981). Geographic variations in cancer incidence into urban populations in India. *Ind J Cancer*, **18**, 91-8.

Kurkure AP, Yeole BB, Koyande SS (2006). Cancer Incidence and its Patterns in Urban Maharashtra, Indian Cancer Soceity, Mumbai.

Parkin DM, Whelan SL, Ferlay J, Teppo L, Thomas DB (2002). Cancer Incidence in Five Continents, Volume 8,IARC Scientific Publication No.155, Lyon, France.

Yeole BB (2001). An assessment of improvement in reliability and completeness of Mumbai Cancer Registry Data from 1965 and 1999. *Asian Pac J Cancer Prev*, **2**, 225-32.

Yeole BB, Jussawalla DJ (1988). An assessment of reliability and completeness of Bombay Cancer Registry data, 1988. *Ind J Cancer*, **25**, 177-90.

Yeole BB, Jussawalla DJ (1990). Geographic differences in cancer incidence by sex at various sites in city wards in Greater Mumbai, 1990. *Ind J Cancer*, **27**, 22-7.

WHO-International Statistical Classification of Disease and related health problems, 10th Revision, Volume 1, 1992: World Health Organization, Geneva.

WHO-International Classification of Diseases for Oncology, ICD-O3, 2000: World Health Organization, Geneva.