ORIGINAL ARTICLE

Evaluation of age-standardized cancer burden in western Tamil Nadu, India

Janani Selvaraj[1], Prashanthi Devi Marimuthu[2], Harathi Parasur Babu[3]

[1]Research Scholar, [2]Assistant Professor, Department of Environmental Management, Bharathidasan University, Trichy, [3]Assistant Professor, Department of Zoology, PSGR Krishnammal College for Women, Coimbatore

Abstract	Introduction	Methodology	Results	Conclusion	References	Citation	Tables / Figures

Corresponding Author

Address for Correspondence: Janani Selvaraj, Research Scholar, Department of Environmental Management, Bharathidasan University, Trichy.
E Mail ID: janani6490.selva@gmail.com

Abstract

Background: The burden of cancer is growing globally and is one of the top leading causes of death. Information on cancer patterns is essential for effective planning of cancer control interventions. **Aims and Objectives:** The present cross sectional study aims to explore the patterns and trends of the cancer incidences in the western regions of Tamil Nadu, India including Coimbatore, Erode, Tiruppur, Salem, Namakkal and Nilgiris. **Materials and Methods:** A sum of 14392 cancer cases were recorded from the hospital based cancer registries of Coimbatore district. The cancer cases were segregated district-wise for specific cancer sites and the age-standardized incident rates were calculated for different age groups. **Results:** Coimbatore district recorded the highest number of incidences among all districts. Among all age-groups the adults aged 50-74 carry the highest burden of cancer. Among men, head and neck and gastrointestinal cancers are predominant while among women, breast and gynecological cancers are high. The age-standardized incidence rates were found to be higher in Coimbatore and least in Salem. **Conclusion:** Through this study, it is observed that Coimbatore district is under major threat and needs further investigation of risk factors for implementing optimized treatment and prevention strategies for reducing the adverse effects of cancer.

Key Words

Cancer; Age-standardized incidence rates; Tamil Nadu

Introduction

Cancer is one of the main causes of morbidity and mortality in the world which makes it an important health problem. Although most cancer incidence rates are found in developed countries, more than 60% of cancer deaths occur in low or medium income countries due to limited resources for prevention, diagnosis and treatment. The International Agency for Research on cancer (IARC,WHO) in its latest report has estimated 14.1 million new cancer cases and 8.2 million cancer-related deaths occurred in 2012, compared to 12.7 million and 7.6 million, respectively, in 2008 (GLOBOCAN,2012).

In India, the IARC estimated indirectly that about 635000 people died from cancer in 2008 representing about 8% of all estimated global cancer deaths and about6% of all deaths in India [1]. The absolute number of cancer deaths in India is projected to increase because of population growth and increasing life expectancy [2]. Rates of cancer deaths are expected to rise, particularly from increases in the age-specific cancer risks of tobacco smoking which increase the incidence of several types of cancer [3]. India is a culturally diverse country, with huge regional and rural-to-urban variation in lifestyles and in age-specific adults' death-rates [4]. Thus understanding the geographical and social distribution of specific cancers is essential to target cancer control programs and spur further research into the causes of cancer.

Globally lung, stomach and colorectal cancers are leading cancers in male whereas breast, lungs and stomach cancers constitute top three leading cancer sites in women (WHO, 2004). In contrast, the common sites for cancer in India are oral cavity, lungs, esophagus and stomach among men and cervix, breast and oral cavity among women [5]. Even

within India there exist variations in the prevalence and patterns of different cancers. In southern India the common cancers among male were found to be stomach, oral, esophagus and leukemia whereas females were mainly affected by cervix, breast, oral and esophageal cancers [6-8]. Similarly, a study from West Bengal, an eastern state of India has reported head and neck, lungs and oral cancers are major in males, whereas among female breast cancer was leading followed by cervical and stomach cancers [9]. In contrast, among north Indian males gastro intestinal tract, larynx and lung are major cancers and among females breast, cervix and lung were leading malignancies [10].These differences in the prevalence of cancers across the country could be due to diversity in gene pools as well as the environmental dynamics [11].

Aims & Objectives

The objective of the present study is to evaluate the cancer burden in the western regions of Tamil Nadu, India through age standardization and to identify the highest disease burden among specific regions and also to highlight the prominent cancer types prevalent among men and women in Tamil Nadu.

Study area and data sources

The present cross sectional study was conducted in the western districts of Tamil Nadu including Coimbatore, Erode, Tirupur, Salem, Namakkal and Nilgiris (Figure 1). The cancer data for the proposed study was collected from the medical records of the hospital based cancer registries of Coimbatore district. Necessary permissions were obtained from the hospital management to acquire the data. The attributes recorded from the case sheets include demographic details, occupation, type of cancer and information regarding the practice of behavioral factors such as tobacco and alcohol consumption. A total of 14392 incident cancers of all sites registered during 2001-2013 were used to study the cancer patterns in the population. Data consisting of incomplete information were excluded from the study.

Methodology

The total cancer incidences were segregated district wise and were observed for different age-groups. The cancer types were broadly classified according to the International Statistical classification of Disease and Related Health Problems, 10th Revision (ICD-10) which is presented in   Table 1 (13).

The age groups were divided into five classes including 0-14(children), 15-24(teenagers and young adults), 25-49(middle adults), 50-74(older adults) and 75+ (elderly) (In accordance with Cancer Research, UK). The age-standardized incident rates (ASIR) were computed by direct standardization using the WHO new world standards as the standard population and are expressed per 100000.

Results

The maximum cancer incidences were recorded in the Coimbatore district (Figure 2) with a total of 5936 cases (41%), moderate incidences in Tiruppur and Erode with 2814 and 2867 cases respectively and the least in Nilgiris with 642 cases (4%). The proportion of female cancer incidences is higher than the male incidences (Figure 3) due to the high incidence of breast and gynecological cancers among women. Among men, the head and neck and gastrointestinal cancers are predominant with highest in Coimbatore and least in Salem. The prominent cancer types prevailing among men and women from the collected data are presented in Table 2. The other cancer types have not been included in the study.

The highest age-standardized incident rates was observed in Coimbatore district where the estimates were higher in women (15.4/100000) than men (12.5/100000) and the least were observed in Salem district (2.03/100000 for men and 3.20/100000 for women). Among all age groups, older adults aged 50 to 74 recorded the highest ASIR for all districts (Table 3).

The most prominent cancer type prevailing among children aged 0 to 14 is the blood cancer that includes lymphomas and leukemia. The highest incidence of blood cancer is found in the district of Coimbatore (37 male and 35 female). The least incidences are found in Salem, Namakkal and Nilgiris. Cancer incidence is also relatively rare in teenagers and young adults. The major cancer type present among young men and women aged 15-24 include the blood cancer with maximum incidences in Coimbatore (29 male and 14 female) and least incidence in Namakkal (3 male and 0 female). Among men, head and neck cancers (10 cases) and genitor-urinary cancer (9 cases) are prevalent in Coimbatore. Gynecological and breast carcinomas are present among the women with 9 cases and 8 cases respectively, in Coimbatore. The other districts show comparatively lower incidences (Figure 4).

The huge increase in cancer incidences in the 15 to 24 age group may be attributed to the high incidence

of breast and gynecological cancer among women. The highest incidence is observed in Coimbatore (breast - 471 cases and gynecological - 315 cases) followed by gastro-intestinal cancers (79 cases) and head and neck (66 cases) cancer incidences. Moderate incidences have been found to be in Tiruppur and Erode. The least incidences have been found in Salem, Namakkal and Nilgiris. Among men, head and neck cancers are found followed by gastrointestinal and genitor-urinary cancers. The highest incidence is found in Coimbatore district with (149 head and neck cases, 86 gastro intestinal cancer cases and 36 genitourinary cancer cases). Blood and respiratory cancers are also found among the male population. Coimbatore district is observed to have highest incidence with 65 blood and 31respiratory cancer cases (Figure 5).

Adults belonging to the 50-74 age-group carry the greatest burden of cancer due to the high incidence of breast and gynecological cancers among women. Head and neck, gastrointestinal and respiratory cancers are prominent among the male population. . Among men, the highest incidences are found in the Coimbatore (587 head and neck cancer cases, 336 gastro-intestinal cases and 192 respiratory cancer cases). Among women, 646 gynecological and 581 breast cancer incidences are found in Coimbatore. Moderate incidences have been found in Tiruppur and Erode. The least incidences are found in Salem, Namakkal and Nilgiris.

The major cancer type that prevails in the elderly aged 75+ is the head and neck cancer among men with the highest incidence in Coimbatore comprising of 93 cases. Among women, breast and gynecological cancers are prevalent with 43 and 36 cases respectively in Coimbatore. The other districts show lower incidences for all cancer types (Figure 6).

In order to study the influence of the behavioral factors namely smoking, chewing and alcohol consumption, data consisting of complete information regarding consumption of tobacco and alcohol were segregated. The women are less prone to such habits but they are still diagnosed for these cancers. On the other hand, head and neck and gastric cancers are more among the male due to the practice of these habits (Figure 7 and Figure 8).

Discussion

From the present study, it is observed that there exists great variation in the cancer incidence patterns among men and women in accordance with age and specific cancer sites. The study confirms that cancer is an important cause of adult deaths with more than 70% of fatal cancers occurring during the productive ages of 50-74 years of age. Among all districts, the highest frequency of cancer cases was observed in Coimbatore district and the least in Nilgiris. But the age-standardized incidence rates were recorded highest in Coimbatore and lowest in Salem district which may be due to the difference in the age- The age-standardized incident rates were found be higher among women than men which is due to the high prevalence of breast and gynecological cancers among women. Among men, oral and digestive cancers are predominant due to the intake of tobacco and alcohol. Tobacco consumption was found to be higher in men diagnosed with oral cancers than respiratory cancers, indicating that the range of fatal cancers caused by tobacco differs substantially from that in high-income countries [12]. A priority for cancer prevention is tobacco control, particularly through high taxation of tobacco products to increase the very low level of cessation [13].

Although age, tobacco and alcohol consumption are known risk factors contributing to the risk of increasing cancer incidences, prolonged exposure to environmental carcinogens may be an added reason. Genetic susceptibility to cancer favors the role of exogenous factors through gene-environment interactions. Age is not the unique factor to be considered since the rising incidence of cancers is seen across all age categories, including children, and adolescents [14]. A few major environmental carcinogens causing cancer include outdoor air pollution, indoor air pollution due environmental tobacco smoke, food contamination by food additives, carcinogenic contaminants such as nitrates, pesticides, certain metals and metalloids, etc,.

A recent study in Taiwan has found that other than cigarette smoking and betel quid chewing, heavy metals such as arsenic and nickel in farm soils may be risk factors for oral cancers [15]. High concentrations of heavy metals such as Chromium, Arsenic and Lead have been found in the industrial and residential areas of Coimbatore district [16]. Investigations relating to associations of heavy metals and specific cancer types could be done in future to assess the carcinogenic effects of the soils of the present study area. Certain infectious agents have proved to show strong association with specific cancer types. Helicobacter pylori, hepatitis B and C viruses, and human papilloma viruses (HPV) were responsible for

1.9 million cases, mainly gastric, liver, and cervix uteri cancers in a global cancer study [17].

Conclusion

Although elucidating biological pathways is important, an association between environmental contaminants and cancers needs to be well established in a terms of medical sciences. Such medical examinations and correlated results will provide an important contribution to the debate on reducing the exposures to air, soil and water pollution. The main limitation of our study is the lack of information to individual risk factors for cancers such as smoking and alcohol consumption. It is reported that the individual risk factors are correlated with the ambient air pollution levels. Another limitation is the use of environmental monitoring data, which do not necessarily represent individual exposures. Although measurements of pollutants at certain selected locations may be used, they can result in misclassification of exposure because individuals may behave differently from the general population. Therefore our study is a preliminary attempt to assess the age based response to environmental carcinogens. We have observed that a multi-disciplinary approach is required to investigate the risk factors associated with cancer along with the traditional practices. Through this we have provided a directive so as to target treatment and preventive and awareness measures in terms of exposures, lifestyles and behavior aspects.

Recommendation

The environmental and life style profile of the high risk regions for the present study needs to be assessed for implementing better treatment, diagnostic and prevention strategies.

Relevance of the study

The present study will be an eye opener to the health professionals to conduct further studies to control cancer in the vulnerable regions of Coimbatore and neighboring areas.

Authors Contribution

All the authors have equally contributed in the preparation of the manuscript.

Acknowledgement

References

1. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. Int J Cancer. 2010 Dec 15;127(12):2893-917. doi: 10.1002/ijc.25516. PubMed PMID: 21351269. [PubMed]

2. Dikshit R, Gupta PC, Ramasundarahettige C, Gajalakshmi V, Aleksandrowicz L, Badwe R, Kumar R, Roy S, Suraweera W, Bray F, Mallath M, Singh PK, Sinha DN, Shet AS, Gelband H, Jha P; Million Death Study Collaborators. Cancer mortality in India: a nationally representative survey. Lancet. 2012 May 12;379(9828):1807-16. doi: 10.1016/S0140-6736(12)60358-4. Epub 2012 Mar 28. Erratum in: Lancet. 2012 May 12;379(9828):1790. PubMed PMID: 22460346. [PubMed]

3. Jha P. Avoidable global cancer deaths and total deaths from smoking. Nat Rev Cancer. 2009 Sep;9(9):655-64. doi: 10.1038/nrc2703. Epub 2009 Aug 20. Review. PubMed PMID: 19693096. [PubMed]

4. Registrar General of India and Centre for Global Health Research. Causes of death in India, 2001–2003: Sample Registration System. New Delhi: Government of India, 2009.

5. Rao Y, Gupta S, Agrawal S. National cancer control program: current status and strategies. Fifty years of cancer control in India. Director General of Health Services, MOHFW, Government of India, 2002: 41-7.

6. National Cancer Registry Program, ICMR. (1996). Population based cancer registries consolidated report (1990-96).

7. Jagnnatha GV, Hiremath SS. Oral Cancer Prevalence and assessment of various risk factors among Oral cancer patients attending Kidwai Memorial institute of oncology-An epidemiological study. 2005 [Google Scholars]

8. Reddy K. Cancer epidemiology in South India. Bangalore: Department of Epidemiology and Statistics Bangalore Cancer Registry. Kidwai Memorial Institute of Oncology. 2010

9. aiti PK, Jana U, Ray A, Karmakar R, Mitra TN, Ganguly S. Patterns of cancer occurrence in different regions of West Bengal--a hospital based study. J Indian Med Assoc. 2012 Jul;110(7):445-8. PubMed PMID: 23520667. [PubMed]

10. Sharma MK, Gour N, Pandey A, Wallia D, Kislay D. Epidemiological trends of cancer morbidity at a government medical college hospital, Chandigarh, India. Asian Pac J Cancer Prev. 2012;13(7):3061-4. PubMed PMID: 22994710. [PubMed]

11. Hussain MA, Pati S, Swain S, Prusty M, Kadam S, Nayak S. Pattern and trends of cancer in odisha, India: a retrospective study. Asian Pac J Cancer Prev. 2012;13(12):6333-6. PubMed PMID: 23464454. [PubMed]

12. International Institute for Population Sciences (IIPS) and Ministry of Health and Family Welfare. Global Adult Tobacco Survey (GATS India), 2009–2010. New Delhi: Government of India, 2010.

13. Peto R, Lopez AD, Boreham J, Thun M, Heath C Jr. Mortality from tobacco in developed countries: indirect estimation from national vital statistics. Lancet. 1992 May 23;339(8804):1268-78. PubMed PMID: 1349675. [PubMed]

14. Irigaray P, Newby JA, Clapp R, Hardell L, Howard V, Montagnier L, Epstein S, Belpomme D. Lifestyle-related factors and environmental agents causing cancer: an overview. Biomed Pharmacother. 2007 Dec;61(10):640-58.

Epub 2007 Nov 20. Review. PubMed PMID: 18055160. [PubMed]

15. Su CC, Lin YY, Chang TK, Chiang CT, Chung JA, Hsu YY, Lian IeB. Incidence of oral cancer in relation to nickel and arsenic concentrations in farm soils of patients' residential areas in Taiwan. BMC Public Health. 2010 Feb 12;10:67. doi: 10.1186/1471-2458-10-67. PubMed PMID: 20152030; PubMed Central PMCID: PMC2834627. [PubMed]

16. Gandhimathi A and Meenambal T. Spatial Prediction of Heavy Metal Pollution for Soils in Coimbatore, India based on universal kriging. International Journal of Computer Applications. 2011;29:52-63.

17. Catherine de Martel , Ferlay J, Franceschi S, Vignat J, Bray F, Forman D, Plummer M. Global burden of cancers attributable to infections in 2008: a review and synthetic analysis. Lancet Oncol. 2012 Jun;13(6):607-15. doi: 10.1016/S1470-2045(12)70137-7. Epub 2012 May 9. Review. PubMed PMID: 22575588. [PubMed]

-------------------------x-------------------------

Tables

TABLE 1 ICD-10 CODING FOR NEOPLASM BASED ON ANATOMICAL SITES

Cancer Group	ICD 10 codes	Cancer sites
Digestive System	C15,C16,C17,C18,C19-C20,C21,C22, C23-C24,C25	Oesophagus, Stomach, Small Intestine, Colon, Rectum, Anus, Anus Canal, Liver, Gall Bladder, Pancreas
Head and Neck	C00,C01-C02,C03-C06,C07-C08,C09,C10 , C11,C12-C13,C14,C30-31,C32	Lip, Tongue, Mouth, Salivary Gland, Tonsil, Oropharynx, Nasopharynx, Hypopharynx, Pharynx unspecified, Nose and Sinus, Larynx
Lymphoid and Haematopoietic System	C81,C82-85 and C96,C90,C91, C92-94,C95	HL,NHL,MM, Lymphoid, leukaemia, myeloid leukaemia, leukaemia unspecified
Breast and Gynaecological	C50,C51,C52,C53,C54,C55,C56, C57, C58	Breast, Vulva, Vagina, Cervix Uteri, Corpus Uteri, Uterus Unspecified, Ovary, Other female genital, Placenta
Respiratory	C33,C34	Trachea, bronchus and lung
Genitourinary	C60,C61,C62,C64,C65,C66,C67	Penis, Prostate, Testis, Kidney, Renal pelvis, Ureter, Bladder

TABLE 2 PROMINENT CANCER TYPES AMONG MEN AND WOMEN FOR ALL DISTRICTS

Prominent cancers among men	Coimbatore	Erode	Tiruppur	Salem	Namakkal	Nilgiris
Head and Neck	848	457	420	102	133	83
Gastrointestinal	487	265	258	77	91	50
Genitourinary	237	108	121	30	43	17
Respiratory	248	94	86	32	26	22
Blood	288	116	112	55	38	40
Prominent cancers among women	Coimbatore	Erode	Tiruppur	Salem	Namakkal	Nilgiris
Gynaecological	1007	536	534	183	219	111
Breast	1103	455	487	144	173	135
Gastrointestinal	300	158	169	39	46	31
Head and Neck	297	130	136	33	48	25
Respiratory	95	18	37	9	9	11
Genitourinary	47	26	25	33	7	5
Blood	180	79	81	33	16	19

TABLE 3 DISTRICT-WISE AGE-STANDARDIZED INCIDENCE RATES

District	N	ASIR (PER 1000000) All ages	0 to 14	15 to 24	25 to 49	50 to 74	75+
Coimbatore(M)	2560	12.5	0.34	0.30	2.26	7.88	1.73
Coimbatore(F)	3375	15.4	0.46	0.28	4.73	9.03	0.99
Erode(M)	1246	9.25	0.20	0.21	1.76	6.12	0.97
Erode(F)	1567	10.99	0.14	0.21	3.82	6.21	0.60
Tiruppur(M)	1234	8.29	0.34	0.23	1.47	5.49	0.76
Tiruppur(F)	1633	10.42	0.17	0.26	3.58	5.90	0.51
Salem(M)	435	2.03	0.08	0.07	0.44	1.25	0.20
Salem(F)	699	3.20	0.01	0.02	1.26	1.79	0.12
Namakkal(M)	402	3.88	0.16	0.09	0.78	2.40	0.45
Namakkal(F)	602	5.50	0.13	0.11	2.04	3.03	0.19
Nilgiris(M)	256	5.87	0.18	0.22	1.15	4.06	0.26
Nilgiris(F)	386	8.06	0.18	0.13	3.13	4.18	0.44

Figures

FIGURE 1 LOCATION OF THE WESTERN REGION OF TAMIL NADU
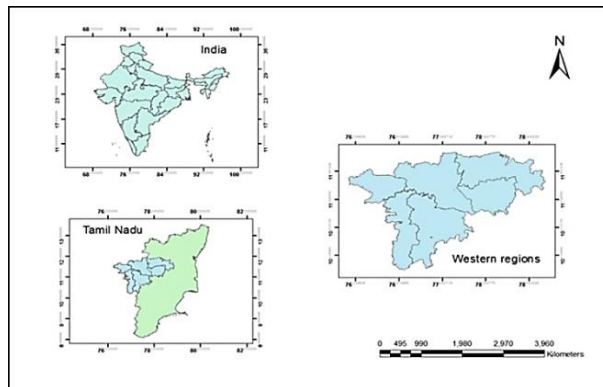
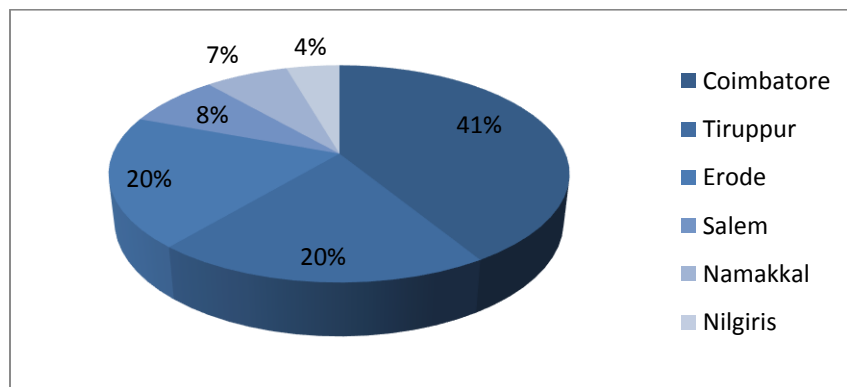## FIGURE 2 DISTRICT-WISE DISTRIBUTION OF CANCER CASES FROM THE COLLECTED DATA (2001-2013)

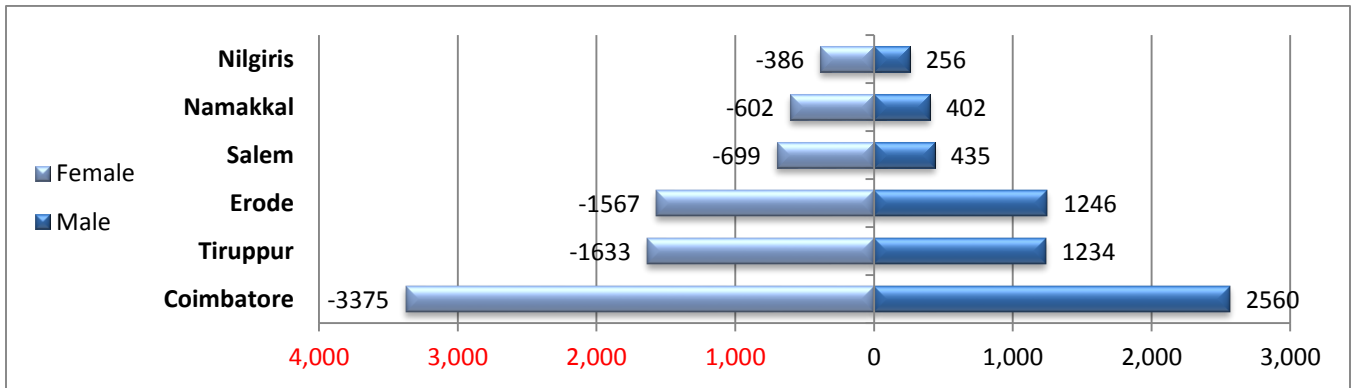**FIGURE 3 GENDER-WISE DISTRIBUTION OF RECORDED CANCER CASES FROM 2001 TO 2013**

FIGURE 4 MAJOR CANCER TYPES IN THE CHILDREN AGED 0-14 AND TEENAGERS AGED 15-24 FOR EACH DISTRICT
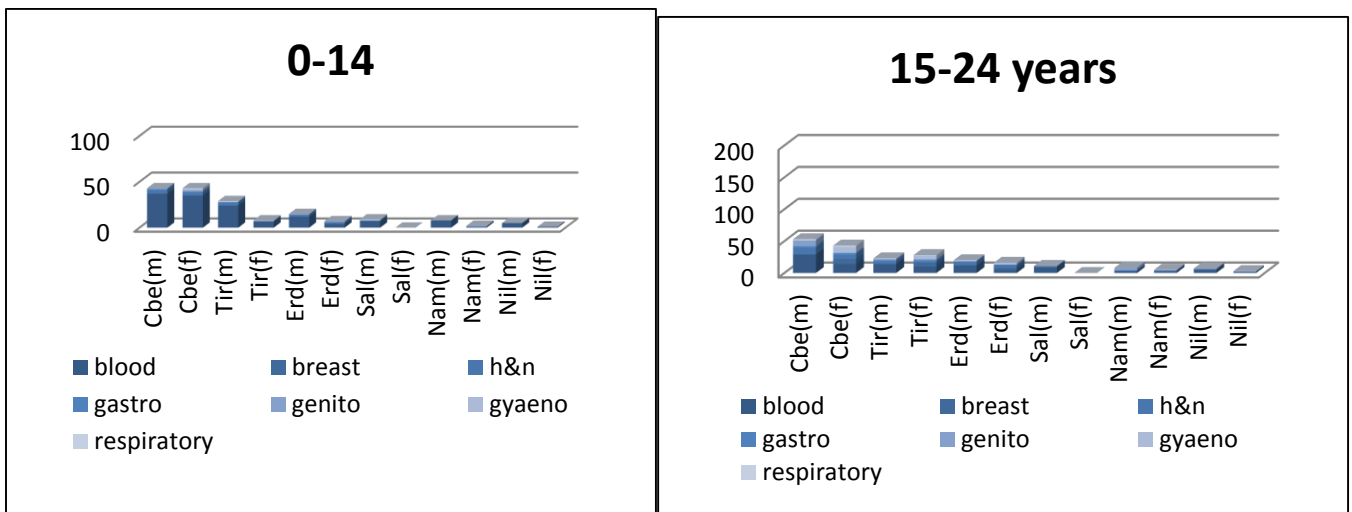

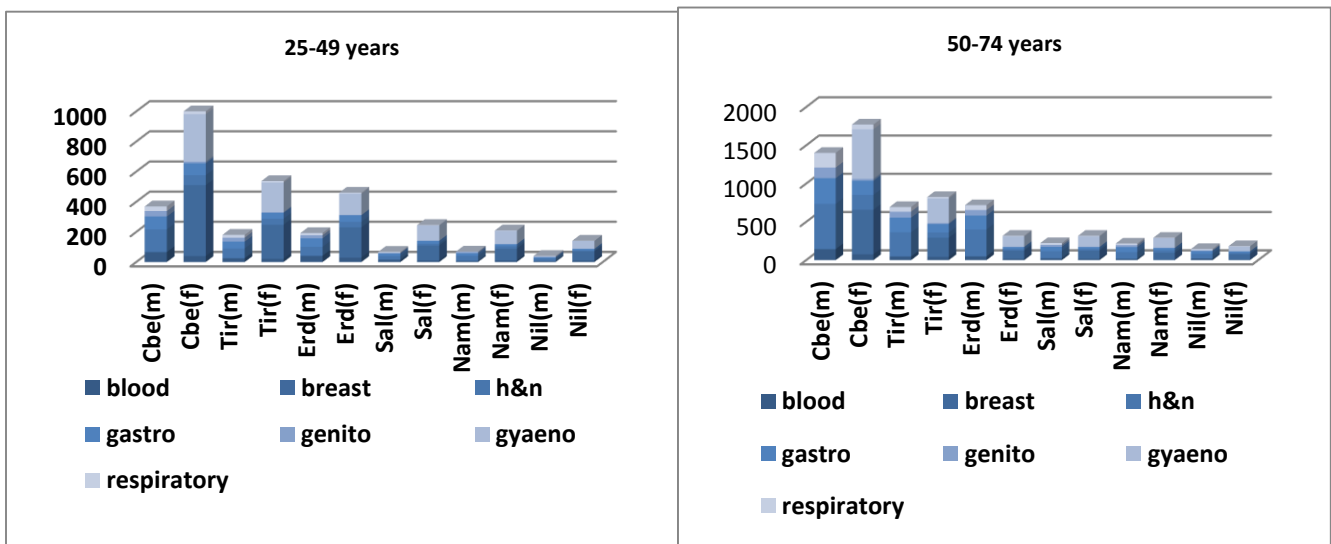**FIGURE 5 MAJOR CANCER TYPES IN THE ADULTS AGED 25-49 AND 50-74 FOR EACH DISTRICT**

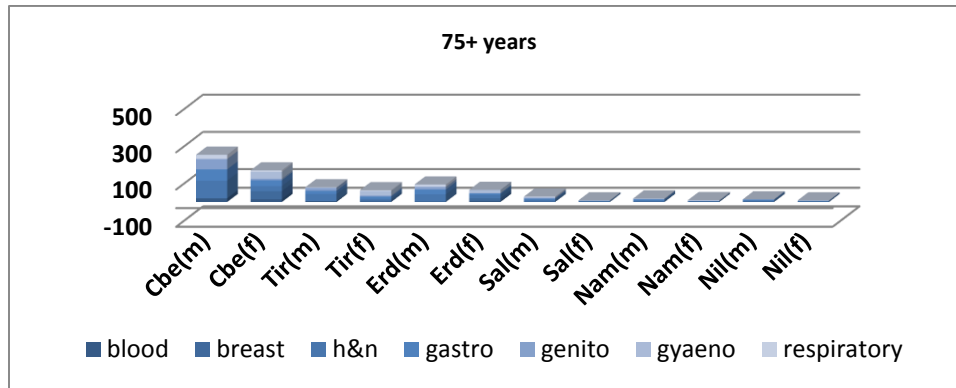**FIGURE 6 MAJOR CANCER TYPES IN THE ELDER AGED 75+ FOR EACH DISTRICT**

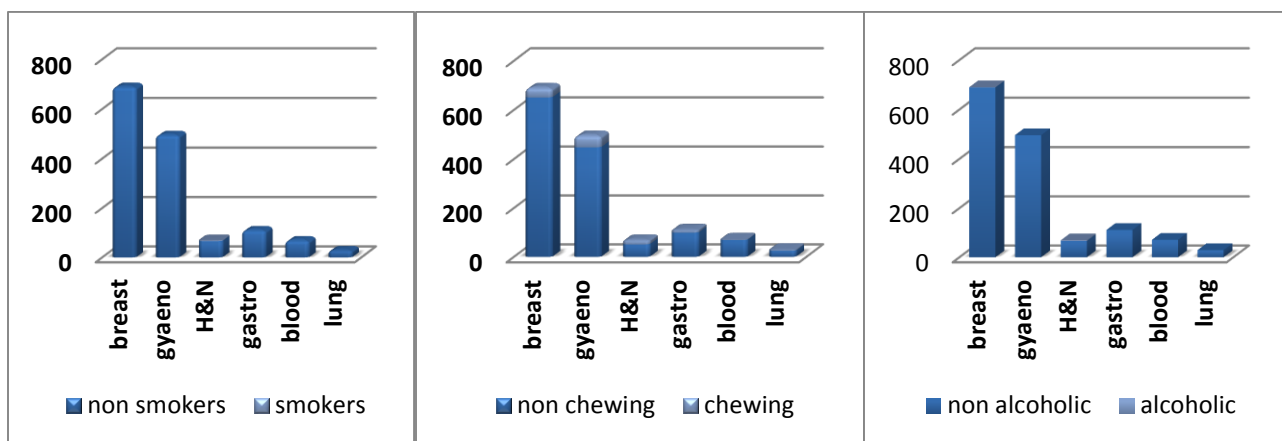**FIGURE 7 TRENDS IN THE BEHAVIORAL FACTORS AMONG THE FEMALE POPULATION**

FIGURE 8 TRENDS IN THE BEHAVIORAL FACTORS AMONG THE MALE CANCER TYPES