AGE-AND GENDER-SPECIFIC CANCER PREVALENCE IN RURAL HIMACHAL PRADESH, INDIA: AN EPIDEMIOLOGICAL ANALYSIS AND REGIONAL VARIATIONS

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Abstract: Cancer remains a significant public health issue globally, and rural regions often face unique challenges in terms of early detection and treatment. This epidemiological study aimed to analyze the age- and sex-specific cancer incidence in rural areas of Shimla district, Himachal Pradesh, India. Data were collected from local hospitals and cancer registries, focusing on distinct age groups and sex differences. The results revealed a clear pattern of cancer types across different age groups, with hematologic and bone cancers prevalent among children, and a diverse range of cancers affecting adolescents and young adults. Gastrointestinal, lung, and reproductive cancers were more common in older populations. Notably, breast and cervical cancers among females and lung, prostate, and colorectal cancers among males were particularly significant. Regional variations highlighted Theog, Rampur, and Jubbal & Kotkhai as areas with the highest cancer incidence, necessitating targeted healthcare interventions. The present study underscores the need for tailored cancer prevention, screening, and treatment programs to address the specific needs of rural populations in Shimla district.

Keywords: Cancer incidence, rural health, age-specific cancer, sex-specific cancer, healthcare disparities

I.   INTRODUCTION

Trillions of cells make up the human body, and for optimal health, these cells need to work together. They can divide and produce new cells, which can either grow or replace old cells. However, it is crucial to regulate this process because uncontrolled cell growth can harm neighboring cells. Normally, specific genes control the growth of individual cells whereas, cancer is a condition characterized by the uncontrolled growth of cells in the body. These cells can also spread and invade other organs, through a process called metastasis. This abnormal growth is detrimental for two reasons. First, it replaces healthy cells within the organs. Second, it disrupts the body's biochemistry, leading to weight loss and a weakened immune system. Ultimately, this can result in fatal outcomes (World Health Organization, 2022). In terms of molecular biology, gene mutations that affect cell growth are responsible for this uncontrolled cell growth. It occurs due to alterations in oncogenes, tumor suppressor genes, and genes responsible for maintaining genome stability (Lippman et al., 2009). It can affect individuals of all ages, regardless of their age, sex, nationality, ethnicity, socioeconomic status, level of education, or geographical location (Mathur et al., 2020).

Cancer is a complex disease caused by multiple modification risk factors, such as increasing age; genetic predisposition; lifestyle factors such as tobacco use in any form; areca nut chewing in any form; alcohol consumption in any form; poor nutritional status; being overweight or obesity; lack of regular physical activity; chronic infection with certain bacteria and viruses such as *Helicobacter pylori,* hepatitis B (BHBV) and C (HCV) viruses; 13 types of human Papillomaviruses (HPV), particularly HPV 16 and 18, and human immunodeficiency virus (HIV) and *Epstein-Barr* virus (EBV) and other environmental risk factors. Approximately 13% of cancers diagnosed in 2018 globally were attributed to carcinogenic infections, which included *Helicobacter pylori*, human papillomavirus (HPV), hepatitis B virus, hepatitis C virus, and *Epstein-Barr* virus (de Martel et al., 2020).

Cancer has a multi-casual etiology (Koul et al., 2010; ICMR, 2001; Somdatta et al., 2008; Sharma et al., 2009; Gaur et al., 2006; Prasad et al, 2005; Sumathi et al., 2009), characterized by lifestyle-related risk factors, environmental and biological agents, chemical pollutants in the air, tobacco, and viruses. Certain microorganisms of public health importance, such as hepatitis B (HBV), hepatitis C virus (HCV), and human papilloma virus (HPV), increase the risk of liver, cervical, and stomach cancers, respectively. Infection with HIV substantially increases the risk of certain specific cancers such as cervical cancer. The challenge of cancer control greatly depends on addressing lifestyle-related practices such as physical inactivity, tobacco use, alcohol intake, trans-fats, etc.

The causes of cancer in India, particularly in Himachal Pradesh, are almost the same as those in other parts of the world. Chemical, biological and other environmental factors are responsible for the uncontrolled and disorganized proliferation of cells (carcinogens). Basically, under special circumstances carcinogens interact with the DNA of normal cells resulting in a series of complex multistep processes responsible for uncontrolled cell proliferation or tumor formation (Carmaeia, 1993). The causes of cancer can be internal factors, such as inherited mutations, hormones, and immune conditions or environmental factors such as tobacco use, diet,

radiation, and other infectious agents. A significant variation in cancer incidence has been reported due to lifestyle and food habits (Helbock et al, 1998). For example, Asians have 25 and 10 times lower incidences of prostate and breast cancer, respectively, than Western countries, which may be attributed to the comparatively simple lifestyles adopted by Asians and safe sexual practices. Interestingly, the incidence of these cancers increases substantially when Asians migrate to Western countries, indicating a clear relationship between carcinogenesis and food habits and lifestyles.

Many health systems face challenges in the early detection of cancer. This could be because of the different ways in which the disease presents across all age groups, population aging and lifestyle changes are the major drivers that further increase the cancer burden in the country. Low- and middle-income countries struggle to address this burden, leading to limited access to timely and accurate diagnosis and effective treatment for numerous cancer patients worldwide. In contrast, countries with strong healthcare systems have improved survival rates for different types of cancer by prioritizing easy access to early detection, high-quality treatment, and comprehensive survivorship care. The problem is manifold for developing nations such as India, particularly Himachal Pradesh which has poor geographical coverage of medical services and negligible financial protection in health (Rajpal et al., 2018).

Cancer is a significant public health issue worldwide, and understanding its prevalence across different demographic conditions is crucial for effective healthcare planning and intervention. In India, cancer incidence rates are rising, with rural areas often experiencing a lack of adequate healthcare resources and awareness. Shimla District, located in the northern state of Himachal Pradesh, is a unique case for studying cancer incidence due to its diverse topography, socioeconomic conditions, and healthcare accessibility.

This study aimed to provide a comprehensive analysis of cancer incidence in the rural areas of Shimla District, focusing on age-and sex-specific patterns. By examining the types of cancer most commonly diagnosed across various age groups and between genders, this research seeks to identify critical public health concerns and regional variations within the district.

The purpose of this study was to address the gap in epidemiological data concerning cancer in rural regions of Shimla District. While urban areas often benefit from more extensive healthcare facilities and research, rural populations are frequently underrepresented in health studies. Understanding the specific types of cancer that affect individuals in these areas according to age group and sex can help tailor public health interventions, improve early detection rates, and allocate healthcare resources more effectively.

By identifying age-and sex-specific cancer patterns, this study can inform targeted cancer screening and prevention programs. Additionally, analyzing regional variations in cancer incidence can highlight areas that may require more focused healthcare services and policy attention. The objective of this study was to analyze and compare the prevalence and types of cancer across different age groups and genders in the rural areas of Shimla District, with a specific focus on identifying significant regional variations and public health implications.

II.   METHODS

The present study employed an epidemiological approach to analyze cancer incidence in Shimla District's rural areas. The data were collected from medical records and cancer registries in local hospitals and healthcare centers across the district. The analysis focused on age-and sex-specific cancer incidence, categorizing the data into distinct age groups and sex demographics.

The sample population included individuals diagnosed with cancer in the rural areas of Shimla district. The data were gathered from various blocks within the district, ensuring a representative sample that included different regions and demographic information. The age groups were categorized as follows: younger than 11 years, 12-17 years, 18-27 years, 28-37 years, 38-47 years, 48-57 years, 58-67 years, and 68 years and older.

The research design was a cross-sectional observational study, analyzing cancer incidence data across different age groups and genders within Shimla district's rural areas. The data were compiled into two main tables: Table 1, which categorizes the types of cancer by age and sex, and Table 2, which presents blockwise variations in cancer incidence. This design allowed for a comprehensive overview of the cancer landscape in the district and facilitated the identification of specific trends and disparities.

The data were analyzed to determine the most prevalent types of cancer within each age group and sex. Further analysis was conducted to explore regional variations across different blocks within the district. Statistical tools were used to compare the incidence rates and identify significant patterns and anomalies.

III.   RESULTS AND DISCUSSION

The present study addresses the following research questions:

Research Question 1**:** Are there any specific types of cancer that are more prevalent among certain age groups in Shimla District's rural areas?

1.1: **Cancer incidence by age and sex**

The data presented in Table 1 include the incidence of cancer across various age and sex groups in different regions. The analysis is as follows:

Table 1: Age specific types of cancer in Shimla district's rural areas

Age	Gender	Type of cancer
Below 11Yrs	M	Blood and Bone Marrow Cancer, Lymphoma Cancer, Bone Cancer, Eye Cancer, Testicular Cancer, Kidney Cancer
	F	Pediatric Cancer, Sarcoma Cancer, Lymphoma Cancer
12 - 17 Yrs	M	Thyroid Cancer, Sarcoma Cancer, Bone Cancer, Ewing Sarcoma Cancer, Lymphoma Cancer, Prostate Cancer, Blood Cancer, Lung Cancer,
	F	Breast Cancer, Thyroid Cancer, Lymphoma Cancer, Bone Cancer, Sarcoma Cancer, Uterine Cancer, Colon Cancer, Blood & Bone Marrow Cancer,

Age	Sex	Cancer Types
18 - 27 Yrs	M	Testicular Cancer, Lymphoma Cancer, Maxillary Sinus Cancer, Lung Cancer, Bladder Cancer, Skin Cancer, Esophageal Cancer, Brain Cancer, Colon Cancer, Head and Neck Cancer, Spine Cancer, Mediastinal Cancer, Kidney Cancer, Prostate Cancer, Blood Cancer, Bone Marrow Cancer, Cervical Cancer, Liver Cancer, Salivary Gland Cancer, Bone Cancer, Sarcoma Cancer
	F	Ovarian Cancer, Stomach Cancer, Thyroid Cancer, Blood and Bone Marrow Cancer, Parotid Cancer, Gestational Trophoblastic Neoplasia Cancer, Rectal Cancer, Lung Cancer, Spine Cancer, Stomach Cancer, Oral Cancer, Lymphoma Cancer, Breast Cancer, Uterine Cancer, Sarcoma Cancer, Bone Marrow Cancer,
28 - 37 Yrs	M	Blood Cancer, Oral Cancer, Prostate Cancer, Rectal Cancer, Penile Cancer, Bone Cancer, Tongue Cancer, Stomach Cancer, Bladder Cancer, Lung Cancer, Gastric Cancer, Larynx Cancer, Tumour Cancer, Liposarcoma Cancer, Liver Cancer, Throat Cancer, Lymphoma Cancer, Testicle Cancer, Esophageal Cancer, Kidney Cancer, Cecum Cancer, Metastatic Cancer, Colorectal Cancer, Testicular Cancer,
	F	Breast Cancer, Brain Cancer, Thyroid Cancer, Leiomyosarcoma Cancer, Ovarian Cancer, Thyroid Cancer, Laryngeal Cancer, Skin Cancer, Cervical Cancer, Uterine Cancer, Kidney Cancer, Skin Cancer, Lung Cancer, Throat Cancer, Lymphoma Cancer, Blood Cancer, Salivary Gland Cancer, Bone Cancer, Spinal Cancer, Stomach Cancer,
38 - 47 Yrs	M	Thyroid Cancer, Colorectal Cancer, Brain Cancer, Supraglottic Cancer, Lymphoma Cancer, Bone Cancer, Bladder Cancer, Parotid Cancer, Lung Cancer, Stomach Cancer, Testicular Cancer, Blood Cancer, Esophageal Cancer, Rectal Cancer, Colon Cancer, Lung Cancer, Plasma Cell Cancer, Bone Marrow Cancer, Head and Neck Cancer, Oral Cancer,
	F	Ovarian Cancer. Cervical Cancer, Breast Cancer, Bone Cancer, Oral Cancer, Thyroid Cancer, Kidney Cancer, Cervical Cancer, Bladder Cancer, Blood and Bone Marrow Cancer, Breast Cancer, Ovarian Cancer, Plasma Cell Cancer, Pancreatic Cancer, Blood Cancer, Uterine Cancer, Gallbladder Cancer, Lung Cancer, Esophageal Cancer, Skin Cancer, Parotid Cancer, Tongue Cancer, Endometrial Cancer,
48 - 57 Yrs	M	Lung Cancer, Stomach Cancer, Prostate Cancer, Colon Cancer, Gastric Cancer, Kidney Cancer, Brain Cancer, Pancreatic Cancer, Supraglottis Cancer, Head and Neck Cancer, Testicle Cancer, Rectal Cancer,

		Lymphoma Cancer, Throat Cancer, Lung Cancer, Bone Marrow Cancer, Esophageal Cancer, Glottis Cancer, Liver Cancer, Bladder Cancer, Skin Cancer
	F	Cervical Cancer, Breast Cancer, Blood Cancer, Ovarian Cancer, Uterine Cancer, Lung Cancer, Stomach Cancer, Bone Marrow, Thyroid Cancer, Lymphoma Cancer, Bladder Cancer, Blood Cancer, Sarcoma Cancer, Colon Cancer, Appendiceal Cancer, Caecum Cancer, Rectal Cancer, Eye Cancer, Skin cancer, Liver Cancer,
58 - 67 Yrs	M	Lung Cancer, Bladder Cancer, Esophageal Cancer, Testicle Cancer, Head and Neck Cancer, Stomach Cancer, Rectal Cancer, Colorectal Cancer, Kidney Cancer, Ear Cancer, Lymphoma Cancer, Brain Cancer, Supraglottis Cancer, Brain Cancer, Liver Cancer, Gastric Cancer, Oral Cancer, Nasopharyngeal Cancer, Prostate Cancer, Bladder Cancer, Colon Cancer,
	F	Cervical Cancer, Breast Cancer, Supraglottis Cancer, Tongue Cancer, Lung Cancer, Spinal Cancer, Esophageal Cancer, Rectal Cancer, Ovarian Cancer, Stomach Cancer, Ampullary Cancer, Pancreatic Cancer, Skin Cancer, Kidney Cancer, Lymphoma Cancer, Eye Cancer, Bladder Cancer,
68 Yrs & Above	M	Mouth Cancer, Lung Cancer, Colorectal Cancer, Bladder Cancer. Prostate Cancer, Rectal Cancer, Esophageal Cancer, Eye Cancer, Supraglottis Cancer, Pancreatic Cancer, Lymphoma Cancer, Liver Cancer, Blood and Bone Marrow Cancer, Kidney Cancer, Head and Neck Cancer, Stomach Cancer, Prostate Cancer, Pancreatic Cancer, Parotid cancer, Testicle Cancer, Bone cancer
	F	Stomach Cancer, Lung Cancer, Gallbladder Cancer, Lymphoma Cancer, Periampullary Cancer, Breast Cancer, Skin Cancer, Rectal Cancer, Esophageal Cancer, Ovarian Cancer, Liver Cancer, Cervical Cancer, Colon Cancer, Metastatic Cancer, Thyroid Cancer, Bladder Cancer, Uterine Cancer, Buccal Mucosa Cancer

Table 1 shows the cancer incidence by age group and gender in Shimla District's rural areas.

Below 11 Years

- Males: The most prevalent cancers included Blood and Bone Marrow Cancer, Lymphoma Cancer, Bone Cancer, Eye Cancer, Testicular Cancer, and Kidney Cancer. This indicates a higher incidence of hematologic and solid tumors affecting bones and eyes.

- Females: patients with pediatric cancer, sarcoma cancer, and lymphoma cancer are predominant. This finding reveals the significant occurrence of cancers specific to pediatric populations and soft tissue cancers.

12 - 17 Years

- Males: The most common cancers are thyroid cancer, sarcoma cancer, bone cancer, Ewing sarcoma cancer, lymphoma cancer, prostate cancer, blood cancer, and lung cancer. This suggests a transition to more adolescent-specific cancers such as thyroid and bone cancers.

- Females: patients with breast cancer, thyroid cancer, lymphoma cancer, bone cancer, sarcoma cancer, uterine cancer, colon cancer, blood and bone marrow cancer. The presence of breast cancer at such a young age is notable, as is the presence of a mix of hematologic and solid tumors.

18 - 27 Years

- Males: This group faces a diverse range of cancers including testicular cancer, lymphoma cancer, maxillary sinus cancer, lung cancer, bladder cancer, skin cancer, esophageal cancer, brain cancer, colon cancer, and many others. The variety indicates the beginning of adult-onset cancer.

- Females: Patients with prevalent cancers including ovarian cancer, stomach cancer, thyroid cancer, blood and bone marrow cancer, parotid cancer. The incidence of reproductive system cancers such as ovarian and uterine cancer is significant.

28 - 37 Years

- Males: A wide array of cancers, such as blood cancer, oral cancer, prostate cancer, rectal cancer, penile cancer, bone cancer, tongue cancer, stomach cancer, bladder cancer, lung cancer, gastric cancer, are observed. This indicates an increased risk for gastrointestinal and urological cancers.

- Females: Cancers, such as breast cancer, brain cancer, thyroid cancer, leiomyosarcoma cancer, ovarian cancer, cervical cancer, uterine cancer, kidney cancer, are common. Breast and cervical cancers are particularly noteworthy.

38 - 47 Years

- Males: Patients with thyroid cancer, colorectal cancer, brain cancer, supraglottic cancer, lymphoma cancer, bone cancer, bladder cancer, parotid cancer. The presence of colorectal and brain cancers is significant.

- Females: Patients with ovarian cancer, cervical cancer, breast cancer, bone cancer, oral cancer, thyroid cancer, kidney cancer, bladder cancer, blood and bone marrow cancer, plasma cell cancer, pancreatic cancer, etc.,. The frequency of breast and ovarian cancers continues to increase.

48 - 57 Years

- Males: Common cancers include lung cancer, stomach cancer, prostate cancer, colon cancer, gastric cancer, kidney cancer, brain cancer, pancreatic cancer. The increase in lung and stomach cancers is evident.

- Females: Patients with cervical cancer, breast cancer, blood cancer, ovarian cancer, uterine cancer, lung cancer, stomach cancer, bone marrow, thyroid cancer, lymphoma cancer, bladder cancer, sarcoma cancer, colon cancer, or appendiceal cancer. The persistent occurrence of cervical and breast cancers is concerning.

58 - 67 Years

- Males: Lung cancer, bladder cancer, esophageal cancer, testicular cancer, head and neck cancer, stomach cancer, rectal cancer, colorectal cancer, kidney cancer, ear cancer, lymphoma cancer, brain cancer, supraglottis cancer, liver cancer, gastric cancer, oral cancer, nasopharyngeal cancer, and others were observed. The prevalence of lung and bladder cancers is notable.

- Females: Cervical cancer, breast cancer, Supralysin cancer, tongue cancer, lung cancer, spinal cancer, esophageal cancer, rectal cancer, ovarian cancer, stomach cancer, ampullary cancer, pancreatic cancer, skin cancer, kidney cancer, lymphoma cancer, eye cancer, and bladder cancer are common. There is a noticeable increase in gastrointestinal cancers.

68 Years & Above

- Males: Mouth cancer, lung cancer, colorectal cancer, bladder cancer, prostate cancer, rectal cancer, esophageal cancer, eye cancer, supraglottis cancer, pancreatic cancer, lymphoma cancer, liver cancer, blood and bone marrow cancer, kidney cancer, head and neck cancer, stomach cancer, parotid cancer, testicular cancer, and Bone Cancer are prevalent. The prevalence of mouth, lung, and colorectal cancers is significant.

- Females: Stomach cancer, lung cancer, gallbladder cancer, lymphoma cancer, periampullary cancer, breast cancer, skin cancer, rectal cancer, esophageal cancer, ovarian cancer, liver cancer, cervical cancer, colon cancer, metastatic cancer, thyroid cancer, bladder cancer, uterine cancer, and buccal mucosa cancer. The significant occurrence of stomach, lung, and gallbladder cancers is notable.

The data revealed a clear pattern of cancer incidence across different age groups and genders in the rural areas of Shimla District. Young children predominantly suffer from hematologic and bone cancers, while adolescents and young adults face a wider range of cancers, including thyroid, bone, and reproductive cancers. As age increases, there are notable increase in gastrointestinal, lung, and reproductive cancers. The prevalence of breast and cervical cancers among females has remained consistently high across multiple age groups. For males, lung, prostate, and colorectal cancers were particularly significantly more common in older age groups. This information is crucial for healthcare providers and policymakers to develop targeted cancer prevention, screening, and treatment programs tailored to the specific needs of these populations.

Research Question 2: Are there any variations in the types of cancer observed between males and females in Shimla District's rural population?

1.2: Blockwise variation in the types of cancer

The data below represent the most prevalent types of cancer across different blocks in the Shimla district, categorized by sex. This analysis identified the leading cancer types affecting males and females in each block and provided insights into regional cancer trends.

Table 2: Prevalence of cancer types in rural areas of Shimla District

Name of Block	Gender	Most Prevalent type of cancer
Basantpur	Male (109)	Lung, Esophageal, Supraglottic, Stomach, Prostate.
	Female (122)	Cervical, Breast, Lung, Ovarian, Uterine.
Chirgaon	Male (132)	Lung, Stomach, Bladder, Rectal, Glottic.
	Female (133)	Lung, Ovarian, Skin, Stomach, Bladder.
Choupal	Male (200)	Lung, Stomach, Bladder, Lymphoma, Supraglottic
	Female (201)	Lung, Breast, Ovarian, Stomach, Uterine.
Jubbal & Kotkhai	Male (267)	Lung, Stomach, Bladder, Prostate, Glottic
	Female (280)	Lung, Breast, Ovarian, Cervical, Sarcoma
Kupvi	Male (25)	Lung, Liver, Bladder
	Female (32)	Cervical, Lung, Ovarian
Mashobra	Male (43)	Lung, Pancreatic, Head & Neck, Cervical, Blood
	Female (65)	Cervical, Breast, Ovarian, Lymphoma, Stomach, Uterine
Narkanda	Male (172)	Lung, Stomach, Lymphoma, Supraglottic, Bladder, Colon.
	Female (172)	Ovarian, Breast, Lung, Cervical, Bladder, Uterine Stomach.
Nankhari	Male (70)	Lung, Stomach, Pancreatic, Rectal, Skin, Supraglottic
	Female (62)	Breast, Ovarian, Lung, Rectal, Skin, Uterine
Rampur	Male (290)	Lung, Stomach, Colon, Bladder, Liver
	Female (259)	Breast, Ovarian, Cervical, Lung, Bladder, Uterine
Rohru	Male (234)	Lung, Stomach, Bladder, Bone Marrow, Pancreatic.
	Female (197)	Ovarian, Breast, Lung, Cervical, Bladder, Uterine
Theog	Male (324)	Lung, Stomach, Bladder, Lymphoma, Blood.
	Female (354)	Cervical, Breast, Lung, Ovarian, Uterine.

Note: Figures in the parentheses are number of cancer patients

Table 2 presents the most prevalent types of cancer among males and females in various blocks of the Shimla district, highlighting significant public health concerns and the necessity for targeted healthcare interventions. Among females, lung cancer is also common but generally ranks behind cervical and breast cancers. Cervical and breast cancers are the leading types of cancer among females in most blocks.

Stomach cancer frequently appears in both males and females across multiple blocks. Additionally, prostate cancer is prevalent among males, and uterine cancer is prevalent among females, highlighting the importance of gender-specific cancer screening and treatment programs.

Concerning regional disparities, Theog, Rampur, and Jubbal & Kotkhai exhibited the highest number of cancer cases, with a diverse range of prevalent cancers. This emphasizes the need for targeted healthcare resources and cancer management strategies in these regions.

The analysis revealed significant trends in the incidences of various cancer types across different blocks in the Shimla district. Lung, cervical, and breast cancers are particularly common, necessitating focused public health strategies to address these issues. By concentrating on high-incidence regions and prevalent cancer types, healthcare systems can enhance cancer prevention, early detection, and treatment outcomes for affected people.

IV. CONCLUSION

Comprehensive analysis of cancer incidence in the rural areas of Shimla district revealed significant age-and sex-specific patterns, as well as regional variations. Children predominantly suffer from hematologic and bone cancers, while adolescents and young adults face a broader spectrum of cancers. In older populations, gastrointestinal, lung, and reproductive cancers are more prevalent. The consistent high incidence of breast and cervical cancers among females and lung, prostate, and colorectal cancers among males highlights critical public health concerns. Regional disparities, with Theog, Rampur, and Jubbal & Kotkhai exhibiting the highest cancer incidences, emphasize the need for focused healthcare resources and cancer management strategies. These findings could lead to valuable insights for healthcare providers and policymakers developing targeted cancer prevention, screening, and treatment programs, ultimately aiming to improve cancer outcomes and healthcare accessibility in the rural Shimla district.

V. ACKNOWLEDGEMENTS

REFERENCES

1. Carmaeia, B. 1993. Molecular mechanisms in cancer induction and Prevention. Environmental Health perspectives supplements 101, 237-245.

2. de Martel, C. Georges, D. Bray, F. Ferlay, J. and Clifford, G. M. 2020. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. Lancet Glob Health.; 8(2):e180-e190. doi: 10.1016/S2214-109X(19)30488-7. Epub 2019 Dec 17. PMID: 31862245.

3. Gaur, D. S. Kishore, S. Harsh, M. Kusum, A. and Bansal, R. 2006. Pattern of cancers among patients attending Himalayan Institute of Medical sciences, Dehradun. Indian J PatholMicrobiol 49, 193-198.

4. Helbock, H. J. Beckman, K. B. Shigenaga, M. K. Walter, P. B. Woodall, A. A. Yeo, H. C. and Ames, B. N. 1998. DNA oxidation matters: The HPLC-electrochemical detection assay of 8-oxodeoxyguanosine and 8-oxo-guanine. Proc Nat AcadSci USA 95, 288-293.

5. Indian council of medical Research. 2001. Annual report of population based cancer registries of the National Cancer Registry programme, ICMR, New Delhi.

6. Koul, P. A. Koul, S. K. Sheikh, M. A. Tasleem, R. A. and Shah, A. 2010. Lung cancer in the Kashmir

valley. Lung India 27, 131-137.

7. Lippman, S. M. and Hawk, E. T. 2009. Cancer prevention: from 1727 to milestones of the past 100 years. Cancer research, 69(13), 5269-5284.

8. Mathur, P. Sathishkumar, K. Chaturvedi, M. Das, P. Sudarshan, K. L. Santhappan, S. and Icmr-Ncdir-Ncrp Investigator Group. 2020. Cancer statistics, 2020: report from national cancer registry programme, India. JCO global oncology, 6, 1063-1075.

9. Prasad, R. R. Singh, J. K. Mandal, M. Kumar, M. and Prasad, S. S. 2005. Profile of gall bladder cancer cases in Bihar. Indian J Med PaediatrOncol 26, 31-35.

10. Rajpal, S. Kumar, A. and Joe, W. 2018. Economic burden of cancer in India: Evidence from cross-sectional nationally representative household survey, 2014. PloS one, 13(2), e0193320.

11. Sharma, R. G. Kumar, R. Jain, S. Jhajhria, S. Gupta, N. Gupta, S. K. Rawtani, S. Kohli, K. Prajapati, L. Gupta, R. Swamy, N. Pathak, D. Verma, H. and Ratnawat, S. S. 2009. Distribution of malignant neoplasms reported at different pathology centres and hospitals in Jaipur, Rajasthan. Indian J cancer 46, 323-330.

12. Somdatta, P. and Baridalyne, N. 2008. Awareness of breast cancer in women of an urban unsettlement colony. Indian J Cancer 45, 149-153.

13. Sumathi, B. Ramalingam, S. Navaneethan, U. and Jayanthi, V. 2009. Risk factors for gastric cancer in South India. Singapore Med J 50, 147-150.