# Cancer Burden in High Altitude Kargil Ladakh: Ten Year Single Centre Descriptive Study

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## Abstract

There is a wide variation in the incidence and prevalence of cancer in different regions of the world and within the same country among different racial and ethnic groups. This descriptive study was undertaken for the first time in the high altitude, landlocked mountainous Kargil Ladakh region to analyze the incidence of different cancers. This study was the need of the hour as there was a rising trend of cancers and cancer related deaths in this region having not even a population of 1.5 lacs, with various risk factors prevalent and peculiar to this region. It was very disheartening to see people die of cancers as young as 40 years. A 10-year (April 2009-April 2019) Hospital based study of 444 cancer patients showed gastric cancer (42.12%), Lung cancer (9.68%) and Liver cancer (9.24%) as the three leading cancers of the region. Gastrointestinal malignancies were the commonest malignancies and together accounted for half (51.35%) of all cancers. Rough terrain, extreme cold, exposure to high UV rays, high altitude with hypoxic conditions, unique food habits of the region, peculiar culture and life-styles and high prevalence of Hepatitis B infections (8.3%) in the region were the various prevalent risk factors. As the pattern of cancers of this region were different from the rest of the India, well designed population-based studies are essential, in future

**Keywords:** Cancer epidemiology, High altitude, Risk Factors, Kargil Ladakh

## Introduction

Latest global cancer data shows that world is facing an epidemic of non-communicable diseases and cancer is responsible for 21% of non-communicable disease deaths [1]. The world cancer burden has risen to 18.1 million cases and 9.6 million cancer deaths in 2018. Globally 1 in 6 deaths is due to cancer. There is a constant rise in cancer cases, but the trend and pattern vary according to the geographical region. According to GLOBOCAN-2018, globally, Lung cancer and Breast cancer are the most common diagnosed cancer and the leading cause of cancer death in males and females respectively [2]. The most frequently diagnosed cancer and the leading cause of cancer deaths, however, substantially vary across countries and within each country depending on the degree of economic development and associated social life-style factors. It has been seen that cancer incidence in India is highest in the North-East region of the country. Lung cancer is the leading cancer site among males, followed by Oral-cavity cancer. In females, Breast cancer is the leading cancer,

followed by cancer of the Cervix [3]. In India, cancer data are obtained from 28 Population-based cancer registries (PBCR) and Hospital-based cancer registries(HBCR) of different region, which are compiled by National Cancer Registry Programme (NCRP) from time to time and publish trends, magnitude and pattern of various cancers.

Kargil Ladakh is a land-locked area of highest plateau in the state of Jammu and Kashmir at a very high altitude ranging from 8780 ft. to 23,000 ft., in the Trans-Himalayan region. Total area of Kargil Ladakh is 14,086 km2 with a population of 1, 40,802 and having Zanskar as its sub-division. The population consists of 77% Muslims and 15% Buddhists and having unique cultural practices, dietary habits and life-styles.

In the historical prospective, the first documented cases of cancer was reported in 1868 by Caley H. He presented the incidence of diseases in the Ladakh region at that time from July-August 1867 and documented 61 cases of Dyspepsia, 6 cases of carcinoma, 1 case of Hepatitis, besides 24 other ailments diagnosed by him at that time [4]. Though he has not mentioned the organ affected, probably stomach or liver could be the site as he reported Dyspepsia as the second most common disease. He highlighted the importance of socio-economic and cultural practices in occurrence of disease in the middle of the nineteenth century. More and more cases of cancer of various organs are being diagnosed during the last 3 decades by doctors in Ladakh due to improved health care delivery system in the region.

Due to non-existence of Population or Hospital based cancer registry or any other cancer related study, no previous data of magnitude of this dreaded disease was available. Hence, an attempt was made to study profile of cancers specific to this geographic region, so that it helps in making well informed policies on cancer care and resource allocation, in future.

## Methods

The present descriptive epidemiological study was carried out at District Hospital Kargil which is the only Multi-specialty hospital of the region. There is no any other alternative private hospital. As Kargil Ladakh remains cut-off from the rest of the state and country for 6 months in the harsh winter, district hospital Kargil serves as the first Sentinel multi-specialty hospital for the entire population, for initial diagnosis, treatment, referral to tertiary centres outside the region, follow-up of the patients after their management at tertiary centres, Chemotherapy of few selected cancer patient and palliative treatment and care of advanced cancer patients. Hence data collection from District Hospital Kargil represents the magnitude and patterns of various cancers of the closed community of whole District. However, it cannot be ruled out that still a few patients might have been missed out being a single centre study.

The data was collected from cancer patients attending district hospital Kargil after the initial diagnosis by clinical examination, ultrasonography abdomen, Upper G.I endoscopy, C.T scan findings and Histopathological Reports. The data collections were started from April 2009 up to April 2019 (Figure 1) from patients diagnosed with cancer in the hospital. Patients who were suspected of cancer and where tissue diagnosis was not made initially, were followed-up after they were referred to attend super-specialty care outside the region and their tissue diagnosis were recorded latter on. In few cases, however, additional endoscopic and histopathological proof of cancer were not required as the diagnosis was obvious from clinical or radiological studies and patients were in advanced stage needing only palliative
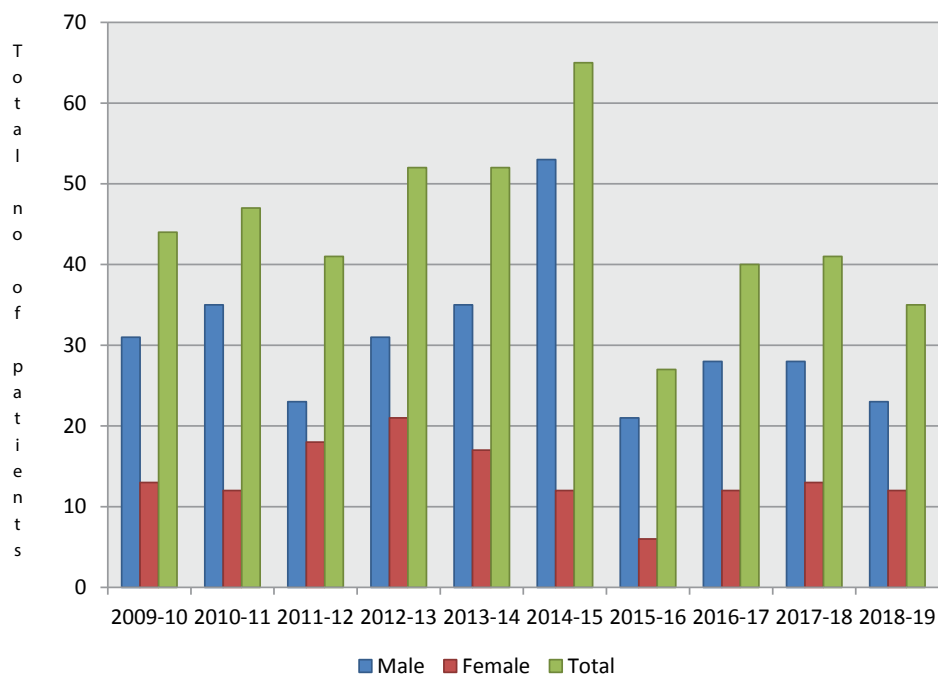


**Figure 1**: Showing Yearly distribution of cancer patients (n=444) in our series over a period of 10 years.

care or where attendants were reluctant to take patient to tertiary hospital in view of advanced stage of cancer and financial constraints. Details of the patient profile, demographic information's, life-style and dietary habits were recorded in detail using a pre-tested semi-structured questionnaire, especially amount of consumption (no. of cups) of traditional salted tea per day, frequency of intake of fresh fruits per week and amount of intake of meat per week on a predefined proforma. Their habit of smoking was also recorded in detail. Their sign and symptoms, details of diagnosis and treatment modalities and staging were recorded in detail. Follow-up of the patients were done for recording the progress of disease, treatment, follow-up investigations and palliative care, in the hospital wards. All the information's were then pooled and processed regularly, using Microsoft Excel and analyzed and presented in the form of tables and figures. Every attempt was made to avoid duplication of data.

## Result

Out of 444 patients who were diagnosed with cancers, 308(69.36%) were males and 136(30.64%) were females, with M: F ratio of 2.26:1. The crude cancer rate of the total population was 31.53 cases/lakh/year. The youngest patient was a 21 days old baby with malignancy of central nervous system(brain) and the oldest patient in our study was a 102 years old patient with Gastric cancer. Sex distribution of cancer across different age groups is shown in table 1. Most of the patients were in the age group of 45-89 years for males and 45-74 years for females. Two-third of the cancer patients were falling in the age group of 45-80 years (Table 2).

Cancer of the Stomach was the most common cancer found in 187(42.12%) patients; 134 males and 53 females; with median age of 56 years for both the sexes. Carcinoma of the Lung was the second most common cancer seen in 43(9.68%) patients, followed by cancer of the Liver seen in 41(9.24%) patients, in both the sexes combined (Table 3). Cancer of the Esophagus was the fourth most common cancer in our study, and when analysed for both the sexes separately, it was again the fourth most common cancer in both of them. Cancer of the Rectum and Urinary Bladder were the fifth and sixth most common cancers, seen in 12(3.89%) and 8(2.59%) patients respectively, in males. Carcinoma of the Gall-Bladder was also common in males and seen in 8(2.59%) patients. In females, cancer of the Gall Bladder was the second most common and breast cancer was the third most common cancers seen in 12(8.82%) and 11(8.08%), respectively. Cancer of the ovary was the fifth most common cancer seen in 10(7.36%) and cancers of the Liver and Pancreas were the sixth and seventh most common cancer seen in 8(5.88%) patients each. Nearly half of the patients had the cancer of gastro-intestinal tract (51.35%) (Table 4). There were only 2(1.48%) cases of cancer of cervix and not a single case of cancer of Penis. Only 2(1.48%) cases of Thyroid cancer was seen and that too, in females and accounted for tenth most common cancer in females. Seminoma of testis was the tenth most common cancer, in males.

In the study population, 138(31.08%) patients were Smokers, 71(15.99%) were Ex-smokers who had quit smoking for >= 2 years and rest were non-smokers, but all of them were exposed to Smoke due to wood - domestic Cooking practices at home due to traditional woody- smoky traditional Chullah's for most of the year. 293(65%) patients used to have > 4 cups of traditional Salty "Noon"-Butter tea and out of which 57(12.84%) patients had the habit of taking > 10 cups of Noon tea per day (Table 5).

All the patients in the study group were non-Vegetarian having dietary habit of intake of Red- meat with fat intake of 1-3 /month in 73(16.45%) patients, 1-2/week in 166(37.38%) patients and 2-4/week in 138(31.08%) patients. In winter, the population used popular stored meats and hot beverages. In the study population, only 5(1.37%) patients were Alcoholic; mostly from Zanskar; where traditional drink "Chang" is popularly used to warm the body during winter and is served as cultural drink there. During six-month winter period almost all the population is devoid of fresh fruits and vegetables as the Zojila Pass connecting Kargil Ladakh to Kashmir valley remains closed and there is no much facility of air-connectivity and fruits-vegetable transportation.

**Table 1:** Showing Age-Sex distribution of Cancers (n=444) in our series.

| Age Range | Males | Females |
|---|---|---|
| 0-14 | 9(02.03%) | 4(00.90%) |
| 15-29 | 9(02.03%) | 4(00.90%) |
| 30-44 | 15(03.37%) | 9(02.03%) |
| 45-59 | 71(15.99%) | 45(10.14%) |
| 60-74 | 145(32.66%) | 65(14.64%) |
| 75-89 | 55(12.38%) | 8(01.81%) |
| = > 90 | 4(00.90%) | 1(00.22%) |
| **Total** | **308 (69.36%)** | **136 (30.64%)** |

**Table 2:** Showing median age and age range with each type of cancer in our series.

| Types of Cancer | Median Age of Cancer Diagnosis | Age Range |
|---|---|---|
| Stomach | 56 | 25-102 |
| Lung | 60 | 48-84 |
| Liver | 52 | 38-78 |
| Gall Bladder | 56 | 38-77 |
| Oesophagus | 60 | 36-80 |
| Rectum | 52 | 18-80 |
| Pancreas | 62 | 50-80 |
| Breast | 45 | 23-72 |
| Urinary Bladder | 55 | 50-70 |
| Ovary | 62 | 27-70 |
| Brain | 62 | 21days-78yrs |
| Colon | 58 | 48-65 |
| Testis | 40 | 34-50 |
| Kidney | 68 | 54-80 |
| Thyroid | 65 | 50-72 |
| Oral Cavity | 55 | 52-67 |
| Malignant Melanoma | 48 | 28-56 |
| Lymphoma | 15 | 12-22 |
| Leukemia | 7 | 6-9 |
| Bone | 26 | 18-35 |
| Thymus | 36 | 20-52 |
| Cervix | 62 | 45-80 |
| Larynx | 77 | 72-80 |
| Nephroblastoma | 10 | 7-14 |
| Cholangio Carcinoma | 60 | 50-70 |

**Table 3**: Showing Ten most common cancers (overall and across sex) in our study.

| No. | Sites | No. of Patients (%) | Males (%) | Females (%) |
|---|---|---|---|---|
| 1 | Stomach | 187 (42.12%) | 134 (71.65%) | 53 (28.35%) |
| 2 | Lung | 43 (9.68%) | 38 (88.37%) | 05 (11.63%) |
| 3 | Liver | 41 (9.24%) | 33 (80.48%) | 08 (19.52%) |
| 4 | Esophagus | 22 (4.96%) | 12 (54.54%) | 10 (45.46%) |
| 5 | Gall Bladder | 20 (4.50%) | 08 (40.00%) | 12 (60.00%) |
| 6 | Rectum | 13 (2.92%) | 12 (92.30%) | 01 (07.70%) |
| 7 | Pancreas | 13 (2.92%) | 04 (30.76%) | 09 (69.24%) |
| 8 | Breast | 11 (2.47%) | - | 11 (100%) |
| 9 | Ovary | 10(2.25%) | - | 10 (100%) |
| 10 | Urinary Bladder | 09(2.02%) | 08 (88.88%) | 01 (11.12%) |

**Table 4:** Showing Top ten Cancers in Males and Females (n=444) in our study.

| | Males=308 | | | Females= 136 | |
|---|---|---|---|---|---|
| Serial No | Types | No. of Patients (%) | Serial No | Types | No. of Patients (%) |
| 1 | Stomach | 134(43.50) | 1 | Stomach | 53 (38.97) |
| 2 | Lung | 38(12.33) | 2 | Gall Bladder | 12 (8.82) |
| 3 | Liver | 33(10.70) | 3 | Breast | 11 (8.08) |
| 4 | Esophagus | 12(3.89) | 4 | Esophagus | 10 (7.36) |
| 5 | Rectum | 12(3.89) | 5 | Ovary | 10 (7.36) |
| 6 | Urinary Bladder | 08(2.59) | 6 | Liver | 08 (5.88) |
| 7 | Gall Bladder | 08(2.59) | 7 | Pancreas | 08 (5.88) |
| 8 | Brain | 06(1.94) | 8 | Lung | 05 (3.68) |
| 9 | Colon | 04(1.29) | 9 | Cervix | 02 (1.48) |
| 10 | Testis | 04(1.29) | 10 | Thyroid | 02 (1.48) |
| | others | 49(15.90) | | Others | 15 (11.02) |

**Table 5**: Showing association between no. of cancer patients and Dietary risk factors and Smoking.

| Risk Factors | Amount of consumption | No. of Patients with Cancer | Percentage |
|---|---|---|---|
| Salted tea | <4 Cups /day | 151 | 34.00% |
| | 4-10 Cups/day | 236 | 53.16% |
| | >10 Cups /day | 57 | 12.84% |
| Fruits | <1 /Wk | 261 | 58.78% |
| | <4/Wk | 109 | 24.55% |
| | >4/wks | 74 | 16.67% |
| Red meat | 1-3/m | 73 | 16.45% |
| | 1-2 /wk | 166 | 37.38% |
| | 2-4/wk | 138 | 31.08% |
| | >4/wk | 67 | 15.09% |
| Tobacco Smoker | | 138 | 31.08% |
| Ex-Smoker | | 71 | 15.99% |
| Non-Smoker | | 235 | 52.93% |

## Discussion

The magnitude and profile of cancer in Ladakh is not reported in any study, till date. It was necessary to measure the burden and distribution of various cancers in the area to ensure well informed policies on cancer management and prioritization of resource allocation.

In the present study, out of 444 cancer patients, 308(69.36%) were males and 136(30.64%) were females with M: F ratio of 2.3:1. More men were reported to have cancer as compared to women for all the commonly encountered cancers like Gastric (2.5:1), Lung (7.6:1),Liver (4.1:1),Oesophagus (1.2:1) , Colo-rectal (5.3:1) cancer, except Gall-Bladder (1:1.5),Pancreatic (1:2) and Thyroid (1:2) cancer, where the ratio was reverse. Male predominance was also seen in other regions like Kashmir [5-7], Delhi and Mumbai but reverse in Bangalore and Chennai, as per Hospital Based Cancer Registries (HBCR) of these regions [3].

This study showed the Cancer of Stomach as the most common cancer found in 187(30.06%) patients, 134 males and 53 females. Stomach cancer is also the leading cancer in both males and females. Two years cancer registry record of neighbouring Leh District also shows Cancer of the Stomach as the leading cancer with 19 cases in 2017-18 and 22 cases in 2019-19 [8], almost similar in comparison to our study in Kargil district with 21 cases in 2017-18 and 19 cases in 2018-19. Prevalence of gastritis and Gastro-Esophageal Reflux Disease (GERD) are also very high in Ladakh region [9]. A hospital based study in Kashmir in 2012 also showed Stomach cancer as the most common reported cancer [6,7,10], but another study in the same year [5] showed Esophageal cancer as the most common cancer of Kashmir. The Hospital based cancer registry of SKIMS-Srinagar from 2012-2014 shows Stomach cancer as the most common cancer in males, where as it is the third most common cancer in females after Esophageal and Breast cancer, in Kashmir.

Our findings are in direct contrast to national cancer registries (2012-2014) where cancer of the Oral Cavity is the most common cancer in males especially in Delhi and Mumbai and Breast cancer is the most common cancer in females as per the National Cancer Registries of Mumbai, Delhi, Chennai and Chandigarh [3,11]. Esophageal cancer seen in 22(4.96%) patients was the fourth most common cancer in both males and females combined and together with stomach cancer, gastro-esophageal cancer accounted for 47% of all malignancies in our study. The high rates of gastro-esophageal cancer in Ladakh region is alarming and may be due to the fact that majority of the risk factors are prevalent in this region. Dietary habits, Smoking, H.Pylori infection, Genetic susceptibility etc. are widely studied [9]. In Ladakh, the most important specific food habit is the consumption of large quantities of hot, salted, butter tea; locally known as "noon" tea or "Gurgur" tea; which is made of local butter added to boiling water mixed with common salt (Nacl), Sodium bicarbonate(soda), milk and green tea leave extracts. In our study, all the cancer patients had the habit of taking this traditional tea, with 34% patients taking <4 cups/day, 53.16% patients taking 4-10 cups/day and 12.84% having the habit of taking >10cups/day of "Noon" tea, especially during the winter 6 months (Table 5).

The sodium bicarbonate(soda) and common salt (Nacl) are well-known irritants of gastric epithelium and have been considered as risk factor for gastric cancer. Salt-tea showed the formation of high amount of N-nitrosopipe-colic acid with several unidentified non-volatile N-nitroso compounds on nitrosation of green tea extracts, which all are irritants to the gastric mucosa [12]. High consumption of Red-Meat and fatty meal are another worrisome risk factors of the area, with all the cancer patients in this study taking the red-meat frequently and mostly taking > 4/week, especially in the winter 6 months (table 5) to keep the body warm. Habit of taking barbecued meat was found to be prevalent in the Zanskar sub-region. Another important risk factor seen in our study was the less intake of fresh fruits and vegetables, with 58.78% patients taking <1/week, 24.55% taking <4/week, and only 16.67% taking fresh fruits and vegetables > 4/week. This was due to loss of air and road connectivity with other parts of the state and country, for 6 months (November-April) in harsh winter, forcing the population to eat excess of dry, raw food stuffs, stored meats, stored tinned food items, besides traditional spicy foods and pickles. All these traditional food habits are the risk factors for Gastro-Esophageal and many other varieties of cancer [6, 9,12,13-14]. Fresh vegetables and fruits are considered to be probable protective factors and other food habits like high rice intake, pickled food, spicy food, smoked, dried, salted meat, use of soda etc. are the significant dietary risk factors of cancer [15]. Another risk-factor in Ladakh is the high colonization of H.Pylori in this population [16-18]. H.Pylori is carcinogenic to humans based on epidemiological evidence [16]. There is 2-3fold increase in gastric cancer among individuals exposed compared to non-exposed ones. The Cag A gene of H.Pylori is the main virulence factor which is responsible for the development of gastric cancer through derangement of cellular architecture and signalling pathway.

The prevalence of H.Pylori is high in India due to low socio-economic condition and poor hygiene. The frequency of Cag A IgG was found to be more common in the healthy controls (89%) compared to gastric cancer patients (76%) [19]. The studies conducted in India over the last 10 years, however, failed to confirm the association between H.Pylori infection and gastric cancer. This is mainly because of high prevalence of H.Pylori infection in Indian population and small sample size of most of the studies [15]. There might be complex interaction between dietary and life-style related factors, H.Pylori infection with certain strain types, in presence of genetic polymorphism, along with heightened inflammatory response that may produce a cascade of changes at molecular level and ultimately cancer cells of the stomach, and needs an in-depth research in future [20]. H.Pylori strains from Ladakh are genetically distinct and possibly less virulent than the isolates from East-Asian countries, such as china and Japan where the prevalence of gastric cancer are very high [18].

We observed Lung cancer as the second most common cancer in males but eight most common cancers in females, with M: F ratio of 7.6:1. This striking difference may be because of smoking pattern which was not seen even in a single female patient in our study. Use of Tobacco in the form of cigarette smoking, hukka and chewing were seen in 138(31.08%) patients. 71(15.99%) patients were ex-smokers and had quit smoking for >=2 years. Only 5(1.37%) patients were alcoholic and were mostly from Zanskar subdivision where local drink called "Chang" is very popular and keeps the body warm at this high altitude area. Tobacco is an independent risk factor for Lung cancer, Stomach cancer and many other cancers while Alcohol may be carcinogenic to Esophagus, Cardia and Liver [14]. All the patients in our study were exposed to smoke with domestic wood cooking practices with traditional "chullahs" at home with the practice of closing all the windows and sealing them with plastic in winter, thus leading to heavy smoke exposure. International Agency for Research on Cancer (IARC) has reported that there is association between Tobacco use and smoke with cancer of Lung, oral-cavity, Pharynx, Esophagus, Larynx, Urinary Bladder, Ovary, Colon and Rectum [20,21]. Tobacco related cancers contribute to two-thirds of all cancers, with three-fourths of cancers among men and more than half of cancers among women. SKIMS Srinagar cancer registry (2012-2014) also showed Lung Cancer as the Second most common cancer in males, in Kashmir, where as it is the sixth most common cancer in females [3]. Another study in Kashmir Valley showed that Lung cancer had highest incidence among the males of Srinagar district of Kashmir Valley [22]. According to Cancer registry of SNM Hospital Leh, they observed five cases of Lung cancer in 2017-2018 and three cases of Lung cancer in 2018-2019[8], with no further elaborate data available. Our study is consistent with National Population Based Cancer Registries (HBCR) of Mumbai, Bangalore and New Delhi which showed Lung cancer as the second most common cancer in males [3].

We observed Liver cancer as the third most common cancer in our study, in 41(9.24%) patients, with M:F ratio 4.1:1. The high incidence of Liver cancer in our region is due

to the fact that the prevalence of Hepatitis B virus is very high in Ladakh region. In Kargil district, the prevalence of Hepatitis B infection is 7.86%-8.3%, where as its prevalence is 3.3-5.75 % in Leh [23-24], 1.2% in Srinagar [25] and 2.445 in Jammu region of Jammu and Kashmir [26]. Chronic Hepatitis B infection is one of the most important causes of Hepato-Cellular carcinoma (HCC) in Kargil Ladakh. Our findings are in contrast to National population based registries of New Delhi, Mumbai, Chennai, Calcutta and Bangalore and hospital based cancer registry of SKIMS Srinagar, where Liver cancer is less common [3].

Our study showed cancer of Gall bladder as the fifth most common finding in Kargil Ladakh and it was second most common cancer in females. It may be due to the fact that the prevalence of gall-stone disease is again very high in Ladakh Region [16,27]. Cancer of Gall-Bladder was the sixth most common cancer in females and tenth most common cancer in males, in hospital-based cancer registry of SKIIMS Srinagar. At national level, cancer of Gall bladder is the fourth most common cancer of females in national population-based cancer registries of Mumbai, New Delhi and Chandigarh.

Cancer of the Rectum was the Sixth most common cancer in our study with 13(2.92%) patients and together with Colon cancer(seen in six patients), it represented 4.28% of cancer patients: with M: F ratio of 5.3:1. The risk factors involved in the rise of Colo-Rectal cancer in this region may be due to vanishing habit of high fiber ancestral diets like" Khulak" and "Pappa", and increased westernization such as Obesity, Physical inactivity including less of agrico-farming activities in modern generation, heavy metal contamination of soil, food and water, use of pesticides, dyes and artificial coloring agents(like Tartazine), food adulteration, reuse of frying oils, increased intake of Killer foods(junk food, snacks, cold-drinks etc.) that are added with dangerous activities and adulterants. Even the milk and milk products in the market contain chemicals such as detergents (caustic soda). Artificial coloring agent or dyes like Tartazine has been found in many edibles, spices and condiments in the area. Tartazine metabolizes to Benzidine and 4-amino bi phenyl, listed under 'known- carcinogenic' category in 13th report on carcinogens by U.S Department of Health and Human Services. Many international studies have linked presence of Heavy Metals (potential carcinogen) in soils, vegetables, fruits and drinking water, to gastrointestinal cancers. All such trends are leading to a health catastrophe especially cancer in Ladakh as there is very little research and monitoring locally. There definitely is a need to investigate role of these potential carcinogens and contaminants vis-à-vis cancer in the region.

In neighbouring Leh district, three cases of Colo-Rectal cancer were observed in the year 2018-19, as per cancer registry of SNM Hospital Leh [8]. No further details could be obtained. National hospital-based cancer registry of SKIMS Srinagar shows Colo-Rectal cancer as the Fourth most common cancer in both males and females. In Contrast, National Population based Cancer Registries don't figure Colo-Rectal cancer among the ten most common malignancies. The frequency of Colo-Rectal cancer varies

remarkably among different populations in India and globally [28].

Carcinoma of Breast was the third most common cancer in females in our study, in contrast to Kashmir region where it was the second most common cancer after the gastro-intestinal malignancies [5]. It is known that breast feeding and having child at an early age, appears to be protective in breast cancer, especially if associated with late menarche and early menopause. Breast cancer is known to be common in nulliparous women. It is also seen that in post-menopausal women, breast cancer is more common in the obese. Long-term exposure to the combined preparation of Hormone replacement therapy does significantly increase the risk of developing breast cancer. In other cities of the country like Chennai, Mumbai, Chandigarh and New Delhi, breast cancer is the most common cancer in females, followed cancer of Cervix Uteri [3]. We encountered only two cases of carcinoma Cervix and not a single case of cancer of penis. This may be because of absence of risk factors like sexual promiscuity and the ritual of early religious Circumcision in this Muslim dominant area, because these risk factors have been implicated in the direct acquisition of infection by oncogenic strains of Human Papilloma Virus (HPV) [29,30].

Seminoma of Testis was found in 4(1.29%) patients in our study, with median age of 40 years, with all of them associated with undescended testis. Two of the Seminoma testis patients presented to our hospital with torsion of giant intra-abdominal testicular tumors [31]. Undescended testis is a risk factor for the cancer of Testis and they report late due to shyness or associated social stigma. The cancer risk of an ectopic testis is 40 times higher than in normal testis, and an abdominal testis is 4 times more likely to undergo malignant degeneration than an inguinal testis.

We encountered only a small no. of Oral cavity cancer (0.67%) in our study, which is among the top three types of cancers in India, and among the most common cancers in males in Mumbai, New Delhi and Utter Pradesh [32]. Tobacco consumption habits especially Tobacco chewing, Gutka, Pan Parag, Zaeda, Khainni etc. are increasingly becoming prevalent, a habit adopted due to high influx of labourers from outside the region.

Due to the alarming rise of cancer in Ladakh region, the Jammu and Kashmir Govt. has already established a chemotherapy centre in the twin frontier districts of Kargil and Leh as it was increasingly becoming difficult for the cancer patients from these districts to visit Srinagar for Chemotherapy doses. Oncologists attribute the increase in cancer deaths to inadequate cancer- related infrastructure and lack of awareness among the people about the disease. Majority of the cancer patients in our study presented late with advanced stage of disease. There is need for urgent mass awareness programme and need for urgent screening protocol to identify patients at earlier stages of the cancer.

The strength of our study is that the detailed epidemiological data were collected in this high altitude mountainous region over a vast period of ten years and also studied the relationship between these cancers and the unique food habits, peculiar personal and cultural habit,

life-style changes in this extreme cold terrain and various other prevalent risk factors, which needs to be investigated further. The weakness of our study is that being a single centre study, still some patients might have been missed out. Establishment of a Hospital based cancer registry programme and population based epidemiological study is needed in future, to establish the true picture of cancer in Ladakh, as this study is far from the true picture of cancer prevalent in this high altitude region.

## Conclusion

The present study is probably the first study in the Ladakh region about the cancer burden and distribution. Malignancies of the Gastro-intestinal tract were the most common (51.35%), followed by Lung Cancer and Liver Cancer. Majority of the risk factors of these cancers are prevalent in this Cancer endemic zone. Majority of the patients presented late, in advanced stage. As Cancer rates spiral in this region, cancer awareness programme, establishment of a proper cancer registry and establishment of active cancer society is the need of the hour to bring a wind of change in Ladakh.

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