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KASHMIR, THE CRUCIBLE OF CANCER: A PHENOMENOLOGICAL REVIEW ARTICLE ON INCREASING PREVALENCE OF CANCER IN THE VALLEY FROM 1986 TO 2026

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ABSTRACT

The Kashmir Valley, home to some 8 million people in a Himalayan basin, has historically been known for its unique cancer profile—an anomaly in South Asia with stomach, esophageal, lung and breast cancer rates three to six times higher than the national average in India. Using data available only in the Sher-I-Kashmir Institute of Medical Sciences (SKIMS) Hospital-Based Cancer Registry reports, ICMR's National Cancer Registry Programme (NCRP) estimates, Union Health Ministry disclosures, Right-to-Information (RTI) documents, J&K Legislative Assembly replies, and over two dozen peer-reviewed papers, this review outlines a 40-year history of cancer in the valley. The evidence points to a grim reality: more than 66,000 cancer cases were registered at SKIMS Soura alone from 2014 to 2025, with the number increasing from 3,940 in 2014 to 5,791 in 2025—a 47% rise in just over a decade. This review amalgamates the epidemiological and etiological evidence, district-specific hotspots, molecular characteristics, and infrastructural deficits that collectively constitute the "cancer epidemic" in Kashmir. Concurrently, the number of PET scans performed at the SKIMS increased from 1,410 in 2024 to 2,250 in 2025, a 60% increase over a 12-month period that reflects growing diagnostic capacity to detect cases that were previously unrecognized.

KEYWORDS: Esophageal, South Asia, SKIMS, Union Health Ministry, Epidemiological, PET Scans, Environmental Carcinogenesis

1. INTRODUCTION

The first scientific account of cancer in Kashmir dates back to 1866, when the British surgeon Dr. William Jackson Elmslie from the Church Missionary Society documented "Kangri burn cancer"—the squamous cell carcinoma resulting from prolonged exposure of the skin to the traditional Kangri fire pot. What began as a stark, monodominant profile of oncology in Kashmir nearly 160 years ago has now transformed into a significantly more complex multi-etiological epidemic. Once characterized by a near-singular focus on esophageal squamous cell carcinoma (which composed 21.5% of all cancers in early hospital registries conducted by Matto and Kaul), Kashmir now struggles with a devastating trio of gastrointestinal cancers, tobacco-related malignancies, and lifestyle-driven conditions that distinctively separate it from the epidemiological patterns observed across the rest of South Asia.

The valley is in an extraordinarily precarious situation. Its multiethnic, predominantly Muslim population—evolved over centuries to survive sub-zero temperatures in a high-altitude Himalayan basin—has developed a unique material and culinary culture. Elements such as the daily intake of high-temperature salted noon-chai, reliance on the charcoal-filled kangri fire pot, heavy hookah usage, and the consumption of sun-dried hokh-syun vegetables and smoked fish during non-agricultural winter seasons have been reframed under contemporary molecular epidemiology as a dense matrix of carcinogenic exposures. Layered on top of these historical practices are the profound toxic chemical exposures of the past three decades: the intense, unfettered deployment of mancozeb, captan, and chlorpyrifos within the 193,109-hectare apple orchard belts of Shopian, Pulwama, Kulgam, and Anantnag. These pesticides, heavily restricted or outright banned by international bodies like the European Union due to their carcinogenic potential, continue to be sprayed extensively in high-density orchards across South Kashmir.

This review seeks to provide a comprehensive, multi-dimensional mapping of the cancer crisis in Kashmir. To resolve the reviewer-noted ambiguities between exploratory etiological assumptions and empirical public health outcomes, this manuscript systematically delineates validated institutional records from emergent molecular hypotheses, using a meticulous triangulation of primary government registries, administrative data acquired via the Right to Information (RTI) Act, and extensive peer-reviewed literature spanning four decades (1986–2026).

2. METHODOLOGY

2.1 Research Design and Framework

This study adopts a robust, secondary-synthesis review framework designed to integrate quantitative epidemiological datasets with qualitative socio-cultural and environmental contexts. Given the profound relationship between the regional environment and human disease patterns in the Kashmir Valley, this approach allows for an analytical model that maps how traditional survival mechanics (e.g., thermal and dietary adaptations to extreme winter cold) intersect dynamically with modern agro-chemical hazards.

2.2 Data Sources and Retrieval Strategy

To build a reliable longitudinal profile and fulfill rigorous standards of academic transparency, empirical data was systematically extracted from six primary administrative and scientific repositories:

- **Hospital-Based Registries:** Longitudinal clinical and histopathological statistics from the Sher-I-Kashmir Institute of Medical Sciences (SKIMS) Hospital-Based Cancer Registry (HBCR) and network data from affiliated tertiary care centers at the Government Medical College (GMC) Srinagar and Shri Maharaja Hari Singh (SMHS) Hospital.
- **National Epidemiological Estimates:** Population-based statistical estimates and projections generated by the Indian Council of Medical Research's (ICMR) National Cancer Registry Programme (NCRP) and the National Centre for Disease Informatics and Research (NCDIR).
- **State Administrative and Legislative Records:** Official public health disclosures, budgetary allocation documents, and formal written responses submitted to the Jammu & Kashmir Legislative Assembly by the Health and Medical Education Department.
- **Legal and Right to Information (RTI) Disclosures:** Certified hospital registration transcripts and year-wise institutional tallies obtained via formal statutory filings under the Right to Information Act by Srinagar-based civil activist Syed Adil.
- **Peer-Reviewed Scientific Literature:** Over two dozen specialized peer-reviewed clinical trials, retrospective case-control protocols, spatiotemporal GIS modeling papers, and molecular oncological studies spanning from 1986 to 2026.



- **Investigative Medical Journalism:** Vetted, fact-checked reporting and expert oncologist statements published in regional and national medical-affiliate press channels (e.g., Greater Kashmir, Kashmir Life) regarding peripheral water-basin contamination and local food safety deficits.

2.3 Inclusion, Exclusion, and Synthesis Protocol

Articles and registries were strictly included if they provided direct, data-linked evaluations of cancer incidence, mortality, geographical clustering, molecular configurations (e.g., gene polymorphisms, mutations), or therapeutic capacity specific to the ten districts comprising the Kashmir Valley basin. Studies focusing generically on broader South Asian populations without regional stratification were excluded.

Data synthesis was executed by thematic triangulation across spatial, clinical, and temporal dimensions. To address potential reporting anomalies, specific adjustments were made during analysis: the pronounced decline in newly registered cancer cases observed across both SKIMS and GMC registries during the 2019–2020 interval was critically analyzed against the backdrop of significant regional sociopolitical disruptions (August 2019 constitutional shifts restricting reference infrastructure) and the acute phase of the COVID-19 pandemic. By treating this drop as a temporary collection artifact resulting from compromised healthcare access and peripheral underreporting rather than a genuine decline in population-wide disease incidence, this methodology prevents artificial downward skews in the long-term longitudinal trajectory.

3. THEMATIC LITERATURE REVIEW & SYNTHESIS

3.1 The Shifting Gastrointestinal Malignancy Paradigm

In stark contrast to global and national oncological patterns—where pulmonary and mammary malignancies overwhelmingly dominate primary diagnostic rankings—the Kashmir Valley exhibits an atypical gastrointestinal (GI) dominant oncological landscape, with malignancies of the digestive tract consistently accounting for more than one-third of the aggregate regional cancer burden. This structural asymmetry is firmly established across multiple institutional datasets. A seminal five-year cross-sectional descriptive audit conducted by Manzoor et al. (2023) at GMC Srinagar examined 5,392 histopathologically proven malignancies across an extensive tertiary care network catering to a vast segment of the valley's population. The investigation demonstrated that gastrointestinal malignancies

composed more than 35% of all cases, with stomach cancer emerging as the absolute leading malignancy overall (17.2%), followed sequentially by lung (12.4%) and colorectal (11.3%) carcinomas. The cohort displayed a striking demographic imbalance, with an overall male-to-female ratio of 59:41 and an average age at clinical diagnosis of 56.73 years, peaking sharply within the 60–69 age demographic.

The relentless rise of gastric oncology has been further clarified through advanced spatial modeling. Mushtaq et al. (2025) executed an extensive 12-year spatiotemporal analysis of 5,554 gastric cancer cases retrieved from the centralized hospital-based cancer registries of the valley covering the period from 2014 to 2023. Employing Geographic Information Systems (GIS) hotspot mapping, spatial autocorrelation, and localized trend analyses, the investigators revealed that the burden of stomach cancer is not only steadily increasing but remains extraordinarily high across all ten districts. This disease profile is heavily skewed toward males, who constituted 75.59% of the aggregate cohort, with incidence rates accelerating dramatically after age 40 and reaching maximum density in the 60–79 age category. The district-level breakdown extracted from this geospatial baseline demonstrates a profound geographic concentration, particularly within the southern agricultural zones:

District	Incidence Rate (per 10,000 population)
Kulgam	10.33
Shopian	8.79
Pulwama	8.58
Srinagar	7.32
Anantnag	7.02
Budgam	6.31
Ganderbal	6.24
Baramulla	5.32
Bandipora	4.81
Kupwara	3.35

Table 1: Spatiotemporal Gastric Cancer Incidence Distribution Across Kashmir Districts (Source: Mushtaq et al., 2025).

The spatial clustering models indicate that South Kashmir constitutes a highly contiguous, high-risk gastric cancer belt. Over the analyzed 12-year tracking period, the localized surge has been severe, with Kulgam documenting a 146.7% escalation in annual gastric cancer diagnoses, followed by substantial increases in northern and central sectors, including Baramulla (109.8% rise) and Bandipora (106.3% rise). This contemporary dominance represents an evolutionary shift from historical benchmarks; the earlier 2006–2012 Shri Maharaja Hari Singh (SMHS) Hospital-Based Registry reports compiled by Qurieshi et al. had initially established gastric malignancies at 18.8% of all total cancer admissions and 25.2% among males, signaling a long-standing baseline that has steadily worsened under modern lifestyle transitions.

3.2 Behavioral and Cultural Carcinogenesis: The Triad of Local Adaptations

The persistence and intensity of upper-gastrointestinal and cutaneous malignancies are profoundly intertwined with specialized socio-cultural practices historically developed to survive the region's harsh sub-zero alpine winters. This behavioral carcinogenesis operates through three distinct native mechanisms:

3.2.1 The Thermal and Chemical Impact of Salted Pink Tea (Noon-Chai)

Historically, esophageal squamous cell carcinoma (SCC) represented the undisputed dominant malignancy in the valley, with early landmark investigations by Khuroo et al. noting that esophageal lesions comprised 46.1% of all gastrointestinal tract cancers. This clinical volume generated age-standardized hospital-based incidence rates of 43.6 per 100,000 in men and 27 per 100,000 in women, positioning Kashmir firmly on the southern frontier of the Central Asian "esophageal cancer belt" running from northern Iran to western China. Unlike modern Western populations where distal esophageal adenocarcinoma secondary to chronic gastroesophageal reflux is standard, more than 95% of histologically confirmed Kashmiri esophageal malignancies present as squamous cell carcinomas of the upper and mid-esophagus.

Etiologically, this specific localization is tied directly to the habitual consumption of Noon-Chai (a traditional pink salted tea prepared from a brick-tea base boiled with sodium bicarbonate and sodium chloride), which is routinely ingested at near-boiling temperatures multiple times per day. Mir and Dar (2009) established that this cultural practice inflicts a highly destructive dual insult on the consumer. Mechanistically, the near-scalding liquid creates severe, repetitive thermal trauma to the esophageal mucosa, inducing chronic cell-

proliferative stress, localized inflammation, and squamous metaplasia. Chemically, analytical evaluations of the tea base have revealed significant concentrations of volatile secondary and tertiary amines—including methylamine, diethylamine, pyrrolidine, and methylbenzylamine. When interacting with native dietary nitrites within the high-salt, alkaline gastric milieu accelerated by the tea's sodium bicarbonate profile, these compounds undergo endogenous nitrosation to produce preformed N-nitroso complexes, such as N-nitrosopiecolic acid, which act as highly potent, aggressive carcinogens on the mucosal surface.

This exogenous chemical insult has been verified at the molecular level. Genetic analyses of Kashmiri esophageal squamous cell tumors reveal that 36.36% possess explicit point mutations within the TP53 tumor suppressor gene. Crucially, these mutations are characterized by an exceptionally high frequency of G:C transversions and a remarkably low incidence of CpG transitions. This highly specific mutational signature serves as definitive molecular proof that the oncogenesis is driven by bulky, exogenous environmental chemical carcinogens (such as N-nitroso structures) rather than endogenous, spontaneous hydrolytic deamination. Furthermore, these TP53 mutations display a strong positive correlation with localized tissue zinc deficiencies. Concurrently, while 5.6% of these regional squamous carcinomas exhibit epidermal growth factor receptor (EGFR) mutations, adjacent pathways such as BRAF, β -catenin, and HER2 consistently maintain a wild-type configuration, confirming a unique, localized pathway of chemical carcinogenesis.

3.2.2 Pulmonary Oncology and the Traditional Hookah Burden

While gastrointestinal cancers lead overall metrics, lung cancer remains the single most frequent primary malignancy among Kashmiri males, presenting a severe public health crisis. A fundamental case-control protocol implemented by Koul et al. comprised an extensive audit of 251 confirmed lung cancer cases matched against 500 age- and sex-stratified non-cancer controls. The results conclusively demonstrated that active smoking behavior was associated with a more than four-fold escalation in pulmonary malignancy risk. Crucially, individuals utilizing the traditional water-pipe, or hookah, exhibited the highest vulnerability, demonstrating an approximate six-fold increase in lung cancer risk (Odds Ratio, OR = 5.83) compared to non-smoking cohorts. This relationship demonstrated a clear, undeniable dose-response effect: the risk increased linearly with the daily frequency and cumulative duration of hookah sessions.

These findings directly dismantle a widespread, deeply embedded cultural assumption within the valley that hookah smoking represents a relatively benign or "filtered" alternative to

commercial cigarette smoking. In reality, the traditional operation of the hookah in Kashmiri households significantly compounds toxic chemical exposure. Koul et al. noted that the water within the internal chamber is rarely changed between consecutive smoking sessions, often remaining stagnant for days. As a result, the water trap quickly becomes saturated with combustion byproducts, completely losing its nominal scrubbing capability. This forces the user to draw deeply against highly concentrated, uncooled volumes of mainstream smoke heavily laden with volatile polycyclic aromatic hydrocarbons (PAHs), carbon monoxide, and tobacco-specific nitrosamines, resulting in aggressive oncogenic stimulation deep within the pulmonary architecture.

3.2.3 Cutaneous Oncogenesis and the Kangri Fire Pot

The unique intersection of extreme climate survival and oncology is most visibly manifested in "Kangri burn cancer," a highly localized cutaneous malignancy comprehensively analyzed by Hassan and Sajad (2016). To combat the sub-zero winters, individuals across all demographic groups utilize a Kangri—an earthenware bowl encased in handmade willow wicker, filled with glowing ignited charcoal wood embers. This portable heating apparatus is worn directly beneath the Pheran, a long, loose traditional woolen robe, and is placed in close contact with the anterior abdomen and inner thighs while sitting.

Prolonged, repetitive exposure to the intense radiant heat generated by the Kangri—which averages sustained temperatures of approximately 150°F (65.5°C)—induces a state of chronic thermal injury. Over a typical duration of 4 to 5 consecutive winter seasons, this persistent thermal stress precipitates the development of *erythema ab igne*, a localized, reticulated hypermelanosis characterized by permanent cutaneous erythema and epidermal atrophy. Left unmitigated, these lesions undergo cellular atypia, frequently progressing into Bowen's disease (carcinoma in situ) before developing into invasive, highly aggressive squamous cell carcinoma of the skin. Clinically, Kangri carcinomas manifest as painful, bleeding, noduloulcerative exophytic masses localized almost exclusively to the anterior abdominal wall and the medial aspects of the thighs. The oncogenesis is dual-action: primarily driven by chronic, severe thermal trauma that impairs localized DNA repair mechanics, and secondarily accelerated by the continuous inhalation and transdermal absorption of volatile combustion organics and charcoal particulates trapped beneath the enclosed space of the Pheran robe.

3.3 The Agro-Chemical Vector: Orchard Pesticide Intensification

While dietary habits and traditional heating mechanisms define the historical baseline of

cancer in Kashmir, the primary driver behind the modern escalation of cancer over the past three decades is the intensive use of chemical pesticides. The valley's agricultural economy is heavily anchored by its massive fruit production sector, with high-density apple orchards currently spanning 193,109 hectares. Approximately 90% of this total acreage is concentrated within seven specific districts: Budgam, Anantnag, Baramulla, Kupwara, Shopian, Kulgam, and Pulwama. To maximize crop yields and secure rapid economic returns from high-market-value apple varieties, regional farming practices have shifted toward an intensive chemical application schedule. Current administrative estimates indicate an aggregate annual application exceeding 10,936 metric tonnes of hazardous compounds, including 3,186 metric tonnes of the neurotoxic organophosphate chlorpyrifos, 3,400 metric tonnes of the dithiocarbamate mancozeb, and 4,350 metric tonnes of the dicarboximide captan. Notably, both mancozeb and captan are classified as clear carcinogens by the European Union, with mancozeb being entirely banned from commercial deployment due to its endocrine-disrupting and oncogenic profiles.

The severe neuro-oncological consequences of this intensive chemical exposure were first identified in a landmark retrospective case-control protocol conducted by the Department of Neurosurgery at SKIMS (Bhat et al., 2010). The investigators evaluated 432 histopathologically confirmed cases of primary malignant brain tumors alongside 457 age-matched non-exposed controls over a three-year period. The findings revealed an extraordinary epidemiological correlation: 90.04% of all confirmed primary brain malignancy patients (389 out of 432) were directly employed as orchard farm-workers, resided immediately adjacent to pesticide-spraying zones, or were children playing frequently within the orchard properties. These individuals possessed documented histories of continuous, long-term (10 to 20 years) occupational exposure to complex chemical mixtures comprising organophosphates (chlorpyrifos, dimethoate, phosalone), dithiocarbamates (mancozeb), dicarboximides (captan), and organochlorines (endosulfan).

The clinical data from this pesticide-exposed cohort revealed several highly alarming features:

- 1. High Histological Grade: Every single one of the 389 orchard-associated cases presented with highly aggressive, high-grade malignancies, dominated by glioblastoma multiforme (GBM), anaplastic astrocytoma, and medulloblastoma.



- 2. **Elevated Mortality:** The documented short-term mortality rate among pesticide-exposed patients stood at 12%, significantly exceeding the 7% mortality rate observed among non-orchard, non-chemical-exposed brain tumor cohorts.
- 3. **Vulnerable Demographics:** The disease profile extended heavily into young and developmental populations, with 31.9% of the orchard-associated cases presenting in individuals under the age of 40, including 31 young children and 23 pregnant women, raising deep concerns regarding transplacental exposure and fetal neurotoxicity.
- 4. **Familial Clustering:** The study identified distinct familial clustering, with three separate orchard-resident families displaying multiple concurrent cases of primary malignant gliomas, strongly indicating a dangerous synergy between shared environmental chemical saturation and inherited genetic vulnerabilities.

Biochemically, these exposed patients exhibited highly variable serum cholinesterase (SCE) levels, returning an odds ratio of 0.28 for primary cases and 1.5 for immediate family controls. This indicates that pesticide-induced glioma genesis may operate through complex, non-cholinergic pathways—such as the systematic disruption of cyclic adenosine monophosphate (cAMP) cell-signaling cascades—rather than through simple, conventional acetylcholinesterase inhibition. Geographically, the alignment is undeniable. The highest incidence rates of primary malignant brain tumors are concentrated within Anantnag, Budgam, and Baramulla, followed closely by Kulgam and Shopian. As illustrated in Figure 1, these high-density neuro-oncology zones align perfectly with the high-risk gastric cancer hotspots mapped by Mushtaq et al. (2025) and correspond precisely with the high-density apple orchard fruit-baskets of the valley. This geographic overlap underscores a population heavily exposed to systemic agro-chemical contamination. Dr. Iqbal Saleem of GMC Srinagar has noted that the indiscriminate, unscientific overuse of these fertilizers and chemical sprays, driven by immediate commercial interests, has led to widespread contamination of local food supplies and groundwater basins, inducing structural changes in human genetic architecture that manifest as regional cancer clusters.

Expert Insight: 'The food safety and public health engineering departments have been criminally silent on pesticide contamination in the water that people consume.' — Senior Oncologist, Sher-I-Kashmir Institute of Medical Sciences (SKIMS).

3.4 Divergent Oncological Profiles: Pediatric vs. Adult Demographics

The regional cancer paradigm changes significantly when stratified by age, revealing a stark divergence between adult epithelial carcinomas and pediatric embryonal malignancies. Sofi et al. (2022) executed a comprehensive 10-year retrospective audit analyzing 1,036 pediatric oncology patients (aged under 15 years) admitted to the regional cancer center at SKIMS between 2010 and 2019. The study established that childhood malignancies account for approximately 2.66% of the aggregate regional cancer burden. The pediatric cohort demonstrated a pronounced male predominance (57.9% male, 42.1% female) and an overwhelming geographic concentration within rural territories, which accounted for 84.9% of all childhood admissions.

Unlike the adult population—where carcinomas of the gastrointestinal and pulmonary systems represent the primary diagnostic volume—the pediatric oncological spectrum is heavily dominated by hematological malignancies and solid embryonal tumors. Acute leukemia emerged as the leading diagnosis overall, accounting for 36.6% of cases (predominantly Acute Lymphoblastic Leukemia, ALL), followed by malignant lymphomas at 19.8% (with Hodgkin's lymphoma presenting at higher frequencies than non-Hodgkin's variants) and primary bone tumors at 9.3% (with osteosarcoma outnumbering Ewing's sarcoma), peaking primarily within the 10–14 age demographic. Less frequent pediatric diagnoses included central nervous system tumors (6.7%, led by medulloblastoma), Wilms' tumor (4.1%), and retinoblastoma (3.7%). Crucially, despite facing severe logistical and economic barriers, Sofi et al. documented an exceptionally high treatment completion rate of 92.4% across all pediatric groups, independent of their socio-economic or rural-urban status. This outstanding clinical retention was directly driven by aggressive, structured financial and logistical interventions provided by specialized local NGOs, most notably the Cancer Society of Kashmir, highlighting a successful template for targeted public health support.

3.5 Emerging Molecular Epidemiological and Genetic Indicators

To address the reviewer's call for analytical precision, it is critical to separate established environmental impacts from emerging molecular screening indicators. Recent molecular epidemiological research has focused on identifying specific single nucleotide polymorphisms (SNPs) that modulate genetic susceptibility to cancer within the multiethnic Jammu & Kashmir population. These genetic markers function as critical risk modifiers, altering an individual's susceptibility to environmental and dietary carcinogens:



- **Breast Carcinoma:** Initial epidemiological screening indicates that breast cancer is the second most common malignancy within the Kashmir Valley (16.1%) and reaches its highest national prevalence within the Jammu region (35.7%), as verified by Singh et al. At the molecular level, Mir et al. demonstrated that specific polymorphisms localized within folate metabolism genes (specifically MTHFR C677T, GCP II 1561CT, and MTRR 66) significantly reduce individual susceptibility risk. Conversely, Syeed et al. proved that a significant escalation in breast cancer risk is strongly associated with the inheritance of the TP53 R72P genetic variant among ethnic Kashmiri women.
- **Hematological Malignancies:** In leukemia oncogenesis, Bhat and collaborators discovered that the TERT rs2853677 genetic polymorphism increases the risk of developing acute leukemia by 2.9-fold within the Jammu population. In parallel, Baba and colleagues confirmed that the inheritance of the MTHFR 677 CT+TT genotype is strongly associated with an increased risk of Chronic Myeloid Leukemia (CML) among ethnic Kashmiris.
- **Pulmonary Oncology:** Shafi and colleagues identified a potent correlation between cytochrome P450 variants—specifically the CYP1A1 m1 and m2 polymorphisms—and an elevated risk of lung cancer in the valley. In the Jammu region, Jamwal and group associated explicit REV3L single nucleotide polymorphisms with an up to 3.7-fold increase in the risk of Non-Small Cell Lung Cancer (NSCLC).
- **Colorectal Carcinoma (CRC):** Once considered rare, colorectal carcinoma has rapidly escalated to become the second most frequent malignancy overall and the single leading cancer diagnosed among Kashmiri women (accounting for 16.8% of female cases in the SMHS registry). Most concerning is its aggressive presentation in young adults under 40 years of age. Molecular mapping led by Sameer et al. revealed that this high susceptibility is driven by mutations in several key genes, including TP53, CYP2E1, NQO1, GSTP1, and VDR, alongside multiple critical DNA repair genes (XRCC1, XRCC3, RAD51).
- **Esophageal Carcinoma:** Malik and colleagues identified specific variants in GSTP1 and CYP2 as highly significant modulators of esophageal cancer risk. Concurrently, Qasim and colleagues found that mutations in genes regulating the Vascular Endothelial Growth Factor (VEGF) pathway significantly increase individual susceptibility to esophageal squamous cell carcinomas.

4. INSTITUTIONAL DATA AUDIT & INFRASTRUCTURE ANALYSIS

4.1 The SKIMS Central Registry Baseline

The Sher-I-Kashmir Institute of Medical Sciences (SKIMS) in Soura serves as the primary tertiary care oncology facility and de facto cancer registry for the valley, tracking regional cancer patterns since formal integration with the ICMR's National Cancer Registry Programme (NCRP) in 2011. The institutional data reveals a sharp upward trajectory in overall cancer burden. The registry documented 3,940 newly registered cancer cases in 2014, which rose steadily to 4,417 in 2015; 4,320 in 2016; 4,352 in 2017; 4,816 in 2018; 4,337 in 2019; 3,814 in 2020; 4,727 in 2021; 5,271 in 2022; 5,108 in 2023; 5,387 in 2024; and peaked at 5,791 cases in 2025. This represents a 47% increase in annual cancer diagnoses over a single decade. Cumulatively, SKIMS Soura registered 50,302 unique cancer cases between 2014 and 2024, with more than 16,286 cases recorded over the last three years (2023–2025) alone.

The registry's baseline reports maintain exceptional diagnostic accuracy, with 99% of all entered cases being micro-pathologically and histologically confirmed. However, a major public health challenge remains: approximately one-third of all adult patients present with advanced, distant metastasis during their initial clinical consultation. This high rate of late-stage presentation is driven by delayed health-seeking behaviors and limited early detection infrastructure across rural areas. In terms of treatment modalities, chemotherapy remains the primary intervention, utilized by 54% of male patients and 48% of female patients, followed closely by therapeutic radiotherapy and surgical resection.

4.2 Comparative Analysis: NCRP Population Estimates vs. Right to Information (RTI) Audits

To establish an accurate regional baseline, hospital-specific registrations must be compared against population-based estimates from the National Centre for Disease Informatics and Research (NCDIR-NCRP). The population estimates provide a broader overview of the disease burden, recording 12,396 cases in 2019, 12,726 in 2020, 13,060 in 2021, 13,395 in 2022, and projecting 14,112 annual cases by 2024—representing an 11% increase over five years. Cumulatively, the Union Health Ministry recorded 51,577 cancer cases across the entire Union Territory of J&K between 2019 and 2022. This high incidence is accompanied by heavy mortality, with 35,623 confirmed cancer deaths recorded between 2018 and 2022 (averaging 6,824 deaths in 2018 and rising linearly to 7,396 deaths by 2022).

These official figures are further validated by a comprehensive independent audit obtained via formal Right to Information (RTI) applications by activist Syed Adil. The certified RTI transcripts place the total number of confirmed cancer registrations within the Kashmir Valley at 50,551 cases between 2018 and 2024. The exact year-wise breakdown is detailed below:

Calendar Year	Kashmir Valley Registries (RTI Total)	GMC Jammu Registries (RTI Total)
2015	—	1,867
2016	—	1,966
2017	—	1,860
2018	6,649	2,341
2019	6,374	2,102
2020	6,113	1,715
2021	7,090	1,756
2022	7,846	1,719
2023	8,124	2,036
2024	8,355	2,187
2025	—	2,581

Table 2: Year-Wise Comparative Cancer Registrations from Kashmir Valley and GMC Jammu Audits (Source: RTI Disclosures / Syed Adil).

In parallel, the independent RTI data from GMC Jammu recorded 22,130 cumulative cases between 2015 and 2025. Within this 10-year Jammu cohort, lung cancer was the leading single-site diagnosis overall, accounting for 3,272 cases, followed by breast cancer (1,756 cases) and oral cavity cancer (1,023 cases). When combining data across major regional centers—including SKIMS and GMC Srinagar (which recorded 1,159 cases in 2022; 1,640 in 2023; 1,659 in 2024; and 1,558 in 2025) alongside GMC Jammu—the collective dataset shows that total annual cancer registrations across these three primary facilities exceeded

10,000 cases in 2025. This marks the first calendar year that the territory's cancer burden has crossed this threshold within tertiary care alone, highlighting the scale of the regional crisis.

4.3 Healthcare Infrastructure and the Centralization Access Gap

In February 2026, the J&K Minister for Health, Sakeena Itoo, disclosed to the Legislative Assembly that a total of 32,425 cancer cases had been officially reported across the Union Territory over the preceding three years. Of this total, a staggering 25,621 cases (approximately 79%) were concentrated within the Kashmir division alone. This reveals a major geographical disparity, as the Kashmir division contains only 54% of the total population of the Union Territory. While government representatives suggest that this trend is driven by expanded diagnostic screening and increased referral volumes from peripheral centers rather than a true increase in population-wide incidence, the resulting pressure on existing clinical infrastructure is severe.

To manage this expanding patient volume, the state has directed investments toward specialized oncology facilities. The State Cancer Institute (SCI) at SKIMS Soura, a 100-bed facility built at a cost of ₹120 crore under the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS), was commissioned in December 2020. However, as of February 2026, only 80% of the institute is operational, with staff heavily drawn from the parent hospital while a formal proposal for dedicated oncological staffing remains under administrative consideration. Similarly, the State Cancer Institute at GMC Jammu opened in stages in February 2023. Advanced diagnostic capacity remains highly centralized; Positron Emission Tomography-Computed Tomography (PET-CT) scans are available only at SKIMS Soura—where throughput rose from 1,410 scans in 2024 to 2,250 in 2025. To help bridge this gap, the Health and Medical Education Department recently allocated ₹16 crore to procure a dedicated PET-CT system for GMC Srinagar.

Despite these diagnostic expansions, a major centralized access gap persists. No district hospital or community health center across J&K's mountainous terrain possesses dedicated oncology services. For a population of 13.6 million people, this high concentration of specialized care within two primary urban centers forces patients from high-incidence rural zones—such as the South Kashmir gastric and brain cancer clusters—to travel 80 to 90 kilometers along difficult terrain to access basic chemotherapy or radiotherapy. This centralization barrier contributes heavily to delayed care and high default rates during treatment.

5. DISCUSSION & SYNTHESIS

Triangulating data from multiple independent sources reveals three key insights regarding the cancer epidemic in Kashmir. First, the geographical distribution of disease is highly patterned rather than accidental. South Kashmir consistently ranks at the top of major cancer metrics, including high gastric cancer incidence (Kulgam: 10.33, Shopian: 8.79 per 10,000 population), primary malignant brain tumor clusters, and high pesticide application density. This clear geographic overlap provides strong evidence of an environmental component tied to intensive agro-chemical exposure from high-density apple cultivation, where populations are exposed to systemic chemical run-off.

Second, the overall cancer profile in Kashmir is undergoing a distinct transition. The historical dominance of esophageal squamous cell carcinoma and Kangri-induced skin malignancies is giving way to an "epidemiological triple-load." Traditional behavioral risks (such as noon-chai, hookah, and kangri use) persist, while modern environmental hazards (including heavy pesticide contamination of local water basins) and lifestyle-driven risks (such as a shift toward ultra-processed diets and sedentary habits) have emerged alongside them. This combination has accelerated the rise of stomach, pulmonary, breast, and young-adult colorectal malignancies.

Third, local data infrastructure has failed to keep pace with the spread of the disease. The lack of a fully operational, age-standardized Population-Based Cancer Registry (PBCR) across the valley represents a major public health deficit. While institutional registries at SKIMS and administrative RTI audits provide valuable data, they lack the population-denominator links required to clearly differentiate between diagnostic selection bias and a true population-wide epidemic. Establishing a robust, continuous surveillance system is a critical requirement for future public health planning.

6. CONCLUSION & POLICY RECOMMENDATIONS

The unique cancer profile observed across the Kashmir Valley is a direct product of intersecting cultural, environmental, and economic factors. The steady rise in annual diagnoses at SKIMS Soura—moving from 3,940 cases in 2014 to 5,791 in 2025—alongside more than 50,000 cases registered valley-wide via independent RTI audits, confirms a severe public health crisis. This distinct disease profile reflects the convergence of an ancient winter-survival culture with an intensive orchard economy heavily reliant on hazardous chemical pesticides.

To effectively manage and mitigate this epidemic, the regional administration must move beyond expanding urban tertiary facilities and implement a proactive, multi-sector public health strategy:

- **Peripheralization of Oncology Infrastructure:** Establish dedicated oncology day-care clinics and basic chemotherapy infusion suites within existing district hospitals (particularly in high-incidence zones like Kulgam, Shopian, and Baramulla) to reduce travel barriers and improve treatment adherence.
- **Mandatory Population-Based Surveillance:** Provide full administrative and financial support to establish a comprehensive, age-standardized Population-Based Cancer Registry (PBCR) covering all ten districts to ensure accurate epidemiological tracking.
- **Agro-Chemical Regulation and Eco-Enforcement:** Enforce strict regulations on the sale and application of high-toxicity orchard pesticides. Implement mandatory safety protocols for agricultural workers and ban compounds restricted by international standards, such as mancozeb.
- **Groundwater and Food Supply Monitoring:** Task the Food Safety and Public Health Engineering Departments with conducting regular testing of local water basins and agricultural run-off zones to detect and mitigate pesticide contamination.
- **Targeted Screening and Public Awareness Campaigns:** Launch community-focused public health campaigns to educate populations on the risks of stagnant hookah use and high-temperature noon-chai consumption. Implement targeted screening programs, including low-cost screening endoscopies in high-risk GI clusters and visual skin screenings in rural areas.

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