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Gastro Intestinal Cancer In Indigenous Population Of Arunachal Pradesh - A Role Of Lifestyle Factors And Dietary Habits

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Abstract:

Background: *Gastrointestinal (GI) cancers represent a significant health burden worldwide, with emerging evidence highlighting ethnic, dietary, and environmental influences. In Arunachal Pradesh, India, a region populated by indigenous tribes with cultural and genetic ties to East and Southeast Asia. This study aimed to assess sociodemographic, dietary, and lifestyle factors associated with GI cancers.*

Material and Methods: *This study comprises 116 histopathologically confirmed GI cancer patients and 116 age and gender matched controls without malignancy. Data were collected using structured questionnaires addressing demographic variables, dietary patterns, food frequency, and lifestyle behaviors. Statistical analysis was performed using chi-square tests, odds ratios, and t-tests to determine significant associations.*

Results: *Male gender (OR=1.75, p=0.035), older age groups (p=0.00004), low education (p=0.0001), and being married (OR=28.29, p=0.0001) were significantly associated with higher cancer risk. Frequent consumption of roasted food (OR=4.75, p=0.01) and daily intake of salted/fermented foods (p=0.0001) showed strong associations with GI cancers. No significant association was found with residence or occupation.*

Conclusion: *This study emphasizing the role of traditional diets rich in salted, fermented, and roasted foods. The findings align with patterns reported in East and Southeast Asian populations, suggesting a possible shared etiological pathway influenced by cultural and genetic factors. Public health interventions focusing on dietary modification and cancer awareness are urgently needed to mitigate the growing cancer burden in this underserved region.*

Keywords: *Gastrointestinal cancer, Arunachal Pradesh, salted food, fermented food, dietary habits, tribal health, case-control study*

INTRODUCTION

Gastrointestinal (GI) cancers, encompassing malignancies of the oesophagus, stomach, and colorectal region, represent a major public health burden globally (1). According to GLOBOCAN 2020, GI cancers account for more than one-third of all cancer-related deaths worldwide, with stomach and colorectal cancers ranking among the top five causes of cancer mortality. These cancers are often diagnosed at an advanced stage due to delayed symptom recognition, limited screening, and socio-cultural barriers to healthcare access particularly in resource-limited regions (2, 3).

In India, gastrointestinal malignancies exhibit considerable regional variation. The North-Eastern states, including Arunachal Pradesh, show disproportionately higher incidence rates of stomach and esophageal cancers compared to other parts of the country (4). This disparity is often attributed to distinct dietary habits, tobacco and alcohol consumption patterns, and genetic predispositions. Arunachal Pradesh, with its ethnically diverse and predominantly tribal population, presents a unique context wherein traditional lifestyles, fermented foods, and home-brewed alcohol consumption are deeply embedded in daily life (5, 6). Despite this, there is a paucity of epidemiological studies focusing on GI cancers in this geographically and culturally distinct population.

Globally, numerous studies have established links between dietary factors such as intake of salted, pickled, and fermented foods and increased risk of gastric and colorectal cancers (7, 8).

Furthermore, very few studies from India, and virtually none from Arunachal Pradesh, have employed. Hence, to address this knowledge gap, the present study was undertaken to evaluate the demographic, and dietary profiles of patients diagnosed with GI cancers in Arunachal Pradesh.

MATERIALS AND METHODS

This prospective case control study was carried out in the Department of Anatomy in collaboration with the cancer care centre at Tomo Riba Institute of Health and Medical Sciences, Naharlagun, Arunachal Pradesh, spanning from January 2021 to April 2024. The study included 232 participants, consisting of 116 cases with clinically and histopathologically confirmed gastrointestinal (GI) cancer and 116 age- and gender-matched controls who had no malignancy. The subjects comprised individuals identified with esophageal, gastric, and colorectal malignancies. Individuals aged 18 years and older, belonging to the indigenous tribes of Arunachal Pradesh, India, who have been clinically diagnosed and histopathologically confirmed with gastrointestinal cancer, and are currently undergoing chemotherapy, radiotherapy, or surgical intervention, and are willing to participate, were included in the study. Individuals who are not indigenous and have gastrointestinal cancers, along with other concurrent malignancies, those with incomplete medical records or unverified diagnoses, patients receiving treatment for other cancers, severely ill individuals unable to respond to questionnaires, and those unwilling to participate were excluded from the study. Written Informed consent was obtained from all the participants and Study proposal was approved by the institutional ethic committee (No. TRIHMS/ETHICS/01/2019-20/8 dated Naharlagun the 29th October, 2021).

A systematic and pre-validated form was utilised to gather data via in-person interviews, conducted following the acquisition of informed consent. Further details were obtained from the medical records. The study gathered comprehensive details encompassing sociodemographic factors such as age, gender, education level, marital status, residence (urban/rural), and occupation. Additionally, it included information on dietary habits, specifically the frequency and types of food consumed—salted, roasted, fermented, and traditional foods. Data on the number of meals per day (once, twice, three times or more), the frequency of consumption of salted and fermented foods (daily, weekly, irregular), as well as vegetable intake and the consumption of all listed dietary types in relation to the type of GIT cancer were also collected.

The analysis of data was conducted utilising IBM SPSS Statistics version 26.0. Calculations were performed for demographic and baseline variables, including means, standard deviations, and percentages. The chi-square test (χ^2) is employed to assess the relationships between categorical variables. Independent t-test: A method utilised for comparing the means of continuous variables across different groups, specifically between cases and controls. Odds Ratio (OR) accompanied by a 95% confidence interval Confidence Interval (CI): A statistical measure used to assess the relationship between exposures and the risk of developing cancer. A p-value less than 0.05 was deemed to indicate statistical significance.

RESULTS

Table 1: Sociodemographic details of study participants

Demographic details	Cases (n=116) Frequency (%)	Controls(n=116) Frequency (%)	Chi-square value	Odd. Ratio	t- test
Gender					
Male	72 (62.07%)	56 (48.23%)	4.462	1.753	0.035
Female	44 (37.93%)	60 (51.72%)			
Age					
35-53	54 (46.55%)	34 (29.31%)	26.950	-	0.00004
54-71	52 (44.82%)	39 (33.62%)			

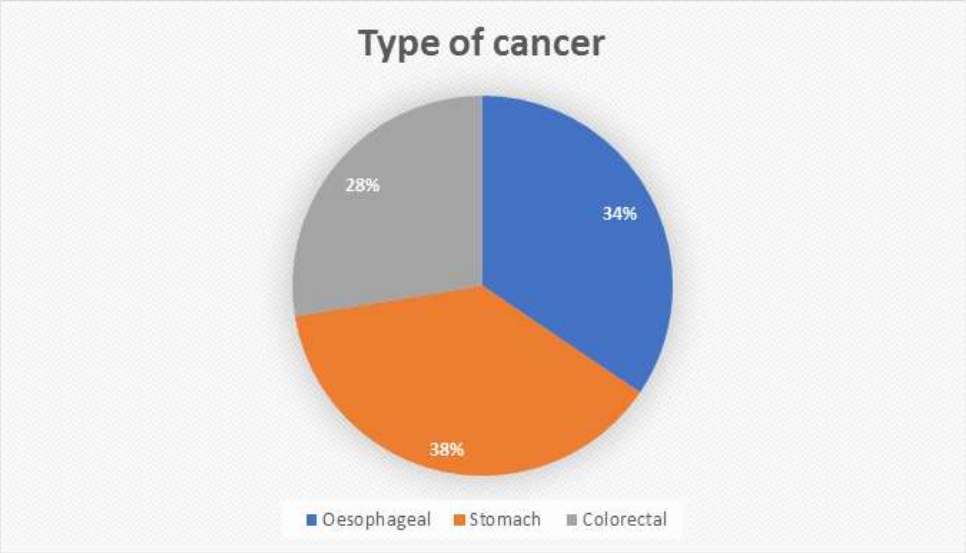
72-90	10 (8.62%)	43 (37.06%)			
Blood group					
A +Ve	18 (15.51%)	43 (37.06%)	32.971	-	0.0001
A -Ve	-	02 (1.72%)			
B +Ve	39 (33.62%)	29 (25%)			
AB +Ve	22 (18.96%)	21 (18.10%)			
AB -Ve	11 (9.48%)	-			
O +Ve	18 (15.51%)	21 (18.10%)			
O -Ve	08 (6.89%)	-			
Residence					
Rural	28 (24.13%)	37 (31.89%)	2.485	-	0.289
Urban	88 (75.86%)	79 (68.10%)			
Education level					
Primary	66 (56.89%)	28 (24.13%)	30.201	-	0.0001
Higher secondary	34 (29.31%)	43 (37.06%)			
Graduation & above	16 (13.80%)	45 (38.80%)			
Occupational status					
Business	11 (9.48%)	15 (12.93%)	3.434	-	0.949
Agriculture	46 (39.65%)	24 (20.68%)			
Govt. employ	16 (13.80%)	12 (10.34%)			
Labour	23 (19.82%)	36 (31.03%)			
unemployed	20 (17.24%)	29 (25%)			
Marital status					
Married	111 (95.68%)	51 (43.96%)	73.651	28.294	0.0001
Unmarried	05 (4.31%)	65 (56.03%)			

Table 2: Dietary profile of study participants

Dietary habits	**Cases**	**Controls**	**Chi-square value**	**Odd. Ratio**	**t- test**
	Frequency (%)	**Frequency** (%)			
Type of food					
Salted food	02 (1.72%)	05 (4.31%)	1.326	0.389	0.250
Roasted food	13 (11.2%)	03 (2.58%)	6.713	4.754	0.010
Fermented food	11 (9.48%)	06 (5.17%)	1.587	1.921	0.208
Traditional food	05 (4.31%)	06 (5.17%)	0.095	0.826	0.757
Vegetables	02 (1.72%)	02 (1.72%)	0.002	1.000	1.000
All the above	105 (90.51%)	116 (100%)	11.548	0.475	0.001
Frequency of food intake (Every day)					
Once a day	02 (1.72%)	35 (29.31%)	37.246	-	0.001
Twice a day	66 (56.89%)	38 (32.75%)			
Three times or more	48 (41.37%)	43 (37.06%)			
Frequency of salted and fermented food intake					
Daily	110 (94.82%)	28 (24.13%)	120.35	-	0.0001
3 times in a week	04 (34.48%)	47 (40.51%)			

5 times in a week	02 (1.72%)	41 (35.34%)			
Irregular	-	29 (25%)			
No smoking	48 (41.38%)	46 (39.65%)			

Graph 1: Type of cancer



DISCUSSION

The gastrointestinal tract (GIT) cancer burden in Arunachal Pradesh, India, presents a unique epidemiological and etiological pattern that aligns closely with trends observed in East and Southeast Asian populations. This linkage is rooted in shared Mongoloid ancestry, cultural similarities, and dietary and lifestyle practices. The indigenous populations of Arunachal Pradesh, such as the Tani, Monpa, and Mishmi tribes, belong to the Tibeto-Burman linguistic group and share genetic ancestry with Mongoloid populations of East and Southeast Asia (9). A shared genetic susceptibility to certain cancers, including GIT cancers, which may be modulated by similar environmental exposures and cultural habits. This case-control study investigated various demographic, dietary, lifestyle, and disease-related factors associated with gastrointestinal (GI) cancers in a tribal population of Arunachal Pradesh. The findings provide novel insights into the interplay between socio-cultural practices and GI cancer risk, especially in under-represented populations in Northeast India.

Male gender has been consistently reported as a risk factor in global and regional GI cancer studies, possibly due to higher exposure to carcinogens, dietary patterns, and hormonal influences. Mid-aged adults showing higher incidence aligns with recent shifts in age trends seen in emerging nations. Contrary to some global reports linking blood group A with gastric cancer risk, this study suggests a possible protective effect of A+ve. This could reflect ethnic or geographic variation in blood group-related pathophysiology. Urbanization has been implicated in dietary changes, sedentary lifestyle, and increased exposure to risk factors, though our data did not confirm a statistically significant association. Lower education correlates with reduced health awareness, limited access to preventive healthcare, and poor dietary habits all contributory to increased cancer risk. These findings support global evidence that lower socioeconomic status increases cancer vulnerability. Although the association was not statistically significant, the occupational exposure in agricultural workers (e.g., pesticides, contaminated water) has been implicated in GI cancers in various studies, especially in Asian countries.

A study by Wang et al. reported that a strong male predominance in gastric and colorectal cancers, often attributed to salt-preserved food, and Helicobacter pylori infection (10). Similarly, education and occupation are strongly associated with increased risk, particularly among rural agricultural workers exposed to nitrosamines and chemical agents.

A study by Nguyen et al. reported that a high prevalence of GI cancers in low socioeconomic groups and among rural populations consuming traditional fermented foods and salted fish in Vietnamese population. The age shift toward younger adults seen in our study echoes similar trends noted in northern Vietnam (11).

A study by Siripong et al. showed a rapid urban shift in GI cancer cases, possibly due to lifestyle modernization, dietary westernization, and alcohol consumption in Thai population, particularly those based in Bangkok. However, unlike our study, urban residents in Bangkok appear at higher risk due to fast-food culture and lower vegetable intake (12). Oyuntsetseg et al. (2022) and Naranzul et al. (2022) emphasize the role of low education, poor sanitation, and Helicobacter pylori as key drivers paralleling our findings on education and diet (13, 14).

Fermented foods are widely consumed across Arunachal Pradesh and many East Asian countries. Fermented bamboo shoots (*ekung*, *kiat*), smoked meats, and *apong* (rice beer) are commonly consumed by indigenous people of Arunachal Pradesh. Similar food types such as Kimchi, miso, soy sauce, natto, fermented fish (pla ra), and pickled vegetables are commonly consumed food in Asian population. These foods often contain high levels of nitrosamines and biogenic amines, known to be carcinogenic to the gastric and esophageal mucosa. Nitrosamines and certain bacteria like *Helicobacter pylori* (more prevalent due to fermented diets) are associated with gastric carcinoma, especially intestinal-type adenocarcinoma. Fermented meat/fish has been linked to esophageal squamous cell carcinoma (ESCC), common in "esophageal cancer belts" across Asia.

High-salt diets and smoked meats are common in the highland and cold areas of Arunachal, mirroring rural regions of Japan and Korea. Salt-preserved food causes gastric mucosal damage, enhancing the effects of *H. pylori*, promoting gastric cancer. Smoked food contains polycyclic aromatic hydrocarbons (PAHs), known mutagens and carcinogens. Roasting at high temperatures can lead to the formation of heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs), known carcinogens that have been linked to gastric and colorectal cancers. A study in Ulaanbaatar, Mongolia (14) observed a similar association between roasted mutton consumption and gastric cancer risk. In Northern Vietnam, where charcoal-grilled meats are common, elevated GI cancer risk was reported (15). Thailand (Bangkok) also reports dietary carcinogen exposure through grilled street food as a public health concern (16).

CONCLUSION

The high incidence of daily fermented and roasted food intake and urban dietary shifts highlight the need for diet-related carcinogenesis public health education. Marital status, education, and nutrition strongly correlate with cancer incidence, reinforcing the role of socioeconomic determinants of health in cancer epidemiology. Although molecular evidence is scarce, the patterns clearly imply that nitrosamines, polycyclic aromatic hydrocarbons, and Helicobacter pylori contribute to these tumours. This study emphasises the need for culturally sensitive, region-specific cancer prevention initiatives including information campaigns, early screening programs, and tribal-specific diets in Northeast India. Elucidating pathways and developing precision public health programs for high-risk populations requires genetic and microbiological profiling research.

Ethical Approval: (No. TRIHMS/ETHICS/01/2019-20/8 dated Naharlagun the 29th October, 2021)**.**

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Conflict of interest: NIL

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