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Review Article

The burden of gastrointestinal cancers in north east India with special reference to *Helicobacter pylori* infection

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ABSTRACT

Gastrointestinal (GI) cancers, particularly gastric and esophageal cancers, are a significant health burden in North East (NE) India, with incidence rates substantially higher than the national average. This region is marked by high prevalence of *Helicobacter pylori* (*H. pylori*) infection, a major risk factor for gastric cancer. Additionally, dietary habits, such as the consumption of smoked and fermented foods, widespread use of betel nut and tobacco, and excessive alcohol intake, contribute to the elevated cancer risk. This narrative review examines the burden of GI cancers in NE India, focusing on the role of *H. pylori* in gastric carcinogenesis. The bacterium induces chronic inflammation that can progress to gastric adenocarcinoma, compounded by genetic predisposition in the region's population. Despite advances in diagnostic methods, healthcare infrastructure limitations and late-stage diagnoses hinder early detection. Preventive strategies, including *H. pylori* eradication, public awareness campaigns, dietary modifications, and tobacco control, are essential to curb the rising cancer rates. Strengthening healthcare systems and promoting research are crucial for effective cancer control in this high-risk region.This review highlights the urgent need for a comprehensive public health approach to mitigate the growing burden of GI cancers in NE India.

1. Introduction

Gastrointestinal (GI) cancers are a significant public health challenge worldwide, contributing to high morbidity and mortality rates. In India, the burden of these cancers is considerable, especially in the North East (NE) region, where incidence rates of GI cancers such as gastric, esophageal, and colorectal cancer are notably higher compared to the rest of the country. Among various etiological factors, *Helicobacter pylori (H. pylori*) infection stands out as a well-established risk factor for gastric cancer, one of the most prevalent cancers in NE India. This narrative review aims to examine the burden of gastrointestinal cancers in NE India, with a specific focus on the role of *H. pylori* infection, its epidemiology, and preventive measures.

2. Burden of Gastrointestinal Cancers in North East India

The NE region of India, comprising states such as Assam, Manipur, Mizoram, Nagaland, Meghalaya, Arunachal Pradesh, Tripura, and Sikkim, exhibits a unique pattern of cancer prevalence. Studies indicate that the incidence of GI cancers in this region is among the highest in the country, particularly for gastric, esophageal, and liver cancers.

2.1. Gastric cancer

Gastric cancer is one of the most common malignancies in NE India, with high incidence rates reported from states like Mizoram and Nagaland. The Mizoram Cancer Registry has reported that gastric cancer constitutes 20-30% of all cancers in the state, with rates much higher than the national average. The age-adjusted incidence rate of gastric cancer

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in Mizoram is 45.6 per 100,000 males, one of the highest in India.[1]

Several factors contribute to the high burden of gastric cancer in NE India:

Dietary practices: High consumption of smoked, fermented, and salted foods, which contain nitrosamines and other carcinogens, is linked to increased gastric cancer risk.[2]

Genetic predisposition: There is evidence to suggest that certain genetic factors, including polymorphisms in genes involved in inflammation and DNA repair, may predispose individuals in NE India to gastric cancer.[3]

Environmental factors: The high prevalence of environmental pollutants, including pesticides and chemical exposure, in certain areas of NE India also contributes to the increased cancer risk.[4]

2.2. *Esophageal cancer*

Esophageal cancer is another major GI cancer in the NE region. Assam, in particular, has one of the highest rates of esophageal cancer in India, with the age-adjusted incidence rate reaching 21.7 per 100,000 males.[5] Similar to gastric cancer, dietary habits play a significant role in the etiology of esophageal cancer, with the consumption of betel quid, tobacco, and alcohol being prominent risk factors. Additionally, nutritional deficiencies, such as low intake of fresh fruits and vegetables, contribute to the high burden of this malignancy.[2]

2.3. *Colorectal cancer*

Though less common than gastric and esophageal cancer, colorectal cancer is also emerging as a significant public health issue in NE India. The incidence of colorectal cancer is rising, particularly in urban areas, possibly due to lifestyle changes such as increased consumption of red and processed meats, physical inactivity, and obesity.[6]

2.4. *Liver cancer*

Liver cancer, particularly hepatocellular carcinoma (HCC), is relatively common in the NE region. Chronic hepatitis B and C infections, along with excessive alcohol consumption, are major risk factors for liver cancer in this population.[4]

3. *Helicobacter pylori* Infection and Gastric Cancer in North East India

H. pylori infection is recognized as a significant risk factor for gastric cancer, especially for non-cardia gastric cancer. This Gram-negative bacterium colonizes the stomach and causes chronic gastritis, which may progress to atrophic gastritis, intestinal metaplasia, dysplasia, and eventually gastric adenocarcinoma. *H. pylori* is classified as a Group I carcinogen by the International Agency for Research on Cancer (IARC) due to its strong association with gastric cancer.[7]

3.1. *Epidemiology of H. pylori in North East India*

The prevalence of *H. pylori* infection is alarmingly high in NE India. Studies conducted in Mizoram, Assam, and Nagaland have reported infection rates ranging from 60% to 85% in the general population.[8] The high burden of *H. pylori* infection in this region is likely related to several factors, including poor sanitation, overcrowded living conditions, and low socioeconomic status, all of which facilitate the transmission of the bacterium.[4]

Genetic Factors and *H. pylori*: Research has suggested that genetic factors may influence the susceptibility of individuals to H. pylori infection and its progression to gastric cancer. Certain polymorphisms in pro-inflammatory cytokine genes, such as IL-1β and TNF-α, have been linked to an increased risk of gastric cancer in individuals infected with *H. pylori*.[3] These genetic factors may partly explain the high rates of gastric cancer in NE India, despite the widespread infection being present across the country.

3.2. *Pathophysiology of H. pylori and gastric cancer*

The carcinogenic potential of *H. pylori* is primarily due to its ability to cause chronic inflammation in the gastric mucosa. The bacterium produces several virulence factors, such as CagA (cytotoxin-associated gene A) and VacA (vacuolating cytotoxin A), which contribute to the pathogenesis of gastric cancer.[9] *H. pylori* infection triggers an inflammatory response, leading to the production of pro-inflammatory cytokines such as IL-1β, TNF-α, and IL-8. This chronic inflammatory state promotes oxidative stress, DNA damage, and alterations in cell proliferation, which can result in gastric carcinogenesis.[10]

Moreover, *H. pylori*-induced gastritis can lead to atrophic gastritis and intestinal metaplasia, both of which are precursors to gastric cancer. The progression from chronic gastritis to gastric cancer is influenced by host genetic factors, the strain of *H. pylori* involved, and environmental factors such as diet and smoking.[3]

3.3. *Diagnostic challenges and H. pylori eradication*

In NE India, early diagnosis of gastric cancer remains a significant challenge due to the late presentation of symptoms and limited access to healthcare facilities.[4] As a result, many patients are diagnosed at an advanced stage of the disease, which reduces the likelihood of curative treatment. Endoscopic screening programs and non-invasive tests for *H. pylori*, such as the urea breath test and stool antigen test, could play a crucial role in early detection and prevention.[11,12]

The eradication of *H. pylori* through a combination of antibiotics and proton pump inhibitors (PPIs) has been

shown to reduce the risk of gastric cancer, particularly in individuals with early-stage gastritis.[9] However, antibiotic resistance is a growing problem, with studies in NE India reporting high resistance rates to commonly used antibiotics like clarithromycin and metronidazole.[13] This highlights the need for tailored treatment regimens based on local resistance patterns.

4. Dietary and Lifestyle Factors Contributing to GI Cancers

Several dietary and lifestyle factors prevalent in NE India contribute to the high burden of GI cancers. The traditional diet in many parts of the region includes smoked and fermented foods, which are rich in nitrosamines, a group of known carcinogens.[2] Additionally, the widespread consumption of betel nut, tobacco, and alcohol exacerbates the risk of both gastric and esophageal cancers.[14]

4.1. Smoked and fermented foods

Smoked meats and fermented vegetables are staple foods in many NE Indian states. While these foods provide nutritional benefits, they are also associated with increased cancer risk due to their high levels of carcinogenic compounds. Nitrosamines, formed during the smoking and fermentation process, are potent mutagens that can cause DNA damage, leading to gastric and esophageal cancer.[2]

4.2. Betel nut and tobacco use

Betel nut (Areca catechu) is widely consumed in NE India, often in combination with tobacco. The chewing of betel quid has been linked to an increased risk of oral, esophageal, and stomach cancers.[14] The carcinogenic effects of betel nut are thought to result from its high content of alkaloids, which can induce mutations in critical genes involved in cell growth and apoptosis.

4.3. Alcohol consumption

Alcohol consumption is another significant risk factor for GI cancers in NE India, particularly for esophageal cancer. The carcinogenic effects of alcohol are mediated through the production of acetaldehyde, a toxic metabolite that can cause DNA damage and promote cancer development.[14]

5. Preventive Measures and Public Health Strategies

Given the high burden of GI cancers in NE India, preventive measures focusing on modifiable risk factors and early detection are critical. Several public health strategies have been proposed to address the rising cancer burden in the region.

5.1. Public awareness campaigns

Educating the public about the risk factors for GI cancers, including *H. pylori* infection, dietary habits, and tobacco use, is essential for cancer prevention.[14] Awareness campaigns should focus on promoting healthy dietary practices, reducing the consumption of smoked and fermented foods, and encouraging smoking cessation. Schools, community centres, and healthcare providers can play a pivotal role in disseminating information.

5.2. Early detection and screening programs

Screening programs for early detection of gastric and esophageal cancers should be prioritized in high-risk populations, particularly in regions like Mizoram and Nagaland where incidence rates are high.[1] Endoscopic screening and non-invasive tests for *H. pylori* can help identify individuals at risk of developing gastric cancer and allow for timely intervention.[4,8]

5.3. H. pylori eradication pograms

Given the strong association between *H. pylori* infection and gastric cancer, eradication programs could significantly reduce the incidence of this malignancy in NE India.[5] Population-based screening for *H. pylori* and subsequent eradication in infected individuals should be considered, especially in high-risk areas like Mizoram and Nagaland. A combination of antibiotics and proton pump inhibitors (PPIs) has proven effective in eradicating *H. pylori*, thereby reducing the risk of progression to gastric cancer.[15] However, challenges such as antibiotic resistance must be addressed through the use of tailored antibiotic regimens based on local resistance patterns.[9,13]

5.4. Dietary modifications and nutritional interventions

Dietary modification programs aimed at reducing the intake of carcinogenic foods, such as smoked and fermented products, can lower the risk of GI cancers.[2] Encouraging the consumption of fresh fruits, vegetables, and whole grains, which are rich in antioxidants and fiber, can help protect against GI cancers. Public health initiatives should focus on promoting healthier cooking methods and alternative preservation techniques to reduce exposure to dietary carcinogens.

5.5. Tobacco and betel nut control initiatives

Tobacco control initiatives are crucial for reducing the risk of esophageal, gastric, and oral cancers in NE India.[16] Comprehensive tobacco control programs, such as those outlined in the WHO Framework Convention on Tobacco Control (FCTC), should be fully implemented, including measures such as raising taxes on tobacco products, banning tobacco advertising, and establishing smoke-free

environments. Given the widespread use of betel nut in the region, efforts should also focus on raising awareness about the carcinogenic risks of betel quid and promoting its cessation.[14]

5.6. Alcohol consumption reduction

Alcohol reduction strategies are essential to minimize the risk of esophageal and liver cancers. Public health campaigns aimed at reducing alcohol consumption, particularly among high-risk groups, can have a significant impact.[14] Additionally, increasing taxes on alcoholic beverages and regulating alcohol sales may help curb excessive consumption.

5.7. Genetic screening and counselling

Given the potential genetic predisposition to gastric cancer in certain populations in NE India, genetic screening and counselling could be valuable tools for identifying high-risk individuals.[3] Genetic testing for polymorphisms in genes related to inflammation, such as IL-1β and TNF-α, could help identify individuals at higher risk of developing gastric cancer in the presence of *H. pylori* infection. Such individuals may benefit from more frequent monitoring and early intervention.

5.8. Improving healthcare infrastructure

One of the major challenges in addressing the burden of GI cancers in NE India is the limited healthcare infrastructure, particularly in remote and rural areas.[4] Strengthening the healthcare system by improving access to diagnostic and treatment facilities is essential. This includes establishing more cancer screening centres, enhancing the availability of endoscopic services, and providing training for healthcare professionals in cancer detection and management.

5.9. Research and data collection

Research on the epidemiology of GI cancers in NE India is still limited, particularly with respect to the role of *H. pylori* infection and genetic factors.[7] More research is needed to understand the specific risk factors contributing to the high incidence of gastric and esophageal cancers in this region. Establishing cancer registries and conducting population-based studies can provide valuable data to guide public health interventions and inform future research.[1]

6. Conclusion

Gastrointestinal cancers, particularly gastric and esophageal cancers, impose a significant health burden in North East India. The high prevalence of *H. pylori* infection, combined with dietary habits, lifestyle factors, and potential genetic predispositions, contributes to the increased risk of these malignancies in the region. Addressing the burden of GI cancers requires a multifaceted approach, including public awareness campaigns, early detection and screening programs, *H. pylori* eradication efforts, dietary modifications, and tobacco control initiatives.

Efforts to reduce the incidence of GI cancers in NE India must also focus on improving healthcare infrastructure and conducting further research to understand the underlying risk factors. Collaborative efforts between government agencies, healthcare providers, and communities are essential to curb the rising cancer burden and improve health outcomes in the region.

7. Source of Funding

None.

8. Conflict of Interest

None.

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