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Research Article

Clinicopathological and Histopathological Patterns of Colorectal Cancer: A Cross-Sectional Study at the National Institute of Cancer Research and Hospital

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Abstract

Colorectal cancer (CRC) is a leading cause of cancer-related morbidity and mortality worldwide, with early detection and prevention playing critical roles in improving prognosis and survival rates. This study aimed to evaluate the histopathological patterns and clinicopathological characteristics of CRC patients. A cross-sectional observational study was conducted over 12 months at the National Institute of Cancer Research and Hospital (NICRH), Department of Medical Oncology, including 61 diagnosed CRC patients. Ethical considerations were ensured, and written informed consent was obtained. Data were collected and analyzed using SPSS version 22.0. The mean age of patients was 52.18 ± 14.33 years, with a majority over 60 years. A male predominance was observed (60.7% male vs. 39.3% female). The most common clinical features were changes in bowel habits (52.45%), per rectal bleeding (42.62%), and generalized weakness (40.98%). The rectum and anal canal were the most frequent tumor sites (39.3%), followed by the sigmoid colon (31.1%). Morphologically, 40.98% of lesions were ulcerative, 32.78% proliferative, 19.67% infiltrative, and 6.57% ulcero-infiltrative. Histologically, adenocarcinoma was the predominant type (85.2%), followed by mucinous carcinoma (9.8%) and undifferentiated carcinoma (4.9%). Significant differences were noted between asymptomatic and symptomatic patients and between tumor grading in younger versus older patients ($p<0.05$). Changes in bowel habits, per rectal bleeding, and generalized weakness were the most commonly reported symptoms, with the rectum and anal canal being the most common tumor sites. Adenocarcinoma was the most prevalent histological type, emphasizing the need for early diagnosis and targeted interventions for better outcomes.

Keywords

Colorectal Cancer (CRC), CRC Epidemiology, Clinicopathology, Histopathology, Colonoscopy, and Colon Cancer Prognosis

1. Introduction

Colorectal cancer (CRC) is a prevalent malignancy in developed countries, with an estimated 32,000 and 160,000 new cases diagnosed annually in the United Kingdom and United States, respectively, and approximately 500,000 new cases globally each

year [1, 2]. Despite advancements in chemotherapy and an increased emphasis on early detection, the prognosis for many patients remains poor [3]. Colorectal cancer is a leading cause of cancer-related morbidity and mortality. Key risk factors include advanced age, family history, male sex, and lifestyle choices. Screening is critical for reducing the incidence and mortality of colorectal cancer by detecting and removing pre-neoplastic adenomas and identifying cancers at early stages. Established screening tools include colonoscopy, flexible sigmoidoscopy, and fecal occult blood tests, with newer fecal immunochemical tests showing higher sensitivity for advanced adenoma and cancer [4]. The individual risk of colorectal cancer is influenced by non-modifiable factors such as age, sex, and family history, as well as modifiable lifestyle factors. It is estimated that 30-50% of colorectal cancer risk is attributable to lifestyle factors like smoking, high consumption of red and processed meat, obesity, diabetes, and excessive alcohol consumption [5]. Age is a significant risk factor, with more than 50% of colorectal cancers diagnosed after age 70 and only 10% before age 55 [6]. Men are approximately twice as likely as women to develop advanced adenoma or cancer, and they tend to develop these conditions earlier in life [7, 8]. A study demonstrated that male sex increases colorectal cancer risk to a similar extent as a positive family history [9].

Colorectal cancer is the most frequent malignant disease of the gastrointestinal tract, the third most common cancer in men (746,000 cases, 10% of all cancers), the second most common in women (614,000 cases, 9.2% of all cancers), and accounts for 600,000 deaths annually worldwide [10]. Over 50% of cases occur in more developed regions, with significant geographic variations in incidence. The highest incidence rates are in Oceania and the lowest in Western Africa. For instance, in 2012, the European Union reported 345,000 new cases and 152,000 deaths [10]. Regions with traditionally low incidence rates, such as Eastern Europe and East Asia, have seen significant increases in colorectal cancer cases, attributed to Westernized lifestyle changes [11, 12].

Colorectal cancer is the third most common cancer in oncologic pathology and the most common malignant cancer in the gastrointestinal tract, representing 13% of all malignant tumors. It is expected to surpass heart diseases as the leading cause of cancer-related death [13-15]. The disease is more prevalent in individuals aged 65-74, with a higher prevalence in women [16]. However, younger patients are increasingly diagnosed due to risk factors like obesity, sedentary lifestyle, poor diet, smoking, and aging population. Symptoms vary depending on tumor location, size, and metastases, including abdominal pain, altered bowel habits, weight loss, nausea, and rectal bleeding.

Carcinogenesis models for colorectal cancer include the suppressor or classic pathway and the mutator or alternative pathway. The classic pathway involves chromosomal instability and is present in 80% of sporadic colorectal cancers, while the alternative pathway involves microsatellite instability, responsible for 20% of sporadic and 80% of hereditary colorectal cancers [17]. Colorectal cancer typically begins as a polyp in the intestinal mucosa, with adenomas having the potential to transform into malignant lesions based on histological presentation and size. Colonoscopic polypectomy significantly reduces colorectal cancer incidence.

Currently, colorectal cancer staging follows the Astler-Coller-Dukes system or the TNM system established by The American Joint Committee on Cancer, which categorizes cancer progression by tumor spread (T), lymph node involvement (N), and metastasis (M) [18].

Cancer is the sixth leading cause of death in Bangladesh, accounting for 10% of all mortality. According to hospital-based cancer registries, approximately 66% of cancer patients fall within the 30 to 65 years age group, which constitutes the main workforce of the country [19]. Colorectal cancer (CRC) is predominantly located in the rectum (37%) and sigmoid colon (31%), with less frequent occurrences in the ascending colon (9%), cecum (8%), descending colon (5%), transverse colon (4%), hepatic angle (4%), and splenic angle (2%) [20]. Approximately 65% of colon cancers are distal to the splenic angle and can be detected by sigmoidoscopy, whereas 35% are proximal and not detectable by flexible sigmoidoscopy [13].

There is evidence of a shifting distribution of colorectal carcinomas, with an increasing proportion of proximal cancers. Molecular pathology has shown site differences, with tumors exhibiting high levels of microsatellite instability (MSI-H) or ras proto-oncogene mutations more frequently located in the caecum, ascending colon, and transverse colon. The ingestion of non-steroidal anti-inflammatory drugs has been shown to reduce the risk of colorectal cancer [20]. Moreover, a diet high in fiber, fruits, and vegetables is a preventive factor against colorectal cancer and other tumors [21].

Given the serious and fatal nature of colorectal cancer and its prevalence in the Bangladeshi population, early diagnosis is crucial to increase patient survival. This study aims to evaluate the histological pattern and clinicopathological characteristics of colorectal cancer in patients attending the National Institute of Cancer Research and Hospital (NICRH). The outcomes of this study will help identify socio-demographic factors contributing to the disease and provide a comprehensive analysis of histological patterns and pathological characteristics. This information is vital for clinicians to make evidence-based decisions and customize treatment procedures for each patient.

This study aims to address the research question: What are the histological patterns and clinicopathological characteristics of colorectal cancer among patients admitted to NICRH? The general objective is to determine the histological pattern of colonoscopic biopsy and clinicopathological characteristics of colorectal cancer in these patients. Specifically, the study seeks to explore the distribution of colon cancer across different age and gender groups, assess the clinical characteristics of the patients, evaluate the morphological and histopathological characteristics of the study participants, and compare symptomatic and asymptomatic groups, as well as younger and older patient groups. This comprehensive approach will provide valuable insights into the disease's demographic and clinical landscape, aiding in the development of targeted treatment and prevention strategies.
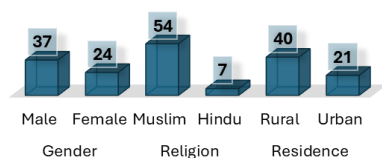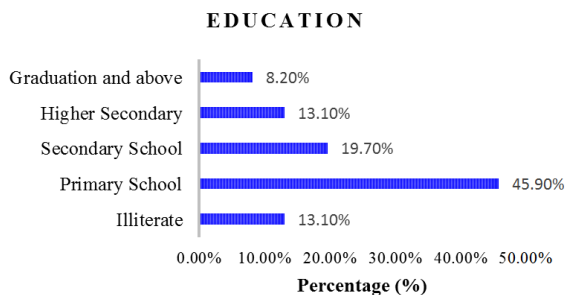
2. Manuscript Formatting
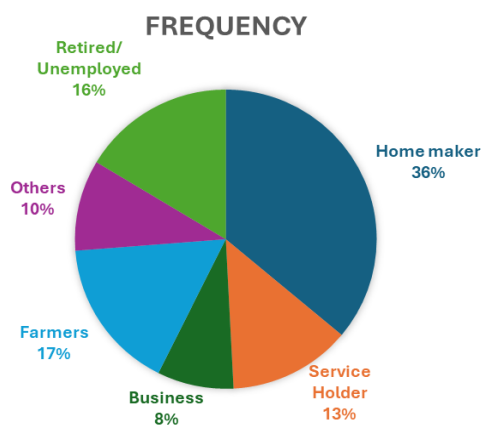
2.1. Figures

DISTRIBUTION OF RESPONDENTS
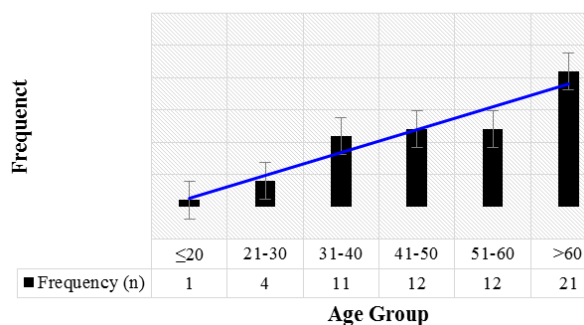
Figure 1. Distribution of respondents by age (n=61).

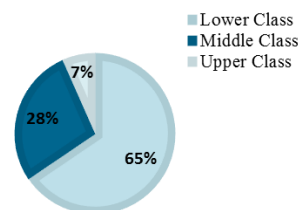*Figure 2. Distribution of respondents by Gender, Religion, and Education (n=61).*

EDUCATION

Figure 3. Distribution of respondents by education (n=61).

FREQUENCY

Figure 4. Stage of disease among deceased patients.

SOCIO ECONOMIC STATUS

Figure 5. Distribution of respondents by socio economic status (n=61).

CLINICAL PRESENTATIONS
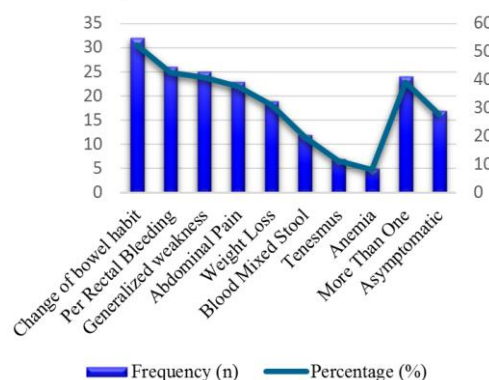
Figure 6. Clinical Presentations of colorectal cancer among respondents (n=61).

MORPHOLOGICAL TYPE OF TUMOUR

Figure 7. Distribution of respondents by location of lesion (n=61).

HISTOPATHOLOGICAL TYPE OF LESION

Figure 8. Distribution of respondents by histopathological types.

Figure 9. Distribution of respondents by Grade of tumour (n=61).

Figure 10. Distribution of respondents by Stage of tumour (AJCC Prognostic staging) (n=61).
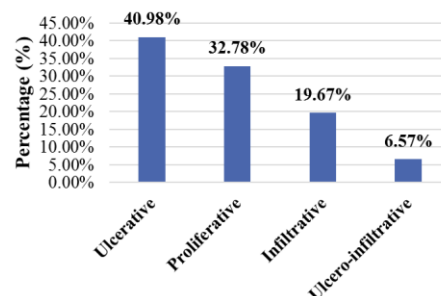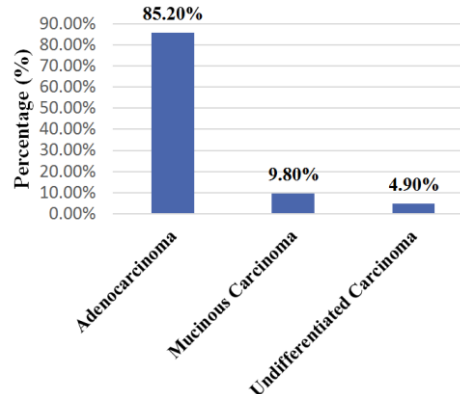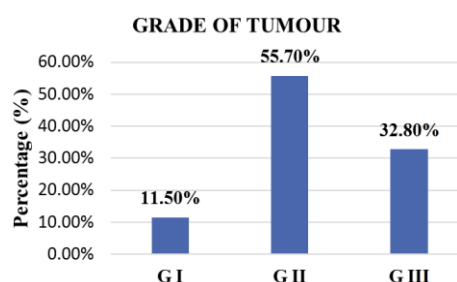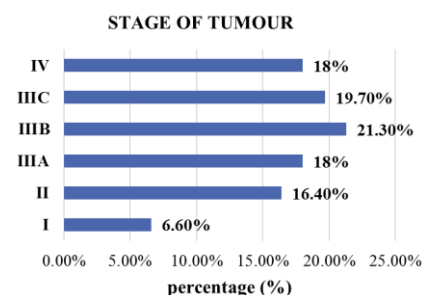
2.2. Tables

Table 1. Comparison of Tumour Grade among symptomatic and asymptomatic patients (n=61).

	Grade of tumour			Total	p value
	GI	GII	GIII		
Symptomatic (n/%)	2 (3.3)	24 (39.3)	18 (29.50)	44 (72.1)	
Asymptomatic (n/%)	5 (8.20	10 (16.4)	2 (3.30)	17 (27.9)	.007*
Total	7 (11.5)	34 (55.7)	20 (32.80)	61 (100)	

*p value was determined by chi square test

Table 2. Comparison of Tumour Grade among younger (<40 years) and older patients (≥40 years) (n=61).

Grade of tumour					
	GI	GII	GIII	Total	p value
Younger patients (<40 years) (n/%)	6 (9.8)	10 (16.4)	1 (1.6)	17 (27.9)	.01*
Older patients (≥40 years) (n/%)	1 (1.6)	24 (39.3)	19 (31.1)	44 (72.1)	
Total	7 (11.5)	34 (55.7)	20 (32.80)	61 (100)	

Table 3. Distribution of Colon Cancer among respondents by age (n=61).

Age Group (Years)	≤20	21-30	31-40	41-50	51-60	>60	Total	P value
Rectum & anal canal (n/%)	1(1.6)	2(3.3)	3(4.80)	7(11.50)	5(8.20)	6(9.80)	24(39.30)	
Sigmoid Colon (n/%)	0	2(3.30)	3(4.90)	2(3.30)	6(9.80)	6(9.80)	19(31.10)	
Descending Colon (n/%)	0	0	1(1.60)	0	0	2(3.30)	3(4.90)	
Transeverse Colon (n/%)	0	0	1(1.60)	1(1.60)	0	2(3.30)	4(6.60)	.837
Ascending Colon (n/%)	0	0	1(1.60)	0	1(1.60)	4(6.60)	6(9.80)	
Caecum (n/%)	0	0	2(3.30)	2(3.30)	0	1(1.60)	5(8.20)	

Age Group (Years)	≤20	21-30	31-40	41-50	51-60	>60	Total	P value
Total	1(1.60)	4(6.60)	11(18)	12(19.70)	12(19.70)	21(34.40)	61(100)	

*p value was determined by chi square test

3. Materials and Methods

3.1. Study Design

This cross-sectional observational study was conducted at the National Institute of Cancer Research and Hospital (NICRH) in Dhaka, Bangladesh, and included all diagnosed cases of colorectal cancer, aged 18 to 70 years, admitted to the Department of Medical Oncology at NICRH. The study was carried out over a 12-month period, from July 2018 to June 2019. A purposive sampling technique was employed based on predefined inclusion and exclusion criteria, and the estimated sample size was calculated to be 384.

3.2. Study Criteria and Variables Overview

This study focuses on patients newly diagnosed or previously diagnosed with colorectal cancer confirmed through histopathology. The inclusion criteria for participation encompass both male and female inpatients aged between 18 and 70 years. Individuals falling outside this age range, outpatients, those with severe disabilities or psychological conditions hindering interviews, and unconscious patients are excluded. Key demographic variables analyzed in this study include age, sex, education, religion, and BMI. Risk factor variables considered involve family history of colorectal cancer, smoking, dietary habits, alcohol consumption, and obesity. Clinical presentation is evaluated through symptoms such as abdominal pain, diarrhea, weight loss, and altered bowel habits. For morphological and histopathological classification, the TNM and Dukes' staging systems are employed to assess the severity and spread of the disease.

3.3. Study Procedure

Prior to the commencement of the study, ethical clearance was obtained from the Ethical Review Committee (ERC) of NICRH. Patients aged 18-70 years admitted to the Department of Medical Oncology were approached for participation. The study procedure, purpose, potential benefits, and risks were explained to them. Verbal permission was followed by a request to sign a written consent form. Participants were interviewed by the researcher using a structured questionnaire to gather demographic information, comorbid diseases, and clinical presentations, which were recorded in a separate case record form. Staging and performance status were evaluated according to the Eastern Cooperative Oncology Group

(ECOG) criteria. Information related to morphological and histopathological classification was collected. Incomplete data or withdrawals were replaced by new participants to meet the desired sample size. Biopsy reports were collected from hospital records or personal files when necessary. Collected data were securely stored and exclusively used for study purposes. Data collection tools included a semi-structured questionnaire and informed written consent forms in both Bangla and English.

3.4. Ethical Implications

The study adhered to ethical guidelines, including obtaining formal ethical clearance from ERC and the Research Review Committee (RRC) of NICRH. Confidentiality of participants and their information was strictly maintained. Informed written consent included explanations of the study's nature, purpose, procedures, and the right to refuse or withdraw from the study at any time. Participants did not receive any financial benefits from the study.

3.5. Data Collection Technique

Data were collected and recorded in a pre-designed structured data collection sheet by the researcher.
Statistical Analysis:
An analysis plan was prepared, and variables were coded for statistical analysis using SPSS version 22.0. Data were analyzed using descriptive statistics, with values presented as frequencies (percentages) and means ± standard deviations. Chi-square tests were used to determine relationships where necessary, with a 95% confidence interval. A p-value of <0.05 was considered statistically significant. Graphs, charts, and tables were prepared using Microsoft Excel 2010 and Microsoft Office 2010.

4. Results

This study was done in National Institute of Cancer Research and Hospital, among 61 patients who had been diagnosed as cases of colorectal cancer.

The age distribution of 61 respondents from figure 1 shows that 34.4% are over 60 years old. The age groups 41-50 and 51-60 each represent 19.7%, while 31-40 accounts for 18%. The age groups 21-30 and ≤20 comprise 6.6% and 1.6%, respectively. The mean age is 52.18 years with a standard deviation of 14.33, highlighting a predominance of older respondents and a wide age range within the sample.

The figure 2 show that 60.7% of respondents are male and 39.3% are female. Regarding religion, 88.5% are Muslim and 11.5% are Hindu. For residence, 65.6% live in rural areas and 34.4% in urban areas. This indicates a majority of male, Muslim, and rural respondents. As per figure 3., the education levels of respondents. Most completed primary school (45.9%), followed by secondary school graduates (19.7%). Both illiterate individuals and those with higher secondary education each make up 13.1%, while those with graduation and above are the smallest group at 8.2%. This indicates a majority with only primary education and fewer with higher education or beyond.

The charts 4 and 5 show that homemakers make up the largest occupational group at 36.1%, followed by service holders (13.1%), farmers, and retired/unemployed individuals (each 16.4%). Businesspersons account for 8.2%, and others 9.8%. Socio-economically, 65.6% are lower class, 27.9% middle class, and 6.6% upper class. This indicates a high number of non-working individuals, significant agricultural dependence, and a skewed economic distribution favoring the lower class, suggesting the need for socio-economic development and increased economic mobility.

The data from figure 6 shows the frequency of clinical presentations among patients. The most common symptoms are a change of bowel habit (52.45%), per rectal bleeding (42.62%), generalized weakness (40.98%), and abdominal pain (37.70%). Other symptoms include weight loss (31.14%), blood mixed stool (19.68%), tenesmus (11.48%), and anemia (8.2%). Multiple symptoms are reported by 39.34% of patients, while 27.86% are asymptomatic. This highlights the need for comprehensive diagnostic approaches in clinical practice.

Morphological data from chart 7 represents that around 40.98% (n=25) lesions were ulcerative, 32.78% (n=20) lesions were proliferative, 19.67% (n=12) lesions were infiltrative and 6.57% (n=4) were ulcero infiltrative.

Histopathological data from chart 8 represents that Around 85.20% (n=52) respondents had adenocarcinoma and followed by in decreasing order Mucinous Carcinoma (9.80%, n=6) and Undifferentiated Carcinoma (4.90%, n=3). Majority respondents' tumours were in Grade II (55.70%, n=34) and followed by in decreasing order G III (32.80%, n=20) and G I (11.50%, n=7) found in figure 9. Majority respondents' tumours were in stage III B (21.30%, n=13) and followed by in decreasing order, III C (19.70%, n=12), III A (18%, n=11), IV (18%, n=11) II (16.40%, n=10), I (6.60%, n=4) found in figure 10.

Table 1 represents the Grade of tumour had been found statistically significant (p=.007, <.05) with presentation of symptoms of patients where as symptomatic patients is associated with higher grade of tumour. Table 2 depicts the Grade of tumor had been found statistically significant (p=.007, <.05) with age of patients whereas older patients associated with higher grade of tumor. As per table 3., No statistical association had been found between age and distribution of colon cancer among respondents (p= .837, > .05).

5. Discussion

Colorectal cancer (CRC) is a significant global health concern, contributing to substantial morbidity and mortality rates worldwide. It is ranked as the fourth leading cause of cancer-related deaths, accounting for nearly 10% of all cancers [22]. CRC has emerged as a multifactorial disease, with various risk factors including genetic predisposition, lifestyle choices, and environmental factors influencing its development. Despite its global prevalence, the exact incidence and characteristics of CRC in Bangladesh remain less well understood. This study, conducted at the National Institute of Cancer Research and Hospital in Bangladesh, sheds light on the socio-demographic and clinico-pathological characteristics of CRC patients in the country, providing valuable insights that could inform future research and public health strategies. One of the most striking findings from the study is the age distribution of CRC patients. The mean age of respondents was 52.18 years, with a standard deviation of 14.33 years, indicating a wide age range within the sample. Notably, 34.4% of the respondents were aged 60 years or older, and 72.1% were over the age of 40. This finding is consistent with the global understanding that CRC predominantly affects older individuals [23] have similarly identified CRC as a disease that primarily impacts older adults. The correlation between advancing age and increased risk of CRC has been well documented in the literature, with some studies suggesting that individuals over the age of 60 are up to 50 times more likely to develop CRC than those under 40 [24]. This highlights the importance of targeted screening and early detection efforts, particularly for older populations, who are at a significantly higher risk of developing the disease. Interestingly, despite the strong association between age and CRC incidence, this study found no statistically significant association between age and the distribution of colon cancer among the respondents (p = 0.837). This finding diverges from the age-related disparities commonly reported in other studies [25]. Several factors could explain this discrepancy, including the relatively small sample size of 61 patients, the limited duration of the study, and the fact that it was conducted at a single study location. These limitations may have contributed to the inability to capture the full spectrum of age-related variations in CRC distribution. Future research involving larger, multi-center studies would be necessary to explore this relationship further and provide a more comprehensive understanding of how age influences CRC development in the Bangladeshi population.

The gender distribution of CRC patients in this study reveals a slight male predominance, with 60.7% of the respondents being male and 39.3% being female. This finding is consistent with global trends, where men are generally more susceptible to CRC than women [26] found similar trends, with men experiencing higher rates of CRC than women. The

increased vulnerability of men to CRC has been attributed to several biological and lifestyle factors. Men are more likely to engage in behaviors that elevate their risk of developing CRC, such as consuming diets high in red and processed meats, smoking, and drinking alcohol [27, 28]. Additionally, men tend to accumulate more visceral fat, which is associated with an increased risk of CRC. The gender disparity observed in this study aligns with the broader literature, reinforcing the need for gender-specific prevention strategies that address the unique risk factors faced by men.

In terms of the socio-demographic characteristics of the study population, the majority of the respondents (65.6%) resided in rural areas, while 34.4% lived in urban areas. This distribution reflects the broader demographic composition of Bangladesh, where a significant portion of the population lives in rural areas. The rural-urban divide observed in this study may also have implications for CRC prevention and treatment. Individuals living in rural areas often face barriers to accessing healthcare services, including cancer screening and treatment. This can result in delayed diagnosis and poorer outcomes for rural patients. As most of the respondents in this study belonged to lower socio-economic classes, it is likely that economic barriers also played a role in shaping their access to healthcare. The finding that 65.6% of the respondents were classified as lower class, while only 6.6% belonged to the upper class, highlights the socio-economic challenges faced by CRC patients in Bangladesh. Public health initiatives aimed at improving access to cancer screening and treatment in rural and low-income areas could help address these disparities and improve CRC outcomes.

The symptomatic presentation of CRC varied among the respondents, with the most common symptoms being changes in bowel habits (52.45%), per rectal bleeding (42.62%), generalized weakness (40.98%), and abdominal pain (37.70%). These findings are consistent with other studies on CRC, which have identified similar patterns of symptomatology [29]. Changes in bowel habits and rectal bleeding are often considered hallmark symptoms of CRC, particularly in cases where the tumor is located in the distal colon or rectum. Generalized weakness and abdominal pain are also common complaints among CRC patients, particularly those with more advanced disease. The finding that 27.86% of the respondents were asymptomatic at the time of diagnosis underscores the challenges of detecting CRC in its early stages. Many patients may not experience noticeable symptoms until the disease has progressed, which can complicate efforts to achieve early detection and treatment. This highlights the importance of routine screening, especially for individuals at higher risk of CRC, such as older adults and those with a family history of the disease.

Histopathological analysis of the CRC cases revealed that adenocarcinoma was the most common histological type, accounting for 85.2% of the cases. This finding aligns with the global understanding of CRC, where adenocarcinoma is the most prevalent histological subtype [30].

Additionally, 40.98% of the lesions were classified as ulcerative, while 32.78% were proliferative and 19.67% were infiltrative. These morphological patterns are consistent with findings from other studies, although the exact distribution of lesion types can vary depending on the population and setting [23]. The predominance of Grade II tumors (55.7%) and the AJCC staging results, which revealed that the majority of tumors were in Stage III, suggest that many patients in this study were diagnosed at relatively advanced stages of the disease. Late-stage diagnosis is a common issue in CRC, particularly in low-resource settings, where access to screening and diagnostic services may be limited [31]. The high proportion of late-stage diagnoses observed in this study underscores the need for improved early detection strategies, particularly in rural and low-income populations.

A statistically significant association was found between the grade of the tumor and both the presentation of symptoms (p = 0.007) and age (p = 0.007), with symptomatic and older patients presenting with higher-grade tumors. This association is consistent with the literature, which suggests that older patients and those with more advanced disease are more likely to present with higher-grade tumors. The significant relationship between tumor grade and symptomatology also highlights the importance of clinical vigilance in diagnosing CRC. Patients presenting with symptoms such as changes in bowel habits and rectal bleeding should be thoroughly evaluated for CRC, particularly if they are older or have other risk factors for the disease. Early diagnosis and prompt treatment are critical for improving CRC outcomes, as patients with higher-grade tumors tend to have poorer prognoses.

While this study provides valuable insights into the clinico-pathological characteristics of CRC in Bangladesh, several limitations must be acknowledged. The relatively small sample size of 61 patients limits the generalizability of the findings, particularly when it comes to identifying statistically significant associations. Additionally, the study was conducted at a single institution, which may not fully represent the diversity of CRC patients across Bangladesh. Future research should aim to include larger, multi-center studies that can capture a more comprehensive picture of CRC in the country. This would allow for more robust analyses of socio-demographic and clinico-pathological factors and help identify potential areas for intervention.

6. Conclusions

In conclusion, this study reinforces the global understanding of CRC as a multifactorial disease influenced by genetic, environmental, and lifestyle factors. The findings highlight the need for improved early detection strategies, particularly in resource-constrained settings, and underscore the significance of targeted public health interventions to address CRC risk factors, especially among rural and lower socio-economic

populations. Given the challenges of detecting CRC in its early stages, particularly among asymptomatic individuals, there is a critical need for routine screening programs that can identify the disease before it progresses to more advanced stages. Public health efforts should focus on increasing awareness of CRC risk factors and symptoms, improving access to screening and diagnostic services, and ensuring that patients receive timely and appropriate care. By addressing these challenges, it may be possible to reduce the burden of CRC in Bangladesh and improve outcomes for patients across the country.

Abbreviations

CRC	Colorectal Cancer
NICRH	National Institute of Cancer Research and Hospital
MSI-H	Microsatellite Instability-High
TNM	Tumor, Node, Metastasis (Staging System)
SPSS	Statistical Package for the Social Sciences
GI	Gastrointestinal
EU	European Union
AJCC	American Joint Committee on Cancer
BMI	Body Mass Index
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
FIT	Fecal Immunochemical Test

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Author Contributions

Atiquzzaman Md.: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Writing – original draft

Toma Sonia Sheherin: Data curation, Validation, Visualization, Writing – review & editing

Biswas Saikat: Formal Analysis, Resources, Software, Writing – review & editing

Shahriar Md. Kabir: Formal Analysis, Investigation, Software, Visualization

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Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Atiquzzaman Md. is a distinguished oncologist with over six years of experience in the treatment and management of cancer. He is currently serving in the Department of Medical Oncology at the National Institute of Cancer Research and Hospital (NICRH). Specializing in the medical management of cancer, Dr. Atiquzzaman employs advanced therapies including chemotherapy, targeted therapy, immunotherapy, and hormonal therapy, making significant contributions to the care and well-being of patients affected by cancer. Dr. Atiquzzaman earned his medical degree (MBBS) from Mymensingh Medical College & Hospital, followed by a Doctor of Medicine (MD) in Medical Oncology from NICRH in January 2020. In addition to his clinical responsibilities, Dr. Atiquzzaman is dedicated to mentoring medical students and oncology fellows, thereby fostering the development of the next generation of specialists in the field of oncology. He is an active member of several prestigious professional organizations, including the European Society for Medical Oncology (ESMO) and the Medical Oncology Society of Bangladesh (MOSB). Dr. Atiquzzaman's work continues to shape the future of oncology through groundbreaking research, compassionate patient care, and an unwavering commitment to the advancement of cancer treatment.

Research Fields

Atiquzzaman Md.: Combination Therapies, Immunotherapy, and Management of Treatment Resistance.
Toma Sonia Sheherin: Targeted Therapy, Early Detection and Screening, and Combination Therapies.
Biswas Saikat: Connective tissue disease, Drug-drug/protein interaction, Infectious disease, Genetic disease.
Shahriar Md. Kabir: Radiobiology, Radiotherapy, and Cancer Metabolism.