International Journal of Clinical Trials
Rawat S et al. Int J Clin Trials. 2026 Feb;13(1):1-10
http://www.ijclinicaltrials.com
pISSN 2349-3240 | eISSN 2349-3259
DOI: https://dx.doi.org/10.18203/2349-3259.ijct20260041

Original Research Article

Prospective observational study on etiological factors, clinical profile and pattern of metastases of colorectal cancer: in a rural population of Central India – a tertiary cancer centre study

Shyamji Rawat, Karthick Raju V. A.*, Anjanette Nabiyal, B. Navya Sahithi, Abhishek Badgoliya, Dhirendra K. Panwar

Cancer Hospital, NSCB Medical College, Jabalpur, Madhya Pradesh, India

Received: 04 September 2025
Revised: 27 December 2025
Accepted: 29 December 2025

***Correspondence:**
Dr. Karthick Raju V. A.,
E-mail: drkarthickoncorad@gmail.com

ABSTRACT

Background: Colorectal cancer (CRC) incidence has increased in Asian countries with 2-4 times surge in colorectal cancer incidence and mortality. There is a significant interaction between lifestyle changes and genetic predispositions. This study, involving 332 patients from central India, investigates the demographic patterns, epidemiological aspects, pattern of metastases, and clinical profiles of patients from the rural central India.
Methods: A prospective observational study was performed at State Cancer Institute, NSCB Medical College in Jabalpur, focussed on all cases of colorectal carcinoma registered at our institution from 2017 to 2023. Staging followed the recent AJCC 8th edition and treatment as per the recent NCCN guidelines.
Results: Among 332 CRC patients (24.09% aged 0–39 years (mean 29.2), 75.91% >40 years (overall mean 48.3)), abdominal pain (50%, n=166) and tobacco use (45.18%, n=150) predominated. Stage III/IV (68.38%, n=227), liver metastases (n=78), and rectal tumours (49.72%, n=165). Rural residents (62.65%, n=208) and illiteracy (29.52%, n=98) were common. Right-sided CRC correlated with females (55%) and mucinous histology (23.1%). Young cases rose 3–5% annually, peaking post-COVID.
Conclusion: This tertiary cancer hospital study (2017-2023) highlights that 68.38 % of patients presented with Stage III/IV disease mostly from rural population. Most cases were sporadic, with no significant family history. Rectum was the most common site, and liver the predominant site of metastasis. Dietary habits indicate low fibre and high red meat intake may contribute to CRC risk. These findings highlight the need for early screening, public awareness, and targeted interventions to address modifiable risk factors in rural populations.

Keywords: Colorectal cancer, Epidemiology, Central India, Metastasis pattern, Clinical profile, Demographic study

INTRODUCTION

Colorectal cancers (CRC) are among the most frequently occurring gastrointestinal tumours on a global scale. As reported by Globocan in 2022, these cancers constitute 9.6% of the total incidence of major cancers worldwide.[1] By the end of 2025, projections based on 2022 data indicate there will be over 1.9 million newly identified cases. This is the fourth most common cancer affecting both genders, with new incidences totalling at 1,069,446 (10.4%) for males and 856,979 (8.9%) for females.[1] In developed countries, the five-year survival rate for CRC is 90% when the disease is identified at an early stage; however, fewer than 40% of cases are diagnosed while the cancer remains localized.[2]

The prevalence of CRC exhibits significant variation across different populations. Historically, this disease was predominantly found in developed regions such as North America, Australia, New Zealand, and Europe, where risk

factors—including physical inactivity, obesity, a diet deficient in fruits and vegetables, and smoking—are prevalent.[3-5] Over the past few decades, there has been an increase in reported cases of colorectal cancer in newly developed and developing nations, where the incidence was previously low. In recent decades, a notable surge in colorectal cancer incidence has been observed in various Asian countries, including China, Japan, South Korea, and Singapore, with rates escalating by two to four times. There is an alarming increase in both incidence and mortality rates in affluent societies compared to poorer regions. Although shifts in dietary habits and lifestyle are considered primary contributors, the lifestyle changes and genetic traits of Asian populations may also be a significant factor.[6]

In developing countries like India, epidemiological transitions have led to a growing incidence of non-communicable diseases, particularly cardiovascular diseases, diabetes, and cancer. Although cancer prevalence in India is currently lower than that in Western nations, the combination of increased life expectancy and the shift towards contemporary lifestyles is resulting in a rise in cancer rates.[7]

CRC comprises 9.6% of global cancers. In India specifically, rural districts exhibit distinct risk factor patterns compared to urban areas, including differences in literacy, domicile, addiction, and diet. While most CRC cases (70-85%) occur sporadically, with only 15-30% linked to hereditary conditions like Lynch syndrome and FAP, dietary factors play a crucial role. The increasing consumption of processed meat and low-fibre diets in rural central India mirrors global dietary transitions that drive CRC risk.

Adenocarcinoma is the most common histopathological variant of colorectal carcinoma with an increase among individuals under the age of 40, typically manifesting in more advanced stages. Research indicates that approximately 2 to 3% of colorectal cancer cases are diagnosed in patients younger than 40 years old.[8] Furthermore, the incidence of rectal cancer is notably higher in men compared to women.[9-11]

Comparing with the western world, the age-standardized rate (ASR) for CRC in India is notably low, with figures of 6.1 and 3.7 per 100,000 for males and females respectively.[2] In a nation with a population exceeding one billion, the total number of individuals afflicted with CRC is substantial. India reports one of the world's poorest CRC survival outcomes, with fewer than 40% surviving five years post-diagnosis.

Notably, findings from the CONCORDE-2 study indicate that the five-year survival rate for rectal cancer in India is declining in certain registries.[12] Population based cancer registries have validated the increasing trend of CRC among people <50 years and more propensity towards males.[13]

Although numerous studies on CRC exist, they predominantly focus on Western populations and their associated factors such as demographics, addiction status, education levels, early screening measures, and disease awareness. In cancers like colorectal carcinoma, where personal lifestyle and environmental factors play a pivotal role, it is necessary to emphasize studies on the Indian population, particularly in central India.

While there are only a few studies on the pattern of presentation of colorectal carcinoma in India, this study is one of the first large- scale investigations in central India, involving 332 patients. The main aim of the study was to determine the demographic pattern, age distribution, clinical profile, stage of presentation at the time of diagnosis, pattern of metastases and relationship between the local extent of disease and metastases.

METHODS

A prospective observational study of patients with pathologically proven treatment-naive colorectal carcinoma was performed. It was approved by the Institutional review boards of our institution [IEC/2024/4386]. The patients presented at our State Cancer Institute, Netaji Subash Chandra Bose Medical College, Jabalpur, which is located in central India and covers almost 20 districts and 40 lakh rural people. All the treatment-naive patients with CRC presented at our hospital between January 2017 and December 2023 were studied.

First, we assessed clinical stage by physical examination, per rectal examination, colonoscopy/flexible sigmoidoscopy and subjecting the patient to contrast-enhanced computed tomography (CECT) and magnetic resonance imaging (MRI) to determine the clinical correlation and spread of the disease, which included both local and nodal spread. TNM staging and stage grouping are based on American Joint Committee on Cancer (AJCC) guidelines (8th edition). Patients with anal cancer have been excluded from this study.

Patients were categorized under various parameters which involves the various demographic factors such as age, gender, literacy rate, domicile, addiction status, presenting symptoms, location of the primary tumour, histopathological classification, pathological staging and pattern of metastases.

Family history of the patients was analysed with association to first and second- degree relatives with CRC. Dietary assessment included food- frequency questionnaire on red/processed meat, fibre-diet, fruits/ vegetables.

Furthermore, stage grouping has also been done and patients were treated according to their respective stage and National Comprehensive Cancer Network (NCCN) guidelines.

Statistical analysis

The IBM statistical package for the social sciences (SPSS) Windows software version 21.0 was used for statistical analyses. Descriptive statistics were used to summarize the data.

RESULTS

A total of 332 patients were newly registered in our institution with histopathology confirmed colorectal cancers during the time period of 2017 till 2023.

The demographic characteristics were summarized in the Table 1. The data presented was categorized by age groups, gender, education level, and domicile (rural or urban).

Age-group

There were total (n=332) patients and mean age of the patients with CRC was 48.3 years (range 14 years-84 years). The young age group CRC constituted one-fourth (n=80; 24.09 %) of total colorectal CRC (N=332) with a mean age of young CRC patients was 29.2 years (range 14-39 years). Most patients (51.51%) belong to the age group ranging from 40 years- 60 years of age. The youngest age of incidence being 14 years and the oldest being 84 years.

Table 1: Demographic details.

Variables	Age groups (years), N (%)								
	0-19	20-29	30-39	40-49	50-59	60-69	70-79	>80	All age groups
Gender									
Males	6 (1.81)	17 (5.12)	23 (6.93)	48 (14.46)	52 (15.66)	29 (8.73)	15 (4.52)	3 (0.90)	193 (58.13)
Female	0 (0.00)	12 (3.61)	22 (6.63)	41 (12.35)	30 (9.04)	22 (6.63)	10 (3.01)	2 (0.60)	139 (41.87)
Total	6 (1.81)	29 (8.73)	45 (13.55)	89 (26.81)	82 (24.70)	51 (15.36)	25 (7.53)	5 (1.51)	332 (100.00)
Education									
Illiterate	0 (0.00)	2 (0.60)	5 (1.51)	20 (6.02)	24 (7.23)	30 (9.04)	15 (4.52)	2 (0.60)	98 (29.52)
Middle	0 (0.00)	6 (1.81)	9 (2.71)	37 (11.14)	26 (7.83)	6 (1.81)	5 (1.51)	1 (0.30)	90 (27.11)
Secondary	2 (0.60)	7 (2.11)	19 (5.72)	21 (6.33)	17 (5.12)	5 (1.51)	1 (0.30)	0 (0.00)	72 (21.69)
Higher secondary	4 (1.20)	8 (2.41)	7 (2.11)	4 (1.20)	9 (2.71)	5 (1.51)	3 (0.90)	2 (0.60)	42 (12.65)
Graduate	0 (0.00)	6 (1.81)	5 (1.51)	7 (2.11)	6 (1.81)	5 (1.51)	1 (0.30)	0 (0.00)	30 (9.03)
Domicile									
Rural	4 (1.20)	19 (5.72)	29 (8.73)	58 (17.47)	46 (13.86)	34 (10.24)	16 (4.82)	2 (0.60)	208 (62.65)
Urban	2 (0.60)	10 (3.01)	16 (4.81)	31 (9.33)	36 (10.84)	17 (5.12)	9 (2.71)	3 (0.90)	124 (37.35)
Total	6 (1.81)	29 (8.73)	45 (13.55)	89 (26.81)	82 (24.70)	51 (15.36)	25 (7.53)	5 (1.50)	332 (100.00)

Gender

Male patients represent 58.13% of the total population, with the highest concentration in the 40 to 49 age group (14.46%). The male population is higher across most age groups, except for the 0 to 19 and Above 80 age groups where females are comparatively more represented. Female patients represent 41.87% of the total population, with the highest concentration in the 30 to 39 age group (6.63%). While fewer in number overall, women are more concentrated in the middle age groups, particularly the 30-39, 40-49, and 50-59 age groups.

Education levels

The data indicates that a considerable segment of the population is illiterate, accounting for 29.52% (n=98), with the highest rates found in the 50 to 59 age group (7.23%) and the 60 to 69 age group (9.04%). Illiteracy is prevalent across various age categories, although it is more pronounced among older adults. In contrast, 27.11% of the population has attained at least a middle school education, predominantly within the 40 to 49 age group (11.14%). Additionally, 21.69% have achieved secondary education, particularly concentrated in the 30 to 39 age group (5.72%) and the 40 to 49 age group (6.33%). Moreover, 12.65% of

the population has reached higher secondary education, with the most significant representation in the 40 to 49 age group (1.20%). A smaller segment, 9.03%, holds a graduate degree, which is sparsely distributed across all age groups, reflecting a lower prevalence of advanced education.

Domicile (rural versus urban)

62.65% of the population lives in rural areas, with the highest representation in the 40 to 49 age group (17.47%). This suggests that the rural population is significantly higher, with a stronger concentration in middle-age groups. Only about 37.35% of the population resides in urban areas, with the highest representation in the 50 to 59 age group (10.84%). While urban residency is lower overall, urban areas have a relatively higher percentage of individuals in older age groups (50+).

Addiction history

Table 2 shows majority of the patients about 45.18% (n=150) shown consumption of tobacco products followed by smoking 18.07% (n=60), alcohol 12.35% (n=41) and ganja 0.30% (n=1).

Table 2: Addiction and symptoms.

Variables	N	%
Addiction		
Tobacco	150	45.18
Smoking	60	18.07
Alcohol	41	12.35
Ganja	1	0.30
Symptoms		
Abdominal distension	9	2.71
Abdominal lump	6	1.81
Abdominal pain	166	50.00
Altered bowel habits	28	8.43
Haemorrhoids	4	1.20
Loss of appetite	1	0.30
Mucoid discharge	3	0.90
Rectal bleeding	96	28.92
Sentinel pile	1	0.30
Tenesmus	18	5.42

Family history

Only 9.3% (n=31) out of 332 patients reported family history of colorectal carcinoma among first-degree relatives; with p=0.27 (statistically not significant) (Table 4).

Symptoms

The most common symptoms (Table 2) in patients at the time of diagnosis were abdominal pain (50%) n=166, rectal bleeding (28.92%) n=96, altered bowel habits (8.43%) constituting the top three symptoms followed by tenesmus, abdominal distension, abdominal lump, haemorrhoids, mucoid discharge, loss of appetite and sentinel pile.

Dietary patterns

The majority of patients (Table 4) reported; diets low in fibre <15 g/day: 68% (n=226), with low fruit/vegetable intake <200 g/day: 72% (n=239) and a greater number of patients with processed meat intake >3 servings/week: 25% (n=83), which are recognized risk factors for CRC in several Indian and international studies.

Clinico-pathological data

Based on HPE variants and differentiation

Among the cohort of 332 patients, (Table 3) histological examination confirmed adenocarcinoma in all cases. Notably, the mucinous subtype was identified in 65 individuals (19.58%), while the signet ring cell variant was observed in 40 patients (12.05%). A comparative analysis of age groups revealed a higher incidence of the signet ring cell subtype in patients over 40 years of age (4.21%) relative to those in the younger cohort (0–39 years; 3.01%). Regarding tumour differentiation, the majority exhibited moderately differentiated tumours (n=113), followed by well-differentiated (n=33) and poorly differentiated (n=29) tumours. However, the degree of differentiation remained undocumented in 157 cases.

Table 3: HPE variant and differentiation.

Variables	N	%
HPE variant		
Adenocarcinoma	332	100.00
Mucinous tumours	65	19.58
Signet ring tumours	40	12.05
Differentiation		
Well-differentiated	33	9.94
Moderately-differentiated	113	34.04
Poorly-differentiated	29	8.73
Differentiation not reported	157	47.29

Based on anatomical distribution of colorectal cancer sites

Rectum was the most affected site (Table 5), with 165 case (49.72%), followed by sigmoid colon with 47 cases (14.16%) and thirdly by rectosigmoid colon with 39 case (11.75%). The least affected sites were hepatic flexure, descending colon and transverse colon with the splenic flexure involvement being the rarest.

Based on age–wise distribution of tumour sites

Majority of cases occurred between 40 to 69 years, accounting for the highest incidence of tumour across all sites with 226 cases (66.86%). Rectal cancer peaked between 40-59 years (25.30%), contributing to a

significant proportion of the total cases. Young onset cases (0-39 years) accounted for 16.06% (n=53) of the total CRC burden with rectum being the most affected site (13.25%). The burden of rectal cancer remained high (3.61%) in the 70–79 age group. Right-sided CRCs (ascending colon, caecum) were slightly more frequent than left-sided CRCs in older patients.

Staging distribution of CRC

In overall cases, stage III (39.16%) and stage IV (29.22%) accounted for the majority of cases (68.38%), indicating late-stage presentation. Stage I (10.24%) and stage II (21.39%) collectively made up 31.63% of cases. Peak incidence of stage III was in the 50–69 age group, comprising 18.07% of total cases. stage IV peaked in the 40–69 age group, making up 19.28% of total cases.

Sites of metastases

Liver metastases (n=78) emerged as the predominant site, constituting a substantial majority, followed by peritoneal (n=17) and lung metastases (n=12). Less frequent sites included bone (n=8), ovarian (n=2), and adrenal, spleen, and brain metastases (each n=1) (Figure 1).

Right versus left-sided CRC

The mean age of patients with right-sided CRC (Table 6): is slightly older than those with left-sided CRC, but the difference is not statistically significant (p=0.08). Right-sided tumours were more common in females (55% versus 43% in left-sided; p=0.02). Mucinous differentiation was significantly higher in right-sided tumours (23.1% versus 12.6%; p=0.01). Signet ring cell tumours showed no significant difference. Both groups had high rates of advanced disease (stage III/IV), but no significant difference (p=0.11). Right-sided CRCs are dominated by liver (65%) and peritoneal (25%) metastases, whereas in left-sided CRCs liver (72%) and lung (18%) metastases contributes the most. Younger patients (0–39 years) showed no significant difference in laterality, suggesting similar tumour aggressiveness across age groups.

Cancer trends in CRC from 2017-2023

Figure 2 shows the annual increase of colorectal cancers from the year 2017-2023 with an annual increase rate of 2-4 % across all age group. The COVID-19 pandemic created a transient dip in reported cases during the year 2020 due to reduced healthcare access in terms of both reduced out-patient visits and delay in diagnosis.

Young age group (0-39 years) cases exhibit steepest increase 3-5 % annually aligning with the global trends. Middle aged (50-69 years) shows modest increase 2-3% annually and stable/slower incidence rates of 1-2% annually in the elderly (70+ years) age group.

Table 4: Dietary patterns.

Dietary parameter	Threshold	Percentage of patients (%)	Number (N)
Processed meat intake	≥3 servings/week	25	83
Fibre intake	<15 g/day	68	226
Fruit/vegetable consumption	<200 g/day	72	239

Table 5: Tumour site and staging.

Variables	Age groups (years), N (%)								
	0-19	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**70-79**	**>80**	**All age groups**
Site									
Ascending colon	0 (0.00)	1 (0.30)	6 (1.81)	5 (1.51)	12 (3.61)	7 (2.11)	3 (0.90)	1 (0.30)	35 (10.540)
Caecum	0 (0.00)	1 (0.30)	3 (0.90)	6(1.81)	5 (1.51)	3 (0.90)	2 (0.60)	0 (90.00)	20 (6.02)
Descending colon	0 (0.00)	1 (0.30)	2 (0.60)	2 (0.60)	3 (0.90)	2 (0.60)	1 (0.30)	0 (0.00)	11 (3.31)
Hepatic flexure	0 (0.00	0 (0.00)	0 (0.00)	2 (0.60)	1 (0.30)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.90)
Rectosigmoid colon	0 (0.00)	5 (1.51)	7 (2.11)	13 (3.92)	6 (1.81)	5 (1.51)	3 (0.90)	0 (0.00)	39 (11.75)
Rectum	5 (1.51)	19 (5.72)	20 (6.02)	44 (13.25)	40 (12.05)	25 (7.53)	10 (3.61)	2 (0.60)	165 (49.72)
Splenic clexure	1 (0.30)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.30)
Sigmoid colon	0 (0.00)	3 (0.90)	6 (1.81)	13 (3.92)	14 (4.22)	5 (1.51)	4 (1.20)	2 (0.60)	47 (14.16)

Continued.

Variables	Age groups (years), N (%)								
	0-19	20-29	30-39	40-49	50-59	60-69	70-79	>80	All age groups
Transverse colon	0 (0.00)	1 (0.30)	1 (0.30)	4 (1.20)	1 (0.30)	4 (1.20)	0 (0.00)	0 (0.00)	11 (3.31)
Stage									
I	0 (0.00)	3 (0.90)	4 (1.20)	11 (3.31)	7 (2.11)	5 (1.51)	4 (1.20)	0 (0.00)	34 (10.24)
II	1 (0.30)	8 (2.41)	11 (3.31)	16 (4.82)	17 (5.12)	8 (2.41)	9 (2.71)	1 (0.30)	71 (21.38)
III	2 (0.60)	7 (2.11)	14 (4.22)	35 (10.54)	37 (11.14)	23 (6.93)	11 (3.31)	1 (0.30)	130 (39.16)
IV	3 (0.90)	11 (3.31)	16 (4.82)	27 (8.13)	21 (6.33)	15 (4.52)	1(0.30)	3 (0.90)	97 (29.22)

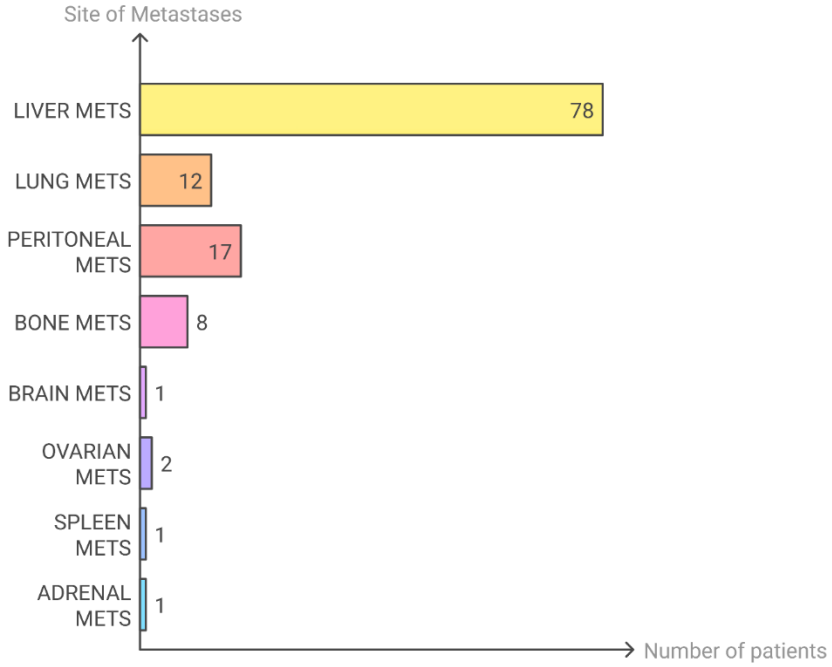

Figure 1: Site of metastases.

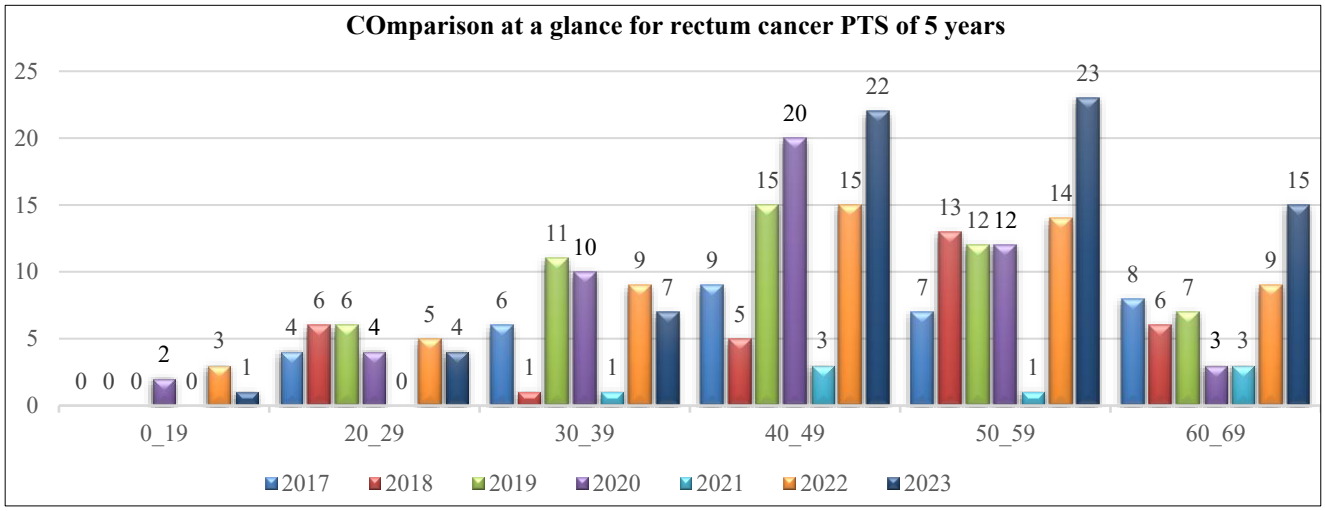

Figure 2: Cancer trends from 2017-2023.

Table 6: Clinico-pathological tumour profile in right versus left- sided CRC.

Characteristics	Right sided CRC, n=78 (%)	Left sided CRC, n=254 (%)	P value	Significance
Mean age (range)	58.2 years (21-84 years)	52.7 years (18-82 years)	0.08	NS
Gender (male: female)	45:55	130:97	0.02	S
Histopathology				
Mucinous	18 (23.1)	32 (12.6)	0.01	S
Signet ring cell	8 (10.3)	22 (8.7)	0.62	NS
Stage III/IV disease	44 (56.4)	168 (66.1)	0.11	NS
Site of metastasis				
Liver	51 (65)	183 (72)		
Lung	5 (8)	46 (18)		
Peritoneal	20 (25)	15 (6)		
Bone	2 (2)	10 (4)		
Age groups (years)				
0-39	12 (15.4)	38 (15)	0.93	NS
>40	66 (84.6)	216 (85)	0.93	NS

NS: Non-significant.

DISCUSSION

CRC continues to be a major worldwide health burden, which is characterized by rapidly changing demographic and geographic trends that are attributed by the interplay of lifestyle, environmental, and genetic factors. The study, conducted at our tertiary cancer care centre in Central India, highlights the various trends in CRC, which is based on the demographics, staging, and histopathology, especially among young adults (<40 years). Our study, aligns with data from both India and other Asian nations. In this discussion we interpret our study findings with global and regional frameworks, further emphasizing the need for urgent targeted interventions.

Factors influencing CRC in India

In consistent with global data, our study also shows male predominance (58.13%), in particular for rectal cancer (49.72% of cases). Indian men are more likely to engage in established risk factors such as tobacco and alcohol consumption.[14] The higher incidence of male rectal cancer burden parallels with data from the National Cancer Registry Programme (NCRP), which ascribes 60–65% of CRC cases in Indian men to distal colonic and rectal tumours.[15] Most of the patients were from rural backgrounds (62.65%), with a significant proportion being illiterate (29.52%).

In accordance with various other Indian studies, family history was not a significant risk factor and most CRC cases were sporadic.[15] The dietary pattern in this rural population was characterized by low intake of fruits, vegetables, and dietary fibre, and increased consumption of red meat and processed foods. These findings further validate the study by Gupta et al, which highlighted the transition towards Westernized diets as a contributing factor to rising CRC incidence in India.[16] The role of diet is further supported by the World Cancer Research Fund and American Institute for Cancer Research, which recommend high fibre and low red meat intake to reduce CRC risk.[17]

One another striking observation in this study, is that nearly a quarter of CRC cases (24.09%) were diagnosed in individuals younger than 40 years, highlighting a demographic shift, far exceeding rates reported in Western populations (2–8%).[18] Our study data further aligns with recent Indian studies, such as those from Tata Memorial Hospital, which reported 15–22% of CRC cases in individuals under 40.[19] Globally, young-onset CRC has risen by 2–4% annually since the 1990s, with the steepest increases in Asia.[20] While hereditary syndromes (e.g., Lynch syndrome) explain 20–30% of young-onset cases, most are sporadic, implicating lifestyle and dietary shifts.[20]

Anatomical sights, HPE and molecular insights

In accordance, with the insights of global studies where right-sided tumours correlate with female sex and mucinous histology, our data also shows right-sided CRC (e.g., cecum, ascending colon) was more common in women (55%).[21] This divergence maybe attributed to influence or difference in gut microbiota composition.[22] Histopathologically in our study, adenocarcinoma dominated (100%), with mucinous (19.58%) and signet ring cell (12.05%) subtypes exceeding global averages 10–15% and 1%, respectively.[23]

In general, aggressive histologies are linked to poorer prognosis, which are increasingly reported in young Indian population. Mucinous differentiation was exhibited in higher number in right sided tumours (23.1% versus 12.6% in left-sided), which is consistent with molecular studies associating proximal CRC with microsatellite instability (MSI) and BRAF mutations.[24] While molecular profiling was beyond this study's scope, emerging data from various other Indian studies suggest distinct mutation patterns, such as lower KRAS, BRAF, PIK3CA mutation compared to Western populations.[25]

Stage presentation and outcomes

Over two-thirds of patients (68.38%) were diagnosed with metastatic or locally advanced disease, signifying the delay in diagnosis due to limited screening and awareness. The late-stage presentation and high prevalence of rectal cancer in this study mirror findings from other Indian and Asian studies, which attribute delayed diagnosis to low awareness, limited screening, and healthcare access disparities. The five-year survival rate of India's CRC (<40%) lags behind high-income nations (70–90%).[12] Similar pattern has been demonstrated in other low- and middle-income countries (LMICs), where >60% of CRC cases are diagnosed at advanced stages.[26] In contrast, countries with organized screening programs, such as the U.S. (via colonoscopy) and Japan (via faecal immune-chemical testing), report 50–60% of cases detected at localized stages.[27] India's opportunistic screening, are restricted to urban elites, which fails to address rural populations (62.65% of this cohort), denoting the disparity in access to healthcare. The CONCORD-3 study highlighted India's declining survival rates for rectal cancer, underscoring systemic gaps in multidisciplinary care.[28]

Risk factor dynamics

The rapid rise of CRC in India mirrors transitions that are observed in other rapidly developing nations. Rapid urbanization has driven dietary transitions, including a 40% surge in meat intake per capita over two decades and processed food intake doubling.[29] Physical inactivity, prevalent in 35–45% of urban Indians, compounds these risks.[30] Conversely, rural populations face dual burdens: traditional diets are being replaced by calorie-dense, low-nutrient foods, while tobacco addiction was prevalent in nearly half the cohort (45.18%), aligning with India's high tobacco burden. Tobacco, a grade I carcinogen, synergizes with alcohol to elevate CRC risk 3–4 fold.[31] These shifts echo trends in 1970s Western nations, where CRC incidence peaked alongside industrialization.[32]

Asia's CRC burden is bifurcating: high-income nations (Japan, South Korea) report stabilizing rates due to screening, while lower middle class countries (LMICs) (India, Indonesia) face rising incidence.[33] China's CRC rates, now surpassing Western Europe, are attributed to rapid dietary westernization.[34] The risk factors in Western populations are predominantly lifestyle-related. However, in India and other parts of Asia, the interplay between lifestyle changes and inherent genetic factors may further compound the risk. Recent studies have begun to explore the role of genetic polymorphisms and epigenetic changes in the pathogenesis of CRC in these populations.

Challenges in the Indian setting

In India, there is a marked difference in incidence of CRC between urban and rural populations. Studies have demonstrated that approximately 62.65% of CRC patients in certain registries are from rural areas, with a notable concentration in the middle-aged group. This urban–rural divide suggests disparity of access to healthcare services and varying exposure to risk factors. Although hospital-based registries provide valuable insights, there is a notable deficiency of population-based cancer registries in many parts of India, particularly in central regions such as Madhya Pradesh. This limits the ability to accurately track incidence trends and devise targeted public health interventions.[35] The awareness of CRC symptoms and the importance of early detection is relatively low among the general population, particularly in rural areas. Public health campaigns and educational initiatives are essential to improve early diagnosis and ultimately increase survival rates.[36]

Socioeconomic status and literacy levels have a direct impact on healthcare access and treatment adherence.[36] With nearly 29.52% of patients in some studies being illiterate, there is a significant barrier to understanding disease symptoms and the need for screening, leading to delays in seeking care.

The predominance of stage III and IV diagnoses in the Indian registries indicates that most patients present with advanced disease, often due to delayed diagnosis and suboptimal screening programs. This advanced stage at presentation is closely associated with poorer outcomes and limited therapeutic options.[37]

Limitations

As a study conducted in a hospital setting, this analysis is unable to provide estimates of CRC incidence at the population level. The presence of referral bias may skew the representation towards more advanced cases, and molecular analyses were not performed. Nevertheless, the research offers crucial insights into CRC patterns in the underexplored regions of Central India.

CONCLUSION

This prospective observational study from a tertiary cancer centre in rural central India from 2017-2023 reveals that colorectal cancer predominantly affects rural, illiterate populations and presents at advanced stages, with rectal cancer being the most common site and liver the most frequent site of metastasis. Most cases were sporadic, with family history not being a significant factor. Dietary patterns characterized by low fibre and high red meat intake, along with tobacco and alcohol use, likely contribute to the increase CRC burden. These findings point out that targeted interventions are necessary to address the modifiable risk factors in rural Indian populations. A holistic approach involving improved healthcare infrastructure, awareness campaigns, and lifestyle modifications is essential to mitigate the rising incidence and late-stage presentation of CRC in this setting.

Recommendations

Early screening protocols

Advocates for lowering screening age to <40 years in high-risk regions and adopting stool-based tests in rural areas.

Awareness campaigns

Focus on "red flag" symptoms (e.g., rectal bleeding, abdominal pain) to reduce diagnostic delays.

Policy interventions

Strengthen tobacco control and promote dietary guidelines to curb CRC risk factors.

Infrastructure development

Urgent need for multidisciplinary care centres and improved rural healthcare access to address advanced-stage burden.

ACKNOWLEDGEMENTS

Authors would like to thank the head of the department and professors whose contribution make immense impact throughout the preparation of this article, Mr. Pramod Mishra (Statistical officer) whose immense support in the statistical analysis of this study is significant and also to the participants of this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rawat S, Karthick RVA, Nabiyal A, Sahithi BN, Badgoliya A, Panwar DK. Prospective observational study on etiological factors, clinical profile and pattern of metastases of colorectal cancer: in a rural population of Central India – a tertiary cancer centre study. Int J Clin Trials 2026;13(1):1-10.