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Exploring the Multifactorial Landscape of Colorectal Cancer Risk: Insights from a Cohort Study at the Oncology Centre in Derna, Libya

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Abstract

Colorectal cancer (CRC) poses a substantial global health burden, particularly in developed nations, and is increasingly affecting low- and middle-income countries. According to the World Health Organization's GLOBOCAN database, it contributes to nearly 1.4 million new cases annually worldwide. While numerous modifiable and non-modifiable risk factors for CRC have been identified, the strength of individual factors and their interactions warrant further investigation. A case-control study was conducted at the Clinical Oncology Center at Derna, Libya, from 2022 to 2023. A total of 316 participants were enrolled, including 158 cases of colorectal cancer and 79 individuals in each control group. Data were collected through structured face-to-face interviews. Data were tested for distribution, and variance homogeneity was confirmed before applying parametric tests. ANOVA was utilized to compare quantitative variables. Demographic analysis revealed that colorectal cancer predominantly affected males, urban residents, and individuals aged 41-50 years. Financial status, educational level, and employment status also showed notable associations. A family history of malignant diseases, colon polyps and ulcerative colitis were prevalent among cases (23%, 10% and 23%, respectively) with significant correlations observed with colorectal cancer risk (P< 0.01). Screening test uptake was low across all groups, indicating a public health concern. Substance misuse patterns, including smoking and alcohol consumption, were more pronounced among cases (P < 0.001). Dietary habits, such as daily consumption of fatty meals and red meat, were significantly associated with increased colorectal cancer risk (P < 0.01). This study highlights significant associations between demographic, lifestyle, and medical factors and colorectal cancer risk. Low physical activity, smoking (active and passive), and high consumption of fat and red meat are associated with elevated risk of colorectal cancer. The inclusion of two control groups provides valuable insights into understanding colorectal cancer risk comprehensively. These findings underscore the importance of maintaining a healthy lifestyle to mitigate the burden of colorectal cancer.

Keywords. *Colorectal Cancer, Risk Factors, Lifestyle Behaviors, Dietary Habits, Screening Tests.*

Introduction

Colorectal cancer (CRC), encompassing cancers of the colon and rectum, has emerged as a significant health concern over the past four decades, particularly in developed nations where it ranks among the most prevalent neoplastic diseases. Recent data suggest a rising burden in many low- and middle-income countries, possibly due to urbanization and the adoption of Western lifestyle-associated risk factors [1,2]. In 2020, colorectal cancer accounted for approximately 10% of all cancers worldwide, causing around 9.2% of cancer-related deaths. The global incidence of CRC continued to rise, with an estimated 1.93 million new cases and 0.94 million deaths, representing approximately 10% of all cancer incidences and deaths globally [3].

Notably, certain regions of Africa such as Nigeria, Egypt, and South africa reported particularly high standardized incidence rates, while Algeria, Morocco, and Ethiopia had elevated standardized death rates. The incidence and mortality rates were notably higher in men compared to women, with the highest rates observed in the elderly population [4].

The aetiology of colorectal neoplasms remains incompletely understood, although extensive research has identified numerous risk factors [5-7]. Age is a primary determinant, with the risk of cancer increasing substantially after the age of 50, particularly beyond 70 years. Inflammatory conditions such as ulcerative colitis and Crohn's disease significantly elevate the risk of colorectal cancer [8]. Lifestyle factors, including low physical activity, high-fat

and calorie-rich diets, excessive red meat consumption, low calcium and folic acid intake, alcohol consumption, and smoking, are associated with increased cancer risk. Obesity, characterized by a high body mass index (BMI), is strongly correlated with colorectal cancer risk, with obese individuals exhibiting a significantly elevated risk compared to those with lower BMIs [8-10]. Genetic predispositions such as familial adenomatous polyposis (FAP) and hereditary nonpolyposis colorectal cancer (HNPCC) also confer a higher risk [2,11,12]. While numerous studies have investigated colorectal cancer risk factors, less attention has been given to understanding the strength of individual factors and their interactions. This study aims to fill this gap by comparing three patient groups to assess the relationship between demographic, environmental, and lifestyle factors and colorectal cancer risk. Notably, our study is unique in its inclusion of two control groups, allowing for a comprehensive analysis of these factors. We seek to determine whether such an approach holds scientific significance and provides insights into understanding colorectal cancer risk factors more comprehensively. The primary objective of this study is to identify and evaluate patient characteristics, demographic factors, and lifestyle behaviours associated with the risk of colorectal cancer at the time of diagnosis.

Methods

Study Design

The research employed a case-control study design, characterized as observational and analytical, incorporating a control group. The investigation was conducted at the Clinical Oncology Centre, Clinical Oncology Center at Derna / Libya, spanning the years 2022 to 2023. It compared exposures between individuals who developed colorectal cancer (cases) and those who did not (controls), selected based on matching criteria. Individuals in the control group were diagnosed with cancers other than colorectal cancer (I), as well as those with a distinct non-cancerous medical condition (II).

Participant Recruitment, Inclusion, and Exclusion Criteria

The study enrolled a total of 316 participants, including 158 with colorectal cancer, 79 in each control group. Participants who aged between 30 to 80 years were recruited. Inclusion criteria involved a proven diagnosis of colorectal cancer at least 3 months prior to the study, a life expectancy exceeding 6 months, age over 18, and awareness of their diagnosis. Exclusions comprised individuals unwilling to participate; those under palliative care, and physically or emotionally unfit patients.

Data Collection

Data were collected through clinical structured face-to-face interviews, lasting approximately 30 minutes per participant. The interviews encompassed demographic, epidemiological, lifestyle, and risk behavior information.

Data Analysis

Descriptive analysis, bivariate and multivariate logistic regression models, ANOVA/Kruskal-Wallis Test, unpaired t/Mann-Whitney test, and exact Chi-square/Fisher test were employed for data analysis. Adjusted odds ratios (AOR) were utilized to determine associations between dependent and independent variables with a significance level set at 95% confidence interval (CI). Statistical significance was established at $P < 0.05$. Analysis was conducted using SPSS statistical package version 15.0 for Windows.

Results

Demographic Data

In this study, the demographics of colorectal cancer were analyzed from a cohort of 158 patients diagnosed with colorectal cancer. The mean age of the patients was 44.5 ± 8.86 years; as depicted in Table 1, which offers a comprehensive view of how this disease impacts different population groups. The distribution by gender shows a slightly higher prevalence among males at 58% compared to females at 42%. Urban areas seem to be more affected, constituting 70% of cases ($P < .005$). Financially, 27% of individuals with colorectal cancer have excellent income, 61% fall into the average category, and 12% have a bad financial status. Age-wise, the majority of cases are observed in the 41-50 age group at 45%, with lower percentages in older age categories. Educational levels vary, with 50%

having higher education, 5% having no education. In terms of marital status, 89% of individuals affected are married ($P < 0.001$). Employment status reveals that 74% are employed, 6% unemployed, and 20% retired.

Table 1. Demographic Characteristics of Colorectal Cancer Patients: A Cohort Analysis

Characteristics	Cases (n 158)	Controls I (n = 79)	Controls II (n = 79)	*P*
Gender				
Female	66 (42%)	50 (63%)	63 (80%)	0.01
Male	92 (58%)	29 (37%)	16 (20%)	
Area of residence				
Urban	111 (70%)	40 (50%)	59 (75%)	0.01
Rural	47 (30%)	39 (50%)	20 (25%)	
Financial income				
Excellent	43 (27%)	19 (24%)	20 (25%)	0.17
Average	96 (61%)	47 (60%)	48 (61%)	
Bad	19 (12%)	13 (16%)	11 (14%)	
Age groups				
30–40	28 (18%)	9 (12%)	43 (55%)	0.71
41–50	71 (45%)	39 (49%)	28 (35%)	
51–60	47 (30%)	14 (18%)	5 (6%)	
61–70	6 (4%)	12 (15%)	3 (4%)	
71–80	5 (3%)	5 (6%)	0 (0%)	
Educational level				
Higher education	79 (50%)	47 (60%)	55 (70%)	0.9
Secondary education	47 (30%)	27 (34%)	20 (25%)	
Primary education	24 (15%)	2 (2%)	0 (0%)	
No education	8 (5%)	3 (4%)	4 (5%)	
Marital status				
Married	141 (89%)	63 (80%)	38 (48%)	0.61
Unmarried	17 (11%)	16 (20%)	41 (52%)	
Employment status				
Employed	117 (74%)	51 (64%)	73 (93%)	0.88
Unemployed	9 (6%)	5 (6%)	2 (2%)	
Retired	32 (20%)	24 (30%)	4 (5)	

Impact of Family History of malignant Diseases:

Approximately 42% of individuals within the patient group noted a familial background of malignant diseases, while 10% indicated a family history of colon polyps, as illustrated in Figure 1. Moreover, this history exhibits a significant correlation with colorectal cancer risk (23%) within this cohort as depicted in Figure 2.

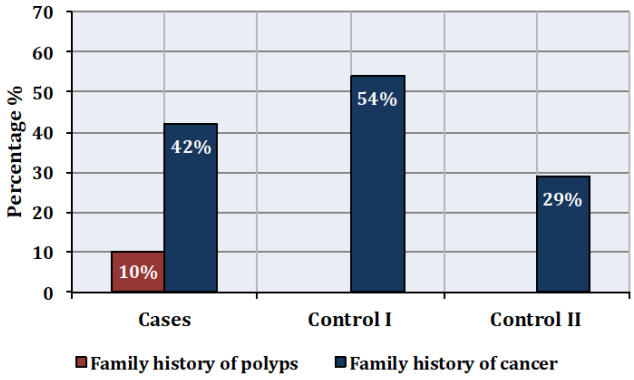

Figure 1: Distribution of Family History of Malignant Diseases and Colon Polyps Among Patients

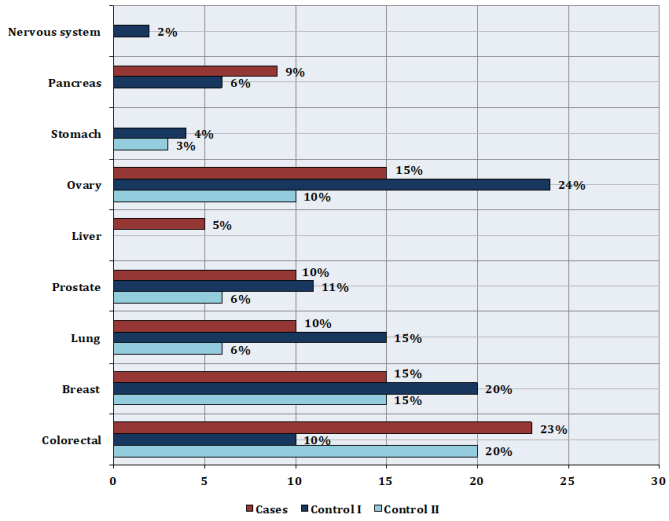

Figure 2: Correlation Between Family History and Colorectal Cancer Risk in the Cohort

Personal Medical History

Among the respondents, there was a notable association between ulcerative colitis and colorectal cancer risk (23%), Figure 3. Moreover, there was a notable lack of participation in screening tests among all groups, highlighting a substantial public health issue. Both colonoscopy and occult blood in stool tests were conducted in minimal numbers within the Cases group, despite the presence of positive family histories (2% each), as well as across all groups, indicating that these tests were not widely employed, as illustrated in Figure 4.

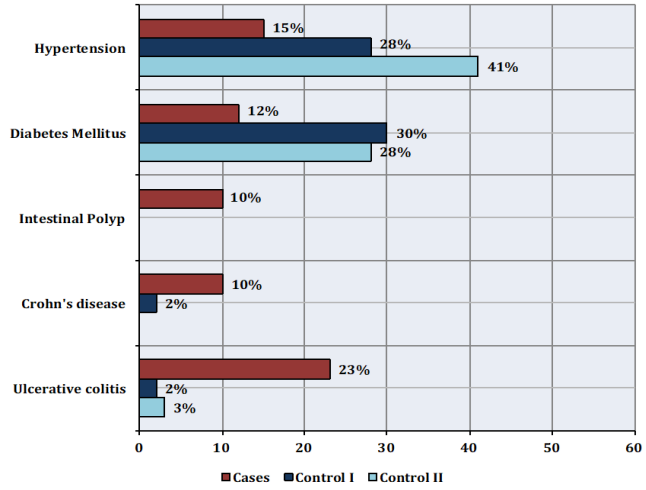

Figure 3: Personal Medical History of Illnesses: An Overview

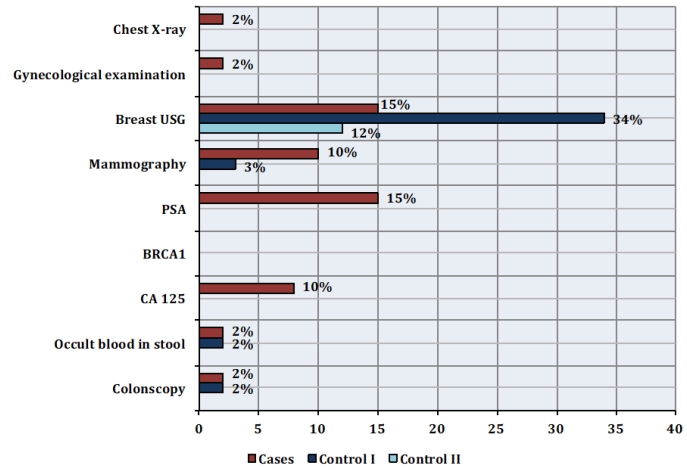

Figure 4: Screening and Diagnostic Tests Utilization Across Cases and Controls

Body Mass Index (BMI) and Physical Activity Levels

Among the 158 patients, 50% had a BMI lesser than 25 kg/m², and this was associated with a higher risk of colorectal cancer ($P < .01$). Additionally, the lack of physical activity, sedentary life and stress exposure were strongly associated with colorectal cancer risk ($P < .001$).

Table 3: Bodyweight and Physical Activity Characteristics among Study Participants

Characteristics	Cases (n = 158)	Controls I (n = 79)	Controls II (n = 79)	P
BMI				
<25	79 (50%)	42 (53%)	47 (60%)	0.17
25.0–29.9	55 (35%)	25 (32%)	26 (33%)	0.5
≥30	24 (15%)	12 (15%)	6 (7%)	0.01
Weekly physical activity time				
Lack of activity	140 (89%)	66 (84%)	62 (79%)	0.03
5 days a week for 30 minutes	11 (7%)	6 (8%)	5 (6%)	0.6
5 days a week for 1 hour	2 (1%)	2 (3%)	4 (5%)	0.9
7 days a week for 30 minutes	4 (3%)	4 (5%)	8 (10%)	0.3
Sedentary hours/day				
≤ 5 hours	13 (8%)	4 (5%)	6 (7%)	0.6
6-8 hours	130 (82%)	59 (75%)	63 (80%)	0.05
≥ 8 hours	16 (10%)	16 (20%)	10 (13%)	0.88
Stress				
Acute	85 (54%)	44 (56%)	51 (65%)	0.03
Chronic	55 (35%)	24 (30%)	12 (15%)	0.88

Comparative Patterns of Substance Misuse

Among Cases, the highest percentage was observed in active smokers (54%), followed by passive smokers (35%). A higher percentage of cases reported smoking for more than 20

years (73%), compared to Controls I and II. Again, this difference was statistically significant (P = 0.005). The number of cigarettes smoked daily also varied among the groups, with Cases having a higher percentage of individuals smoking 20 or more cigarettes a day (13%) compared to Controls I and II. The majority of Cases were abstinent from alcohol (93%), while a small percentage reported weekly or monthly consumption.

Table 4: Comparison of Smoking Habits and Alcohol Consumption Among Cases and Controls

Characteristics	Cases (n = 158)	Controls I (n = 79)	Controls II (n = 79)	P
Smoking				
Never	27 (16%)	29 (37%)	38 (48%)	0.73
Passive smoking	55 (35%)	36 (46%)	36 (45%)	0.90
Active smoker	85 (54%)	28 (36%)	6 (8%)	0.001
Former smoker	27 (17%)	24 (31%)	2 (3%)	0.02
Time of smoking				
<10 years	11 (7%)	43 (55%)	20 (25%)	0.05
10–20 years	32 (20%)	11 (14%)	51 (64%)	0.05
>20 years	115 (73%)	24 (31%)	9 (11%)	0.001
Number of cigarettes				
10 cigarettes/day	42 (27%)	20 (26%)	12 (15%)	0.10
11 to 20 a day	115 (73%)	59 (75%)	55 (70%)	0.05
20 a day	20 (13%)	16 (20%)	14 (18%)	0.41
Alcohol Consumption				
Abstinent	147 (93%)	58 (73%)	75 (95%)	0.04
Daily	0 (0%)	0 (0%)	0 (0%)	0
Weekly	11 (7%)	7 (9%)	0 (0%)	0.62
Monthly	11 (7%)	7 (9%)	4 (5%)	0.94

Dietary habits

A large proportion (47%) of patients reported daily vegetables and fruits consumption, with no significant difference among the groups. Furthermore, the cases had a significantly higher proportion of individuals consuming daily fatty meals (57%) and more than 500 grams of red meat per week (67%), compared to Controls I and II which were associated with an increased risk of colorectal cancer within this cohort (P < .001), Table 5.

Table 5: Comparison of Dietary Habits Among Cases and Controls

Characteristics/% (N)	Cases (n = 158)	Controls I (n = 79)	Controls II (n = 79)	P
Fresh vegetables, fruits				
Several times every day	27 (17%)	14 (18%)	17 (21%)	0.26
Daily once a day	74 (47%)	39 (50%)	39 (49%)	0.20
Often several times a week	52 (33%)	25 (32%)	24 (30%)	0.21
Preparation of dishes				
Boiled/steamed	3 (2%)	2 (3%)	4 (5%)	0.55

Fried	52 (33%)	24 (30%)	46 (58%)	0.05
Baked	47 (30%)	24 (30%)	28 (36%)	0.63
Grilled	3 (2%)	2 (3%)	4 (5%)	0.91
Fatty meals				
Daily	90 (57%)	35 (44%)	40 (51%)	0.71
A few times a week	43 (27%)	24 (31%)	29 (37%)	0.41
Several times a month	9 (6%)	4 (5%)	9 (11%)	0.73
Consumption of red meat				
500 g/week	21 (13%)	5 (6%)	5 (6%)	0.85
> 500 g/week	106 (67%)	43 (54%)	27 (34%)	0.001

These findings highlight the significant associations between demographic, lifestyle, and medical factors and the risk of developing colorectal cancer within this cohort.

Discussion

Our study delved into the characteristics of patients diagnosed with colorectal cancer, examining demographic and lifestyle factors associated with the disease. By evaluating both nonmodifiable and modifiable risk factors, we aimed to provide a comprehensive understanding of colorectal cancer onset. A notable strength of our study was the inclusion of two control groups, enabling robust comparisons and visualization of differences.

The demographic analysis provides crucial insights into the profile of colorectal cancer patients within the studied cohort. The mean age of 44.5 years indicates that this disease affects individuals in their midlife years, aligning with recent literature highlighting that colorectal cancer is no longer predominantly a disease of older age groups [13-15].

The observed slight male predominance echoes findings from global epidemiological studies, where males have often been reported to be at a higher risk of developing colorectal cancer compared to females [8,9]. The higher prevalence of colorectal cancer in urban areas compared to rural areas underscores the potential influence of environmental and lifestyle factors associated with urban living, such as dietary habits, sedentary lifestyle, and exposure to environmental pollutants, all of which have been implicated in the aetiology of colorectal cancer.

The significant proportion of individuals with a familial background of malignant diseases, including colon polyps, underscores the importance of genetic predisposition in colorectal cancer development. This observation aligns with established evidence highlighting the role of genetic susceptibility in colorectal cancer risk, with familial adenomatous polyposis (FAP) and Lynch syndrome being well-recognized hereditary colorectal cancer syndromes [16-18]. The strong correlation between family history and colorectal cancer risk further emphasizes the need for comprehensive genetic counseling and screening strategies, particularly among individuals with a positive family history, to facilitate early detection and intervention.

The association between ulcerative colitis and colorectal cancer risk reaffirms the well-documented link between chronic inflammatory conditions of the gastrointestinal tract and increased susceptibility to colorectal cancer development [19-21]. This finding underscores the importance of regular surveillance and monitoring of individuals with inflammatory bowel diseases (IBD) to detect precancerous changes and facilitate timely intervention. The notable lack of participation in screening tests among all groups highlights a critical gap in preventive healthcare practices, reflecting broader challenges in healthcare access, awareness, and adherence to screening guidelines.

In this study, a notable and unexpected finding emerged regarding the association between body mass index (BMI) and colorectal cancer risk. Contrary to prevailing expectations and established literature [5, 12,15], individuals with a BMI < 25 kg/m² were found to be more susceptible to colorectal cancer. This intriguing observation challenges conventional paradigms surrounding the relationship between BMI and colorectal cancer risk and warrants further investigation to elucidate underlying mechanisms and potential confounding factors. The identification of individuals with a lower BMI as a high-risk group for colorectal cancer introduces novel considerations in risk stratification and preventive strategies. While obesity

has long been recognized as a significant risk factor for colorectal cancer due to its association with chronic low-grade inflammation, insulin resistance, and altered adipokine signaling pathways, the observed susceptibility among individuals with a lower BMI suggests the presence of distinct pathophysiological mechanisms [9]. One plausible explanation for this unexpected association could be the presence of other risk factors or confounding variables that exert a more pronounced influence on colorectal cancer risk in individuals with a lower BMI. Factors such as dietary patterns, physical activity levels, genetic predisposition, and metabolic abnormalities may interact synergistically or antagonistically with BMI to modulate colorectal cancer susceptibility. Furthermore, the role of visceral adiposity, rather than overall BMI, in colorectal carcinogenesis warrants consideration.

The differential patterns of smoking habits among cases and controls highlight the complex interplay between tobacco exposure and colorectal cancer risk. Active smoking, particularly long-term smoking, emerges as a significant risk factor for colorectal cancer, consistent with established evidence linking tobacco smoke carcinogens to colorectal tumorigenesis [22-24]. The observed abstinence from alcohol among the majority of cases contrasts with previous studies reporting a positive association between alcohol consumption and colorectal cancer risk [25]. This discrepancy may reflect variations in alcohol consumption patterns, cultural factors, and sample characteristics across different populations.

The association between dietary factors and colorectal cancer risk underscores the role of lifestyle choices in modulating disease susceptibility. Daily consumption of fatty meals and high intake of red meat, both hallmark features of Western dietary patterns, have been consistently implicated in colorectal cancer pathogenesis [17]. The pro-inflammatory and pro-carcinogenic properties of saturated fats and heme iron present in red meat, coupled with the production of carcinogenic compounds during high-temperature cooking methods, contribute to the oncogenic potential of these dietary components. These findings underscore the importance of dietary modifications and adherence to balanced nutritional guidelines in colorectal cancer prevention strategies.

Study Limitations

Despite the valuable insights provided by this study, several limitations should be acknowledged. Firstly, the retrospective nature of the study design introduces inherent biases and limits the establishment of causal relationships between variables. Secondly, the reliance on self-reported data may introduce recall bias and inaccuracies in the assessment of exposure variables, such as dietary habits, smoking history, and medical comorbidities. Additionally, the relatively small sample size and single-center setting may restrict the generalizability of findings to broader populations. Furthermore, the lack of longitudinal follow-up precludes the assessment of temporal relationships and long-term outcomes, necessitating caution in extrapolating findings to real-world clinical practice. Finally, the absence of comprehensive data on potential confounding variables, such as family history, genetic predisposition, and environmental exposures, hampers the ability to fully elucidate the complex interplay between various determinants and colorectal cancer risk.

Conclusion

This study provides valuable insights into the demographic, lifestyle, and medical factors associated with colorectal cancer risk within the studied cohort. The identification of unexpected associations, such as the increased susceptibility among individuals with a BMI < 25 kg/m², underscores the complexity of colorectal cancer etiology and highlights the need for tailored risk assessment strategies. Despite the study's limitations, the findings contribute to our understanding of colorectal cancer pathogenesis and inform the development of targeted prevention and intervention initiatives. Moving forward, prospective studies incorporating larger, more diverse populations and comprehensive assessments of confounding variables are warranted to validate findings and advance our knowledge of colorectal cancer risk factors. Ultimately, a multifaceted approach encompassing public health interventions, lifestyle modifications, and early detection strategies is essential for mitigating the burden of colorectal cancer and improving patient outcomes on a global scale.

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