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Research Article
Influence of Age, BMI and Sex on Colorectal Cancer Risk

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Abstract

Background and Objective: Colorectal cancer (CRC) risk is influenced by demographic factors such as age, Body Mass Index (BMI) and sex. This study aimed to investigate the association of these factors with CRC risk to inform targeted preventive interventions. **Materials and Methods:** In this case-control study, 70 CRC patients and 70 matched controls were recruited. Data were collected using structured questionnaires and medical records. Statistical analyses included t-tests, Chi-square tests and logistic regression to examine the relationships between age, BMI, sex and CRC risk. Statistical significance was set at $p<0.05$. **Results:** Higher age, male sex and elevated BMI were significantly associated with increased CRC risk. The mean age of CRC cases was 54.0±13.1 years versus 49.5±10.4 years in controls ($p = 0.023$). Mean BMI was higher in cases than controls (30.0±5.8 vs. 28.2±4.4, $p = 0.045$). The CRC incidence was greater in men than women (57.1% vs. 42.9%, $p = 0.042$). **Conclusion:** Age, BMI and male sex are important risk factors for CRC. These findings emphasize the need for prioritizing high-risk populations in CRC screening and prevention programs.

Key words: Colorectal cancer (CRC), risk factors, age, Body Mass Index (BMI), sex differences, case-control study, prevention strategies

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Colorectal carcinoma is the third leading cause of cancer-related death among men and the second among women worldwide. The continued upward trend of incidence translates into an urgent need for improved screening and prevention methods. The latter realization of improved interventions takes place based on the attainment of a better understanding of demographic risks associated with the causation of colorectal cancer (CRC). A number of detailed elements that have been identified include age, body mass index and sex[1].

Older age is a well-established risk factor for CRC due to the accumulation of genetic mutations and extended time of exposure to carcinogens. Indeed, it is shown that the incidence of CRC increases sharply past the age of 50, thus justifying the recommendation to begin regular screening at this age[2].

Another critical factor having a role in CRC risk is Body Mass Index (BMI), a measure of body fat based on height and weight. According to reports, a higher BMI has been found to have metabolic changes, insulin resistance and chronic inflammation capable of leading to carcinogenesis. Obesity will lead to high insulin levels and insulin-like growth factors, thus fostering the emergence of cancer cells. Several studies have consistently shown a positive association between obesity and CRC risk[3-5].

Sex differences in CRC incidence and outcomes suggest that both biological and lifestyle factors may modulate risk. In comparison to women, there exists an increased risk for CRC in men[6,7]. This disparity might, therefore, emanate from differences in lifestyle, diet, or even exposure to risk factors and biological differences like the levels of hormones. This is considered to be due to the protective effect of oestrogen against CRC in women, while in men, higher rates of smoking and alcohol consumption increase the risk of CRC[8-10].

It aims to explain exactly how age, BMI and sex contribute to CRC risk. Elucidation of risk factors may help improve screening and develop preventive measures that reduce incidence and mortality from CRC.

MATERIALS AND METHODS

Study area and duration: The study was conducted in Baghdad, Iraq and participants were recruited and/or data were obtained through Al-Yarmouk Teaching Hospital (Yarmouk Hospital), Al-Karkh, Baghdad, Iraq. The study was carried out from January 2020 to December 2022.

Study design and participants: This case-control study included 140 participants, comprising 70 colorectal cancer (CRC) cases and 70 controls. Controls were selected from first-degree relatives of CRC cases, presumed to have similar genetic predispositions. Although initially matched for age and sex, significant differences in age, BMI and sex were observed and were accounted for in the analyses.

Data collection: Data on CRC cases were obtained from a cancer registry that contained detailed demographic and clinical information. For both cases and controls, structured questionnaires and medical records were used to collect demographic and clinical data.

Variables and measures: The primary variables assessed included age, Body Mass Index (BMI), sex, family history and marital status. Age and BMI were treated as continuous variables, while sex, family history and marital status were categorical.

Statistical analysis: Descriptive statistics, including frequencies and means, were used to summarize participant characteristics. Independent t-tests were used to compare

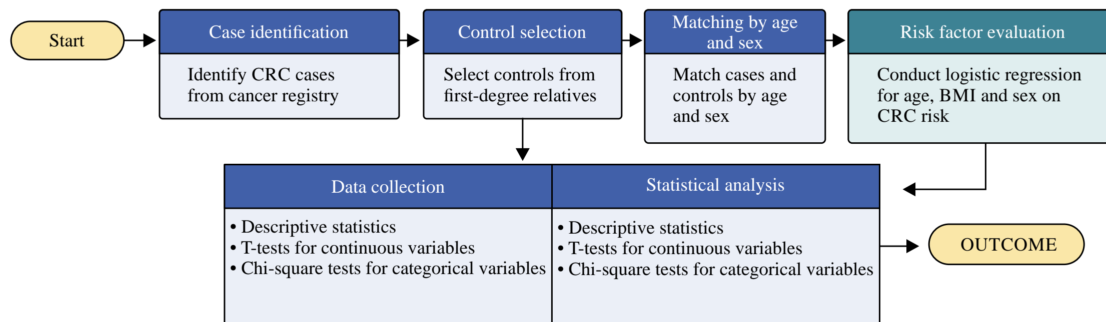

Fig. 1: A schematic diagram of the study methodology

Table 1: Demographic characteristics of study family (n = 140)

Characteristics	Cases (n = 70)	Controls (n = 70)	p-value
Sex			0.042*
Man	40 (57.1%)	28 (40.0%)	
Woman	30 (42.9%)	42 (60.0%)	
Age			0.023*
Mean±SD	54.0±13.1	49.5±10.4	
BMI			0.045*
Mean±SD	30.0±5.8	28.2±4.4	

Values are presented as frequency (%) or Mean±Standard Deviation (SD). *p-value indicates statistical significance at α: 0.05, NS: Not significant, BMI: Body Mass Index and CRC: Colorectal cancer. Crowdedness levels were categorized as low, medium and high based on household size

Table 2: Cross-tabulation of demographic factors associated with CRC (n = 140)

Factor	Cases (n = 70)	Controls (n = 70)	p-value
Family history			<0.001*
No	20 (28.6%)	45 (64.3%)	
Yes	50 (71.4%)	25 (35.7%)	
Marital status			0.901 NS
Single	6 (8.6%)	6 (8.6%)	
Married	62 (88.6%)	61 (87.1%)	
Widowed	2 (2.9%)	3 (4.3%)	
Crowdedness			0.755 NS
Low	24 (34.3%)	26 (37.1%)	
Medium	28 (40.0%)	27 (38.6%)	
High	18 (25.7%)	17 (24.3%)	

Values are presented as frequency (%) or mean±standard deviation (SD). *p-value indicates statistical significance at α: 0.05, NS: Not significant, BMI: Body Mass Index, and CRC: Colorectal cancer. Crowdedness levels were categorized as low, medium and high based on household size

means of continuous variables (age and BMI) between cases and controls. Associations of categorical variables (sex, family history and marital status) with CRC were assessed using chi-square tests. Logistic regression analyses were performed to examine the independent effects of age, BMI and sex on CRC risk, adjusting for potential confounders. Statistical significance was set at $p<0.05$.

The study methodology is summarized in a schematic diagram (Fig. 1), illustrating the selection of CRC cases from the cancer registry, matching with first-degree relative controls, data collection and subsequent statistical analyses, including descriptive statistics, t-tests, Chi-square tests and logistic regression.

RESULTS

The demographic characteristics of the study family are summarized in Table 1. The mean age of CRC cases was significantly higher than that of controls (54.0±13.1 vs. 49.5±10.4, p = 0.023). The mean BMI of CRC cases was also significantly higher than that of controls (30.0±5.8 vs. 28.2±4.4, p = 0.045). Men had a higher prevalence of CRC compared to women (57.1% vs. 42.9%, p = 0.042).

Table 2 presents the cross-tabulation of demographic factors associated with CRC. The analysis revealed that a significant proportion of CRC cases had a family history of cancer (71.4%) compared to controls (35.7%), with a p-value of less than 0.001. Marital status did not show a significant association with CRC, as the proportions of single, married and widowed individuals were similar between cases and controls (p = 0.901).

DISCUSSION

The present study identified age, Body Mass Index (BMI) and sex as significant determinants of colorectal cancer (CRC) risk. Our findings demonstrated that CRC patients were significantly older than controls (54.0±13.1 vs. 49.5±10.4 years, p = 0.023). This observation is consistent with previous studies showing that CRC incidence increases with age due to the accumulation of genetic mutations and prolonged exposure to environmental carcinogens[9]. Aging is also associated with reduced immune surveillance and a higher prevalence of precancerous lesions in the colon, which may further contribute to cancer development[10].

The BMI was also significantly higher among CRC cases compared with controls (30.0±5.8 vs. 28.2±4.4, p = 0.045), supporting previous research linking obesity with increased CRC risk. Obesity promotes metabolic alterations such as insulin resistance and elevated insulin-like growth factor (IGF) levels, which stimulate tumor cell proliferation and inhibit apoptosis. Additionally, obesity is associated with chronic

low-grade inflammation characterized by elevated cytokines such as TNF-α and IL-6, creating a pro-tumorigenic environment that may facilitate carcinogenesis[11]. These mechanisms have been widely documented in epidemiological studies examining obesity-related cancers.

Lifestyle factors may further strengthen the association between obesity and CRC. Diets rich in processed foods, red meat and refined sugars have been linked to inflammatory processes and alterations in gut microbiota composition. Such changes may promote dysbiosis and the production of carcinogenic metabolites that contribute to colorectal tumor development[12,13]. Sedentary behavior, commonly associated with obesity, may also exacerbate these metabolic and inflammatory pathways, further increasing CRC risk.

Hormonal mechanisms also play an important role in the relationship between obesity and CRC. Increased levels of insulin, IGF and leptin in obese individuals promote cellular proliferation and angiogenesis while inhibiting apoptosis. Conversely, adiponectin, which has anti-inflammatory properties, is typically reduced in obesity and may therefore lose its protective effects against tumor development[14-16]. These biological pathways have been highlighted in previous studies, including the meta-analysis by Larsson and Wolk, which reported a positive association between obesity and CRC risk[17]. Similarly, Harriss *et al.*[18] found that elevated BMI modestly increases CRC risk, supporting the findings of the current study.

Sex differences in CRC incidence were also observed, with a higher proportion of cases occurring in men (57.1%) compared with women (42.9%) ($p = 0.042$). This observation is consistent with previous epidemiological studies reporting a greater CRC risk among men[5,19]. Several explanations have been proposed for this disparity. Hormonal factors may play a protective role in women, as estrogen is believed to reduce inflammation and regulate cellular proliferation within the colon[20]. Consequently, premenopausal women tend to have a lower CRC risk, while this protective effect diminishes after menopause when estrogen levels decline[21].

In contrast, men may experience increased CRC risk due to both biological and behavioral factors. Testosterone and other hormonal changes may influence inflammatory responses and cellular proliferation, although the exact mechanisms remain under investigation[22]. Additionally, lifestyle factors such as higher rates of smoking, alcohol consumption and diets rich in red or processed meat are more prevalent among men and may contribute to the increased CRC risk observed in this group[23].

Sex disparities in CRC risk may also reflect differences in healthcare utilization and screening behaviors. Studies suggest that men are less likely to undergo routine health examinations and cancer screening compared with women, potentially leading to later diagnosis and worse outcomes[14]. Furthermore, differences in tumor biology between sexes have been reported in some studies, which may also contribute to variations in CRC incidence and progression[17].

Family history was another notable factor observed in this study, with a higher proportion of CRC cases reporting a family history of cancer compared with controls (71.4% vs. 35.7%, $p<0.001$). Since controls were selected from first-degree relatives, this finding highlights the importance of genetic predisposition in CRC risk. Individuals with affected first-degree relatives are known to have a substantially increased likelihood of developing CRC and therefore may benefit from earlier and more frequent screening[16].

Other sociodemographic variables, including education level, marital status, job level and crowdedness, did not show significant associations with CRC risk in this study. Although these factors may influence health outcomes indirectly through socioeconomic conditions, healthcare access, or lifestyle behaviors, they did not appear to independently affect CRC development in our sample. Similar findings have been reported in previous research examining the complex relationship between social determinants and cancer risk[24].

Age-related factors may also influence behavioral determinants such as physical activity. Older individuals may experience reduced mobility, comorbid conditions, or environmental limitations that restrict engagement in regular physical activity. These barriers may contribute indirectly to CRC risk, highlighting the importance of promoting accessible lifestyle interventions for older populations[20].

Overall, the results of this study align with a growing body of literature demonstrating that age, obesity and male sex are key contributors to colorectal cancer risk. These factors likely interact through a combination of biological mechanisms, hormonal influences and lifestyle behaviors, emphasizing the multifactorial nature of CRC development.

Despite providing valuable insights, several limitations should be acknowledged. The case-control design does not allow causal relationships to be established and differences between cases and controls may introduce potential bias. Additionally, important lifestyle factors such as diet, physical activity, smoking status and healthcare access were not fully evaluated. The relatively modest sample size may also limit the generalizability of the findings. Future studies using larger

prospective cohorts and incorporating additional behavioral and genetic variables would help clarify the complex mechanisms underlying CRC risk.

CONCLUSION

This study demonstrates that age, BMI and sex are significant contributors to colorectal cancer (CRC) risk, with older individuals, those with higher BMI and men being at greater risk. These findings emphasize the need for targeted preventive measures, including lifestyle modifications, maintaining a healthy weight and regular medical checkups. Raising awareness about CRC screening is also crucial for early detection, particularly among individuals with a family history of the disease. Sociodemographic factors such as marital status, crowdedness and job level did not show a significant association with CRC in this study. Further research is warranted to elucidate the mechanisms underlying the identified risk factors and to inform more effective prevention strategies.

SIGNIFICANCE STATEMENT

This study highlights the significant roles of age, Body Mass Index (BMI) and sex as key risk factors for colorectal cancer in an Iraqi population. The findings contribute to regional epidemiological evidence and emphasize the importance of targeted screening and prevention strategies for high-risk groups, particularly older individuals, men and those with elevated BMI. These results may support public health efforts aimed at early detection and lifestyle-based prevention of colorectal cancer.

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