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Original Article

Impact of Various Risk Factors on the Positive Fecal Immunochemical Test for Colorectal Cancer in the Iranian Population

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Abstract

Background: Colorectal cancer (CRC) is the most prevalent cancer with high mortality worldwide. We aimed to evaluate the incidence of CRC based on the positive fecal immunochemical test (FIT) result in the Iranian population.

Methods: The present study was conducted on the health assessment data recorded in the SINA (Integrated Health Information System) in 2018 and 2019 from individuals who had participated in the national program, including asymptomatic people aged 50-69 years or had risk factors of CRC such as family or past personal history of CRC as well as symptomatic individuals, for the early detection and prevention of CRC in Mashhad, Iran.

Results: The study participants included 140,463 eligible individuals, of whom 8258 (5.88%) and 145 (2.21%) were positive for FIT and diagnosed with colon cancer, respectively. Unfortunately, only 654 people had undergone colonoscopy. Our results indicated that age, fast food intake (≥two units per day), family history of CRC in first or second-degree relatives, some gastrointestinal diseases such as inflammatory bowel disease (IBD) and CRC, as well as bleeding per anus, constipation, abdominal cramp, and losing body weight were associated with increased risk of positive FIT. However, some other factors, including having a hard job, physical activity, and Iranian nationality (compared to non-Iranians), were associated with a low risk of positive FIT screening tests for CRC.

Conclusion: A high number of high-risk persons in Mashhad were positive for the FIT test in 2018-2019, and many of them were diagnosed with CRC, according to the colonoscopy results. Therefore, screening is highly recommended as the first step in the early detection of CRC.

Keywords: Colorectal cancer, Epidemiology, Fecal immunochemical test, Prevention, Screening

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Introduction

Colorectal cancer (CRC) is a common cause of death before the age of 70 in different countries. Moreover, this cancer is one of the most prevalent cancers worldwide, including in Iran.[1] According to the global cancer burden (GLOBOCAN 2020), based on information from the International Agency for Research on Cancer in 2020, CRC is the 3rd most prevalent cancer in both men and women and is the second in terms of mortality in the world.[1] However, the incidence and mortality of CRC are declining in developed countries.[2]

Iran is one of the regions with a lower incidence of CRC, and based on the available evidence, the incidence of the disease in Iran is close to its incidence in other Middle Eastern countries but is lower compared with its rate in Western countries.[3] According to the information available in the Iranian population cancer registration systems, the incidence of this disease in Iran is higher in the northern provinces, such as Golestan and Mazandaran, compared with the central and southern provinces.[3] Between the years 2003 and 2008, the rate of cancer in Iran increased in both men and women (from 3.92 to 7.78 in women and from 5.56 to 12.7 per 100 000 people in men) due to changes in diet and lifestyle.[4] In Iran, nearly 4000 new cases of CRC are reported each year, with 1,150 fatalities annually.[5] A study conducted in Iran from 2003-2008 demonstrated that 61.83 %, 27.54%, 7.46%, and 3.10% of patients with CRC had colon cancer, rectal cancer,

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rectosigmoid cancer, and anal cancer, respectively.[4]

Genetic and environmental factors are among other causes of CRC. Several risk factors have been identified in association with this disease such as red meat intake, positive family history, alcohol use, tobacco smoking, and certain hereditary cancer syndromes. Protective factors include calcium, vegetables, folate, hormone replacement therapy, physical activity, and non-steroidal anti-inflammatory drugs.[6]

Colon cancer is known as a silent disease, and people affected by this disease usually do not show symptoms until the advanced stages of the disease; however, according to the available evidence, the most important symptoms of this disease, which should be taken into consideration, include rectal bleeding, weight loss, abdominal pain and changes in bowel movements. In addition to these, the most important laboratory symptoms are the presence of blood in stool and anemia.[7]

CRC is often diagnosed after the onset of symptoms or through screening tests for asymptomatic cases. Various screening tests are available in this regard, such as non-invasive stool-based testing or colonoscopy. A patient with any abnormal non-invasive stool-based screening test result for CRC requires a colonoscopy to be evaluated for CRC. Stool-based screening tests include guaiac-based fecal occult blood tests (g-FOBT), fecal immunochemical tests (FITs), and multi-target stool DNA testing (sDNA-FIT). The mentioned tests for CRC are different in terms of sensitivity and specificity, evidence of effectiveness, safety, convenience, cost, and availability.[8,9]

It should be noted that tumors have different prevalence around the world, and environmental exposures and racial factors may affect this prevalence. Therefore, it can be concluded that environmental exposures can play a key role in CRC. We surveyed the incidence of CRC in terms of the available non-invasive screening test (FIT) in the city of Mashhad, Iran, and compared the relative frequency of FIT test results (positive-negative-invalid) in eligible patients who had been referred to Mashhad Comprehensive Health Service Centers in 2018-2019 based on the presence of CRC risk factors and lifestyle. A spatial analysis of FIT-positive participants was conducted based on the participants' specific geography, culture, and ethnicity.

Materials and Methods

Study Design

The present study was performed based on the health assessment data recorded in the SINA (Integrated Health Information System) system in 2018-2019 related to individuals who participated in the national program for the early detection and prevention of CRC in Mashhad, Iran.

In this study, the sampling was performed based on the census method, and we included all patients who were eligible to enter the health centers and willing to participate in the study. We observed all ethical considerations in performing this study, and the participants were initially informed about the study objectives and procedure. Moreover, written informed consent was obtained from all of them.

Inclusion and Exclusion Criteria

The study population was selected based on the inclusion criteria, including Iranians living in regions covered by the Mashhad University of Medical Sciences who were referred to Comprehensive Health Centers and were eligible for FIT. Criteria for entering the national program for the prevention and early detection of CRC with the FIT included: (1) the asymptomatic individuals with the age range of 50-69 years, (2) personal history of gastrointestinal cancer, adenoma, or inflammatory bowel disease (IBD), (3) family history of CRC or adenoma in the first-degree family or the same history in those under 49 years of age in the second-degree family, (4) any gastrointestinal symptom, such as bleeding from the lower gastrointestinal tract in the last year, and (5) constipation during the last month (with or without diarrhea, feeling full in the anus after defecation, and abdominal pain), and the weight loss of more than 10%. The exclusion criteria were incomplete information and the inability to give a history or visit a comprehensive health center, for instance in the case of those with acute mental or emotional disorders, or physical illness.

A total number of 140 463 patients with indications for colorectal screening via the FIT test were enrolled in this study. The FIT was performed for all eligible participants on a single stool sample from each participant. The mentioned test measured hemoglobin in the stool and was a single-stage test using a qualitative immunoassay method to detect human blood in the stool.

Additionally, demographic characteristics of individuals, physical activity, nutritional status, and other risk factors were assessed (using a questionnaire) and recorded in the SINA system by health caregivers. The FIT result was recorded for each participant, and those with positive FIT results were referred for colonoscopy. Unfortunately, out of the 8258 patients who tested positive for FIT, only 654 (12.6%) had undergone a colonoscopy. The relative frequency of FIT test results (positive, negative, and invalid) was determined, and the presence of CRC risk factors and lifestyle was compared between the groups.

Statistical Analysis

Data analysis was performed using SPSS software (version 22.0). Descriptive statistics were used to assess the frequency and percentage of qualitative variables, and quantitative variables with normal distribution were presented with mean ± standard deviation (SD). The normal distribution of data was determined using the Kolmogorov-Smirnov test. The independent Student's *t* test was used to compare the quantitative variables between positive and negative FIT groups. The qualitative variables were analyzed using chi-square or Fisher's exact

tests. The logistic regression model was used to evaluate the relationship between independent variables and the positive results of FIT, and the odds ratio (OR), and 95% confidence intervals (CI) were reported for the significant risk factors. The level of significance was set at $P<0.05$.

Results

The characterization of 140,463 participants according to the results of the FIT is summarized in Table 1. Our results demonstrated that 5.9%, 93.2%, and 1.0% of the included population had positive, negative, and invalid FIT results, respectively. The mean ± SD age of the subjects in the groups of positive, negative, and invalid FIT was 58.94 ± 10.92, 59.76 ± 10.92, and 62.1 ± 15.12, respectively, with a significant difference between positive and negative FIT groups ($P<0.001$). Overall, 55.8% of individuals were women, and a significant difference was observed between the two groups based on sex ($P<0.001$). Moreover, 82.6% of the subjects were married with a spouse, while 13.3% and 4% were married without a spouse and single, respectively ($P<0.001$). Furthermore, 96.5% of participants had Iranian nationality compared with 3.5% with non-Iranian nationality ($P<0.001$). Non-academic and academic education was observed in 55.8% and 9.1% of the subjects, and 35.1% of the subjects were illiterate ($P<0.001$). In total, 39% and 50.3% of the study population had hard jobs involving heavy physical activity or physical activities, respectively, and there was a significant difference between the negative and positive FIT groups ($P<0.001$).

Overall, 31.6%, 42.2%, and 33.5% of the subjects consumed dairy products, vegetables, and fruits two or more than two units per day, whereas 66.2%, 54.5%, and 63.4% had no or rare intake of dairy, vegetables, and fruits, respectively. In total, 77.2% used two or more units of fast food, and 76.3% never or rarely consumed salt per day. In our study, 51%, 14.1%, and 34.8% of the population used liquid oil, solid oil, and a combination of both, respectively. There was a significant difference between positive and negative FIT groups in terms of all lifestyle parameters ($P<0.001$).

The clinical symptoms, including bleeding per anus, constipation, abdominal cramp, feeling of residuum per defecation, and body weight loss, were observed in 71.6%, 11%, 1.3%, and 0.3% of the participants during the last month with significant differences between the results of negative and positive FIT groups. Additionally, 19%, 41.2%, 0.2%, 0.2%, and 0.1% of the enrolled subjects had diabetes, hypertension, IBD, CRC, and colorectal adenoma, respectively. A total of 1.7% and 0.5% of the subjects had first-degree or second-degree relatives with CRC, respectively. As presented in table 1, no significant difference was found in terms of diabetes mellitus between negative and positive FIT groups ($P<0.954$). However, there were significant differences between the mentioned groups in terms of other medical histories and symptoms.

Table 2 presents the significant effect of risk factors associated with the positive FIT results based on the logistic regression model with an OR at a CI of 95%. It was found that hard jobs (OR = 0.730, CI = 0.674-0.791), physical activity (OR = 0.763, CI = 0.703-0.829), and Iranian nationality versus non-Iranian nationality (OR = 0.768, CI = 0.655-0.901), independently reduced the risk of positive FIT. In contrast, bleeding per anus (OR = 4.169, CI = 3.502-4.963), loss of body weight (OR = 3.543, CI = 2.462-5.097), IBD (OR = 3.476, CI = 2.393-5.050), CRC (OR = 2.880, CI = 1.872-4.432), constipation (OR = 2.303, CI = 2.126-2.495), abdominal cramp, feeling of residuum per defecation (OR = 2.039, CI = 1.709-2.432), second-degree (OR = 2.203, CI = 1.610-3.016) or first degree (OR = 1.734, CI = 1.445-2.081) relatives with CRC, and hereditary diseases (OR = 1.891, CI = 1.079-3.314) were independently associated with a high risk of positive FIT results. Additionally, the non-academic (OR = 1.390, CI = 1.279-1.511) or academic (OR = 1.459, CI = 1.285-1.657) education of the subjects increased the odds of positive FIT by 1.4 fold, compared with illiterate participants. The consumption of fast food for two or more units (OR = 1.208, CI = 1.094-1.333) independently increased the risk of positive results compared with the less usage of fast food (less than two units). Furthermore, the increase in the age of the participants was related to an increase in the likelihood of a positive FIT test (OR = 1.005, CI = 1.001-1.009). Our results revealed that the bleeding per anus was associated with a 4.2-fold higher risk of positive FIT and was determined as the risk factor with the highest significant effect in this study.

Discussion

The burden of common cancers, such as CRC, is changing in different regions.[10] In addition, incidence rates of CRC have been increasing in many countries in South-Central Asia, Eastern Europe, and South America.[11] According to data from 184 countries, the rate of CRC is regarded as a measure of community development.[12] The increase in the rate of this cancer likely reflects changes in lifestyle factors, including physical activity and diet.[13]

In the present study, the rate of CRC was estimated to be 2.21%, with a standardized incidence of 22.1 per 100 000 people. However, this rate was lower in a previous study in which CRC was estimated to be the fourth most common cancer among women with a standardized rate of 6.5 to 7.5 per 100 000 and the third most prevalent cancer among Iranian men with a standardized rate of 8.1-8.3 per 100 000 individuals.[14] Based on our data, only 654 individuals had undergone colonoscopy, and others with a positive FIT test either did not undergo colonoscopy, or there was no information regarding the performance of colonoscopy recorded in the SINA system, despite the thorough investigations performed by the health care professional. Accordingly, the mentioned results should be performed with caution. The present study recommended that the application of an appropriate national cancer control program seems to be of great importance in controlling

Table 1. Characteristics of 140463 subjects based on the results of the fecal immunochemical test (FIT)

Variables	FIT			*P* value*
	Positive	Negative	Invalid	
Demographic				
Age	58.94±10.92	59.76±10.92	62.1±15.12	<0.001
Sex				<0.001
Male	3303 (40.0)	58152 (44.4)	586 (43.9)	
Female	4955 (60.0)	72717 (55.6)	750 (56.1)	
Marital status				<0.001
Single	430 (5.2)	5194 (4.0)	63 (4.7)	
Married with spouse	6792 (82.2)	108276 (82.7)	1024 (76.6)	
Married without spouse	1036 (12.5)	17399 (13.3)	249 (18.6)	
Nationality				<0.001
Iranian	7882 (95.4)	126472 (96.6)	1291 (96.6)	
Non-Iranian	376 (4.6)	4397 (3.4)	45 (3.4)	
Education				<0.001
Illiterate	2247 (27.2)	46568 (35.6)	563 (42.1)	
Non-academic	5044 (61.1)	72596 (55.5)	668 (50.0)	
Academic	967 (11.7)	11705 (8.9)	105 (7.9)	
Hard job	2609 (31.6)	51762 (39.6)	444 (33.2)	<0.001
Lifestyle				
Dairy consumption				<0.001
Never or rarely	4550 (60.7)	80534 (66.6)	688 (65.5)	
<Two units	209 (2.8)	2584 (2.1)	26 (2.5)	
≥Two units	2739 (33.2)	37870 (31.3)	337 (32.1)	
Vegetable consumption				<0.001
Never or rarely	2684 (47.6)	49585 (55.0)	300 (50.8)	
<Two units	236 (4.2)	2926 (3.2)	36 (6.1)	
≥Two units	2721 (32.9)	37724 (41.8)	254 (43.1)	
Fruit consumption				0.005
Never or rarely	4624 (61.6)	76775 (63.5)	644 (61.2)	
<Two units	256 (3.4)	3758 (3.1)	39 (3.7)	
≥Two units	2621 (34.9)	40463 (33.4)	370 (35.1)	
Salt consumption				<0.001
Never or rarely	6066 (75.4)	98318 (76. 4)	953 (72.5)	
<Two units	477 (5.8)	5075 (3.9)	70 (5.3)	
≥Two units	1503 (18.2)	25277 (19.6)	292 (22.2)	
Fast food consumption				<0.001
Never or rarely	504 (6.3)	6965 (5.4)	86 (6.6)	
<Two units	1228 (15.3)	22545 (17.5)	177 (13.5)	
≥Two units	6299 (78.4)	99089 (77.1)	1048 (79.9)	
Oil consumption				
Solid	1304 (16.2)	18046 (14.0)	207 (15.7)	
Liquid	4214 (52.3)	65485 (50.8)	680 (51.7)	<0.001
Both	2545 (31.6)	45288 (35.2)	428 (32.5)	
Physical activity	3474 (47.8)	66679 (59.7)	579 (53.9)	<0.001
Symptoms during last month and medical history				
Bleeding per anus	469 (5.7)	1002 (0.8)	5 (0.4)	<0.001
Constipation	2143 (26.0)	13240 (10.1)	67 (5.0)	<0.001
Abdominal cramp and feeling of residuum per defecation	397 (4.8)	1414 (1. 1)	12 (0.9)	<0.001

Table 1. Continued.

Variables	FIT			*P* value*
	Positive	Negative	Invalid	
Loss of body weight (>10%)	97 (1.2)	283 (0.2)	4 (0.3)	<0.001
Diabetes	1657 (24.9)	24724 (24.9)	276 (27.3)	0.954
Hypertension	3414 (51.2)	53829 (54.2)	598 (59.1)	<0.001
IBD	90 (1.1)	253 (0.2)	2 (0.1)	<0.001
CRC	58 (0.7)	201 (0.2)	1 (0.1)	<0.001
Colorectal adenoma	12 (0.1)	93 (0.1)	2 (0.1)	0.034
Hereditary diseases	38 (0.5)	148 (0.1)	0 (0.0)	<0.001
First- degree relatives with CRC	284 (3.4)	2161 (1.7)	6 (0.4)	<0.001
Second- degree relatives with CRC (<50 years)	83 (1.0)	553 (0.4)	5 (0.4)	<0.001

IBD: Inflammatory bowel disease; CRC: Colorectal carcinoma; * Between positive and negative FIT.
The quantitative variables were presented as the mean±standard deviation (SD), and the qualitative variables were presented by frequency (percentage).

Table 2. The effect of significant risk factors on positive fecal immunochemical test results using the logistic regression model

Variables	Odds ratio	95% CI		*P* value
		Lower	Upper	
Age	1.005	1.001	1.009	0.011
Nationality (Iranian)	0.768	0.655	0.901	0.001
Education				
Non-academic	1.390	1.279	1.511	<0.001
Academic	1.459	1.285	1.657	<0.001
Hard job	0.730	0.674	0.791	<0.001
Fast food (≥Two units)	1.208	1.094	1.333	<0.001
Physical activity	0.763	0.703	0.829	<0.001
Bleeding per anus	4.169	3.502	4.963	<0.001
Constipation	2.303	2.126	2.495	<0.001
Abdominal cramp and feeling of residuum per defecation	2.039	1.709	2.432	<0.001
Loss of body weight (>10%)	3.543	2.462	5.097	<0.001
IBD	3.476	2.393	5.050	<0.001
CRC	2.880	1.872	4.432	<0.001
Hereditary diseases	1.891	1.079	3.314	0.026
First- degree relatives with CRC	1.734	1.445	2.081	<0.001
Second- degree relatives with CRC (<50 years)	2.203	1.610	3.016	<0.001

CI: Confidence interval; IBD: Inflammatory bowel disease; CRC: Colorectal carcinoma.

the rate of CRC.

Currently, the IFOBT test is the most widely used CRC screening in the world. The performance of this test (FIOBT or FIT) leads to a two-fold increase in the diagnosis of assiduous and also a three to four-fold increase in the diagnosis of advanced adenomas.[15] Based on the evidence from different countries, the adoption of screening programs using this test significantly reduces the CRC incidence and mortality rate.[16,17] The present study showed the status of people screened for CRC in 2018-2019 in Mashhad using FIT, among whom 8258 (5.88%) individuals tested positive for FIT.

The results of similar studies in different countries indicate that this rate varies from about 1% to 11%. For example, the risk of a positive FIT result was 5.9% in Mexico,[18] 8.7% in Thailand,[19,20] 4.1% in Italy, 9.7% in Brazil,[17] 11.1% in Uruguay,[21] and 3.4% in Serbia.[15] This variation indicates the difference in the percentage of positive people in each country and region and can be explained by the difference in the age range of the people screened as well as the difference in the cut-off point used for the FIT. Accordingly, the lower cut-off points for positive FIT decrease the test sensitivity and decrease the test specificity.[18] In the present study, although a small percentage of the subjects were non-Iranians, the rate of positive FIT result was higher among them, compared with their Iranian counterparts. Therefore, it can be concluded that the Iranian nationality has a protective effect against CRC (OR=0.768), which can be explained by the lack of health insurance coverage and the late referral of non-Iranian people to health centers.

The evaluation of demographic features of participants who had undergone FIT showed that age had a positive association with the result of the FIT and that the chance of a positive FIT result increased with age (OR=1.005). In general, based on the evidence, the risk of developing polyps as well as cancer is expected to increase with age.[22] Therefore, as people get older, they need to pay more attention to cancer screening tests for CRC and perform them more regularly. In terms of education, the study results showed that the odds of positive FIT were increased by 1.4-fold among those with non-academic (OR=1.390, CI=1.279-1.511) and academic (OR=1.459, CI=1.285-1.657) education compared with the illiterate population. Moreover, those with higher awareness of the issue participated more in screening programs for the disease. Various studies and research have shown that the lack of knowledge and awareness, especially the misconception of not having symptoms and being healthy, can be considered the main obstacle to greater participation in screening programs.[23]

Lifestyle, including diet and physical activity, may contribute to the increased CRC incidence.[24] However, the relation between diet and predisposition to colon cancer is undeniable. The types of foods that can affect the risk

of these cancers are not yet fully recognized. Moreover, different studies have provided conflicting evidence for or against an association between eating vegetables and fruits and CRC.[25-27] Extensive cohort studies show that the incidence of these cancers decreases up to 25% with increased consumption of fish, fruits, vegetables, dietary fiber, and intake of vitamin D and calcium.[24,27,28] Our study demonstrated that the consumption of two units or more fast food (OR = 1.208, CI = 1.094-1.333) independently increased the risk of positive results of FIT.

Based on the obtained results, the risk of positive FIT in people who are physically active or have hard jobs is less compared with those who are not physically active. In other words, having physical activity is a protective factor in this regard. This result is consistent with those obtained in other studies.[29-31] Numerous biological mechanisms have been proposed to justify the association between physical activity and colon cancer.[31] In general, exercise reverses the mechanisms associated with the risk of CRC indirectly by controlling weight, insulin, and body mass index.[31]

The study results indicated that the signs and symptoms of colon cancer in the last month had a direct impact on the FIT test result and increased the chances of a positive FIT test result. These symptoms include rectal bleeding, constipation, abdominal pain, a feeling of residuum after defecation, body weight loss of more than 10%, personal history of CRC, history of IBD, family history of CRC in first-degree relatives, history of colon cancer in second-degree families under the age of 50, and history of inherited diseases. CRC is a preventable disease, and screening plays an important role in the early detection of this disease. However, given the balance between cost-effectiveness, potential benefit, and the extent of harm, FOBT tests are the simplest, cheapest, and most non-invasive way of diagnosing CRC by detecting human blood in the lower intestines.[15,17] Selective screening in people with positive symptoms and medical history can be very effective in the prevention and early detection of CRC.

Many studies worldwide have shown a correlation between a family history of cancer and CRC. This result was confirmed in the present study, given the higher number of positive cases of FIT in people with a family history of colon cancer, particularly among first-degree relatives. The increased risk of CRC may be justified by genetic commonalities or by shared exposure to certain environmental factors over time.[32] The high prevalence of a family history of CRC among Iranian patients suggests that a high number of CRCs arise among the family members and relatives of patients with CRC.[33] Therefore, screening should be performed regularly in families with a member affected by CRC, and they should be provided with relevant information and awareness.[33]

In this study, we investigated the association of chronic diseases with CRC. However, some studies have shown that diabetes, metabolic syndrome, and increased insulin resistance are related to an increased risk of CRC.[34,35] Some evidence revealed that diabetes treatment did not affect the risk of cancer in patients with type 2 diabetes. Based on our findings, diabetes treatment has no impact on the risk of cancer associated with type 2 diabetes. Accordingly, an increase in cancer rate does not justify the prescription of glucose-lowering treatment for type 2 diabetic patients.[36]

Study Strengths and Limitations

The large sample size is one of the strengths of this study, which allows for the generalizability of the results and a more comprehensive view of the subject. The data used in this study was made available by Mashhad University of Medical Sciences to determine the relative frequency and risk factors of colon cancer in the covered population for the first time. The limitations of the present study include the inactive collection of information by physicians and health care providers, incorrect or incomplete health information in some cases, lack of full coverage of the urban population in the health care system, and incorrect or low-quality sampling for the FIT test. In addition, only 654 individuals had undergone colonoscopy, and others with a positive FIT test either did not undergo colonoscopy, or there was no such information regarding the performance of colonoscopy recorded in the SINA system, despite the thorough investigations performed by the health care professional. Another limitation of this study is the lack of access to pathology and the number of polyps detected in the colonoscopy of the patients. Further studies are suggested to follow up on these as well.

Conclusion

Although the incidence and mortality of CRC are declining in developed countries, the prevalence of CRC in recent years has increased in the Iranian population. Our results revealed that bleeding per anus, body weight loss, and some gastrointestinal diseases, including IBD or previous history of CRC, first-degree or second-degree relatives with CRC, and hereditary diseases, as well as constipation and abdominal cramp symptoms were independently associated with a high risk of positive FIT result for CIC. According to the present study, bleeding per anus was associated with 4.2-fold odds of positive FIT and considered the risk factor with the highest significant effect. It can be concluded that early detection of CRC or premalignant polyps through convenience cancer screening and diagnosis of associated risk factors for CRC leads to the reduction of mortality rate and an increase in the level of public health.

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Authors' Contribution

NM and TJD drafted the manuscript and provided the data related to the study population. NM was the principal investigator and project leader. EMF, TJD, and LG contributed to data gathering from

SINA. NM and MK critically revised the text. MK performed the data analysis. All authors read and approved the final manuscript.

Competing Interests
The authors have no relevant financial or non-financial interests to disclose.

Consent to Participate
Written informed consent was obtained from the subjects.

Consent to Publish
The authors affirm that participants provided informed consent for publication.

Data Availability Statement
All data are included in the present article.

Ethical Approval
This study was reviewed by the Ethics Committee of the School of Medicine at Mashhad University of Medical Sciences (IR.MUMS.MEDICAL.REC.1399.047). The data were provided to the researchers anonymously and without specifications.

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