Tehran University of Medical Sciences Publication
http://tums.ac.ir

Iran J Parasitol

Open access Journal at http://ijpa.tums.ac.ir

Iranian Society of Parasitology
http://isp.tums.ac.ir

Original Article

Prevalence and Associated Risk Factors of Helminthic Parasites among the Patients with Colorectal Cancer in Western Iran; A Case-Control Study

Alireza Moayyedkazemi [1], Amal Khudair Khalaf [2], Abdolreza Mirjani [3], Akram Sepahvand [3], Parastoo Baharvand [4], *Hossein Mahmoudvand [4]

1. *Department of Internal Medicine, School of Medicine, Shahid Rahimi Hospital, Lorestan University of Medical Sciences, Khorramabad, Iran*
2. *Department of Microbiology, College of Medicine, University of Thi-Qar, Thi-Qar, Iraq*
3. *Universal Scientific Education and Research Network Office, Lorestan University of Medical Sciences, Khorramabad, Iran*
4. *Social Determinants of Health Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran*

Received 23 May 2026
Accepted 05 Aug 2026

Keywords:
Colorectal cancer;
Infection;
Malignancy;
Parasites;
Iran

***Correspondence Email:**
dmahmodvand@gmail.com

Abstract
Background: Helminths modulate host immune responses through immunoregulatory mechanisms that may influence carcinogenesis. We investigated the prevalence and risk factors of helminthic infections among colorectal cancer (CRC) patients in Lorestan Province, western Iran.
Methods: This case-control study enrolled 87 CRC patients and 87 healthy controls from general hospitals between October 2022 and August 2024. Stool samples were examined via direct wet mount and formol-ether concentration, with agar plate culture used to detect *Strongyloides stercoralis*.
Results: Helminthic infections were found in 15 of 87 CRC patients (17.2%) versus 6 of 87 controls (6.9%). *Trichostrongylus* spp. was most common (52.4%), followed by *Enterobius vermicularis* (19%) and *S. stercoralis* (14.3%). Among CRC patients, age under 40 years was associated with higher infection odds versus those ≥60 years (OR=12.33, 95% CI: 1.38–110.2, P=0.025), while animal contact was protective (OR=0.06, 95% CI: 0.01–0.30, P=0.008). Among controls, rural residence (OR=15.25, 95% CI: 1.70–136.5, P=0.015) and animal husbandry (OR=12.61, 95% CI: 1.32–120.5, P=0.024) increased odds, while frequent fast-food consumption was protective (OR=0.16, 95% CI: 0.03–0.94, P=0.045).
Conclusion: Intestinal helminthic infections were significantly more prevalent among CRC patients than healthy controls, indicating potential clinical relevance in this population. Detection of *S. stercoralis* in CRC patients, along with links to environmental exposure factors, supports systematic parasitological screening in endemic regions, particularly before immunosuppressive treatment. Larger multicenter studies with molecular diagnostics are needed to clarify the association between helminthic infection and CRC.

Introduction

Colorectal cancer (CRC) ranks among the most prevalent malignancies within the gastrointestinal system. In recent years, it accounted for 10.0% of global cancer incidence and 9.4% of cancer-related mortality. Projections indicate that by 2040, there will be over 3.2 million new cases of CRC reported (1). While the primary risk factors associated with the onset of CRC include obesity, a diet low in fruits and vegetables, physical inactivity, and tobacco use, the potential contribution of infectious agents should not be disregarded (2).

Infections are implicated in the etiology of numerous malignancies, including cancer, as they can lead to chronic inflammation, genomic instability, suppression of apoptosis or tumor suppressor functions, and alterations in cell proliferation, angiogenesis, or glucose metabolism (3). Recent research has established a significant correlation between microbial pathogens and cancer development. Notable pathogens, including *Helicobacter pylori*, *Mycobacterium tuberculosis*, *human papillomavirus*, Epstein-Barr virus, human immunodeficiency virus, and herpes virus, have demonstrated carcinogenic effects on the tissues or organs in which they reside (4).

Helminth infections impact over 2 billion individuals in low- and middle-income countries (LMICs) (5). Concerning helminthic infections, the available data suggest that that certain species, specifically blood and liver flukes, may play a role in carcinogenesis. In particular, infections caused by *Schistosoma haematobium* have been definitively associated with the development of bladder cancer (6). Additionally, infections with *Chlonorchis sinensis* or *Opisthorchis viverrini* have been demonstrated to lead to cholangiocarcinoma and bile duct cancer (6). Immune response profiling following helminth infection has revealed characteristic helminthic immune responses alongside a suppression of conventional anti-tumor immunity (7). Additionally, findings from studies involving chronically infected murine models have demonstrated heightened systemic inflammation and an augmented local innate immune response within the gastrointestinal tract, both of which may influence the pathogenesis of CRC (7,8).

Considering that helminths exhibit a strong capacity to suppress inflammation via diverse immunoregulatory mechanisms, while also potentially promoting carcinogenesis, we sought to investigate the prevalence, socioeconomic characteristics, and risk factors associated with helminthic infections in patients with CRC in Iran.

Materials and Methods

Study region

Lorestan Province, located within the valleys of the Zagros Mountain range in Western Iran, exhibits a diverse range of climatic conditions, encompassing cold mountainous, Mediterranean, and warm climates. The estimated population of this province is approximately 1,716,527 individuals. Key urban centers within the province include Khorramabad, Borujerd, Aligudarz, Dorud, Kuhdasht, Azna, Aleshtar, Nurabad, and Pol-e Dokhtar. The region experiences extremely hot summers characterized by low humidity levels, while winters are marked by adequate precipitation.

Participants

The cohort included 87 treatment-naïve CRC patients (76 colon, 11 rectal cancer) recruited from general hospitals between October 2022 and August 2024, with most classified as American Joint Committee on Cancer (9) stage II (79.3%), followed by stage III (18.4%) and stage I (2.3%). CRC diagnosis was confirmed by a gastroenterologist using colonoscopy, blood tests, histopathology, stool tests, immunochemical testing, and computed tomography. The control group comprised 87 healthy individuals with no gastrointestinal symptoms and negative colonoscopy and/or fecal blood test results. Exclusion criteria included refusal to participate, prior chemotherapy, systemic antibiotic use within the preceding three months, and immunocompromised status.

Ethical Approval

The protocol was authorized by Lorestan University of Medical Sciences' Ethics Committee under permit number: IR.LUMS.REC.1399.167.

Questionnaire, socio-economic, and the possible risk factors

Information and consent documents were developed and disseminated to the participants in both studies groups. Following this, a questionnaire was administered to collect demographic information, including age, gender, place of residence, education level, occupation, monthly income, exposure to animals, consumption of raw vegetables, history of agriculture, consumption of fast food, history of animal husbandry, and history of washing hands before eating.

Sample collection

A fresh stool specimen was obtained from each participant and placed in a sterile, labeled container. Subsequently, these stool samples were transported to the Parasitology Laboratory at the Faculty of Allied Medicine, Lorestan University of Medical Sciences, located in Khorramabad, Iran, for further analyses.

Macroscopic and Microscopic analysis

All specimens underwent macroscopic examination to identify the presence of helminths that were either visible to the naked eye or detectable with the aid of a hand lens. Microscopic analysis was conducted utilizing both the direct smear method (wet mount) and the formol-ether concentration technique (9). *Enterobius vermicularis* eggs were identified only when incidentally present in stool specimens during routine microscopic examination. Since the adhesive perianal tape test was not performed, stool microscopy has limited sensitivity for the diagnosis of enterobiasis and the prevalence reported in this study may therefore be underestimated. Participants who received a positive diagnosis were subsequently referred to an infectious disease specialist for appropriate guidance, medical treatment, and follow-up care.

Agar plate culture method

Furthermore, all samples underwent the agar plate culture technique for the identification of *Strongyloides stercoralis*, as previously outlined in references (10). Specifically, 3-4 gr of fecal material were placed onto a nutrient agar plate, which was then incubated at a temperature range of 28–30 °C for a duration of 2–3 d. The plates were subsequently examined using a stereomicroscope to identify the presence of larvae, adult forms, or their indicative tracks. To isolate the larvae, the surface of the positive agar plate was rinsed with lukewarm phosphate-buffered saline (PBS) solution. The differentiation of *S. stercoralis* from other potential nematode larvae, such as *Trichostrongylus* spp., hookworms, and free-living nematodes, was conducted based on distinct morphological characteristics (10).

Statistical Analysis

Statistical analyses were performed using SPSS ver. 24.0 (IBM Corp., Armonk, NY, USA). Continuous variables were tested for normality using the Kolmogorov–Smirnov test and presented as mean ± SD or median (interquartile range), as appropriate, while categorical variables were summarized as frequencies and percentages. Associations between demographic, socioeconomic, and behavioral characteristics and parasitic infections were assessed using chi-square or Fisher's exact test, followed by univariable logistic regression to estimate odds ratios (ORs) with 95% confidence intervals, using absence of infection and the unexposed category as reference groups.

Results

Prevalence of helminthic infections

The demographic and socioeconomic characteristics of the participants in the case and control groups are summarized in Table 1. Parasitological assessments indicated that out of 87 patients diagnosed with CRC, 15 individuals (17.2%) were found to have helminthic infections. In contrast, among the 87 healthy individuals in the control group, 6 participants (6.9%) exhibited helminthic infections (Table 2). This data demonstrates a statistically significant difference (*P*=0.038, OR: 2.81, 95% CI=1.03-7.63) in the prevalence of helminthic infections between the case and control groups. The most frequent intestinal helminth parasites were found *Trichostrongylus* spp. (11/21, 52.4%), *Enterobius vermicularis* (4/21, 19%), and *Strongyloides stercoralis* (3/21, 14.3%, Fig. 1), respectively (Table 3).

Table 1: Frequency distribution of demographic characteristics by study groups

Variable	Group	
	Case (colorectal cancer patients) No. (%)	**Control (healthy individuals) No. (%)**
Age		
<40 yr	4 (4.6)	5 (5.8)
41-60 yr	43 (49.4)	43 (49.4)
60< yr	40 (46.0)	39 (44.8)
Gender		
Male	51 (58.6)	48 (55.2)
Female	36 (41.4)	39 (44.8)
Residence		
Urban	59 (67.8)	62 (71.3)
Rural	28 (32.2)	25 (28.7)
Education		
<diploma	66 (75.9)	64 (73.6)
Diploma≤	21 (24.1)	23 (26.4)
Income		
<300$	41 (47.1)	45 (51.7)
300-600$	44 (50.6)	43 (49.4)
<600$	2 (2.3)	2 (2.3)

Fig. 1: Representative rhabditiform larva of *Strongyloides stercoralis* recovered from the stool specimen of a patient with colorectal cancer using the agar plate culture technique and identified by light microscopy (×400)

Table 2: Comparison the prevalence of helminthic infection in the case (colorectal cancer patients) and control (non-colorectal healthy individuals) groups.

Group	Helminthic infection		Pearson χ^2 *P*-value	OR	95% CI	Fisher's exact *P*-value
	Positive No (%)	Negative No (%)				
CRC	15 (17.2)	72 (82.8)	0.031	2.81	1.03-7.63	0.038
Non-CRC	6 (6.9)	81 (93.1)	-	1.00	-	-

Table 3: Distribution of intestinal helminth species detected among colorectal cancer patients and healthy controls.

Parasite	Helminth parasites No. (%)	
	CRC	**Non-CRC**
Trichostrongylus spp	8 (52.4)	3 (50)
Enterobius vermicularis	2 (13.4)	2 (33.3)
Strongyloides stercoralis	3 (20)	0 (0)
Hymenolepis nana	1 (6.6)	1 (16.7)
Ascaris lumbricoides	1 (6.6)	0 (0)
Total	15 (100)	6 (100)

Factors Associated with Helminthic Infection in CRC patients

In CRC patients, univariable logistic regression analysis demonstrated that participants younger than 40 yr had significantly greater odds of helminthic infection than those aged ≥60 yr (*P*=0.025). Conversely, a history of contact with animals was associated with significantly lower odds of helminthic infection (*P*=0.008). No significant associations were identified between helminthic infection and sex, place of residence, educational level, monthly family income, family size, agricultural activity, animal husbandry, consumption of unwashed vegetables or fruits, fast-food consumption, or handwashing before meals (all

P>0.05). Nevertheless, participants involved in agricultural activities, animal husbandry, and those reporting consumption of unwashed vegetables or fruits showed a non-significant trend toward increased odds of helminthic infection (Table 4).

Table 4: Prevalence of helminthic infection in patients with colorectal cancer based on the demographic, socio-economic, and risk factors by Chi-square and univariate logistic regression analysis.

Variable	Helminthic infection		*P* value Chi-Square	Odds ratio	95% Confidence interval	*P* value
	Positive number (%)	Negative number (%)				
Age						
<40 yr	2 (13.3)	2 (2.8)	0.019	12.33	1.38-110.2	0.025
40-60 yr	10 (66.7)	33 (45.8)	0.084	3.74	0.89-15.70	0.079
≥60 yr	3 (20.0)	37 (51.4)	-	1.00	-	-
Gender						
Male	10 (66.7)	41 (56.9)	0.573	1.51	0.45-5.08	0.50
Female	5 (33.3)	31 (43.1)	-	-	-	-
Residence						
Rural	8 (53.3)	20 (27.8)	0.071	2.971	0.952-9.272	0.061
Urban	7 (46.7)	52 (72.2)	-	-	-	-
Education						
≤Diploma	11 (73.3)	55 (76.4)	0.751	0.85	0.24-3.02	0.80
>Diploma	4 (26.7)	17 (23.6)	-	-	-	-
Monthly family income						
<300 USD	5 (33.3)	36 (50.0)	-	-	-	-
300-600	9 (60.0)	35 (48.6)	0.212	1.85	0.52-6.54	0.34
>600 USD	1 (6.7)	1 (1.4)	0.124	7.2	0.39-133.7	0.19
Family members						
<4	1 (6.7)	10 (13.9)	-	1.00	-	-
4-6	10 (66.7)	36 (50.0)	0.271	2.78	0.31-24.8	0.36
6<	4 (26.7)	26 (36.1)	0.832	1.54	0.15-16.12	0.72
Contact with animal						
No	13 (86.6)	20 (27.8)	0.000	0.059	0.012-0.303	0.008
Yes	2 (13.3)	52 (72.2)	-	-	-	-
Agriculture activity						
Yes	10 (66.7)	40 (55.6)	-	-	-	-
No	5 (33.3)	32 (44.4)	0.569	1.60	0.50-5.17	0.431
Animal Husbandry						
Yes	8 (53.3)	23 (31.9)	0.143	2.43	0.79-7.45	0.122
No	7 (46.7)	49 (68.1)	-	-	-	-
Consuming unwashed vegetables/fruits						
Yes	8 (53.3)	33 (45.8)	0.777	1.35	0.44-4.011	0.60
No	7 (46.7)	39 (54.2)	-	-	-	-
Fast food consumption						
Yes	11 (73.3)	53 (73.6)	0.609	0.99	0.288-3.48	0.982
No	4 (26.7)	19 (26.4)	-	-	-	-
Handwashing prior to consuming meals						
Yes	13 (86.7)	65 (90.3)	0.650	0.70	0.13-3.632	0.677
No	2 (13.3)	7 (9.7)	-	-	-	-

Factors Associated with Helminthic Infection in non-CRC patients

Among the non-CRC controls, participants residing in rural areas were significantly more likely to have helminthic infection than those living in urban areas (*P*=0.015). Similarly, engagement in animal husbandry was independently associated with higher odds of helminthic infection (*P* =0.024). In contrast, frequent fast-food consumption was associated with lower odds of helminthic infection (*P*=0.045). No statistically significant associations were found for age, sex, educational level, monthly family income, family size, contact with animals, agricultural activity, consumption of unwashed vegetables or fruits, or handwashing before meals (all *P*>0.05) (Table 5).

Table 5: Prevalence of helminthic infection in non-colorectal cancer participants based on the demographic, socio-economic, and risk factors by Chi-square and univariate logistic regression analysis.

Variable	Helminthic infection		P value Chi-Square	Odds ratio	95% Confidence interval	*P* value
	Positive number (%)	Negative number (%)				
Age						
<40 yr	1 (16.7)	4 (4.9)	-	-	-	-
40-60 yr	2 (33.3)	41 (50.6)	0.132	0.2	0.015-2.490	0.21
≥60 yr	3 (50.0)	36 (44.4)	0.528	0.33	0.032-3.46	0.37
Gender						
Male	4 (66.7)	44 (54.3)	0.687	1.68	0.29-9.84	0.561
Female	2 (33.3)	37 (45.7)	-	-	-	-
Residence						
Rural	5 (83.3)	20 (24.7)	0.007*	15.25	1.70-165.50	0.015
Urban	1 (16.7)	61 (75.3)	-	-	-	-
Education						
≤Diploma	4 (66.7)	60 (74.1)	0.653	0.70	0.12-4.04	0.693
>Diploma	2 (33.3)	21 (25.9)	-	-	-	-
Monthly family income						
<300 USD	3 (50.0)	38 (46.6)	0.923	0.079	0.175-3.895	0.809
300-600	2 (33.3)	42 (48.3)	-	-	-	-
>600 USD	1 (16.7)	1 (1.1)	-	-	-	-
Family members						
<4	1 (16.7)	10 (12.3)	0.681	2.11	0.18-24.07	0.55
4-6	2 (33.3)	42 (51.9)	-	-	-	-
6<	3 (50.0)	29 (53.9)				
Contact with animal						
No	5 (83.3)	48 (59.3)	0.397	0.291	0.032-2.605	0.270
Yes	1 (16.7)	33 (40.7)	-	-	-	-
Agriculture activity						
Yes	5 (83.3)	39 (48.1)	-	-	-	-
No	1 (16.7)	42 (51.9)	0.202	5.38	0.60-48.1	0.132
Animal Husbandry						
Yes	5 (83.3)	23 (28.4)	0.012*	12.61	1.32 -130.5	0.024
No	1 (16.7)	58 (71.6)	-	-	-	-
Consuming unwashed vegetables/fruits						
Yes	5 (83.3)	41 (50.6)	0.050	4.88	0.55-43.50	0.15
No	1 (16.7)	40 (49.4)	-	-	-	-
Fast food consumption						
Yes	2 (33.3)	61 (75.3)	0.047*	0.16	0.028-0.94	0.045
No	4 (66.7)	20 (25.7)	-	-		
Handwashing prior to consuming meals						
Yes	4 (66.7)	74 (91.4)	0.115	0.19	0.032-1.10	0.082
No	2 (33.3)	7 (8.6)	-	-	-	-

Discussion

This case-control study demonstrated a significantly higher prevalence of intestinal helminthic infections among CRC patients compared with healthy controls. *Trichostrongylus* spp. was the most frequently identified helminth, while *S. stercoralis* was detected exclusively in the CRC group. Univariable logistic regression identified several demographic and behavioral factors associated with helminthic infection, though these findings warrant cautious interpretation given the limited number of positive cases. Within the CRC group, younger age (<40 yr) and animal contact were significantly associated with infection, whereas among controls, rural residency and animal husbandry were the notable associated factors. Case-control studies, cross-sectional analyses, and systematic reviews collectively suggest that colorectal cancer patients may carry a greater burden of intestinal parasitic infections than non-malignant individuals (11–15). This increased susceptibility may reflect cancer-related immune dysregulation, impaired intestinal barrier integrity, gut microbiome alterations, nutritional deficiencies, and reduced cellular immunity. However, whether helminthic infections directly contribute to colorectal carcinogenesis or primarily occur as opportunistic infections in immunocompromised hosts remains unclear.

A case-control study from Iran involving 87 CRC patients and an equal number of healthy controls used sucrose concentration, Ziehl–Neelsen staining, and nested-PCR to detect *Cryptosporidium* infection, reporting significantly higher prevalence among CRC patients than controls (42.5% vs. 12.6%; P<0.001), suggesting either increased susceptibility to parasitic infection in cancer patients or a possible contributory role of intestinal parasites in disease progression (11). Similarly, a cross-sectional study from Tashkent reported elevated frequencies of intestinal protozoa, particularly *Blastocystis* spp., among CRC patients, with higher prevalence in those with metastatic disease (12). A recent meta-analysis of 34 studies involving 4,752 cancer patients estimated overall intestinal parasitic infection prevalence at 28.42% (95% CI: 22.22–34.63), with higher rates in solid tumor patients; studies using molecular diagnostics reported higher detection rates than conventional microscopy, suggesting that less sensitive techniques may underestimate infection prevalence (13). Whereas previous research has largely focused on protozoan parasites in cancer populations, the present study extends this evidence base to intestinal helminth infections, which remain comparatively underexplored in CRC patients. The detection of helminths, particularly *S. stercoralis*, in this cohort is clinically relevant, as such infections can persist chronically and worsen following immunosuppressive cancer treatment.

The present findings provide insight into factors associated with helminthic infection among CRC patients and controls. Among CRC patients, younger age (<40 yr) was significantly associated with higher odds of helminthic infection compared with older individuals. Although helminthic infection prevalence is typically expected to increase with cumulative environmental exposure and age, this finding may reflect differences in lifestyle, occupational exposure, dietary habits, or environmental contact among younger individuals. This association should nonetheless be interpreted cautiously given the limited number of helminth-positive cases and the wide confidence interval observed. Larger epidemiological studies are needed to determine whether this age-related pattern reflects a genuine biological relationship or sampling variability (13).

Notably, animal contact was significantly associated with helminthic infection in CRC patients. This association is biologically plausible, as domestic animals and livestock can serve as reservoirs for zoonotic helminths, and close contact with contaminated soil, animal feces, or infected hosts may facilitate transmission. Similar findings have been reported in studies of parasitic infections among immunocompromised populations, where animal exposure was linked to elevated infection risk (12-14). However, animal contact in the present study was assessed via self-report; further research incorporating detailed data on animal species, exposure duration, occupational activities, and environmental conditions is needed to better clarify this relationship.

Among non-CRC controls, rural residence was strongly associated with helminthic infection, consistent with prior studies showing that rural populations face greater exposure to contaminated soil, untreated water, livestock environments, and inadequate sanitation, all of which facilitate helminth transmission (11–13). This finding underscores the continued relevance of environmental and socioeconomic determinants of helminth transmission even in the absence of underlying malignancy. Similarly, animal husbandry was significantly associated with helminthic infection among controls, likely reflecting exposure to infective larval stages in soil, animal waste, and contaminated agricultural settings. This finding further supports zoonotic and environmental transmission pathways and highlights the need for preventive measures, including improved hygiene practices, protective precautions during animal handling, and routine parasitological monitoring in at-risk populations (13, 15).

An inverse association was observed between frequent fast-food consumption and helminthic infection among non-CRC controls. This should not be interpreted as a protective effect of fast food itself, but rather as a reflection of broader lifestyle differences, food sourcing patterns, and environmental exposures. Individuals relying predominantly on commercially prepared foods may have reduced contact with contaminated home-grown produce, soil, or livestock environments compared with those following more traditional dietary practices (13). Given the small number of positive cases, this finding warrants cautious interpretation and requires validation in larger studies. Collectively, these results suggest that helminthic infection arises from a complex interplay of host, environmental, and behavioral factors. Although some associations reached statistical significance, the limited number of infection events precludes definitive conclusions regarding independent risk factors, and these findings should be considered exploratory pending confirmation in larger, multicenter studies.

Although overall *S. stercoralis* prevalence was low in this study, its exclusive detection among CRC patients carries important clinical implications. Unlike many intestinal helminths, *S. stercoralis* has a unique autoinfection cycle enabling prolonged host persistence, increasing the risk of hyperinfection and disseminated disease in immunocompromised individuals. CRC patients may have compromised cellular immunity due to malignancy-associated immune dysfunction, malnutrition, chemotherapy, corticosteroid therapy, or other immunosuppressive treatments, meaning even asymptomatic strongyloidiasis may become clinically significant once immunosuppressive regimens begin (13,16). In endemic regions, targeted screening for *S. stercoralis* prior to chemotherapy or corticosteroid administration could enable early detection and reduce the risk of severe complications. A study from Ethiopia involving 41 cancer patients undergoing chemotherapy reported helminthic infections including hookworm, *A. lumbricoides*, and *H. nana* in approximately 17% of participants; despite its limited sample size, this study highlights the importance of parasitological assessment in immunocompromised populations within helminth-endemic regions (17). Together with the present findings, these observations indicate that helminthic infections should not be overlooked in cancer patients, as they may meaningfully affect clinical management and outcomes (17).

Several mechanisms may explain the increased occurrence of helminthic infections among CRC patients (18, 19). Cancer-associated immune alterations, particularly impaired cell-mediated immunity, may reduce the host's ability to control persistent helminth infections. In addition, changes in intestinal microbiota and mucosal integrity associated with CRC may create a favorable environment for parasite persistence. Conversely, chronic helminth infections may theoretically contribute to colorectal carcinogenesis through prolonged immune modulation, inflammatory responses, and alterations in the intestinal microenvironment; however, the current evidence does not establish a causal relationship, and further longitudinal studies are required (19, 20).

This study has several strengths, including its case-control design, standardized parasitological methods, and assessment of multiple demographic and exposure variables. However, limitations should be noted. First, the small number of helminth-positive individuals limited statistical power and precluded multivariable logistic regression; thus, identified associations should be considered exploratory rather than definitive independent predictors. Second, parasite identification relied on conventional parasitological methods without molecular confirmation, potentially limiting species-level accuracy. Third, molecular characterization of detected helminths, which could offer additional epidemiological insight into transmission patterns, was not performed.

An additional limitation is the exclusive focus on intestinal helminths; protozoan parasites such as *Giardia duodenalis*, *Cryptosporidium* spp., and *Entamoeba histolytica/dispar* were not evaluated, despite potentially sharing similar transmission pathways and contributing to intestinal inflammation and gut ecosystem alterations. Future studies incorporating both helminthic and protozoan parasites using sensitive molecular diagnostics would provide a more comprehensive assessment of the relationship between intestinal parasitic infections and CRC. Finally, the prevalence of *E. vermicularis* should be interpreted cautiously, as the adhesive perianal tape test—the preferred diagnostic method for enterobiasis was not performed, and reliance on stool examination alone may have underestimated its true prevalence.

Conclusion

This case-control study found a higher prevalence of intestinal helminthic infections among CRC patients than controls, with *S. stercoralis* detected exclusively in the CRC group, supporting targeted parasitological screening before immunosuppressive therapy. Environmental and behavioral factors including animal contact, rural residency, and animal husbandry were associated with infection, though these exploratory findings require validation in larger, multicenter studies using molecular diagnostics. Future research integrating parasitological, immunological, and microbiome analyses is needed to clarify the relationship between helminthic infection and CRC progression.

Conflict of interest

The authors declare no conflict of interest in this study.

Acknowledgements

The authors thank the staff of the health centers of Khorramabad, Iran for their help in collecting the stool specimens. No funds, grants, or other support were received.

References

1. Roshandel G, Ghasemi-Kebria F, Malekzadeh R. Colorectal cancer: epidemiology, risk factors, and prevention. Cancers (Basel). 2024; 16(8):1530.
2. Marcellinaro R, Spoletini D, Grieco M, et al. Colorectal cancer: current updates and future perspectives. J Clin Med. 2023; 13(1):40.

3. Baden LR, Swaminathan S, Almyroudis NG, et al. Prevention and treatment of cancer-related infections, version 3.2024, NCCN clinical practice guidelines in oncology. J Natl Compr Canc Netw. 2024; 22(9):617-44.
4. White MT, Sears CL. The microbial landscape of colorectal cancer. Nat Rev Microbiol. 2024; 22(4):240-54.
5. Bhattacharyya T, Miles MA. Human helminth infections above latitude 60 N: reports published 2001-2024. Parasitology. 2025; 152(9):890-6.
6. Brindley PJ, Loukas A. Helminth infection-induced malignancy. PLoS Pathog. 2017; 13(7):e1006393.
7. Oikonomopoulou K, Brinc D, Hadjisavvas A, et al. The bifacial role of helminths in cancer: involvement of immune and non-immune mechanisms. Crit Rev Clin Lab Sci. 2014; 51(3):138-48.
8. Li H, Shan C, Zhu Y, et al. Helminth-induced immune modulation in colorectal cancer: exploring therapeutic applications. Front Immunol. 2025; 16:1484686.
9. Glinz D, Silué KD, Knopp S, et al. Comparing diagnostic accuracy of Kato-Katz, Koga agar plate, ether-concentration, and FLOTAC for *Schistosoma mansoni* and soil-transmitted helminths. PLoS Negl Trop Dis. 2010; 4(7):e754.
10. Inês ED, Souza JN, Santos RC, et al. Efficacy of parasitological methods for the diagnosis of *Strongyloides stercoralis* and hookworm in faecal specimens. Acta Trop. 2011; 120(3):206-10.
11. Ghanadi K, Khudair Khalaf A, Jafrasteh A, et al. High prevalence of *Cryptosporidium* infection in Iranian patients suffering from colorectal cancer. Parasite Epidemiol Control. 2022; 19:e00271.
12. Toychiev A, Abdujapparov S, Imamov A, et al. Intestinal helminths and protozoan infections in patients with colorectal cancer: prevalence and possible association with cancer pathogenesis. Parasitol Res. 2018; 117(12):3715-3723.
13. Tsegaye A, Asrat D, Alemu A. Global prevalence of intestinal parasites in cancer patients: a systematic review and meta-analysis. BMC Infect Dis. 2025; 25(1): 815.
14. Mahmoudvand H, Sepahvand A, Badparva E, et al. Possible Association and Risk Factors of *Blastocystis* Infection and Colorectal Cancers in Western Iran. Arch Clin Infect Dis. 2021;16(1):e90861.
15. Mahmoudvand H, Sepahvand A, Khatami M, et al. Prevalence and associated risk factors of *Cystoisospora belli* and *Cyclospora cayetanensis* infection among Iranian patients with colorectal cancer. J Parasit Dis. 2019;43(3):402-5.
16. Esteghamati A, Khanaliha K, Bokharaei-Salim F, et al. Prevalence of intestinal parasitic infection in cancer, organ transplant and primary immunodeficiency patients in Tehran, Iran. Asian Pac J Cancer Prev. 2019; 20(2):495-501.
17. Sitotaw E, Sitotaw A, Aleka Y, et al. Prevalence of intestinal helminths among cancer patients who are under chemotherapy at the University of Gondar Comprehensive Specialized Hospital Oncology Clinic, Northwest Ethiopia. J Cancer Epidemiol. 2022; 2022:4484183.
18. Yu Y, Guo D, Qu T, et al. Increased risk of *Toxoplasma gondii* infection in patients with colorectal cancer in Eastern China: seroprevalence, risk factors, and a case-control study. Biomed Res Int. 2020; 2020:2539482.
19. Łanocha A, Łanocha-Arendarczyk N, Wilczyńska D, et al. Protozoan intestinal parasitic infection in patients with hematological malignancies. J Clin Med. 2022; 11(10):2847.
20. Hataminejad M, Basirpour B, Baharlou M, et al. Global prevalence and correlation of intestinal parasitic infections in patients with colorectal cancer: a systematic review and meta-analysis. BMC Gastroenterol. 2025; 25(1):584.