JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

https://doi.org/10.61919/e0y69w76

Original Article

Association of Lifestyle and Dietary Factors with Colorectal Cancer Risk and Stage at Diagnosis in Northern Punjab: A Case–Control Study

Rida Akhtar[1], Khalid Bilal Khan[2], Muhammad Salman Babar[3], Muhammad Azhar[4], Sabeen Khaliq[5], Usman Arshad Hameed[6]

[1] PhD Scholar Pharmacology, The Islamia University of Bahawalpur, Bahawalpur, Pakistan
[2] MSc Food and Nutrition, Consultant Gastroenterologist, POF Hospital, Wah Cantt, Rawalpindi, Pakistan
[3] MBBS, DG Khan Medical College, Bahawalpur, Pakistan
[4] Professor of Surgery, Wah Medical College, NUMS University, Pakistan
[5] Student of MS Public Health Business, Administration in Healthcare Public Health, I.M. Sechenov First Moscow State Medical University, Moscow, Russia
[6] MBBS Student, Gujranwala Medical College, Pakistan; ORCID: 0009-0000-6521-565X

***Corresponding author: Khalid Bilal Khan, Khalidbilal2011@yahoo.com**

"Cite this Article" Received: 08 January 2026; **Accepted**: 11 April 2026; **Published**: 29 April 2026

Author Contributions: Concept: RA and KBK; Design: RA, KBK, and MA; Data Collection: MSB, SK, and UAH; Analysis: RA and KBK; Drafting: RA, MSB, and MA. **Ethical Approval**: POF Hospital, Wah Cantt, Rawalpindi, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Colorectal cancer is increasingly recognized as an important public health problem in Pakistan, where lifestyle transition, unhealthy dietary patterns, limited screening, and delayed symptom recognition may contribute to both disease occurrence and advanced-stage presentation. Objective: This study examined the association of lifestyle and dietary factors with colorectal cancer risk and assessed factors associated with advanced stage at diagnosis among colorectal cancer cases. Methods: A hospital-based unmatched case–control study was conducted in selected tertiary care hospitals of Northern Punjab, Pakistan. The study included 300 adults, comprising 150 histopathologically confirmed colorectal cancer cases and 150 controls without colorectal cancer. Data were collected using a structured interview-based questionnaire covering socio-demographic characteristics, dietary exposures, physical activity, sedentary behavior, smoking, body mass index, and family history. Clinical presentation and stage at diagnosis were extracted from hospital records. Odds ratios and multivariable logistic regression were used to estimate associations. Results: Red meat intake ≥3 times/week, processed meat use, low-fiber diet, low physical activity, current smoking, and obesity remained independently associated with colorectal cancer. Daily fruit and vegetable intake showed protective associations. Among cases, 57.3% presented with Stage III–IV disease. Advanced stage was most strongly associated with symptom duration >3 months (AOR 4.12; 95% CI 2.02–8.41), followed by low-fiber diet, low fruit and vegetable intake, and low physical activity. Conclusion: Colorectal cancer in this setting was strongly linked with modifiable dietary and lifestyle factors and delayed symptom presentation. Prevention strategies should combine healthier dietary patterns, physical activity promotion, tobacco control, weight management, symptom awareness, and faster referral pathways. Keywords: colorectal cancer; case-control study; dietary factors; lifestyle factors; stage at diagnosis; Pakistan; red meat; fiber intake; physical inactivity.

INTRODUCTION

Colorectal cancer is a major and increasing global public health burden, with rising incidence and mortality reported not only in high-income countries but also in low- and middle-income settings undergoing nutritional, demographic, and lifestyle transition (1–3). The disease is influenced by both non-modifiable determinants, such as age and family history, and modifiable exposures, including dietary composition, physical inactivity, obesity, tobacco use, alcohol intake, and delayed health-seeking

behavior. This distinction is important because preventable lifestyle and dietary factors may offer practical targets for risk reduction, particularly in settings where organized screening remains limited and diagnosis often occurs after symptoms have progressed.

The epidemiological transition in South Asia has created a risk environment in which traditional dietary patterns coexist with increasing consumption of red meat, processed foods, refined carbohydrates, fried foods, sugar-sweetened beverages, and sedentary routines. International evidence consistently links high intake of red and processed meat with increased colorectal cancer risk, while higher intake of dietary fiber, whole grains, fruits, and vegetables appears protective (4,5,12–17). Physical activity has also been associated with lower colon cancer risk, whereas sedentary behavior, obesity, smoking, and alcohol exposure contribute to risk through mechanisms involving insulin resistance, chronic inflammation, altered bowel transit, oxidative stress, carcinogen exposure, and metabolic dysregulation (6–11). However, these exposures rarely occur in isolation; they often cluster as broader lifestyle patterns, making local assessment essential for identifying prevention priorities.

In Pakistan, colorectal cancer presents additional clinical and public health challenges because population-level screening is not widely established, awareness of warning symptoms remains uneven, and many patients reach specialist care after prolonged symptoms. Evidence from Pakistani tertiary care settings suggests that diagnostic delay contributes to advanced-stage presentation and poorer prognosis (19–21). This issue is clinically important because stage at diagnosis strongly determines treatment complexity, cost, survival probability, and long-term outcome. Therefore, studies that evaluate lifestyle and dietary factors only as risk exposures may provide an incomplete picture unless they also examine how these factors relate to presentation patterns and disease stage at first diagnosis.

Although global evidence on colorectal cancer risk factors is substantial, region-specific evidence from Pakistan remains comparatively limited, especially from Northern Punjab. Existing studies have addressed dietary practices, addictive behaviors, bowel habits, diagnostic delay, and survival, but fewer have simultaneously examined modifiable lifestyle and dietary exposures in relation to both colorectal cancer occurrence and stage at diagnosis (19–21). This knowledge gap is important because local food practices, health literacy, socioeconomic conditions, referral pathways, and symptom interpretation may differ from populations represented in large international cohorts. Locally generated evidence is therefore needed to guide practical prevention messages, early referral strategies, and targeted risk-based screening approaches.

The present hospital-based case–control study was designed to examine the association of lifestyle and dietary factors with colorectal cancer among adults presenting to selected tertiary care hospitals in Northern Punjab, Pakistan. It further assessed whether selected modifiable exposures and symptom duration were associated with advanced-stage disease among confirmed colorectal cancer cases. The study was guided by the research question: among adults attending tertiary care hospitals in Northern Punjab, are unhealthy dietary patterns, physical inactivity, smoking, obesity, sedentary behavior, and delayed symptom presentation associated with colorectal cancer occurrence and advanced stage at diagnosis?

MATERIALS AND METHODS

This hospital-based unmatched case–control study was conducted at selected tertiary care hospitals in Northern Punjab, Pakistan, where patients from urban, semi-urban, and rural catchment populations commonly seek surgical, gastroenterology, and oncology services. The case–control design was selected because it allowed efficient comparison of previous dietary and lifestyle exposures between histopathologically confirmed colorectal cancer cases and cancer-free controls, while also enabling secondary analysis of factors associated with stage at diagnosis among cases. Administrative approval and institutional ethical clearance were obtained before data collection, and all procedures were conducted in accordance with accepted ethical principles for human participant research.

The study population comprised adult participants recruited into two groups. Cases were newly diagnosed patients with histopathologically confirmed colorectal cancer who were managed in surgical, gastroenterology, or oncology departments of the participating hospitals. Newly diagnosed patients were included to reduce exposure misclassification related to major post-diagnosis dietary or lifestyle changes. Controls were adults without a known history of colorectal cancer or other malignancy, selected from the same hospital environment, including attendants and outpatient visitors with conditions not primarily related to diet-associated cancers. This approach was used to ensure that controls broadly represented the source population from which cases arose, while reducing the likelihood of selecting individuals whose current disease status could strongly alter long-term dietary behavior.

Eligible cases were adults of either sex with confirmed colorectal cancer who were clinically stable and able to provide interview-based information directly or with minimal assistance. Patients were excluded if they were critically ill, had recurrent colorectal cancer, had a previous history of another major malignancy, or were unable to provide reliable exposure information. Eligible controls were adults of either sex with no history of colorectal cancer and no known diagnosis of malignancy. Individuals with chronic gastrointestinal disorders likely to substantially alter habitual diet, such as inflammatory bowel disease, and those with a strong previous history of cancer were excluded from the control group. Participants were recruited after eligibility screening, and written informed consent was obtained before interview and record review.

A structured interview-based questionnaire was used for data collection. The instrument was developed after review of published literature on colorectal cancer risk factors and adapted to the local dietary and cultural context. It collected socio-demographic variables, including age, sex, marital status, residence, education, occupation, and household income; medical and family history, including family history of colorectal cancer and major comorbidities; lifestyle exposures, including smoking status, smokeless tobacco use, physical activity, sedentary behavior, and sleep pattern; and dietary exposures assessed through a semi-structured food-frequency format. For cases, dietary and lifestyle exposures referred to the usual pattern during the years before diagnosis, while controls were asked about a comparable recent habitual period.

Dietary assessment included frequency of intake of red meat, processed meat, chicken, fish, milk, yogurt, fruits, vegetables, pulses, whole grains, refined flour products, fried foods, fast foods, spicy foods, pickles, sweets, bakery items, tea, soft drinks, and water. Intake frequency was categorized using practical response options such as daily, several times per week, weekly, occasionally, or rarely. Red meat intake of three or more times per week, processed meat use, frequent fried food intake, frequent fast-food intake, frequent soft-drink intake, daily fruit intake, daily vegetable intake, whole-grain use, and low-fiber diet were operationalized as primary dietary exposure variables. Portion size was estimated using household measures where possible to improve participant understanding and consistency of responses.

Physical activity was assessed through routine occupational movement, household activity, walking, and planned exercise. Participants were categorized into low, moderate, or high physical activity groups based on reported weekly activity patterns. Sedentary behavior was assessed by asking about average daily sitting time, including television viewing, desk work, transport-related sitting, and other inactive routines; prolonged sedentary time was defined as sitting for more than six hours per day. Smoking status was classified as current smoker, former smoker, or non-smoker, with additional information on duration and average consumption. Body mass index was calculated from measured or recently documented height and weight when available, and obesity was categorized using standard BMI-based classification.

For colorectal cancer cases, clinical information was abstracted from hospital records using a structured data extraction form. Extracted variables included tumor site, histopathological diagnosis, tumor grade where available, presenting symptoms, duration of symptoms before diagnosis, and stage at diagnosis. Presenting symptoms included bleeding per rectum, altered bowel habits, abdominal pain, weight loss,

and anemia. Stage was recorded according to TNM-based clinical or pathological staging documented in the hospital file. For analytical interpretation, Stage I and II disease were grouped as early-stage disease, while Stage III and IV disease were grouped as advanced-stage disease, reflecting clinically meaningful differences in prognosis, treatment intensity, and likelihood of systemic spread.

Several steps were used to reduce bias and improve data quality. The questionnaire was pretested on participants from a similar background who were not included in the final analysis, after which wording, item sequence, and locally relevant food categories were refined. Data collectors were trained to use neutral interview techniques and standardized prompts. Exposure questions were phrased in relation to habitual pre-diagnosis patterns for cases to reduce the influence of recent illness-related dietary changes. Completed questionnaires were checked for completeness and internal consistency on the same day. Study codes rather than participant names were used during data handling to preserve confidentiality.

The sample size was calculated using the standard formula for unmatched case–control studies, based on expected exposure frequency among controls, anticipated odds ratio for major modifiable exposures, 95% confidence level, and adequate statistical power. A small allowance was added for non-response and incomplete questionnaires. The final sample included 300 participants, comprising 150 histopathologically confirmed colorectal cancer cases and 150 controls, providing equal allocation to improve statistical efficiency and group comparison.

Data were entered, cleaned, coded, and analyzed using statistical software. Categorical variables were summarized as frequencies and percentages, while continuous variables were presented as mean with standard deviation or median with interquartile range depending on distribution. Group comparisons between cases and controls were performed using chi-square or Fisher's exact test for categorical variables and independent-sample t-test or non-parametric equivalent tests for continuous variables, as appropriate. Crude odds ratios with 95% confidence intervals were calculated for associations between individual exposures and colorectal cancer status.

Multivariable logistic regression was used to estimate adjusted associations between lifestyle and dietary exposures and colorectal cancer. The primary adjustment set included age, sex, family history of colorectal cancer, and body mass index, with additional covariate consideration based on clinical relevance and bivariate association patterns. A separate logistic regression model was applied among colorectal cancer cases to examine factors associated with advanced-stage presentation. Variables included in the stage model were selected from clinically relevant dietary, lifestyle, and symptom-duration variables. Multicollinearity among candidate predictors was assessed before final model interpretation, and adjusted odds ratios with 95% confidence intervals were reported. A p-value below 0.05 was considered statistically significant.

Missing or incomplete questionnaire entries were reviewed during data cleaning, and analyses were performed using complete available data for variables required in each model. Confidentiality was maintained throughout the study by anonymizing participant records and limiting access to study data. No invasive procedure was performed for research purposes. The study was designed to generate locally relevant evidence for colorectal cancer prevention, early symptom recognition, referral strengthening, and risk-informed clinical awareness in Pakistan.

RESULTS

A total of 300 participants were analyzed, including 150 histopathologically confirmed colorectal cancer cases and 150 controls. The mean age was higher among cases than controls (54.1 ± 10.9 vs. 50.7 ± 12.4 years; p=0.011). Sex distribution was comparable between groups, while low education and low household income were significantly more frequent among cases (p=0.007 and p=0.003, respectively).

Table 1. Socio-demographic characteristics of cases and controls

Variable	Cases (n=150)	Controls (n=150)	p-value
Mean age, years	54.1 ± 10.9	50.7 ± 12.4	0.011
Male	87 (58.0%)	82 (54.7%)	0.563
Female	63 (42.0%)	68 (45.3%)	0.563
Urban residence	91 (60.7%)	78 (52.0%)	0.129
Rural residence	59 (39.3%)	72 (48.0%)	0.129
Low education level	74 (49.3%)	51 (34.0%)	0.007
Low household income	83 (55.3%)	57 (38.0%)	0.003

Dietary risk exposures were consistently more common among cases. Red meat intake ≥3 times/week was reported by 46.7% of cases versus 24.7% of controls (OR 2.67; 95% CI 1.62–4.40; p<0.001), while low-fiber diet showed one of the strongest crude associations (OR 2.88; 95% CI 1.77–4.68; p<0.001). Daily fruit and vegetable intake were inversely associated with colorectal cancer.

Table 2. Dietary factors among cases and controls

Dietary variable	Cases n (%)	Controls n (%)	OR (95% CI)	p-value
Red meat ≥3 times/week	70 (46.7)	37 (24.7)	2.67 (1.62–4.40)	<0.001
Processed meat use	51 (34.0)	25 (16.7)	2.57 (1.47–4.48)	0.001
Fried food frequent use	78 (52.0)	49 (32.7)	2.23 (1.38–3.59)	0.001
Fast food frequent use	59 (39.3)	33 (22.0)	2.29 (1.36–3.84)	0.002
Soft drinks frequent use	66 (44.0)	40 (26.7)	2.16 (1.32–3.52)	0.002
Daily fruit intake	39 (26.0)	73 (48.7)	0.37 (0.23–0.60)	<0.001
Daily vegetable intake	52 (34.7)	86 (57.3)	0.39 (0.24–0.63)	<0.001
Whole grain use	41 (27.3)	68 (45.3)	0.45 (0.28–0.74)	0.001
Low fiber diet	84 (56.0)	46 (30.7)	2.88 (1.77–4.68)	<0.001

Lifestyle-related exposures also differed significantly. Low physical activity was reported by 54.7% of cases compared with 29.3% of controls (OR 2.91; 95% CI 1.79–4.73; p<0.001), and sedentary time >6 hours/day was more common among cases (50.7% vs. 28.0%; OR 2.64; p<0.001). Current smoking, obesity, and family history of colorectal cancer were also significantly associated with case status.

Table 3. Lifestyle factors among cases and controls

Lifestyle variable	Cases n (%)	Controls n (%)	OR (95% CI)	p-value
Current smoker	49 (32.7)	27 (18.0)	2.21 (1.29–3.78)	0.004
Former smoker	19 (12.7)	14 (9.3)	1.41 (0.68–2.92)	0.352
Low physical activity	82 (54.7)	44 (29.3)	2.91 (1.79–4.73)	<0.001
Sedentary time >6 h/day	76 (50.7)	42 (28.0)	2.64 (1.61–4.34)	<0.001
Overweight	47 (31.3)	39 (26.0)	1.30 (0.78–2.17)	0.311
Obese	38 (25.3)	20 (13.3)	2.20 (1.20–4.03)	0.010
Family history of CRC	18 (12.0)	7 (4.7)	2.77 (1.12–6.82)	0.027

Among cases, altered bowel habits were the most common symptom (62.7%), followed by bleeding per rectum (56.0%), abdominal pain (48.0%), and weight loss (42.7%). Advanced-stage disease was frequent, with 86 patients (57.3%) diagnosed at Stage III or IV.

Table 4. Clinical presentation and stage at diagnosis among cases

Variable	Cases (n=150)
Bleeding per rectum	84 (56.0%)
Altered bowel habits	94 (62.7%)
Abdominal pain	72 (48.0%)
Weight loss	64 (42.7%)
Anemia	58 (38.7%)
Symptoms <3 months	39 (26.0%)
Symptoms 3–6 months	61 (40.7%)
Symptoms >6 months	50 (33.3%)
Colon cancer	83 (55.3%)
Rectal cancer	67 (44.7%)
Stage I	19 (12.7%)
Stage II	45 (30.0%)
Stage III	52 (34.7%)

Variable	Cases (n=150)
Stage IV	34 (22.7%)
Early stage (I–II)	64 (42.7%)
Advanced stage (III–IV)	86 (57.3%)

Within the case group, advanced-stage diagnosis was significantly associated with low fiber intake, low fruit intake, low vegetable intake, low physical activity, and symptom duration >3 months. Symptom delay showed the strongest association with advanced stage (AOR 4.12; 95% CI 2.02–8.41; p<0.001).

Table 5. Factors associated with advanced stage at diagnosis

Variable	Early stage (n=64)	Advanced stage (n=86)	Adjusted OR (95% CI)	p-value
Red meat frequent intake	22 (34.4%)	48 (55.8%)	1.86 (0.94–3.68)	0.074
Low fiber diet	26 (40.6%)	58 (67.4%)	2.71 (1.35–5.43)	0.005
Low fruit intake	37 (57.8%)	67 (77.9%)	2.20 (1.03–4.70)	0.041
Low vegetable intake	34 (53.1%)	64 (74.4%)	2.18 (1.07–4.44)	0.031
Smoking	15 (23.4%)	34 (39.5%)	1.92 (0.91–4.02)	0.084
Low physical activity	27 (42.2%)	55 (64.0%)	2.16 (1.09–4.26)	0.027
Symptoms >3 months	24 (37.5%)	67 (77.9%)	4.12 (2.02–8.41)	<0.001

After adjustment for age, sex, family history, and body mass index, red meat intake, processed meat use, low-fiber diet, low physical activity, current smoking, and obesity remained independently associated with colorectal cancer. Daily fruit and vegetable intake retained protective associations.

Table 6. Multivariable logistic regression for colorectal cancer risk

Variable	Adjusted OR	95% CI	p-value
Red meat ≥3 times/week	2.31	1.33–4.02	0.003
Processed meat use	1.89	1.01–3.51	0.045
Low fiber diet	2.54	1.49–4.35	0.001
Low physical activity	2.63	1.54–4.49	<0.001
Current smoking	1.97	1.08–3.59	0.026
Obesity	1.96	1.01–3.81	0.047
Daily fruit intake	0.46	0.26–0.82	0.008
Daily vegetable intake	0.49	0.28–0.86	0.013

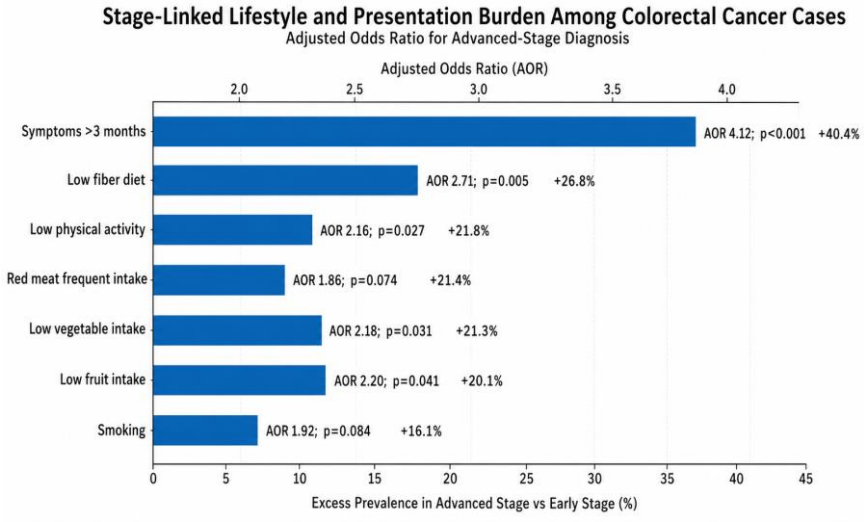

Figure 1. Stage-Linked Lifestyle and Presentation Burden Among Colorectal Cancer Cases

The figure demonstrates that symptom duration >3 months produced the largest excess burden among advanced-stage cases, with prevalence 40.4 percentage points higher than in early-stage cases and the strongest adjusted association with advanced diagnosis (AOR 4.12; p<0.001). Low fiber diet showed the second-largest excess prevalence difference (+26.8%) and remained significantly associated with advanced stage (AOR 2.71; p=0.005), while low physical activity, low vegetable intake, and low fruit intake

each showed clinically meaningful excess prevalence of approximately 20–22 percentage points with significant adjusted associations.

DISCUSSION

This hospital-based case–control study showed that colorectal cancer was significantly associated with a cluster of modifiable dietary and lifestyle exposures, including frequent red meat intake, processed meat use, low-fiber diet, low physical activity, current smoking, and obesity. Conversely, daily fruit and vegetable intake showed protective associations. These findings are consistent with global epidemiological evidence indicating that colorectal cancer risk is shaped by dietary transition, metabolic risk, tobacco exposure, and reduced physical activity (1–12). The results are particularly relevant for Pakistan, where organized screening remains limited and prevention depends heavily on risk-factor awareness, early symptom recognition, and timely referral.

The dietary pattern observed among cases supports the role of meat-heavy, low-fiber eating habits in colorectal carcinogenesis. Frequent red meat intake remained independently associated with colorectal cancer after adjustment, and processed meat use also retained statistical significance. These findings align with previous meta-analytic evidence showing increased colorectal cancer risk with higher red and processed meat consumption (4,17). Biologically, this association may be explained through exposure to heme iron, N-nitroso compounds, lipid peroxidation products, and mutagens generated during high-temperature cooking. In contrast, higher intake of fruits, vegetables, whole grains, and fiber-rich foods may reduce risk through improved bowel transit, dilution of carcinogens, modulation of gut microbiota, reduced inflammation, and production of short-chain fatty acids with anti-neoplastic potential (5,12–16).

Lifestyle-related findings were also clinically meaningful. Low physical activity was one of the strongest independent predictors of colorectal cancer, while prolonged sedentary behavior was significantly more common among cases. This is consistent with previous evidence showing that regular physical activity reduces colon cancer risk, whereas sedentary behavior increases risk through mechanisms involving insulin resistance, adiposity, systemic inflammation, and slower intestinal transit (6,11). Smoking and obesity also remained independently associated with colorectal cancer, supporting prior evidence that tobacco-related carcinogen exposure and obesity-related metabolic dysregulation contribute to colorectal tumor development (7,8,10).

A key contribution of this study is its focus not only on colorectal cancer occurrence but also on stage at diagnosis. More than half of the colorectal cancer cases presented with Stage III or IV disease, indicating a substantial burden of late diagnosis. Among cases, symptom duration longer than three months showed the strongest association with advanced-stage presentation, followed by low-fiber diet, low fruit and vegetable intake, and low physical activity. These findings suggest that delayed consultation remains a major determinant of late-stage diagnosis in Pakistan and is consistent with previous local evidence identifying diagnostic delay as an important contributor to advanced colorectal cancer presentation (20,21).

The association between unhealthy lifestyle patterns and advanced-stage disease should be interpreted carefully. Some exposures may contribute biologically to disease progression, while others may reflect broader health behavior, socioeconomic disadvantage, low health literacy, or limited access to timely diagnostic services. For example, individuals with poorer diet quality and lower activity levels may also be less likely to seek early medical advice or recognize warning symptoms. The higher frequency of low education and low household income among cases further supports the possibility that social determinants influence both disease risk and delayed presentation.

These findings have practical implications. Prevention strategies in Pakistan should address diet quality, physical activity, smoking cessation, and weight control as part of colorectal cancer risk reduction. At the same time, early detection efforts should emphasize warning symptoms, including bleeding per

rectum, altered bowel habits, unexplained weight loss, abdominal pain, and anemia. Primary care clinicians and frontline healthcare providers should be trained to identify suspicious bowel symptoms earlier and refer patients promptly for colonoscopy and specialist evaluation. In resource-limited settings, risk-based early detection pathways may be more feasible than immediate population-wide screening and could prioritize older adults, patients with family history, persistent bowel symptoms, obesity, smoking history, and unhealthy lifestyle profiles.

This study has limitations. As a hospital-based case–control study, it is susceptible to recall bias, particularly for retrospective dietary assessment. Selection bias may also be present because controls were recruited from hospital settings rather than the general population. Residual confounding cannot be fully excluded, especially for socioeconomic factors, healthcare access, and unmeasured dietary variables. However, the study has important strengths, including histopathological confirmation of cases, inclusion of equal case and control groups, assessment of both dietary and lifestyle exposures, and additional analysis of advanced-stage presentation. These features make the findings clinically useful for prevention and early detection planning in Northern Punjab.

CONCLUSION

Colorectal cancer among adults presenting to tertiary care hospitals in Northern Punjab was strongly associated with modifiable dietary and lifestyle factors, particularly frequent red meat intake, processed meat use, low-fiber diet, low physical activity, smoking, and obesity, while daily fruit and vegetable intake showed protective associations. Advanced-stage diagnosis was common and was most strongly associated with symptom duration longer than three months, along with poor dietary quality and low physical activity. These findings indicate that colorectal cancer control in Pakistan should combine primary prevention through healthier diet, increased physical activity, tobacco control, and weight management with earlier recognition of warning symptoms and faster referral pathways for diagnostic evaluation.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209-249.

2. Arnold M, Sierra MS, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global patterns and trends in colorectal cancer incidence and mortality. Gut. 2017;66(4):683-691.

3. Kahi CJ, Imperiale TF, Juliar BE, Rex DK. Colorectal cancer: epidemiology, risk factors, and prevention. Cancers (Basel). 2024;16(8):1530.

4. Chan DSM, Lau R, Aune D, Vieira R, Greenwood DC, Kampman E, et al. Red and processed meat and colorectal cancer incidence: meta-analysis of prospective studies. PLoS One. 2011;6(6):e20456.

5. Aune D, Chan DSM, Lau R, Vieira R, Greenwood DC, Kampman E, et al. Dietary fibre, whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies. BMJ. 2011;343:d6617.

6. Wolin KY, Yan Y, Colditz GA, Lee IM. Physical activity and colon cancer prevention: a meta-analysis. Br J Cancer. 2009;100(4):611-616.

7. Botteri E, Iodice S, Bagnardi V, Raimondi S, Lowenfels AB, Maisonneuve P. Smoking and colorectal cancer: a meta-analysis. JAMA. 2008;300(23):2765-2778.

8. Botteri E, Borroni E, Sloan EK, et al. Smoking and colorectal cancer risk, overall and by molecular subtypes: a meta-analysis. Am J Gastroenterol. 2020;115(12):1940-1949.

9. Fedirko V, Tramacere I, Bagnardi V, et al. Alcohol drinking and colorectal cancer risk: an overall and dose-response meta-analysis of published studies. Ann Oncol. 2011;22(9):1958-1972.

10. Moghaddam AA, Woodward M, Huxley R. Obesity and risk of colorectal cancer: a meta-analysis of 31 studies with 70,000 events. Cancer Epidemiol Biomarkers Prev. 2007;16(12):2533-2547.

11. Cong YJ, Gan Y, Sun HL, et al. Association of sedentary behaviour with colon and rectal cancer: a meta-analysis of observational studies. Br J Cancer. 2014;110(3):817-826.

12. Aune D, Lau R, Chan DSM, et al. Nonlinear reduction in risk for colorectal cancer by fruit and vegetable intake based on meta-analysis of prospective studies. Gastroenterology. 2011;141(1):106-118.

13. van Duijnhoven FJB, Bueno-de-Mesquita HB, Ferrari P, et al. Fruit, vegetables, and colorectal cancer risk: the European Prospective Investigation into Cancer and Nutrition. Am J Clin Nutr. 2009;89(5):1441-1452.

14. Wakai K, Date C, Fukui M, et al. Dietary fiber and risk of colorectal cancer in the Japan Collaborative Cohort Study. Cancer Epidemiol Biomarkers Prev. 2007;16(4):668-675.

15. Bradbury KE, Murphy N, Key TJ. Diet and colorectal cancer in UK Biobank: a prospective study. Int J Epidemiol. 2020;49(1):246-258.

16. Lu Y, Cao H, Wang X, et al. Association between dairy product consumption and colorectal cancer risk in adults: a systematic review and meta-analysis of epidemiologic studies. Adv Nutr. 2022;13(5):1953-1977.

17. Santarelli RL, Pierre F, Corpet DE. Processed meat and colorectal cancer: a review of epidemiologic and experimental evidence. Nutr Cancer. 2008;60(2):131-144.

18. Tayyem RF, Bawadi HA, Shehadah I, Bani-Hani KE, Takruri HR, Al-Jaberi T, et al. Fast foods, sweets and beverage consumption and risk of colorectal cancer: a case-control study in Jordan. Asian Pac J Cancer Prev. 2018;19(1):261-269.

19. Khan NA, Hussain M, ur Rahman A, Farooqui WA, Rasheed A, Memon AS. Dietary practices, addictive behavior and bowel habits and risk of early onset colorectal cancer: a case control study. Asian Pac J Cancer Prev. 2015;16(17):7967-7973.

20. Ahmed RN, Rai L, Samo KA, Saeed S, Salam A, Khan H, et al. Factors affecting delay in diagnosis of colorectal cancer: a cross-sectional study from a tertiary care hospital of Karachi, Pakistan. Int J Clin Pract. 2021;75(10):e14529.

21. Shamsi U, Qureshi S, Moosaji M, Azam I, Idrees R. Colorectal cancer survival and its prognostic factors in Karachi, Pakistan. J Coll Physicians Surg Pak. 2024;34(6):688-694.

22. Brandt PA van den, Botteri E, Lugo A, et al. Smoking and colorectal cancer risk, overall and by molecular subtypes: a meta-analysis. Am J Gastroenterol. 2020;115(12):1940-1949.

23. Clinton SK, Giovannucci EL, Hursting SD. The World Cancer Research Fund/American Institute for Cancer Research Third Expert Report on diet, nutrition, physical activity, and cancer: impact and future directions. J Nutr. 2020;150(4):663-671.

24. Markozannes G, Tzoulaki I, Karli D, et al. Dietary-lifestyle patterns and colorectal cancer risk: Global Cancer Update Programme systematic literature review. Am J Clin Nutr. 2025;121(2):352-367.

25. Fararouei M, Zeighami S, Khodakarim S, et al. Lifestyle, dietary pattern and colorectal cancer: a case-control study. BMC Nutr. 2024;10:18.