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Epidemiological Characteristics and Risk Factor Associations of Colorectal Cancer in a Community Health Setting in the Appalachian Region (2020-2024)

Jasneet Gill[1], Amukta Palakurthi[2], Hunter Brady[3], Rahul Kapil[4], Suhail Sapkota[5], Chimezie Mbachi[6]

[1]Department of Internal Medicine, Tennova North Knoxville Medical Center, Knoxville, TN, USA
[2]Department of Internal Medicine, Appalachian Regional Healthcare, Middlesboro, KY, USA
[3]Department of Medicine, Lincoln Memorial University-DeBusk College of Osteopathic Medicine, Knoxville, TN, USA
[4]Department of Pulmonary Medicine, Yale Newhaven Health, Waterford, CT, USA
[5]Department of Internal Medicine, University of Michigan Health Sparrow Hospital, Lansing, MI, USA
[6]Department of Gastroenterology, Tennova North Knoxville Medical Center, Knoxville, TN, USA
Email: drjasneetgill@gmail.com

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Abstract

Background: Colorectal cancer (CRC) disproportionately affects rural populations in the United States, particularly those residing in the Appalachian region. **Objective:** This paper aims to examine demographic characteristics and behavioral risk factors associated with CRC in an Appalachian community health setting. **Methods:** A retrospective analysis of cancer registry data was conducted for CRC patients diagnosed between 2020 and 2024. Descriptive statistics and multivariate logistic regression were used to evaluate associations between CRC and selected risk factors. **Results:** Smoking, alcohol use, obesity, and family history of cancer were significantly associated with increased CRC risk. **Conclusion:** Region-specific prevention strategies addressing modifiable risk factors and screening access are urgently needed in Appalachian communities.

Keywords

Colorectal Cancer, Appalachia, Rural Health, Cancer Epidemiology, Behavioral Risk Factors, Smoking, Alcohol Use, Obesity, Health Disparities, Community Health, Cancer Registry, Preventive Screening

1. Introduction

Colorectal cancer (CRC) remains one of the most common and deadly cancers in

the United States, but its impact is particularly pronounced in rural regions such as Appalachia. In this area, CRC incidence and mortality rates are higher than the national average, driven by a complex interplay of geographic, socioeconomic, and behavioral factors [1] [2]. Appalachia's mountainous terrain and dispersed population create significant barriers to accessing healthcare services, which are compounded by economic challenges such as high levels of poverty and limited job opportunities. These factors not only make it harder for individuals to receive timely screenings and treatment but also contribute to high-risk behaviors—such as smoking, obesity, and excessive alcohol consumption—that increase the likelihood of developing CRC [3] [4].

The cultural context in Appalachia also plays a crucial role in shaping health outcomes. Traditional values and attitudes toward healthcare often emphasize self-reliance, which can discourage individuals from seeking preventive care or adopting health-promoting behaviors. Additionally, persistent stigma surrounding illness in some communities may reduce willingness to discuss or seek help for potentially life-threatening conditions such as CRC. These cultural and social factors, combined with limited healthcare infrastructure, create a unique set of challenges that heighten CRC risk in Appalachia [4] [5].

Despite growing awareness of these issues, much of the existing research on CRC focuses on national or urban populations, leaving rural areas—particularly Appalachia—underrepresented in the literature. Previous studies have identified the important role of lifestyle factors and healthcare access in rural cancer mortality, but few have examined how these challenges interact specifically within Appalachian communities [6]. This gap highlights the need for targeted studies that address not only behavioral and demographic risk factors but also the structural barriers that hinder early detection and treatment.

This study aims to address these gaps by focusing on the Appalachian population and examining demographic and behavioral factors associated with CRC in this underserved region. By identifying these trends, the findings may help inform public health strategies tailored to the unique needs of Appalachian communities, with the goal of reducing CRC incidence and improving early detection in this high-risk population.

2. Methods

2.1. Study Design and Setting

We conducted a retrospective study using data from a cancer registry associated with a community health center serving an Appalachian population. The study spanned a five-year period (2020-2024), with the goal of identifying demographic and behavioral risk factors that contribute to colorectal cancer (CRC) in this underserved region. By using cancer registry data, we were able to gather comprehensive information on CRC cases, including key lifestyle factors and demographics. This registry allowed access to a larger and more representative patient population than alternative data sources, providing a more complete picture of CRC in Appalachia.

2.2. Inclusion and Exclusion Criteria

All patients diagnosed with CRC during the study period were included, provided that complete information was available for key variables, including smoking status, family history of cancer, alcohol use, and obesity. Patients were excluded if their records were incomplete for any of these variables or if they were diagnosed with other cancers concurrently, to minimize potential confounding effects.

2.3. Data Collection

Data were extracted from the cancer registry and included patient demographics (age, sex, and race) as well as lifestyle factors known to influence CRC risk, such as smoking status, alcohol use, obesity, and family history of cancer. Smoking status was classified as current smoker, former smoker, or never smoker. Alcohol consumption was recorded as a binary variable (yes/no) based on self-reported regular use, defined as drinking at least once per week. Obesity was defined as a body mass index (BMI) of ≥30, consistent with World Health Organization guidelines [7].

Although the cancer registry provided reliable case identification, data entry may have been inconsistent or incomplete for certain lifestyle variables, which is a known limitation of retrospective registry-based studies [8]. For example, alcohol use and smoking status may have been underreported. To address this limitation, only cases with complete data for all key variables were included in the analysis. When possible, registry entries were cross-checked against available medical records to improve data accuracy. Patient surveys or interviews were not conducted as part of this study.

2.4. Statistical Analysis

Descriptive statistics were used to summarize demographic and behavioral characteristics of the study population. Frequencies and percentages were calculated for categorical variables such as smoking status and alcohol use. Associations between lifestyle factors and CRC were assessed using Chi-square tests.

To evaluate the independent effects of multiple risk factors on CRC, multivariate logistic regression models were constructed. These models allowed adjustment for potential confounders, including age and sex, while estimating the effects of smoking, alcohol use, and obesity on CRC risk. Logistic regression was selected due to its suitability for modeling relationships between multiple predictors and a binary outcome. Model assumptions, including linearity between continuous predictors and the log odds of the outcome, were assessed using diagnostic procedures, and appropriate adjustments were made to ensure model validity [9].

Statistical significance was defined as $p < 0.05$. All analyses were performed using SPSS software (version 28).

3. Results

3.1. Demographic Profile

Out of the 500 CRC patients included in the study, the average age was 62 years.

A notable gender disparity was observed, with 80.4% of patients being male. The racial composition of the study population and other baseline characteristics are summarized in Table 1. This mirrors broader national trends, as men are generally at higher risk for developing CRC compared to women [10]. The gender gap in CRC rates could also be influenced by local cultural and lifestyle factors. For instance, in many Appalachian communities, men may be more likely to engage in behaviors such as smoking and alcohol consumption, which are well-documented risk factors for CRC [11]. Additionally, certain gender norms in rural areas could influence how men perceive healthcare and preventive screenings, potentially delaying diagnosis and treatment. This underscores the importance of addressing gender-specific barriers in CRC prevention and early detection strategies.

Table 1. Demographic characteristics of CRC patients (N = 500).

Variable	Value
Mean age	62
Male	80.4%
Female	19.6%
Race	94.4%
White	4.7%
Other	0.9%

The racial composition of the study sample was predominantly White (94.4%), reflecting the demographic makeup of the Appalachian region, where the majority of residents are White. A small proportion of Black patients (4.7%) was also included, providing a limited but valuable perspective on racial differences in CRC risk within this population.

3.2. Behavioral Risk Factors

When examining lifestyle factors associated with CRC risk in the Appalachian population, several key findings emerged. The prevalence of major behavioral and familial risk factors among colorectal cancer patients is shown in Figure 1.

- **Smoking:** A substantial proportion of patients (51%) were current smokers, which is considerably higher than the national average of approximately 14% [11]. Smoking is a well-established risk factor for CRC, and its high prevalence in Appalachia may be linked to socioeconomic challenges, limited access to smoking cessation programs, and long-standing cultural acceptance of tobacco use in many rural communities.
- **Alcohol Use:** Nearly half of the patients (47%) reported regular alcohol consumption, defined as drinking at least once per week. Alcohol use has been associated with increased CRC risk, with risk escalating as consumption levels rise. In Appalachia, alcohol use may be more prevalent due to social and cul-

tural norms that promote drinking as a common social activity, underscoring the importance of targeted prevention strategies.

- **Obesity:** Approximately 18.2% of patients were classified as obese based on a BMI of ≥30. Obesity is a significant risk factor for CRC, and its prevalence in Appalachia represents a major public health concern. Excess adiposity has been shown to increase CRC risk through mechanisms involving insulin resistance, chronic inflammation, and alterations in gut microbiota [12]. Although BMI does not capture all dimensions of obesity, such as fat distribution or waist circumference, it served as the primary measure in this study due to data availability. Physical inactivity, which often accompanies obesity, is also a known CRC risk factor in this region. Public health interventions promoting weight management and physical activity could play a critical role in reducing CRC risk in Appalachian communities.

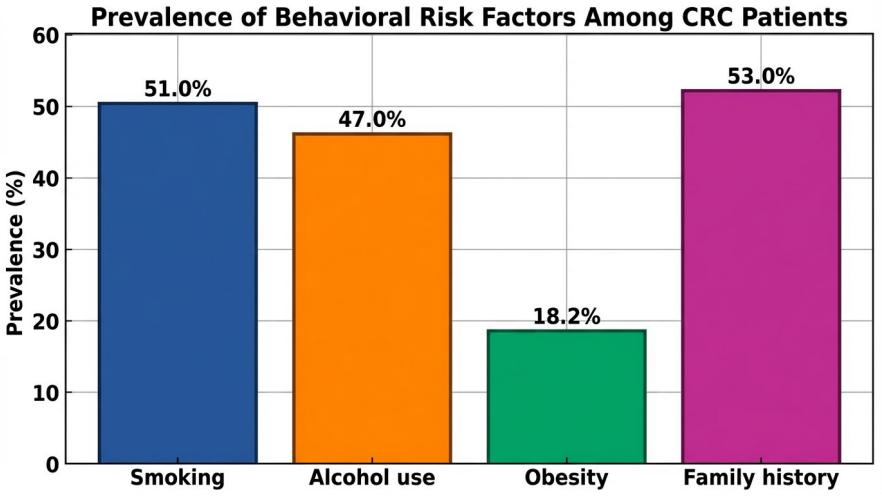

Figure 1. Prevalence of behavioral and familial risk factors among CRC patients.

3.3. Statistical Findings

Multivariate logistic regression analysis demonstrated that smoking, alcohol use, and obesity were each significantly associated with CRC. Results of the multivariate logistic regression analysis are summarized in Table 2.

- **Smoking:** Smokers had 2.4 times higher odds of developing CRC compared to non-smokers (OR = 2.4, $p < 0.05$). This finding reinforces the need for comprehensive smoking cessation efforts in Appalachian communities, where tobacco use remains a persistent public health challenge.
- **Alcohol Use:** Regular alcohol consumption was associated with a 1.8-fold increase in CRC odds compared to non-regular drinkers (OR = 1.8, $p < 0.05$). Given prevailing social norms around alcohol use in the region, public health strategies emphasizing moderation may help reduce CRC risk.
- **Obesity:** Obese patients had 1.6 times higher odds of developing CRC (OR = 1.6, $p < 0.05$), consistent with prior evidence linking excess body weight to increased CRC risk. Elevated obesity rates in Appalachia may be influenced by

limited access to healthy foods, lower physical activity levels, and socioeconomic constraints that complicate weight management [4].

Family history was also a significant predictor of CRC risk. Approximately 53% of patients reported a family history of cancer, which was associated with a substantially increased likelihood of CRC (OR = 2.2, $p < 0.05$). This finding emphasizes the importance of incorporating family history into CRC screening guidelines and expanding access to genetic counseling for high-risk populations.

Table 2. Multivariate logistic regression results for CRC risk.

Predictor	Adjusted OR	95% CI	p-value
Current smoking	2.4	(1.6 - 3.5)	0.002
Regular alcohol use	1.8	(1.2 - 2.7)	0.01
Obesity (BMI ≥ 30)	1.6	(1.1 - 2.4)	0.03
Family history of cancer	2.2	(1.5 - 3.2)	0.001

3.4. Impact of Missing Data

Approximately 12% of patient records were excluded due to missing information on key variables such as alcohol use and family history. Although this exclusion did not materially alter the demographic profile of the study population, missing data may have introduced bias if the absence of information was not random. Sensitivity analyses indicated that exclusion of incomplete records did not meaningfully affect the study's conclusions [13].

4. Discussion

4.1. Public Health Implications

This study provides important insights into the high rates of colorectal cancer (CRC) in Appalachia and the behavioral risk factors that significantly contribute to the disease. Smoking, alcohol use, and obesity were found to be strongly linked to CRC, confirming their well-established roles as major risk factors for cancer [12]. These findings highlight the urgent need for public health interventions in the region, particularly given the high prevalence of these behaviors in Appalachia.

The study underscores the importance of implementing community-based public health programs aimed at addressing smoking, alcohol use, and obesity. For example, smoking cessation programs could be tailored to meet the specific needs of Appalachian communities, where smoking rates are disproportionately high compared to the national average. Localized interventions such as mobile cessation units or peer-led support groups could be effective, particularly in areas with limited healthcare infrastructure. Similarly, alcohol reduction programs should be culturally sensitive, recognizing that social drinking is deeply embedded in many rural Appalachian communities. Health campaigns that focus on the long-term risks of alcohol consumption, alongside support for individuals who

wish to cut back, could help reduce CRC risk.

Given the high obesity rates in Appalachia, obesity prevention programs should be a priority. These could focus on increasing access to affordable healthy food options, promoting physical activity through community events, and offering weight management programs that address the unique challenges of rural populations. Programs that incorporate education on nutrition and physical activity should consider the logistical barriers in rural areas, such as limited public transportation and access to fitness centers.

Additionally, telemedicine has the potential to bridge the healthcare access gap in Appalachia. Telehealth platforms could be used for consultations, follow-up appointments, and education on lifestyle changes, making it easier for individuals in remote areas to engage in health programs without the need for long-distance travel. Given the geographic isolation of many Appalachian communities, telemedicine could play a significant role in improving health outcomes and promoting early CRC detection.

4.2. Cultural Sensitivity

Given the distinct cultural characteristics of Appalachia, public health interventions must be culturally sensitive and mindful of the local values and attitudes toward health. Appalachian communities often emphasize self-reliance and personal responsibility, which may influence their willingness to seek preventive care or accept health messages that seem outside of local norms. To be successful, public health efforts must engage local leaders and build trust within these communities. Research has shown that community engagement and local trust are critical for the success of public health programs in rural areas. For example, community health workers who are trusted members of the region could play a key role in delivering messages about CRC prevention and early screening.

Addressing health literacy is another crucial component. Low health literacy, which is common in many rural regions, can significantly hinder the effectiveness of health messages. Public health campaigns must use clear, straightforward language and visuals to communicate health risks and promote early CRC screening. Offering education through local media channels, such as regional radio or town hall meetings, might also be effective ways to reach underserved populations.

4.3. Family History and Genetic Counseling

Our findings also highlight the importance of family history as a significant risk factor for CRC, with 53% of patients reporting a family history of cancer. This is a particularly important consideration in rural areas where healthcare access may be limited. The strong association between family history and CRC underscores the need for genetic counseling and early screening for individuals at higher risk. In Appalachia, where healthcare providers may be scarce, genetic counseling services could be offered remotely via telemedicine or through outreach programs to ensure that individuals with a family history of cancer receive the care they need.

There is also a need to improve awareness of genetic testing and early screening in rural regions. Many individuals in Appalachia may not be aware of the increased risk posed by family history, and healthcare-seeking behaviors can be influenced by cultural factors. Public health efforts should include education on the benefits of early screening, particularly for those with a family history of CRC or other cancers, to reduce CRC mortality in these at-risk populations.

4.4. Limitations

While this study provides valuable data, several important limitations should be acknowledged. First, the retrospective nature of the study limits the ability to draw causal conclusions. Although associations between smoking, alcohol use, obesity, and CRC are well established [12], causal relationships cannot be confirmed due to the observational design.

Another limitation relates to self-reported data, particularly for smoking and alcohol use. These behaviors are frequently underreported due to social desirability bias or recall error, which may introduce inaccuracies [13]. Future studies incorporating objective measures such as biomarkers could help improve data accuracy.

Approximately 12% of patient records were excluded due to missing information on key variables such as alcohol use and family history. While sensitivity analyses were conducted, non-random missingness remains a concern and may have influenced results. Future research should consider data imputation methods or alternative approaches to reduce bias associated with missing data.

Finally, prospective studies are needed to better understand causal relationships between lifestyle factors, family history, and CRC. Incorporating genetic testing into future research may further clarify biological mechanisms contributing to CRC risk, particularly in rural populations such as those in Appalachia.

5. Conclusion

This study emphasizes the urgent need for targeted CRC prevention and early detection programs in Appalachia. Smoking, alcohol use, and obesity are major risk factors in this region, and addressing these behaviors through public health campaigns is essential to reducing the CRC burden. Early screening, especially for those with a family history of cancer, should be prioritized to improve health outcomes in this underserved community.

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advancing public health research and improving cancer prevention strategies in underserved rural communities.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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