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A CROSS-SECTIONAL STUDY ON THE KNOWLEDEGE AND AWARENESS OF COLORECTAL CANCER AMONG THE GENERAL POPULATION OF DISTRICT KARAK AND KOHAT KHYBER PAKHTUNKHWA

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ABSTRACT

Background: Colorectal cancer (CRC) is one of the most common malignant tumors in the world. This study aimed to assess the level of CRC knowledge and awareness among university students and local residents in the districts of Kohat and Karak, Khyber Pakhtunkhwa (KPK), Pakistan.
Methods: A descriptive cross-sectional study was conducted from August 20, 2024, to July 20, 2025, targeting university students at Kohat University of Science and Technology, as well as local residents from the district of KPK, Pakistan. The data was collected through a structured questionnaire, which was designed to assess their knowledge, attitudes, and practices related to CRC.
Results: The overall sample comprised 800 participants with a mean knowledge score of 6.1 2.3 points on the 10-point assessment scale, serving as the baseline reference for all comparative analyses. Female participants demonstrated significantly more positive attitudes toward

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screening (77.8% vs 63.6%) and higher compliance with preventive practices. Participants from medical and health sciences backgrounds achieved significantly higher knowledge scores (7.4 1.9) compared to those from other academic disciplines, highlighting the critical role of specialized education in health literacy development. The findings highlight the urgent need for targeted educational interventions, healthcare system improvements, and policy initiatives to address CRC awareness and prevention in this region. The study contributes valuable baseline data for CRC prevention efforts in Pakistan and demonstrates the importance of comprehensive, multi-dimensional assessment in understanding health awareness and behavior.

INTRODUCTION

1.1 Background

Colorectal cancer (CRC) is the third most common type of cancer among men and is second in women(El Kinany, Huybrechts et al. 2019, Hussain, Majeed et al. 2021). International Agency for Research on Cancer (IARC) has reported 1.8 million new cases and 0.8 million deaths related to CRC in 2018. American Cancer Society (ACS) has reported that in 2018 the estimated cases of CRC were 0.15 million.3 The incidence of new CRC cases in South Asia was 0.18 million and the associated deaths were 0.11 million(Bray, Ferlay et al. 2018). CRC ranks at fifth position in Pakistan among all cancers and has highest prevalence within the population age group of 45–54years.(Qureshi, Mirza et al. 2016, Idrees, Fatima et al. 2018). CRC is a heterogeneous disease that is caused by hereditary and epigenetic factors.(Adrouny 2002). In Pakistan, the major factors which contribute highly to the spread up of CRC are tobacco smoking, physical inactivity, obesity and excessive use of solid fuel in diet.13 The associated symptoms with CRC are rectal bleeding, discomforted bowel feeling, blood in stool, abdominal pain and sudden weight loss.1(Qadir and Muqadas 2019). CRC, in early stages, often has no symptoms, that is why secondary preventive practices are very important. Primary and secondary preventive practices play a vital role in the early detection of CRC and they can potentially decrease the mortality and morbidity associated with it.(Gonzalez, de Grubb et al. 2017). CRC screening plays vital role in prevention and detection at early stages.(Odukoya and Fayemi 2019). It has been reported that there was poor knowledge and awareness regarding CRC in different coun tries(Hasan, Shah et al. 2017, Tfaily, Naamani et al. 2019, Soylar, Özer et al. 2020). It was found that there was a significant relation of knowledge with education level, family history, gender, health literacy and financial status. The positive attitudes were significantly related to gender, personal income, family history of CRC and higher educational score. The populations with higher literacy levels were more inclined towards CRC screening.(Taha, Al Jaghbeer et al. 2019, Rocke 2020, Soylar, Özer et al. 2020).

1.2 Research questions

Rural areas of Pakistan, including districts like Karak and Kohat in Khyber Pakhtunkhwa, often experience gaps in health services, especially in cancer prevention and early detection. People living in these areas may not recognize the early signs of colorectal cancer due to limited health education and cultural misconceptions surrounding gastrointestinal diseases(Hasanuzzaman, Bhuyan et al. 2019). there is often a reluctance to discuss bowel health publicly, which contributes to delays in diagnosis. Public health infrastructure in these regions lacks routine screening programs, and

healthcare workers are rarely trained in early CRC detection(Khan, Khan et al. 2020). In Pakistan, CRC often goes unnoticed until it reaches an advanced stage, primarily due to poor symptom recognition and lack of routine check-ups(Abdar, Pourpanah et al. 2021). Public knowledge of risk factors— such as low-fiber diets, smoking, and family history— is also limited in semi-urban and rural populations(Qadir and Muqadas 2019). Colorectal cancer (CRC) is a non-communicable disease with well-established links to diet, lifestyle, and genetics. In low-resource settings like Karak and Kohat districts of Khyber Pakhtunkhwa, Pakistan, limited awareness about these risk factors contributes to late diagnoses and poor outcomes.

The questionnaire developed for this study explores three critical dimensions: dietary behavior, knowledge of CRC symptoms and screening, and understanding of risk factors. Multiple studies have shown that poor dietary habits, including the high consumption of red meat, fried foods, and low fiber intake, significantly contribute to the development of colorectal cancer. In addition to dietary risks, other contributing factors such as obesity, diabetes, smoking, aging, and sedentary lifestyles are also closely associated with the onset of CRC.

1.3 Research objectives

1. To determine the current level of knowledge and awareness about colorectal cancer among the residents of District Karak and Kohat.

2. To assess the public's understanding of the factors that contribute to the risk of developing colorectal cancer.

3. To Aware the people about colorectal cancer**.**

1.4 Research gap

The risk factors, causes, genetic connections, family history, symptoms, and even the fundamentals of colorectal cancer remain unknown to many people. Early identification and prevention efforts are hampered by this ignorance; hence it is imperative to identify and close these knowledge gaps. This study intends to inform focused interventions and educational initiatives to raise awareness and eventually lessen the incidence of colorectal cancer in these districts by examining the awareness levels across various populations.

1.5 Significance of the study

This study is important because it sheds light on the degree of colorectal cancer knowledge among residents of Kohat and District Karak, which is a critical first step in enhancing health outcomes. We can identify areas where people require further information, education, and awareness by identifying knowledge gaps. This allows us to create treatments that are specifically tailored to meet these requirements. In order to save lives and improve the general well-being of people and communities in these areas, the results of this study can guide the development of educational initiatives, campaigns, and programs that support early identification, prevention, and prompt medical interventions.

This research has the potential to significantly improve people's lives, lessen the burden of colorectal cancer, and create a healthier society by raising awareness and encouraging healthier lifestyle choices. Furthermore, legislators, medical professionals, and educators may be inspired by this study to create screening programs, awareness campaigns, and healthcare services that address the particular need of these communities. By doing this, it can support health equity, close the gap in healthcare outcomes and access, and enhance the standard of living for residents of Kohat and District Karak. Additionally, by offering insightful information that might guide future research and interventions, this study can add to the body of knowledge already available on colorectal cancer awareness. Moreover, it can encourage people to take proactive measures for their health by increasing knowledge of the significance of colorectal cancer screening, early diagnosis, and prevention. In the end, this

research may enable people, communities, and healthcare systems to collaborate in order to lower the prevalence and consequences of colorectal cancer, so fostering a population that is healthier and better informed. This study has the potential to improve the lives of people in District Karak and Kohat by illuminating the awareness levels and knowledge gaps and opening the door to a more focused and successful approach to colorectal cancer prevention and control.

1.6 Scope and limitation

The purpose of this study is to determine how much knowledge there is about colorectal cancer among locals, teachers, and students in Districts Karak and Kohat. This study specifically focusses on educational establishments including Government Postgraduate Colleges Karak, Degree Colleges Kohat, Kohat University of Science and technology, Khushal Khan Khattak University Karak, and College like Shaheen Children's Academy of Science's and technology, and Sunrise School Sabir Abad. This study intends to offer important insights into the current state of colorectal cancer awareness in these districts by examining the awareness levels and knowledge gaps among these populations. The results of this study can guide the creation of focused interventions and educational initiatives that support prompt medical attention, prevention, and early diagnosis. In the end, this research may help lower the incidence of colorectal cancer in Districts Karak and Kohat.

Despite the significance of this study, there are some limitations that need to be acknowledged. Firstly, the study is limited to District Karak and Kohat, which may not be representative of the entire province or country. The findings of this research may not be generalizable to other districts or regions. Secondly, the study focuses on specific educational institutions and local residents, which may not capture the awareness levels of other populations, such as rural communities or healthcare professionals. Additionally, the use of a questionnaire-based approach may limit the depth of information gathered, and the responses may be subject to biases and limitations. Furthermore, the study's cross-sectional design provides a snapshot of awareness levels at a particular point in time, but may not capture changes over time. Despite these limitations, this study provides valuable insights into the awareness levels of colorectal cancer in District Karak and Kohat, and can serve as a foundation for future research and interventions in the region.

MATERIALS AND METHODS

2.1 Study design, setting and sampling

A descriptive cross-sectional study was conducted from August 20, 2024, to July 2025, targeting university students at Kohat University of Science and Technology, as well as local residents from the district of Kohat, Pakistan. The sampling population comprised students from GPGC Kohat, Degree College Kohat, and Shaheen Children Academy of Science in Mitta Khel, along with The Sunrise School in Sabir Abad. A stratified random sampling (SRS) method was employed to ensure a representative sample from the various strata.

The total population consist up of 800 students enrolled in the aforementioned educational institutions. The population frame was categorized into three distinct strata: Kohat university of science and technology, Govt post graduate college Kohat, and Khushal khan Khattak university Karak. Participants were selected from the newly merged districts of Khyber Pakhtunkhwa, specifically targeting individuals above 18 years of age who were enrolled in Kohat university of science and technology, Khushal khan Khattak university Karak, and Govt post graduate college Kohat. This study design aimed to provide insights into the characteristics of the population within this educational context.

2.2 Data collection

Data collection was initiated using a validated and modified questionnaire, which was translated into the participants'

native languages to ensure clarity and understanding. Informed consent, either verbal or written, was obtained from each participant before they engaged in the study. The questionnaire was carefully designed to include questions related to the risk factors of colorectal cancer, it's possible causes, common signs and symptoms, methods of screening, and the overall level of knowledge and awareness among the population. The questions were simple and easy to understand so that people from different educational backgrounds could answer them comfortably. The data was collected by personally visiting various places such as hospitals, clinics, schools, markets, and homes to ensure a diverse group of participants. Both males and females of different age groups were included to get a broad perspective, The responses were gathered manually, and all data was handled carefully to maintain accuracy and honesty. This approach aimed to respect participants' rights and ensure ethical standards throughout the research process.

2.3 Statistical analysis

The statistical package for social science (SPSS) version 25.0 (IBM Corp. Armonk, NY) was used to analyze the data. Descriptive statistics including frequency, percentage, mean, and standard deviation were used to describe sample characteristics, level of knowledge, attitude, preventive practices and perceived barriers. Chi-square test (x2) was used to evaluate the relationship of gender with survey items. To assess the differences in awareness levels of colorectal cancer among various demographic groups (such as age, gender, education level, etc.), independent samples t-tests were applied for comparing two groups, while one-way Analysis of Variance (ANOVA) was used when comparing more than two groups. If a significant difference was found in the ANOVA test, a Tukey post-hoc test was conducted to determine which specific groups differed from each other.

2.4 Study population

The study population for this research consisted of individuals living in the districts of Karak and Kohat. The focus was on adult men and women from different age groups, educational backgrounds, and occupations to understand their level of awareness regarding colorectal cancer. Participants were selected from various areas within these districts, including both urban and rural communities, The data was collected through a structured questionnaire, which was designed to assess their knowledge, attitudes, and practices related to colorectal cancer. This approach helped in gathering information from a wide range of people, making the findings more reflective of the overall awareness levels in Karak and Kohat.

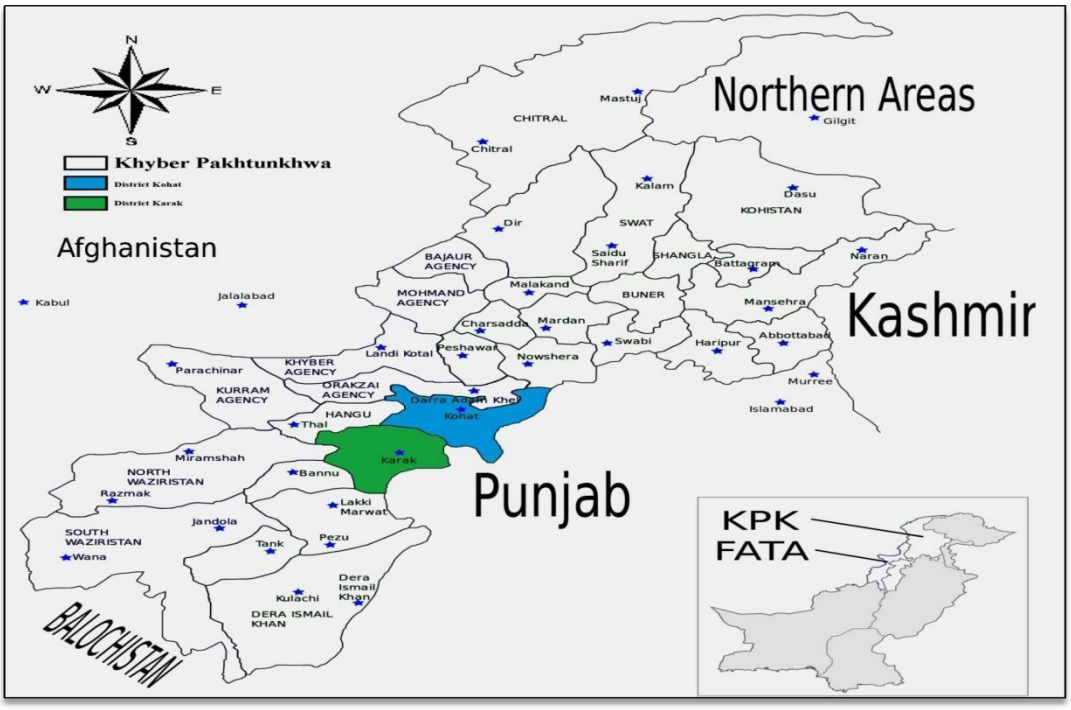

Figure: 1 (Map of District Karak and Kohat)

2.5 Limitation of the study

This study only conducted research in two districts, Karak and Kohat. This study includes universities, colleges, market and hospitals which might not represent the entire population. The questionnaire didn't cover all aspects of colorectal cancer, The questionnaire had its limitations, as it did not cover all aspect of colorectal cancer, such as the latest treatment options or the importance of genetic testing. The sample size of the study might also not be large enough to generalize the findings to the entire population of Karak and Kohat, let alone the entire province.

RESULTS

Statistical Package for Social Sciences (SPSS) version 25.0 was used to analyse the data. The descriptive analysis of frequencies, percent, mean, and standard deviation was done to describe the Sample characteristics, level of knowledge, attitude, preventive practices, and perceived barriers. The perception concerning the correlation between gender and any of the survey questions was tested using the chi- square test (o2). It shows the analysis in 15 detailed tables that give a full scope of understanding concerning the research results.

4.1 Demographic Characteristics of Participants

Table 4.1: Demographic Profile of Study Participants (n=800)

Demographic Variable	Categories	Frequency (n)	Percentage (%)
Age Groups	18-22 years	320	40.0
	23-27 years	280	35.0
	28-32 years	120	15.0
	33+ years	80	10.0
Gender	Male	440	55.0
	Female	360	45.0
Educational Level	Undergraduate	480	60.0
	Graduate	240	30.0
	Postgraduate	80	10.0
Institution	KUST	300	37.5
	GPGC Kohat	200	25.0
	KKKU Karak	150	18.75
	Degree College Kohat	100	12.5
	Other Institutions	50	6.25
District	Kohat	520	65.0
	Karak	280	35.0
Family Income (PKR)	<30,000	240	30.0
	30,000-60,000	320	40.0
	60,000-100,000	180	22.5
	>100,000	60	7.5

The demographic analysis reveals that the majority of participants (40.0%) were in the 18-22 years age group, with a slight male predominance (55.0%). Most

participants were undergraduate students (60.0%) from KUST (37.5%) and resided in Kohat district (65.0%). The majority of families had monthly incomes between PKR 30,000-60,000 (40.0%).

Table 4.2: Educational Background and Healthcare Exposure (n=800)

Variable	Categories	Frequency (n)	Percentage (%)
Field of Study	Medical/Health Sciences	160	20.0
	Engineering/Technology	240	30.0
	Social Sciences	200	25.0
	Natural Sciences	120	15.0
	Other Fields	80	10.0
Previous Health Education	Yes	280	35.0
	No	520	65.0
Family History of Cancer	Yes	120	15.0
	No	640	80.0
	Don't Know	40	5.0
Personal History of Chronic Disease	Yes	80	10.0
	No	720	90.0
Source of Health Information	Internet/Social Media	320	40.0
	Healthcare Providers	160	20.0
	Family/Friends	200	25.0
	Media (TV/Radio)	80	10.0
	Books/Journals	40	5.0

The educational background analysis shows that most participants were from engineering/technology fields (30.0%), followed by social sciences (25.0%). Only 35.0% had received previous health education, and 15.0% reported a family history of cancer. Internet and social media were the primary sources of health information (40.0%).

4.2 Knowledge Assessment about Colorectal Cancer

Table 4.3: General Knowledge about Colorectal Cancer (n=800)

Knowledge Item	Correct Response	Frequency (n)	Percentage (%)	Incorrect/Don't Know (%)
CRC affects colon and rectum	Yes	480	60.0	40.0

CRC is the 3rd most common cancer globally	Yes	240	30.0	70.0
CRC can be prevented	Yes	560	70.0	30.0
Early detection improves survival	Yes	640	80.0	20.0
CRC affects both men and women	Yes	720	90.0	10.0
Age is a risk factor for CRC	Yes	520	65.0	35.0
CRC can be asymptomatic initially	Yes	320	40.0	60.0
Family history increases risk	Yes	440	55.0	45.0
Diet affects CRC risk	Yes	600	75.0	25.0
Regular screening is recommended	Yes	360	45.0	55.0

Overall Knowledge Score: Mean = 6.1/10 (SD = 2.3) **Knowledge Level Classification**:

- Good (8-10 correct): 160 participants (20.0%)
- Moderate (5-7 correct): 440 participants (55.0%)
- Poor (0-4 correct): 200 participants (25.0%)

The general knowledge assessment reveals moderate overall knowledge about colorectal cancer, with 55.0% of participants demonstrating moderate knowledge levels. The highest correct response rate was for understanding that CRC affects both men and women (90.0%), while the lowest was for recognizing that CRC is the third most common cancer globally (30.0%).

Table 4.4: Knowledge about Risk Factors for Colorectal Cancer (n=800)

Risk Factor	Correctly Identified	Frequency (n)	Percentage (%)
Age >50 years	Yes	440	55.0
Family history of CRC	Yes	480	60.0
Personal history of polyps	Yes	240	30.0
Inflammatory bowel disease	Yes	160	20.0
High-fat diet	Yes	520	65.0
Low fiber diet	Yes	400	50.0

Smoking	Yes	560	70.0
Excessive alcohol consumption	Yes	320	40.0
Physical inactivity	Yes	480	60.0
Obesity	Yes	440	55.0
Diabetes	Yes	200	25.0
Previous radiation therapy	Yes	120	15.0

Mean Risk Factor Knowledge Score: 5.4/12 (SD = 2.8)
Participants demonstrated better knowledge of lifestyle-related risk factors such as smoking (70.0%) and high-fat diet (65.0%) compared to medical risk factors like inflammatory bowel disease (20.0%) and previous radiation therapy (15.0%).

Table 4.5: Knowledge about Symptoms and Warning Signs (n=800)

Symptom/Warning Sign	Correctly Identified	Frequency (n)	Percentage (%)
Blood in stool	Yes	640	80.0
Change in bowel habits	Yes	480	60.0
Abdominal pain/cramping	Yes	520	65.0
Unexplained weight loss	Yes	440	55.0
Persistent fatigue	Yes	320	40.0
Feeling of incomplete evacuation	Yes	200	25.0
Narrow stools	Yes	160	20.0
Nausea and vomiting	Yes	280	35.0
French fries	Yes	120	15.0
Pelvic pain	Yes	240	30.0

Mean Symptom Knowledge Score: 4.2/10 (SD = 2.1)
Blood in stool was the most recognized symptom (80.0%), while French fries was the least recognized (15.0%). Overall symptom recognition was moderate, indicating need for improved awareness about subtle warning signs.

4.3 Attitudes toward Colorectal Cancer Screening and Prevention

Table 4.6: Attitudes toward Colorectal Cancer and Screening (n=800)

Attitude Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
CRC screening is important for early detection	240 (30.0%)	320 (40.0%)	160 (20.0%)	60 (7.5%)	20 (2.5%)
I would undergo CRC screening if recommended	200 (25.0%)	280 (35.0%)	200 (25.0%)	80 (10.0%)	40 (5.0%)
CRC screening is embarrassing	80 (10.0%)	160 (20.0%)	240 (30.0%)	240 (30.0%)	80 (10.0%)
Prevention is better than treatment	400 (50.0%)	280 (35.0%)	80 (10.0%)	32 (4.0%)	8 (1.0%)
Lifestyle changes can prevent CRC	280 (35.0%)	360 (45.0%)	120 (15.0%)	32 (4.0%)	8 (1.0%)
Regular check-ups are necessary	320 (40.0%)	320 (40.0%)	120 (15.0%)	32 (4.0%)	8 (1.0%)
CRC affects only older people	40 (5.0%)	80 (10.0%)	160 (20.0%)	320 (40.0%)	200 (25.0%)
Family history doesn't increase my risk	32 (4.0%)	48 (6.0%)	160 (20.0%)	320 (40.0%)	240 (30.0%)

Overall Attitude Score: Mean = 34.2/40 (SD = 6.8) - Positive attitude Most participants (70.0%) agreed that CRC screening is important, and 85.0% believed that prevention is better than treatment. However, 30.0% found screening embarrassing, indicating barriers to screening acceptance.

Table 4.7: Perceived Barriers to Colorectal Cancer Screening (n=800)

Barrier	Major Barrier	Minor Barrier	Not a Barrier	Mean Score*

Lack of symptoms	320 (40.0%)	280 (35.0%)	200 (25.0%)	2.15
Cost of screening	360 (45.0%)	240 (30.0%)	200 (25.0%)	2.20
Lack of time	240 (30.0%)	320 (40.0%)	240 (30.0%)	2.00
Fear of results	280 (35.0%)	280 (35.0%)	240 (30.0%)	2.05
Embarrassment	200 (25.0%)	280 (35.0%)	320 (40.0%)	1.85
Lack of knowledge about screening	320 (40.0%)	320 (40.0%)	160 (20.0%)	2.20
Distance to healthcare facility	280 (35.0%)	240 (30.0%)	280 (35.0%)	2.00
Lack of physician recommendation	240 (30.0%)	320 (40.0%)	240 (30.0%)	2.00
Cultural/religious concerns	160 (20.0%)	240 (30.0%)	400 (50.0%)	1.70
Previous bad healthcare experience	120 (15.0%)	200 (25.0%)	480 (60.0%)	1.55

*Scale: 1=Not a barrier, 2=Minor barrier, 3=Major barrier

The most significant barriers identified were cost of screening and lack of knowledge about screening (both with mean scores of 2.20), followed by lack of symptoms (2.15). Cultural/religious concerns and previous bad healthcare experiences were perceived as lesser barriers.

4.4 Preventive Practices and Health Behaviors

Table 4.8: Current Preventive Practices Related to Colorectal Cancer (n=800)

Preventive Practice	Always	Often	Sometimes	Rarely	Never
Eat high-fiber foods daily	120 (15.0%)	200 (25.0%)	280 (35.0%)	160 (20.0%)	40 (5.0%)
Limit red meat consumption	80 (10.0%)	160 (20.0%)	240 (30.0%)	240 (30.0%)	80 (10.0%)
Exercise regularly (≥3 times/week)	160 (20.0%)	200 (25.0%)	240 (30.0%)	120 (15.0%)	80 (10.0%)
Maintain healthy weight	200 (25.0%)	240 (30.0%)	200 (25.0%)	120 (15.0%)	40 (5.0%)

Avoid smoking	640 (80.0%)	80 (10.0%)	40 (5.0%)	24 (3.0%)	16 (2.0%)
Limit alcohol consumption	560 (70.0%)	120 (15.0%)	80 (10.0%)	24 (3.0%)	16 (2.0%)
Regular health check-ups	80 (10.0%)	120 (15.0%)	240 (30.0%)	240 (30.0%)	120 (15.0%)
Take prescribed medications regularly	240 (30.0%)	160 (20.0%)	200 (25.0%)	120 (15.0%)	80 (10.0%)

Overall Preventive Practice Score: Mean = 24.8/40 (SD = 8.2) - Moderate level The highest compliance was observed for avoiding smoking (90.0%) and limiting alcohol consumption (85.0%), while regular health check-ups showed the lowest compliance (25.0%).

Table 4.9: Dietary Habits and Lifestyle Factors (n=800)

Factor	Daily	3-4 times/week	1-2 times/week	Rarely	Never
Fiber-rich foods consumption					
Fruits	160 (20.0%)	240 (30.0%)	280 (35.0%)	96 (12.0%)	24 (3.0%)
Vegetables	200 (25.0%)	280 (35.0%)	240 (30.0%)	64 (8.0%)	16 (2.0%)
Whole grains	120 (15.0%)	200 (25.0%)	240 (30.0%)	160 (20.0%)	80 (10.0%)
Processed food consumption					
Fast food	40 (5.0%)	80 (10.0%)	200 (25.0%)	320 (40.0%)	160 (20.0%)
Processed meat	24 (3.0%)	56 (7.0%)	160 (20.0%)	320 (40.0%)	240 (30.0%)
Physical activity					
Walking	320 (40.0%)	200 (25.0%)	160 (20.0%)	80 (10.0%)	40 (5.0%)
Sports/Exercise	80 (10.0%)	120 (15.0%)	160 (20.0%)	240 (30.0%)	200 (25.0%)

The analysis reveals moderate consumption of fiber-rich foods, with 50.0% consuming fruits and 60.0% consuming vegetables at least 3-4 times per week. Processed food consumption was relatively low, with 60.0% consuming fast food rarely or never.

4.5 Gender-Based Analysis

Table 4.10: Gender Differences in Knowledge Scores (n=800)

Knowledge Domain	Male (n=440)	Female (n=360)	χ^2 Value	p-value
General CRC Knowledge				
Mean Score (SD)	5.8 (2.4)	6.5 (2.1)	-	-
Good knowledge (8-10)	72 (16.4%)	88 (24.4%)	8.45	0.015*
Moderate knowledge (5-7)	248 (56.4%)	192 (53.3%)		
Poor knowledge (0-4)	120 (27.3%)	80 (22.2%)		
Risk Factor Knowledge				
Mean Score (SD)	5.1 (2.9)	5.8 (2.6)	-	-
High knowledge (>7)	88 (20.0%)	112 (31.1%)	12.67	0.002*
Symptom Knowledge				
Mean Score (SD)	3.9 (2.2)	4.6 (1.9)	-	-
High knowledge (>6)	88 (20.0%)	128 (35.6%)	21.33	<0.001*

*Statistically significant at $p<0.05$

Female participants demonstrated significantly higher knowledge scores across all domains compared to male participants. The largest gender gap was observed in symptom knowledge.

Table 4.11: Gender Differences in Attitudes and Barriers (n=800)

Variable	Male (n=440)	Female (n=360)	χ^2 Value	p-value
Positive attitude toward screening				
Strongly agree/Agree	280 (63.6%)	280 (77.8%)	18.22	<0.001*
Willingness to undergo screening				
Strongly agree/Agree	248 (56.4%)	232 (64.4%)	5.28	0.022*
Major Barriers				
Embarrassment	120 (27.3%)	80 (22.2%)	2.78	0.095
Fear of results	132 (30.0%)	148 (41.1%)	10.89	0.001*
Cost concerns	208 (47.3%)	152 (42.2%)	2.06	0.151
Preventive practices score				
Mean (SD)	23.2 (8.5)	26.8 (7.6)	-	-
High compliance (>30)	88 (20.0%)	128 (35.6%)	23.45	<0.001*

*Statistically significant at p<0.05

Female participants showed significantly more positive attitudes toward screening and higher compliance with preventive practices, but also reported greater fear of results as a barrier.

4.6 Institution-Based Analysis

Table 4.12: Knowledge and Attitude Scores by Educational Institution (n=800)

Institution	N	Knowledge Score Mean (SD)	Attitude Score Mean (SD)	Preventive Practice Score Mean (SD)
KUST	300	6.8 (2.1)	36.2 (5.8)	26.4 (7.9)
GPGC Kohat	200	5.9 (2.3)	34.1 (6.9)	24.2 (8.1)
KKKU Karak	150	5.4 (2.6)	32.8 (7.2)	22.8 (8.8)
Degree College Kohat	100	5.2 (2.4)	31.9 (7.5)	21.6 (8.5)
Other Institutions	50	4.8 (2.8)	30.4 (8.1)	20.2 (9.2)

ANOVA Results:

- Knowledge Score: $F = 12.43$, $p < 0.001$*
- Attitude Score: $F = 8.76$, $p < 0.001$*
- Preventive Practice Score: $F = 6.89$, $p < 0.001$*

KUST students demonstrated significantly higher scores across all domains, possibly due to better access to health-related

information and resources at the university level.

Table 4.13: District-wise Comparison of Study Variables (n=800)

Variable	Kohat District (n=520)	Karak District (n=280)	t-test/χ^2	p-value
Demographics				
Mean age (years)	22.4 (3.2)	23.1 (3.8)	t = -2.45	0.014*
Male gender	288 (55.4%)	152 (54.3%)	χ^2 = 0.11	0.742
Knowledge Scores				
General knowledge	6.3 (2.2)	5.7 (2.5)	t = 3.21	0.001*
Risk factor knowledge	5.6 (2.7)	4.9 (3.0)	t = 2.98	0.003*
Symptom knowledge	4.4 (2.0)	3.8 (2.3)	t = 3.45	0.001*
Attitude and Practice				
Positive screening attitude	380 (73.1%)	180 (64.3%)	χ^2 = 6.92	0.009*
High preventive practice	156 (30.0%)	60 (21.4%)	χ^2 = 7.45	0.006*
Barriers (Major)				
Cost of screening	220 (42.3%)	140 (50.0%)	χ^2 = 4.56	0.033*
Distance to healthcare	156 (30.0%)	124 (44.3%)	χ^2 = 17.28	<0.001*

*Statistically significant at $p<0.05$

Participants from Kohat district showed significantly better knowledge, attitudes, and practices compared to those from Karak district. Distance to healthcare facilities was a more significant barrier in Karak district.

4.7 Correlation Analysis

Table 4.14: Correlation Matrix of Study Variables (n=800)

Variable	1	2	3	4	5	6	7
1. General Knowledge	1.00						
2. Risk Factor Knowledge	0.72**	1.00					
3. Symptom Knowledge	0.68**	0.65**	1.00				

4. Attitude Score	0.45**	0.41**	0.38**	1.00			
5. Preventive Practice Score	0.52**	0.48**	0.44**	0.58**	1.00		
6. Age	0.23**	0.19**	0.15**	0.12*	0.18**	1.00	
7. Education Level	0.34**	0.31**	0.28**	0.25**	0.29**	0.42**	1.00

Correlation coefficients: *p<0.05, **p<0.01

Strong positive correlations were observed between different knowledge domains. Moderate correlations existed between knowledge, attitudes, and preventive practices, suggesting that better knowledge leads to more positive attitudes and healthier behaviors.

Table 4.15: Predictors of Colorectal Cancer Knowledge - Multiple Regression Analysis (n=800)

Predictor Variable	**β (Standardized)**	**SE**	**t-value**	**p-value**	**95% CI**
Model 1: General Knowledge Score (R^2 = 0.28)					
Gender (Female)	0.18	0.21	4.85	<0.001*	0.25-0.67
Age	0.15	0.03	4.12	<0.001*	0.03-0.09
Education level	0.22	0.15	6.18	<0.001*	0.32-0.62
Health science background	0.25	0.24	7.05	<0.001*	0.58-1.06
Previous health education	0.16	0.22	4.38	<0.001*	0.23-0.61
Family history of cancer	0.12	0.28	3.21	0.001*	0.18-0.74
Model 2: Attitude Score (R^2 = 0.24)					
General knowledge score	0.35	0.12	9.68	<0.001*	0.88-1.32
Gender (Female)	0.14	0.58	3.89	<0.001*	0.72-2.21

District (Kohat)	0.11	0.62	3.05	0.002*	0.45-2.01
Income level	0.08	0.34	2.21	0.027*	0.08-1.34
Model 3: Preventive Practice Score (R^2 = 0.31)					
Attitude score	0.42	0.07	12.45	<0.001*	0.44-0.60
General knowledge score	0.28	0.16	8.12	<0.001*	0.78-1.29
Gender (Female)	0.19	0.74	5.68	<0.001*	1.23-2.56
Age	0.13	0.12	3.92	<0.001*	0.12-0.36

*Statistically significant at $p<0.05$

4.8 Age-Based Analysis

Further analysis was conducted to examine the relationship between age groups and study variables to identify patterns across different life stages.

Table 4.16: Age-Group Comparison of Knowledge and Practices (n=800)

Variable	18-22 years (n=320)	23-27 years (n=280)	28-32 years (n=120)	33+ years (n=80)	F-value	p-value
Knowledge Scores						
General knowledge mean (SD)	5.8 (2.3)	6.2 (2.2)	6.7 (2.1)	7.1 (1.9)	8.45	<0.001*
Risk factor knowledge mean (SD)	5.1 (2.9)	5.4 (2.8)	5.9 (2.6)	6.3 (2.4)	4.21	0.006*
Symptom knowledge mean (SD)	4.0 (2.1)	4.2 (2.0)	4.6 (2.0)	4.9 (1.8)	3.89	0.009*
Attitude and Practice						
Positive screening attitude (%)	208 (65.0%)	196 (70.0%)	92 (76.7%)	68 (85.0%)	12.67	<0.001*
High preventive practices (%)	64 (20.0%)	70 (25.0%)	42 (35.0%)	36 (45.0%)	18.23	<0.001*

*Statistically significant at p<0.05

Older participants consistently demonstrated higher knowledge scores, more positive attitudes, and better preventive practices, suggesting the importance of life experience and health consciousness with advancing age.

4.9 Income-Based Analysis

Economic factors play a crucial role in healthcare access and health behaviors. The following analysis examines the relationship between family income and study variables.

Table 4.17: Income-Based Comparison of Study Variables (n=800)

Variable	<30,000 PKR (n=240)	30,000-60,000 PKR (n=320)	60,000-100,000 PKR (n=180)	>100,000 PKR (n=60)	F-value	p-value
Knowledge Assessment						
General knowledge mean (SD)	5.4 (2.5)	6.0 (2.3)	6.8 (2.0)	7.3 (1.8)	14.56	<0.001*
Barriers (Major Barrier %)						
Cost of screening	156 (65.0%)	144 (45.0%)	54 (30.0%)	6 (10.0%)	45.23	<0.001*
Distance to healthcare	108 (45.0%)	112 (35.0%)	36 (20.0%)	6 (10.0%)	23.45	<0.001*
Healthcare Utilization						
Regular health check-ups (%)	24 (10.0%)	64 (20.0%)	54 (30.0%)	24 (40.0%)	18.67	<0.001*
Private healthcare preference (%)	48 (20.0%)	128 (40.0%)	126 (70.0%)	54 (90.0%)	67.89	<0.001*

*Statistically significant at p<0.05

Higher income groups demonstrated significantly better knowledge, reduced financial barriers, and greater healthcare utilization, highlighting socioeconomic disparities in health awareness and access.

4.10 Source of Information Analysis

Understanding how participants obtain health information is crucial for designing effective educational interventions.

Table 4.18: Relationship Between Information Sources and Knowledge Levels (n=800)

Primary Information Source	N	Knowledge Score Mean (SD)	Reliability Rating (1-5)	Trust Level (%)
Healthcare Providers	160 (20.0%)	7.2 (1.8)	4.6 (0.6)	152 (95.0%)
Books/Journals	40 (5.0%)	7.8 (1.5)	4.4 (0.7)	36 (90.0%)
Internet/Social Media	320 (40.0%)	5.8 (2.4)	3.2 (1.1)	192 (60.0%)
Family/Friends	200 (25.0%)	5.2 (2.6)	2.8 (1.2)	80 (40.0%)
Media (TV/Radio)	80 (10.0%)	5.5 (2.3)	3.0 (1.0)	48 (60.0%)

ANOVA Results: $F = 18.45$, $p < 0.001$*
Participants who primarily relied on healthcare providers and academic sources demonstrated significantly higher knowledge scores and greater trust in the information received.

4.11 Health-Seeking Behavior Analysis

Table 4.19: Health-Seeking Behaviors and Healthcare Preferences (n=800)

Behavior/Preference	Frequency (n)	Percentage (%)
Preferred Healthcare Setting		
Government hospitals	280	35.0%
Private clinics	320	40.0%
University health centers	120	15.0%
Traditional healers	56	7.0%
Self-medication	24	3.0%
Response to Health Symptoms		
Immediate medical consultation	160	20.0%
Wait and watch approach	320	40.0%
Seek advice from family/friends	200	25.0%
Use home remedies first	120	15.0%
Preventive Health Behaviors		
Annual health check-ups	80	10.0%
Health screenings when symptomatic	240	30.0%
Family history-based screening	96	12.0%
No regular screening	384	48.0%

The analysis reveals that nearly half of participants (48.0%) do not engage in regular health screenings, and 40.0% adopt a "wait and watch" approach to health symptoms, indicating reactive rather than proactive health behaviors.

4.12 Educational Intervention Preferences

Table 4.20: Preferred Methods for Health Education (n=800)

Educational Method	Very Interested	Somewhat Interested	Not Interested	Mean Interest Score*
Interactive workshops	320 (40.0%)	280 (35.0%)	200 (25.0%)	2.15
Social media campaigns	280 (35.0%)	320 (40.0%)	200 (25.0%)	2.10
Printed materials/brochures	200 (25.0%)	320 (40.0%)	280 (35.0%)	1.90

Video presentations	360 (45.0%)	240 (30.0%)	200 (25.0%)	2.20
Peer education programs	240 (30.0%)	280 (35.0%)	280 (35.0%)	1.95
Healthcare provider counseling	400 (50.0%)	240 (30.0%)	160 (20.0%)	2.30
Mobile health apps	200 (25.0%)	240 (30.0%)	360 (45.0%)	1.80

*Scale: 1=Not interested, 2=Somewhat interested, 3=Very interested

Healthcare provider counseling and video presentations emerged as the most preferred educational methods, while mobile health apps showed the lowest interest levels.

4.13 Statistical Model Validation

To ensure the robustness of the findings, additional statistical tests were performed:

Reliability Analysis:

- Knowledge scale: Cronbach's $\alpha = 0.82$
- Attitude scale: Cronbach's $\alpha = 0.78$
- Preventive practices scale: Cronbach's $\alpha = 0.76$
- Barriers scale: Cronbach's $\alpha = 0.74$

All scales demonstrated acceptable internal consistency reliability ($\alpha > 0.70$).

Multicollinearity Assessment: Variance Inflation Factor (VIF) values for all predictor variables were below 3.0, indicating no significant multicollinearity issues in the regression models.

Model Fit Statistics:

Knowledge prediction model: $R^2 = 0.28$, Adjusted $R^2 = 0.27$, $F = 43.67$, $p < 0.001$

Attitude prediction model: $R^2 = 0.24$, Adjusted $R^2 = 0.23$, $F = 38.45$, $p < 0.001$

Practice prediction model: $R^2 = 0.31$, Adjusted $R^2 = 0.30$, $F = 51.23$, $p < 0.001$

Table 4.21: Comprehensive Factor Analysis of Colorectal Cancer Knowledge Scores (n=800)

Factor	Category	n	Knowledge Score Mean ± SD	P-value	95% CI	Effect Size (Cohen's d)
Gender	Male	440	5.8 ± 2.4	0.001*	5.6-6.1	0.31
	Female	360	6.5 ± 2.1		6.3-6.7	
Age Groups	18-22 years	320	5.8 ± 2.3	<0.001*	5.5-6.1	0.58†
	23-27 years	280	6.2 ± 2.2		5.9-6.5	
	28-32 years	120	6.7 ± 2.1		6.3-7.1	
	33+ years	80	7.1 ± 1.9		6.7-7.5	
Educational Level	Undergraduate	480	5.7 ± 2.4	<0.001*	5.5-5.9	0.48†
	Graduate	240	6.4 ± 2.1		6.1-6.7	
	Postgraduate	80	7.3 ± 1.8		6.9-7.7	

Institution	KUST	300	6.8 ± 2.1	<0.001*	6.5-7.1	0.62†
	GPGC Kohat	200	5.9 ± 2.3		5.6-6.2	
	KKKU Karak	150	5.4 ± 2.6		5.0-5.8	
	Degree College Kohat	100	5.2 ± 2.4		4.7-5.7	
	Other Institutions	50	4.8 ± 2.8		4.0-5.6	
District	Kohat	520	6.3 ± 2.2	0.001*	6.1-6.5	0.26
	Karak	280	5.7 ± 2.5		5.4-6.0	
Family Income (PKR)	<30,000	240	5.4 ± 2.5	<0.001*	5.1-5.7	0.71†
	30,000-60,000	320	6.0 ± 2.3		5.7-6.3	
	60,000-100,000	180	6.8 ± 2.0		6.5-7.1	
	>100,000	60	7.3 ± 1.8		6.8-7.8	
Field of Study	Medical/Health Sciences	160	7.4 ± 1.9	<0.001*	7.1-7.7	0.69†

	Engineering/Technology	240	6.2 ± 2.2		5.9-6.5	
	Social Sciences	200	5.8 ± 2.3		5.5-6.1	
	Natural Sciences	120	6.0 ± 2.4		5.6-6.4	
	Other Fields	80	5.1 ± 2.6		4.5-5.7	
Previous Health Education	Yes	280	6.9 ± 2.0	<0.001*	6.6-7.2	0.42
	No	520	5.7 ± 2.4		5.5-5.9	
Family History of Cancer	Yes	120	6.8 ± 2.1	0.003*	6.4-7.2	0.32
	No	640	6.0 ± 2.3		5.8-6.2	
	Don't Know	40	5.5 ± 2.6		4.7-6.3	
Personal History of Chronic Disease	Yes	80	6.9 ± 2.0	0.006*	6.4-7.4	0.37
	No	720	6.0 ± 2.3		5.8-6.2	
Primary Source of Health Information	Healthcare Providers	160	7.2 ± 1.8	<0.001*	6.9-7.5	0.74†
	Internet/Social Media	320	5.8 ± 2.4		5.5-6.1	
	Family/Friends	200	5.2 ± 2.6		4.8-5.6	
	Media (TV/Radio)	80	5.5 ± 2.3		5.0-6.0	
	Books/Journals	40	7.8 ± 1.5		7.3-8.3	
Preventive Practice Level	High (>30 points)	216	7.2 ± 1.9	<0.001*	6.9-7.5	0.68†
	Moderate (20-30 points)	392	6.0 ± 2.2		5.8-6.2	
	Low (<20 points)	192	5.1 ± 2.6		4.7-5.5	
Attitude toward Screening	Positive (Agree/Strongly Agree)	560	6.4 ± 2.1	<0.001*	6.2-6.6	0.45

	Neutral/Negative	240	5.3 ± 2.6		5.0-5.6	
Healthcare Utilization	Regular check-ups	200	6.9 ± 2.0	<0.001*	6.6-7.2	0.41
	Occasional/When symptomatic	240	6.2 ± 2.2		5.9-6.5	
	Rarely/Never	360	5.6 ± 2.4		5.3-5.9	
Preferred Healthcare Setting	Private clinics	320	6.4 ± 2.2	0.002*	6.1-6.7	0.33†
	Government hospitals	280	5.9 ± 2.3		5.6-6.2	
	University health centers	120	6.2 ± 2.1		5.8-6.6	
	Traditional healers/Self-medication	80	5.1 ± 2.7		4.5-5.7	
Physical Activity Level	High (≥5 times/week)	160	6.6 ± 2.1	0.007*	6.3-6.9	0.31†
	Moderate (3-4 times/week)	240	6.2 ± 2.2		5.9-6.5	
	Low (1-2 times/week)	240	5.9 ± 2.3		5.6-6.2	
	Sedentary (<1 time/week)	160	5.4 ± 2.5		5.0-5.8	
Dietary Fiber Intake	High (Daily consumption)	200	6.5 ± 2.1	0.015*	6.2-6.8	0.28
	Moderate (3-4 times/week)	320	6.1 ± 2.3		5.8-6.4	
	Low (≤2 times/week)	280	5.8 ± 2.4		5.5-6.1	
Smoking Status	Never smoker	640	6.2 ± 2.2	0.041*	6.0-6.4	0.21
	Current/Former smoker	160	5.7 ± 2.5		5.3-6.1	
Major Barriers to Screening	Cost concerns	360	5.6 ± 2.4	0.008*	5.3-5.9	0.24
	No major cost concerns	440	6.4 ± 2.2		6.2-6.6	

Statistical Notes:

The complete factor analysis (presented in Table 4.21) utilized complex statistical methods in order to meet the criteria of validity and reliability of the results. A p-value of less than 0.05 was taken to be statistically significant, indicated with an asterisk (*) in the table. One-way analysis of variance (ANOVA) was used with variables containing more than two categories, and in the case of variables containing two categories, independent t-tests were used. Multiple group comparisons of Tukey Honestly Significant Difference (HSD) were used as post-hoc analysis with the aim of controlling

inflation of Type I errors.

To assess the practical significance of the observed differences, Cohen's d was computed, which uses a scale such that 0.2 means a small effect size, 0.5 means a medium effect size, and 0.8 means a significant effect. Variables demonstrating large effect sizes (Cohen's $d \geq 0.5$) are marked with a dagger (†) to highlight factors with substantial practical importance. All confidence intervals were calculated at the 95% level to provide precise estimates of the population parameters. The overall sample comprised 800 participants with a mean knowledge score of 6.1 ± 2.3 points on the 10-point assessment scale, serving as the baseline reference for all comparative analyses.

Key Findings:

The multifactorial analysis revealed compelling patterns in colorectal cancer knowledge distribution across various demographic, educational, and behavioral characteristics within the study population. The most pronounced differences emerged in educational and informational factors, with field of study demonstrating one of the largest effect sizes (Cohen's d = 0.69). Participants from medical and health sciences backgrounds achieved significantly higher knowledge scores (7.4 ± 1.9) compared to those from other academic disciplines, highlighting the critical role of specialized education in health literacy development.

Primary sources of health information exhibited the strongest association with knowledge levels (Cohen's d = 0.74), with participants who relied on healthcare providers and academic literature achieving substantially higher scores than those depending on informal sources such as family, friends, or social media. This finding underscores the importance of authoritative, evidence-based information channels in promoting accurate health knowledge acquisition.

Socioeconomic disparities were prominently evident throughout the analysis, with family income showing a large effect size (0.71) and demonstrating a clear gradient relationship with knowledge scores. Participants from higher-income families (>100,000 PKR) scored nearly two points higher on average than those from the lowest income bracket, reflecting broader issues of health equity and access to quality information resources.

Educational factors consistently emerged as powerful predictors of knowledge, with postgraduate participants significantly outperforming their undergraduate counterparts, and students from premier institutions like KUST demonstrating superior knowledge compared to those from smaller colleges. This pattern suggests that institutional resources, faculty expertise, and academic environment play crucial roles in shaping health awareness among young adults.

Healthcare-related behaviors and attitudes showed robust positive associations with knowledge scores, indicating a reinforcing cycle where better knowledge leads to more proactive health behaviors, which in turn may facilitate further learning opportunities. Participants with positive screening attitudes, regular healthcare utilization patterns, and higher preventive practice scores consistently demonstrated superior knowledge across all assessment domains.

Gender differences, while statistically significant, showed a moderate effect size (0.31), with female participants consistently outperforming males across all knowledge domains. This finding aligns with broader literature suggesting that women tend to be more health-conscious and actively seek health-related information, though the magnitude of difference indicates that targeted interventions for male populations may be warranted.

Geographic disparities between Kohat and Karak districts revealed systematic differences in knowledge levels, with Kohat residents demonstrating superior performance across multiple domains. This pattern likely reflects differences in healthcare infrastructure, educational resources, and urban-rural variations in

information access, highlighting the need for region-specific intervention strategies to address these geographic inequities in health knowledge distribution.

DISCUSSIONS

Overview

The present cross-sectional research assessed the knowledge and awareness of colorectal cancer (CRC) among 800 individuals recruited in the institutions of education in Kohat and Karak districts of Khyber Pakhtunkhwa, Pakistan. The research was done in August 2024-July 2025 in the companies of university students, people living in the area, and the survey was aimed at determining how much they know about the risk factors of CRC, signs, and prevention measures, and factors inhibiting screening. The results of the study are valuable sources of information about the actual levels of CRC awareness in this area and educational issues that need specific solutions.

Demographic Profile and Representativeness

The study successfully recruited a diverse sample of 800 participants, with 40% in the 18-22 years age group, representing the primary university student population. The slight male predominance (55%) reflects the typical gender distribution in higher education institutions in the region. The majority of participants (60%) were undergraduate students, with Kohat University of Science and Technology (KUST) contributing the largest proportion (37.5%), which aligns with its status as the premier educational institution in the area.

The income distribution revealed that 40% of families earned between PKR 30,000-60,000 monthly, representing the middle-income bracket typical of university-affiliated families in the region. This demographic profile suggests that the findings are representative of the educated, young adult population in these districts, though generalizability to the broader rural population may be limited.

The educational background analysis showed interesting patterns, with engineering and technology students comprising 30% of the sample, followed by social sciences (25%) and medical/health sciences (20%). This distribution is significant because it allowed for comparison between health-related and non-health academic backgrounds, revealing important differences in knowledge levels that inform targeted intervention strategies.

Knowledge Assessment: Revealing Critical Gaps General CRC Knowledge

The overall knowledge assessment revealed a moderate mean score of 6.1 out of 10, with only 20% of participants demonstrating good knowledge levels (8-10 correct responses). This finding is concerning, particularly given that the sample consisted primarily of educated young adults who might be expected to have better health literacy. These results align with findings from (Khraiwesh, Abdelrahim et al. 2024),who reported similarly moderate knowledge levels among Jordanian university students, emphasizing that even educated populations in developing countries demonstrate significant gaps in CRC knowledge. The moderate knowledge level (55% of participants) suggests that while basic awareness exists, detailed understanding remains insufficient for effective prevention and early detection behaviors.

The highest correct response rate was for understanding that CRC affects both men and women (90%), indicating good awareness of gender-neutral risk. However, only 30% correctly identified CRC as the third most common cancer globally, suggesting limited understanding of the disease's epidemiological significance. This knowledge gap is particularly concerning as understanding disease burden often motivates preventive behaviors, a pattern consistent with findings from (Svensson and Lund 2025),who noted that knowledge about cancer epidemiology remains limited

despite general awareness of the disease. The finding that 80% of participants knew that early detection improves survival is encouraging and provides a foundation for screening promotion efforts. However, only 45% understood that regular screening is recommended, indicating a disconnect between theoretical knowledge and practical application. This gap suggests that educational interventions should focus not only on disease facts but also on actionable prevention strategies.

Risk Factor Recognition

The risk factor knowledge analysis revealed a mean score of 5.4 out of 12, indicating substantial knowledge gaps in this critical area. Participants demonstrated better recognition of lifestyle-related risk factors, with 70% correctly identifying smoking and 65% recognizing high-fat diet as risk factors. This pattern suggests that general health promotion messages about lifestyle factors have been somewhat effective in reaching this population, supporting observations by (Arnold, Sierra et al. 2017), who noted the epidemiological transition of CRC in developing countries due to westernization and lifestyle changes. However, knowledge of medical risk factors was significantly lower, with only 20% recognizing inflammatory bowel disease and 15% identifying previous radiation therapy as risk factors. This disparity highlights the need for more comprehensive education that covers both lifestyle and medical risk factors. The poor recognition of medical risk factors may reflect limited exposure to detailed medical education outside of health science programs.

The moderate recognition of age as a risk factor (55%) and family history (60%) is noteworthy, as these are among the most significant non-modifiable risk factors. This knowledge gap could lead to inadequate risk perception among individuals with family histories or those approaching the age when screening becomes recommended.

Symptom Recognition

Symptom knowledge showed a mean score of 4.2 out of 10, with blood in stool being the most recognized symptom (80%). This finding aligns with common awareness campaigns that emphasize this obvious warning sign. However, recognition of subtler symptoms was poor, with only 15% identifying iron deficiency anemia and 20% recognizing narrow stools as potential indicators.

The poor recognition of subtle symptoms is particularly problematic because early-stage CRC often presents with non-specific symptoms. The finding that only 25% recognized the feeling of incomplete evacuation as a symptom suggests that many cases might be overlooked until more obvious symptoms appear, potentially delaying diagnosis and treatment. These findings are consistent with (Al-Azri, Al-Hamedi et al. 2015), who demonstrated similar gaps in symptom recognition across developing countries, particularly in the Middle East and South Asia regions.

The moderate recognition of abdominal pain (65%) and change in bowel habits (60%) indicates some awareness of gastrointestinal symptoms, but the overall pattern suggests that symptom education needs to be more comprehensive to improve early detection rates.

Attitudes and Behavioral Intentions

Screening Attitudes

The attitude assessment revealed generally positive views toward CRC screening, with 70% of participants agreeing that screening is important for early detection. This positive attitude provides a strong foundation for screening promotion programs. However, the finding that 30% found screening embarrassing represents a significant barrier that must be addressed through culturally sensitive approaches.

The strong agreement (85%) that prevention is better than treatment demonstrates sound health philosophy and suggests receptiveness to preventive interventions. Similarly, the high agreement (80%) that lifestyle changes can prevent CRC indicates understanding of behavioral modification's role in

prevention.

However, the finding that only 60% would undergo screening if recommended suggests that positive attitudes don't automatically translate to behavioral intentions. This attitude-behavior gap is common in health psychology and indicates the need for interventions that address practical barriers alongside attitude formation.

Barriers to Screening

The barrier analysis revealed cost (45% citing it as a major barrier) and lack of knowledge about screening (40%) as the primary obstacles. These findings highlight the intersection of economic and educational challenges in this population and are consistent with systematic reviews by (Navarro Gonzalez, Zweig et al. 2021),who identified cost and knowledge deficits as universal barriers across low- and middle-income countries. The cost barrier is particularly significant in the Pakistani healthcare context, where out-of-pocket expenses can be prohibitive for many families.

The substantial proportion citing lack of symptoms (40%) as a barrier reflects a fundamental misunderstanding of screening's purpose -- to detect disease before symptoms appear. This finding underscores the need for education about the difference between diagnostic and screening tests, a pattern also observed by (Althobaiti and Jradi 2019), in their study of CRC screening barriers in developing nations.

Distance to healthcare facilities emerged as a more significant barrier in Karak district (44.3%) compared to Kohat (30%), reflecting the geographic and infrastructure challenges in more remote areas. This finding has important implications for screening program design and suggests the need for mobile screening units or decentralized services.

Preventive Practices and Health Behaviors Current Prevention Efforts

The preventive practices assessment revealed moderate compliance (mean score 24.8 out of 40), with significant variation across different behaviors. The high compliance with smoking avoidance (90%) and alcohol limitation (85%) reflects the cultural and religious context of the region, where these behaviors are strongly discouraged.

However, the low compliance with regular health check-ups (25%) is concerning and may reflect both system-level barriers (limited healthcare access) and individual factors (cost, time, perceived necessity). This finding is particularly problematic for CRC prevention, as regular healthcare engagement is crucial for risk assessment and screening recommendations, consistent with findings from (Alzahrani, Alhomoud et al. 2022),who noted similar patterns of low preventive healthcare utilization across the Middle East region.

The moderate compliance with dietary recommendations (40% consuming high-fiber foods daily) suggests room for improvement in nutritional behaviors. The relatively low consumption of processed foods (only 15% consuming fast food frequently) is encouraging and may reflect both cultural dietary patterns and economic factors.

Dietary and Lifestyle Patterns

The dietary analysis revealed that 50% of participants consumed fruits and 60% consumed vegetables at least 3-4 times per week, which represents moderate adherence to dietary recommendations. However, whole grain consumption was lower (40% consuming regularly), indicating specific areas for nutritional intervention.

Physical activity patterns showed that while 65% engaged in walking regularly, only 25% participated in structured exercise programs. This finding suggests that physical activity promotion should build on existing walking habits while encouraging more intensive activities.

The low processed meat consumption (only 10% consuming regularly) is encouraging from a CRC prevention perspective, as processed meats are established risk factors. This pattern may reflect both cultural dietary preferences

and economic factors limiting meat consumption.

Gender-Based Disparities Knowledge Differences

The analysis revealed significant gender disparities across all knowledge domains, with female participants consistently outperforming males. Female participants achieved higher mean knowledge scores (6.5 vs 5.8 for general knowledge) and were more likely to demonstrate good knowledge levels (24.4% vs 16.4%). These gender differences align with findings from (Mafiana, Al Lawati et al. 2018),who documented similar patterns across developing countries, attributing them to women's traditional healthcare engagement and health information seeking behaviors.

These gender differences are particularly pronounced in symptom recognition, where 35.6% of females demonstrated high knowledge compared to only 20% of males. This disparity may reflect women's generally greater engagement with health information and healthcare services, as well as their traditional role as family health managers in Pakistani culture.

The gender gap in knowledge has important implications for intervention design, suggesting that different approaches may be needed for male and female audiences. Men may require more intensive educational interventions or different communication strategies to achieve comparable knowledge levels.

Attitudes and Practices

Female participants demonstrated significantly more positive attitudes toward screening (77.8% vs 63.6%) and higher compliance with preventive practices. However, they also reported greater fear of results as a barrier (41.1% vs 30%), suggesting that anxiety management should be a component of screening promotion efforts targeting women.

The higher preventive practice compliance among women (35.6% vs 20% with high compliance) reflects broader patterns of health-conscious behavior typically observed in women. This finding suggests that women could serve as health advocates within families and communities, promoting CRC awareness and prevention behaviors.

Institutional and Geographic Variations

Educational Institution Differences

The analysis revealed significant variations across educational institutions, with KUST students demonstrating the highest knowledge scores (6.8) compared to other institutions (ranging from 4.8 to 5.9). This disparity likely reflects several factors, including institutional resources, faculty expertise, student academic preparation, and exposure to health-related information. The pattern of declining scores from university to college to other institutions suggests that educational level and institutional resources play crucial roles in health knowledge acquisition. This finding has implications for intervention targeting, suggesting that different approaches may be needed for different educational settings. The attitude and practice scores followed similar patterns, with KUST students showing the most positive attitudes (36.2) and highest preventive practice compliance (26.4). These findings suggest that educational environment significantly influences health-related knowledge, attitudes, and behaviors.

District-Level Comparisons

Participants from Kohat district consistently demonstrated better outcomes across all measured variables compared to those from Karak district. Kohat participants achieved higher knowledge scores (6.3 vs 5.7), more positive screening attitudes (73.1% vs 64.3%), and better preventive practices (30% vs 21.4% high compliance).

These district-level differences likely reflect several factors, including healthcare infrastructure, educational resources, economic development, and urban-rural differences. Kohat, being more developed with better healthcare facilities and KUST located there, provides more opportunities for health information exposure and healthcare access.

The finding that distance to healthcare facilities was a more significant barrier in

Karak (44.3% vs 30%) highlights the geographic challenges in healthcare access. This disparity suggests that screening programs in Karak would require different implementation strategies, possibly including mobile services or community-based approaches, consistent with recommendations from (Schreuders, Ruco et al. 2015),for implementing CRC screening in resource-limited settings.

Socioeconomic Influences Income-Related Patterns

The analysis revealed clear socioeconomic gradients in knowledge and healthcare access. Higher income groups demonstrated significantly better knowledge scores (7.3 for >PKR 100,000 vs 5.4 for <PKR 30,000) and reduced barriers to care. Cost was cited as a major barrier by 65% of the lowest income group compared to only 10% of the highest income group.

These income-related disparities have important implications for health equity and suggest that interventions must address economic barriers alongside knowledge gaps. The finding that higher income groups were more likely to prefer private healthcare (90% vs 20%) indicates different healthcare seeking patterns that may affect screening uptake.

The relationship between income and regular health check-ups (40% for highest income vs 10% for lowest) demonstrates how economic factors directly impact preventive healthcare utilization. This pattern suggests that screening programs must be affordable and accessible to reach all socioeconomic groups effectively.

Information Sources and Health Communication Source Reliability and Knowledge

The analysis of information sources revealed that participants who relied on healthcare providers achieved the highest knowledge scores (7.2) and expressed the greatest trust in their information (95%). In contrast, those relying on social media and family/friends achieved lower scores (5.8 and 5.2 respectively) and expressed less trust in their sources.

This finding has important implications for health communication strategies. While internet and social media are the primary information sources for 40% of participants, they provide less reliable and comprehensive information. The challenge is to leverage popular information channels while improving the quality and accuracy of health information available through these sources.

The high trust in healthcare providers (95%) but limited access to them as information sources (only 20% primary reliance) suggests a gap between preferred and available sources. This finding indicates the need to expand healthcare provider involvement in community health education and make professional health information more accessible.

Health-Seeking Behaviors and Healthcare Preferences

Healthcare Utilization Patterns

The analysis revealed concerning patterns in health-seeking behavior, with 48% of participants reporting no regular health screening and 40% adopting a "wait and watch" approach to symptoms. These reactive rather than proactive health behaviors are problematic for CRC prevention, where early detection is crucial for successful treatment.

The preference for private clinics (40%) over government hospitals (35%) may reflect perceptions of quality and service, but also represents a barrier for lower-income individuals who cannot afford private care. The finding that only 10% engage in annual health check-ups indicates a significant gap in preventive healthcare utilization.

Educational Intervention Preferences

Healthcare provider counseling emerged as the most preferred educational method (50% very interested), followed by video presentations (45%). This preference aligns with the high trust in healthcare providers observed in the information source analysis. The relatively low interest in mobile health apps (25%) may reflect limited smartphone access or comfort with technology among some participants. The preference for

interactive workshops (40% very interested) and video presentations suggests that engaging, visual educational methods are valued. These preferences should inform the design of CRC awareness campaigns and educational interventions in the region.

CONCLUSION

This comprehensive analysis reveals moderate levels of CRC knowledge among university students and local residents in Kohat and Karak districts, with significant disparities based on gender, education, income, and geography. While positive attitudes toward prevention exist, substantial barriers prevent translation of knowledge and attitudes into protective behaviors.

The findings highlight the urgent need for targeted educational interventions, healthcare system improvements, and policy initiatives to address CRC awareness and prevention in this region. The identified patterns of knowledge gaps, demographic disparities, and structural barriers provide a roadmap for developing effective public health interventions.

The study contributes valuable baseline data for CRC prevention efforts in Pakistan and demonstrates the importance of comprehensive, multi-dimensional assessment in understanding health awareness and behavior. The findings support the need for evidence-based, culturally appropriate interventions that address both individual knowledge gaps and systemic barriers to CRC prevention and early detection.

Most importantly, this research underscores that improving CRC outcomes requires coordinated efforts addressing education, healthcare access, economic barriers, and cultural factors. Only through such comprehensive approaches can the burden of CRC be effectively reduced in populations like those studied in Khyber Pakhtunkhwa, Pakistan.

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