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# Colorectal cancer knowledge and screening awareness in Syria: a cross-sectional study

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## Abstract

**Background** Colorectal cancer (CRC) is the third most common cancer globally, with rising incidence in developing countries due to lifestyle and dietary shifts. CRC often presents with late-stage symptoms, leading to higher mortality. Early detection through screening can significantly improve survival rates. In Syria, CRC is the second most common cancer, but screening rates remain low, especially following the decade-long war. This study aims to assess the knowledge of CRC and evaluate the awareness of CRC screening among Syrians to guide prevention and detection strategies.

**Methods** A cross-sectional online survey was conducted from September 27 to October 21, 2023, across six governorates: Damascus, Homs, Aleppo, Latakia, Hama, and Tartus, using a self-administered questionnaire distributed via social media. Statistical analysis was performed using SPSS v28.0, with a Chi-square test to explore differences in knowledge based on socio-demographical factors. Multicollinearity was assessed using the Variance Inflation Factor (VIF), and multinomial regression was performed to confirm relationships established by the Chi-square analysis.

**Results** The study included 772 participants, 42.6% of whom were aged 30–35 years. The majority were female (64.4%) and married (56.3%). Only 27.8% considered themselves informed about CRC. While 54.8% had heard of colonoscopy, only 15.4% had undergone the procedure. Significant knowledge gaps were identified, particularly regarding the link between adenocarcinoma polyps and CRC (29.9%), the role of diet (33.2%), and the protective effect of aspirin (17.7%). Individuals aged 50 and above demonstrated higher awareness levels, particularly in recognizing CRC's hereditary nature ( $p$ -value = 0.033) and the potential for cure ( $p$ -value = 0.012). Education and economic status were also strongly associated with better CRC knowledge, and males generally exhibited higher awareness than females.

**Conclusion** This study highlights significant gaps in CRC knowledge and screening awareness among Syrians, emphasizing the need to integrate education and complimentary screening into national health policies. Targeted campaigns, nonprofit collaboration, and media engagement are essential to bridge these gaps. Future research should address limitations like sampling bias and the cross-sectional design through longitudinal and comparative studies to guide tailored interventions.

**Keywords** Colorectal cancer, Colon cancer, Colonoscopy, Awareness, Knowledge, Screening, Syria

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## Background

Colorectal cancer (CRC) is the third most prevalent cancer globally, with incidence rates particularly high in developed countries. However, these rates are rising in developing nations as their lifestyle and diets increasingly mirror those of wealthier countries [1].

Lifestyle factors such as the consumption of processed meat, dietary fiber intake, body mass index (BMI), physical activity levels, and smoking significantly influence the risk of developing CRC. Population-attributable risk estimates suggest that approximately 60% of CRC cases in males and 50% in females could be prevented through healthy diet and lifestyle choices [2].

CRC typically presents with symptoms such as abdominal discomfort, changes in bowel habits, bloody stools, fatigue, and weight loss. However, these symptoms often manifest only in the advanced stages of the disease, where mortality rates are significantly higher [3].

Early detection through screening is crucial, as it identifies CRC and precancerous polyps in asymptomatic stages, thereby improving survival rates. The American Cancer Society recommends that average-risk adults begin CRC screening at age 45 and continue through age 75, with the frequency of screening depending on the method used. After age 75, the decision to continue screening should be individualized. Special guidelines apply to individuals at increased risk, such as those with a personal or family history of CRC, genetic conditions like Lynch syndrome and familial adenomatous polyposis, and those with inflammatory bowel disease [4].

In Syria, the National Cancer Registry indicated that CRC was the second most common cancer in both males and females in 2009, ranked after lung cancer in males and breast cancer in females [5]. Statistics after the decade-long Syrian war are limited, but there is evidence that cancer cases, including CRC, are on the rise, and screening rates remain negligible in the absence of an official national CRC screening policy [6–8]. This underscores the urgent need to raise public awareness about CRC, its risk factors, and the importance of early detection through screening. Increased awareness could lead to more proactive health behaviors, such as seeking screening and adopting healthier lifestyles, ultimately reducing CRC incidence and mortality.

While many studies have assessed CRC knowledge and screening behaviors in neighboring countries, our study is the first one that comprehensively goes through these topics in Syria to bridge the gap in the literature and address the absence of data on CRC awareness and screening in Syria, providing insights into the population's knowledge, attitudes, and barriers to screening. These findings offer a foundation for designing culturally and contextually relevant public health interventions to improve CRC outcomes in the nation.

## Methods

### Study design, setting, and participants

A cross-sectional online survey was conducted using the self-selection method across six Syrian governorates: Damascus, Homs, Aleppo, Latakia, Hama, and Tartus. The survey took place from September 27, 2023, to October 21, 2023, using a self-administered questionnaire distributed as a Google Form on social media platforms. The sample size was calculated using Co-pilot, a well-established statistical method powered by AI tools [9] due to the unknown population size. The sample size (N) was estimated using the formula:

$$N = \frac{Z^2 \times P \times (1 - P)}{e^2}$$

Where Z represents the z-score, set at 1.96 for a 95% confidence level, P represents the population proportion, set at 0.5 for this study, and e is the margin of error, set at 0.05 or 5%. The calculated sample size was  $N = 384$ .

Data were collected from five regions in Syria to ensure the diversity and representativeness of the sample within the Syrian population. The inclusion criteria were Syrian participants aged 30 and above who agreed to complete the questionnaire. Participants under 30 were excluded, as CRC primarily affects older individuals, ensuring the findings are relevant to those at higher risk and most likely to benefit from preventive behaviors and screening.

### Study tool

A survey using a self-administered Arabic questionnaire was employed, adapted from a previously published study to fit the cultural context of the Syrian society [10]. The questionnaire was translated into Arabic by a specialized medical translator to ensure accuracy and comprehensibility for all respondents. The translated version was then reviewed by a panel of healthcare professionals, including oncology and public health experts, to ensure cultural appropriateness and alignment with local terminologies. The internal consistency of the instrument was good (Cronbach's alpha = 0.86). Additionally, face validity was assessed by sharing the questionnaire with a small group of non-participating individuals representative of the target population, who provided feedback on clarity and comprehension. The study utilized social media platforms, including Facebook and WhatsApp, to distribute the survey link to eligible participants. These platforms were chosen due to their widespread use in Syria and ability to reach diverse demographic groups. Recruitment posts were shared in public groups and forums related to health, education, and community interests, targeting individuals aged 30 and older. To ensure eligibility, the survey included an initial screening question about the participant's age, and those below 30 years were

automatically excluded. Participants were encouraged to share the survey link within their networks, employing a snowball sampling approach to maximize reach. The questionnaire consisted of six socio-demographical questions (sex, age, social status, working status, educational level, and economic level), as well as questions assessing knowledge of symptoms and management of colorectal cancer, knowledge about colonoscopy, and participants' opinions on the study. It also included questions on intestinal stoma, diet, and the effect of low-dose acetylsalicylic acid on colorectal cancer.

### Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) v28.0. Categorical variables were presented as frequencies and percentages. To determine differences between knowledge questions and socio-demographical variables, a Chi-square test of independence was performed. We assessed multicollinearity among the independent variables (age, economic status, gender, and education level), treated as categorical, using Variance Inflation Factor (VIF) values. All VIFs ranged from 1 to 1.5, indicating no multicollinearity concerns. Additionally, multinomial regression was conducted to determine the adjusted odds ratio (OR) for age as a predictor of CRC knowledge, further confirming the relationship previously identified through Chi-square analysis.

### Ethical considerations

The study protocol was approved by the Research Ethics Committee of Damascus University, Faculty of Medicine (MD-020624-247). The research adhered to the ethical principles of the Declaration of Helsinki, ensuring respect for participants' autonomy, confidentiality, and

well-being. Informed consent was obtained electronically via the survey's introduction page, which outlined the study's purpose, voluntary nature, and confidentiality measures. Participants confirmed their consent by selecting an agreement checkbox before accessing the survey questions. Data collection was anonymized; participants were not required to provide identifying information, and responses were linked to unique codes instead of personal identifiers. The data were securely stored on a password-protected server accessible only to the research team, and no individual-level data were disclosed in the results.

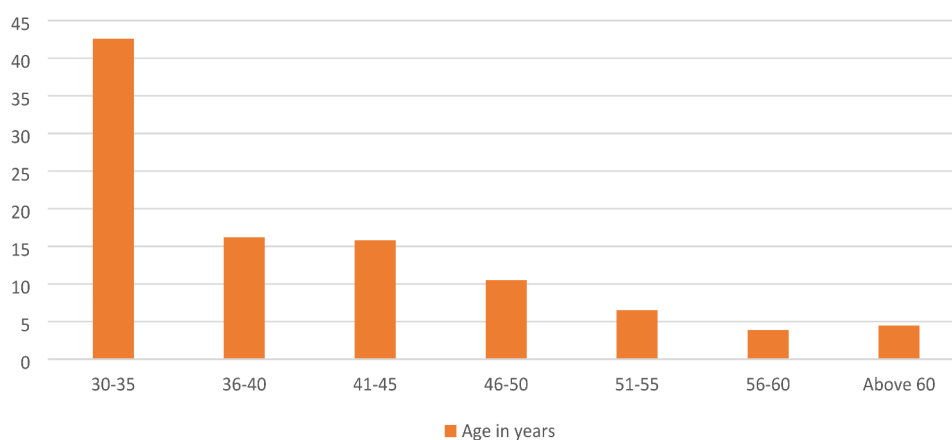
### Results

The study included 772 participants. Online distribution through social media platforms prevents determining the exact response rate due to the lack of tracking for the number of individuals reached or invited.

The majority of respondents were female (64.4%) and aged between 30 and 35 years (42.6%) (Fig. 1). Most respondents were married (56.3%) and employed (62.3%), reflecting a population engaged in work and family life. The socioeconomic status varied, with 46.9% reporting a median economic status and 48.6% holding a bachelor's degree as the highest level of education (Table 1).

Regarding colorectal cancer (CRC) knowledge, 27.8% of participants considered themselves informed. However, only 29.9% correctly identified a link between adenocarcinoma polyps and CRC, and 35.9% believed that CRC could be an inherited disease. A significant portion of respondents lacked clarity on key aspects of CRC; for instance, 25.5% thought that CRC could not be completely cured, while 38% were uncertain about the effectiveness of surgical treatments. In addition, awareness of diet as a risk factor for CRC was limited, with only 33.2%

Age Percentage Distribution of the Study Sample



**Fig. 1** Age percentage distribution of the study sample. This figure shows the proportion of participants in each age group

**Table 1** General characteristics of the sample

Characteristics		Count (n) [N = 772]	Percentage (%)
Gender	Male	275	35.6
	Female	497	64.4
Age Groups (years)	30–35	329	42.6
	36–40	125	16.2
	41–45	122	15.8
	46–50	81	10.5
	51–55	50	6.5
	56–60	30	3.9
	Above 60	35	4.5
Economic Status	Bad	107	13.9
	Median	362	46.9
	Good	259	33.5
	Excellent	44	5.7
Educational Level	Incomplete Elementary Education	12	1.6
	Elementary school	39	5.1
	Middle school	56	7.3
	High school	96	12.4
	Technical institute	105	13.6
	Bachelor	375	48.6
	Master	66	8.5
	Doctorate	23	3.0
Work Status	Employed	481	62.3
	Unemployed	291	37.7
Marital Status	Single	229	29.7
	In a relationship	17	2.2
	Engaged	40	5.2
	Married	435	56.3
	Divorced	25	3.2
	Widower	26	3.3

recognizing the role of diet in increasing CRC risk. Furthermore, only 17.7% were aware of the potential protective role of aspirin in reducing CRC risk (Table 2).

Colonoscopy was known to 54.8% of the respondents. However, only 15.4% of participants had undergone a colonoscopy, with most of these procedures being performed without anesthesia (Table 3). Despite low utilization, 86.4% of participants would undergo the procedure if recommended by a healthcare provider. Additionally, 62.5% believed that colonoscopy helps detect and treat CRC, yet 55.3% perceived the procedure as painful, 38.6% found it embarrassing, and 16.4% considered it an unsafe examination. Moreover, 34.1% were unaware of the need for preparation prior to the procedure (Table 3).

Statistical analysis (Table 4) revealed significant associations between CRC knowledge and demographic factors. Statistically significant gender differences were observed, with males generally demonstrating higher awareness levels. The data showed that 34% of males accurately recognized the link between polyps and CRC, compared to 27% of females. Additionally, 42% of females were uncertain about whether CRC is curable,

in contrast to 36% of males. Furthermore, 38% of males acknowledged the role of diet in CRC, compared to 30% of females.

Education level was a strong predictor of CRC knowledge; respondents with a bachelor's degree or higher were more likely to be informed about the disease, recognize its malignant nature, and understand the role of surgical treatment. They were also more aware of the usefulness of fecal occult blood tests in detecting CRC and the potential role of aspirin in preventing CRC. Economic status also played a role, with participants in higher economic strata exhibiting greater awareness of most aspects of the disease (Table 4).

The data also confirmed that CRC knowledge levels significantly varied among different age groups (Table 4). Higher awareness levels were observed in older individuals in the population. For instance, 37% of people aged 30–35 did not believe that CRC could be hereditary (OR = 5.43, 95% CI: 1.17–25.13,  $p = 0.033$ ), compared to 24% of those aged 50–55 (OR = 2.15, 95% CI: 0.19–23.27,  $p = 0.033$ ) and 29% of those over 60 (OR = 6.78, 95% CI: 0.48–95.39,  $p = 0.033$ ) (Fig. 2). Similarly, 29% of

**Table 2** Survey results

Question	NOT AT ALL	RATHER NOT	NEITHER POSITIVE NOR NEGATIVE	RATHER YES	DEFINITELY YES
Do you consider yourself an <b>informed person</b> , with awareness of colorectal cancer?	97(12.5%)	168(21.8%)	293(38.0%)	188(24.4%)	26(3.4%)
According to your knowledge, is there a proven link between the presence of adenocarcinoma <b>polyps</b> in the large intestine and the possibility of colorectal cancer development?	68(8.8%)	128(16.6%)	348(45.1%)	188(24.4%)	40(5.5%)
Do you think that colorectal cancer is an <b>inherited disease</b> ?	70(9.1%)	193(25.0%)	232(30.1%)	227(29.4%)	50(6.5%)
Does colorectal <b>cancer in your immediate family</b> put you at an increased risk for developing colorectal cancer?	95(12.3%)	184(23.8%)	266(34.5%)	188(23.6%)	45(5.8%)
Do you think <b>colorectal cancer is a malignant</b> neoplastic disease?	182(23.6%)	247(32.0%)	218(28.2%)	96(12.4%)	29(3.8%)
Do you agree with the statement that colorectal cancer is a disease with <b>no possibility to be completely cured</b> ?	149(19.3%)	236(30.6%)	240(31.1%)	107(13.9%)	40(5.2%)
Can colorectal cancer be <b>treated surgically</b> ?	45(5.8%)	111(14.4%)	293(38.0%)	261(33.8%)	62(8.0%)
Can colorectal cancer be <b>completely cured</b> ?	62(8.0%)	135(17.5%)	308(39.9%)	206(26.7%)	61(7.9%)
Do you agree with the statement that colorectal cancer can be completely cured in any case <b>in all cases</b> ?	105(13.6%)	221(28.6%)	281(36.4%)	122(15.8%)	43(5.6%)
Is a <b>fecal occult blood test</b> helpful in detecting colorectal cancer?	69(8.9%)	132(17.1%)	300(38.9%)	216(28.0%)	55(7.1%)
Do you think <b>inflammatory bowel diseases</b> can be linked to the development of colorectal cancer?	69(8.9%)	154(19.9%)	283(36.7%)	223(28.9%)	43(5.6%)
In case of having colorectal cancer, would you <b>agree to undergo a colostomy</b> to have a permanent intestinal stoma if that would be required?	85(11.0%)	148(19.2%)	247(32.0%)	248(32.1%)	44(5.7%)
Do you think that the type of <b>diet can affect</b> the development of colorectal cancer?	67(8.7%)	123(15.9%)	328(42.5%)	206(26.7%)	48(6.2%)
Do you think that taking <b>regular small doses of aspirin</b> may protect against colorectal cancer?	100(13.0%)	155(22.1%)	381(49.4%)	97(12.6%)	39(5.1%)
	Yes	No			
Have you ever <b>had any tests</b> for colorectal cancer?	80(10.4%)	692(89.6%)			
Have you ever <b>looked for information</b> about colorectal cancer?	252(32.6%)	520(67.4%)			
Do you know what a <b>screening</b> is?	197(25.5%)	575(74.5%)			
Do you know what an <b>intestinal stoma</b> (fecal fistula) is?	322(41.7%)	450(58.3%)			
Do you pay attention to the <b>appearance of the stool</b> , bearing in mind that a change in the appearance of stool or finding e.g. blood in it may be one of colorectal symptoms?	491(63.6%)	281(36.4%)			

individuals aged 30–35 doubted that CRC could be cured (OR = 1.68, 95% CI: 0.38–7.36,  $p = 0.012$ ), a significantly higher percentage than older individuals in the study (Fig. 3).

## Discussion & conclusion

This study reveals significant gaps in Colorectal Cancer (CRC) knowledge and screening awareness in Syria, influenced by various sociodemographic factors.

A concerning finding is that only 27.8% of respondents considered themselves informed about CRC, with 12.5% feeling “not at all” informed and 21.8% “rather not” informed. That highlights a substantial knowledge deficit regarding CRC. A significant portion of the population was unsure about the links between CRC and adenocarcinoma polyps (45.1%), inflammatory bowel diseases (36.7%), and diet (42.5%). Additionally, 35% of respondents were unaware of the hereditary risk of CRC. This lack of awareness can be due to insufficient public health education. Similar findings have been reported in neighboring developing countries such as Lebanon, Egypt,

Jordan, and Iraq, where public health education is similarly limited [11–14].

Our study also demonstrated limited knowledge about CRC detection and treatment methods. A high percentage (84%) of respondents aged 45 and older had never undergone tests for CRC, a figure comparable to Lebanon [11] but slightly lower than in Saudi Arabia and Iraq [14, 15]. The primary barrier appears to be the lack of knowledge about CRC screening [16]. Additionally, misconceptions, such as the belief that screening is unnecessary in the absence of a family history of CRC, were commonly reported in Lebanon. In that study, over half of the participants unwilling to get screened cited this misconception as a primary reason for their reluctance [11].

Other contributing factors include misunderstandings about screening methods, financial restraints, living in distant villages with restricted access to healthcare, fear of cancer, and self-neglect. A notable barrier observed in Lebanon, which could also explain the findings in Syria, is the low priority given to CRC screening due to a lack of perceived risk [11]. Cultural attitudes, such as fatalistic

**Table 3** Survey results

	Yes	No			
Do you <b>know</b> what <b>colonoscopy</b> is?	424(54.8%)	348(45.1%)			
	Yes, under general anesthesia	Yes, without anesthesia	No		
Have you ever <b>had</b> a <b>colonoscopy</b> ? (all age groups)	44(5.7%)	75(9.7%)	653(84.6%)		
30–35	12	25	292		
36–40	10	18	97		
41–45	7	16	99		
46–50	8	9	64		
51–55	2	1	47		
56–60	1	3	26		
60<	4	3	28		
	Yes (under anesthesia)	Yes (does not matter whether the test would be performed under anesthesia or without it)	Yes (without anesthesia)	No	
<b>Would you undergo colonoscopy</b> if your doctor told you it is necessary to have this examination?	394(51.0%)	188(24.4%)	85(11.0%)	105(13.6%)	
Would you undergo a <b>second colonoscopy</b> if your doctor told you to repeat this examination?	337(43.7%)	183(23.7%)	88(11.4%)	164(21.1%)	
	NOT AT ALL	RATHER NOT	NEITHER POSITIVE NOR NEGATIVE	RATHER YES	DEFINITELY YES
Do you think that colonoscopy is <b>helpful in detecting and treating</b> colorectal cancer?	32(4.2%)	48(6.2%)	210(27.2%)	395(51.2%)	87(11.3%)
Do you think that colonoscopy is an examination that can <b>protect against</b> colorectal cancer?	34(4.4%)	103(13.3%)	272(35.2%)	303(39.2%)	60(7.8%)
Do you think colonoscopy is a <b>painful</b> examination?	35(4.5%)	84(10.9%)	226(29.3%)	356(46.1%)	71(9.2%)
Do you think colonoscopy is a <b>shameful, embarrassing</b> examination?	110(14.2%)	183(23.7%)	181(23.4%)	239(31.0%)	59(7.6%)
Do you think that colonoscopy <b>requires anesthesia</b> for the patient?	48(6.2%)	66(8.5%)	256(33.2%)	327(42.4%)	75(9.7%)
Do you think that a colonoscopy is a <b>safe examination</b> ?	43(5.6%)	83(10.8%)	264(34.2%)	311(40.3%)	71(9.2%)
	Yes (diet and laxative)	I do not know	No		
Do you think the patient has to <b>prepare</b> for colonoscopy in a special way?	465(60.2%)	44(5.7%)	263(34.1%)		

beliefs about illness (“there is no escape from God’s will”), further restrict proactive health measures like screening. These shared cultural and systemic barriers could help explain the results of our study, given the great cultural and societal similarities between the two countries [11].

Obstacles in the Syrian healthcare system, including inadequate primary care services and fragmented referral systems, could also hinder early detection and timely treatment of CRC. Additionally, the absence of a comprehensive health insurance system creates significant financial barriers, leaving individuals to bear the full cost of CRC screening and treatment. This financial strain discourages many from seeking preventive care or addressing symptoms early, leading to delayed diagnoses

and poorer health outcomes, particularly among lower-income populations.

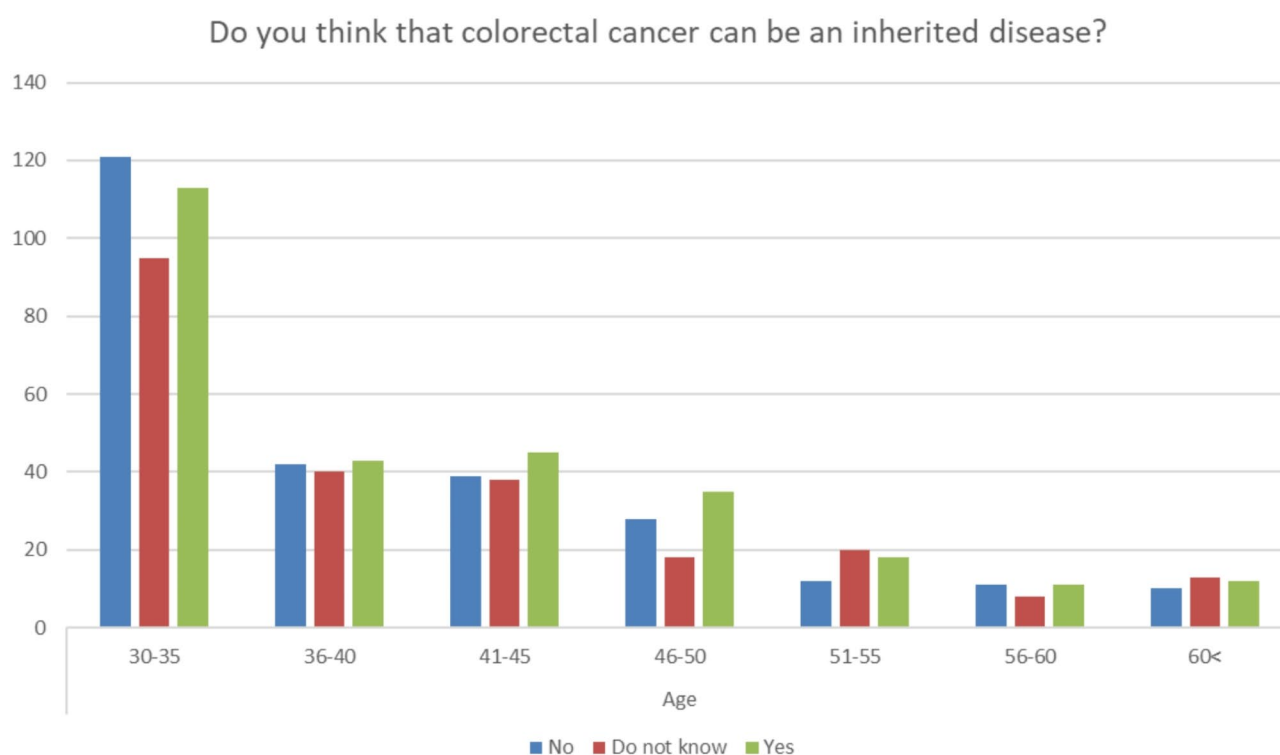
Only 54.8% of respondents knew what a colonoscopy was, and even fewer had undergone the procedure (15.4%). Moreover, a significant number of respondents were not aware of the usefulness of fecal occult blood tests (38.9% were neutral or uninformed). That indicates an urgent need for improved health education and better access to screening services.

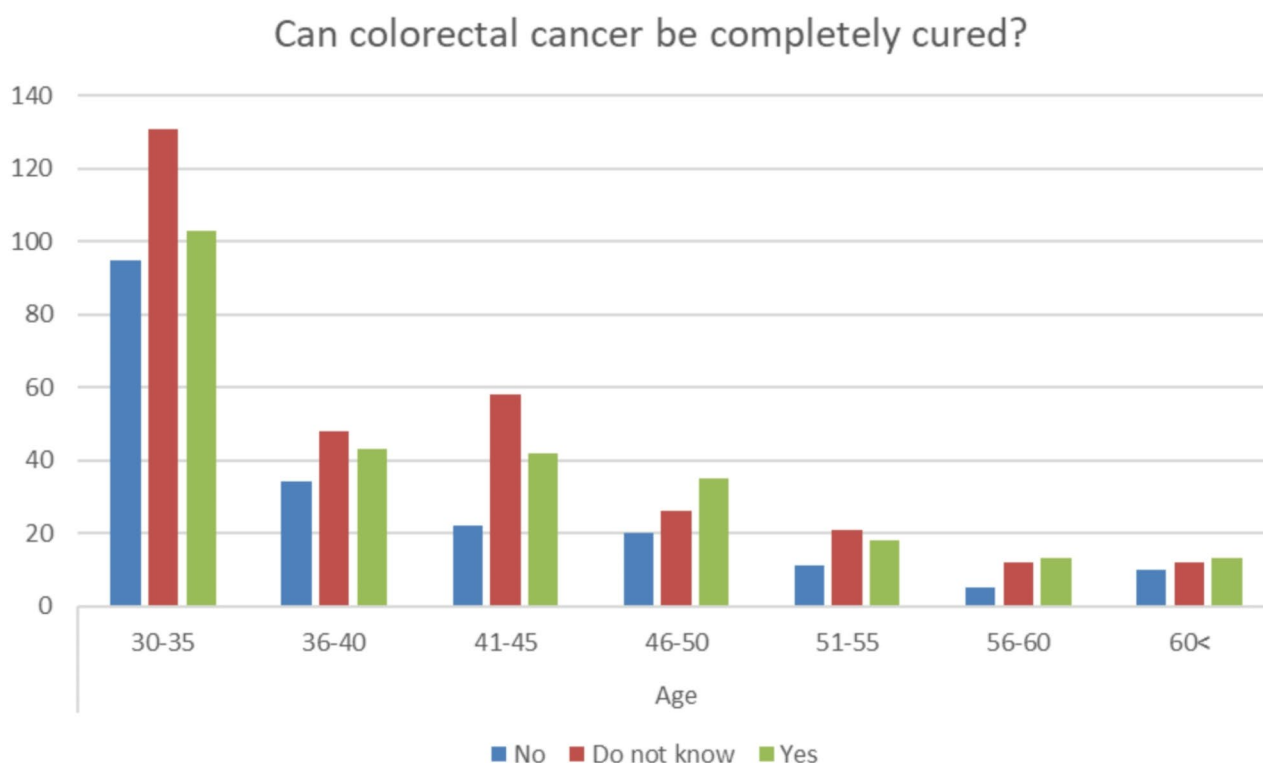
In addition, we found significant associations between knowledge levels and sociodemographic factors such as gender, education, and economic status. Understandably, higher education levels correlated with better knowledge about the treatment of CRC surgically. Financial status also played a role, with those in better economic standing



**Table 4** Correlation between knowledge and other variables

Knowledge questions	Chi-square test <i>p</i> -value			
	Knowl- edge* Gender	Knowl- edge* Education	Knowl- edge* Eco- nomic Status	Knowl- edge* Age
Do you consider yourself an <b>informed person</b> , with awareness of colorectal cancer?	0.13	0.19	<b>0.01</b>	0.816
According to your knowledge, is there a proven link between the presence of adenocarcinoma <b>polyps</b> in the large intestine and the possibility of colorectal cancer development?	<b>0.001</b>	0.5	<b>0.01</b>	0.91
Do you think that colorectal cancer can be an <b>inherited disease</b> ?	0.3	0.2	<b>0.01</b>	<b>0.033</b>
Does colorectal <b>cancer in your immediate family</b> put you at an increased risk for developing colorectal cancer?	<b>0.004</b>	0.28	0.26	<b>0.032</b>
Do you think <b>colorectal cancer is a malignant</b> neoplastic disease?	<b>0.004</b>	<b>0.02</b>	0.065	<b>0.008</b>
Do you agree with the statement that colorectal cancer is a disease with <b>no possibility of being completely cured</b> ?	<b>0.001</b>	0.09	0.19	0.548
Can colorectal cancer be <b>treated surgically</b> ?	<b>0.04</b>	<b>0.04</b>	<b>0.04</b>	0.121
Can colorectal cancer be <b>completely cured</b> ?	<b>0.002</b>	<b>0.009</b>	<b>0.01</b>	<b>0.012</b>
Do you agree with the statement that colorectal cancer can be completely cured <b>in any case</b> ?	<b>0.001</b>	<b>0.01</b>	<b>0.01</b>	<b>0.008</b>
Is <b>fecal occult blood test</b> helpful in detecting colorectal cancer?	<b>0.001</b>	<b>0.01</b>	<b>0.01</b>	0.394
Do you think <b>inflammatory bowel diseases</b> can be linked to the development of colorectal cancer?	<b>0.03</b>	0.65	0.17	0.19
In case of having colorectal cancer, would you <b>agree to undergo colostomy</b> to have permanent intestinal stoma if that would be required?	<b>0.02</b>	0.17	0.67	0.226
Do you think that the type of <b>diet can affect</b> the development of colorectal cancer?	<b>0.01</b>	0.08	<b>0.001</b>	0.247
Do you think that taking <b>regular small doses of aspirin</b> may protect against colorectal cancer?	<b>0.001</b>	<b>0.01</b>	0.13	0.086

**Fig. 2** Awareness of the hereditary nature of colorectal cancer (CRC) across age groups. The figure illustrates the distribution of responses (“Yes,” “No,” and “Do not know”) to whether CRC can be inherited, stratified by age groups. Statistical analysis indicates significant differences among age groups ( $p=0.033$ )



**Fig. 3** Awareness of the curability of colorectal cancer (CRC) across age groups. This figure illustrates the distribution of responses (“Yes,” “No,” and “Do not know”) to whether CRC can be completely cured, stratified by age groups. Statistical analysis indicates significant differences among age groups ( $p=0.012$ )

being more informed about CRC. There were statistically significant differences in knowledge between genders. For instance, 34% of males correctly identified the association between polyps and CRC compared to 27% of females. 42% of females did not know whether CRC can be cured, compared to 36% of males. In addition, regarding the impact of diet on CRC, 38% of males answered affirmatively, compared to 30% of females. This increased knowledge among males could be due to more educational and public engagement opportunities for men in many societies, including Syria. Traditional gender roles may also limit women’s access to health information and healthcare services, as men might have more freedom to attend educational sessions, access media, and participate in community discussions about health.

Age also influenced awareness levels. For example, 37% of individuals aged 30–35 did not believe that CRC could be hereditary, compared to 24% of those aged 50–55 and 29% of those above 60. Similarly, 29% of individuals aged 30–35 did not think CRC could be cured, a significantly higher percentage than older individuals in the study. This disparity can be explained by the fact that CRC screening guidelines are recommended starting at age 45, leading to increased exposure to information about CRC

among older age groups. Additionally, older adults may perceive themselves at higher risk for CRC, prompting them to seek more information. They also typically have more frequent interactions with the healthcare system for various age-related conditions, providing opportunities for healthcare providers to educate them about CRC. The increased knowledge among individuals aged 50 or above is consistent with findings from studies in Saudi Arabia and Lebanon [11, 15].

The data also revealed prevalent misconceptions about CRC. For instance, 31.1% of respondents were neutral on whether CRC can be cured, and only 7.9% strongly believed it can be. Additionally, misconceptions about the necessity of anesthesia for colonoscopy (52.1% thought it was required) and the embarrassment associated with the procedure (38.6% found it embarrassing) were noted. These misconceptions could stem from cultural traditions and a lack of educational campaigns addressing these issues.

#### Recommendations

The study’s findings highlight the urgent need for a multi-faceted approach to improve CRC awareness and screening in Syria. Rebuilding the war-affected healthcare



sector should be prioritized, focusing on restoring medical centers and providing essential diagnostic equipment. A national CRC screening campaign should be established, with a specific month dedicated to intensive outreach and awareness. To enhance accessibility, screening services should be complimentary, especially for economically disadvantaged populations.

The correlation between higher education and CRC knowledge underscores the importance of targeted educational interventions. Campaigns should be tailored to various socioeconomic and educational groups, simplifying messages for low-literate populations through visuals, infographics, and community meetings. For college students, CRC education should be integrated into university programs. Roadshows and mobile units can also promote CRC screening, particularly in rural areas.

Existing nonprofit organizations focused on healthcare education for underserved populations should include CRC awareness in their outreach. These organizations, with their established networks, can significantly expand awareness among vulnerable groups. Additionally, the Ministry of Health should collaborate with social media influencers to reach younger, tech-savvy audiences, using platforms to promote CRC prevention and screening.

Global CRC awareness initiatives, such as those in the US, the UK, and Canada, provide valuable lessons for Syria. Adapting these strategies to the post-war context may require international partnerships for financial and technical support. Local adaptation should focus on cultural relevance, leveraging existing networks, and community involvement for sustainable impact.

### Limitations

This study is significant as it is the first of its kind in Syria, providing valuable insights into the current state of CRC awareness and knowledge. However, there are several limitations to acknowledge. First, the reliance on online questionnaires and the use of the snowballing method for participant selection limit the sample to those with internet access, digital literacy, and social networks, excluding many individuals, particularly in rural areas or from lower socioeconomic backgrounds. This limits the generalizability of the results and introduces sampling and self-selection bias, as participants might already have a higher interest or awareness regarding health issues. Second, conducting research via social media presents challenges such as the potential inaccuracy of user-generated content, lack of editorial oversight, and difficulties in verifying participants' authenticity. Third, the use of a self-administered survey carries risks of response bias, as participants may overestimate or underestimate their knowledge. Additionally, cultural and social desirability bias might influence responses, with participants potentially answering based on what they perceive as socially

acceptable rather than accurate. Self-reported data can also lead to recall bias or inconsistencies due to varying interpretations of medical or technical terms in the questionnaire. Fourth, the cross-sectional design prevents the assessment of changes in knowledge or awareness over time and limits causal inferences.

### Future research

In conclusion, while this study highlights the urgent need for enhanced public health education and accessible screening programs to improve CRC awareness and knowledge among the Syrian population, these limitations suggest that further research using more diverse sampling methods, such as in-person surveys or mixed-method approaches, would improve representativeness and generalizability. Additionally, future research should consider strategies to mitigate the limitations of online recruitment and self-reported data.

Future research in this field should also consider longitudinal studies to track changes in CRC knowledge and screening behaviors over time, especially following public health interventions. Additionally, qualitative research exploring the cultural, socioeconomic, and systemic barriers to CRC screening could deepen our understanding of the challenges faced by specific groups. Comparative studies with neighboring countries such as Lebanon, Iraq, and Jordan would help identify regional similarities and differences in CRC knowledge, offering a broader perspective on public health needs.

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### Author contributions

AA, RS, FN, SD, and HF participated in data collection & analysis and manuscript writing. YL supervised the study preparation, scientifically and academically. All authors read and approved the final manuscript.

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### Data availability

All data generated or analyzed during this study are included in this published article.

### Declarations

#### Ethics approval and consent to participate

The study protocol was approved by the Research Ethics Committee of Damascus University, Faculty of Medicine (MD-020624-247). The research adhered to the ethical principles outlined in the Declaration of Helsinki, ensuring respect for participants' autonomy, confidentiality, and well-being. Informed consent was obtained electronically via the survey's introduction page, which outlined the study's purpose, voluntary nature, and confidentiality measures. Participants confirmed their consent by selecting an agreement checkbox before accessing the survey questions. Data collection was anonymized; participants were not required to provide identifying information, and responses were linked to unique codes instead of personal identifiers. The data were securely stored on a password-protected server accessible only to the research team, and no individual-level data were disclosed in the results.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare no competing interests.

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