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Colorectal Cancer Awareness and Its Predictors among adults aged 50 to 74 years in the State of Qatar, 2019

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Abstract

Objective: The current study aimed to assess the elderly's awareness regarding CRC risk factors, symptoms, and its predictors.

Design: A cross-sectional study design was employed.

Setting: Across six primary health centers in Qatar

Participants: Clients (n=448), aged 50-74 years, attending at the main waiting areas of the selected health centers and are Arabic or English speakers.

Data collection and analysis: Participants were interviewed using a modified version of the Cancer Awareness Measures (CAM) tool - Cancer Research UK. A non-probability sampling technique was applied to recruit participants. Data was analyzed using the SPSS version 22. Descriptive and analytic statistics were applied when appropriate. Multivariate linear regression was applied.

Results: A total of 448 clients have participated in the study (response rate 87%). The mean age of the participants was 58.48 years (SD=6.37 years). The participants' mean awareness score (%) regarding CRC symptoms, risk factors, and overall were 40.3%, 49.3%, and 45.2% respectively. A multivariate linear regression analysis identified that being a female, a non-Qatari Arab, and having a formal education were independent predictors of higher CRC awareness.

Conclusion: In conclusion, the present study has shown a low awareness regarding the symptoms and risk factors of CRC as well as the related national screening program in Qatar. Such results underline the importance of tailoring future educational campaigns that are relevant, specific, and appealing to such cohort, especially the nationals.

Strengths and limitations of this study

- This was the first study in the State of Qatar to evaluate CRC awareness and its predictors among a high-risk population.
- The study achieved a high response rate (87%) and included a sample from a variety of nationalities that represents the diversity of the community in Qatar.
- The use of a validated questionnaire to collect data from the target population strengthened the validity of the study.
- One of the limitations in this study was that recruiting participants from a healthcare setting may have over-estimated the awareness level of CRC.
- In addition, the non-probability sampling method utilized in the study may affect the generalizability of the results.

Keywords: colorectal cancer; awareness; symptoms; risk factors

INTRODCUTION

Colorectal cancer (CRC) is the second leading cause of cancer-related deaths and the third-most commonly diagnosed cancer globally. CRC accounted for almost 1.8 million new cases and about 860,000 deaths during 2018. By 2030, the global burden of CRC is expected to increase by 60% and result in more than 2.2 million new cases and 1.1 million deaths. [1] In addition, a rapid rise in the incidence and mortality of CRC has been witnessed in several middle-to-high income countries in Asia, Eastern Europe, and South America. [2] On the other hand, there has been a decline in CRC-related mortality among western countries; partly attributed to their effective national screening programs. [3]

Like other non-communicable diseases, colorectal cancer possesses modifiable risk factors such as obesity, physical inactivity, consumption of red or processed meat, excessive alcohol intake, and smoking. Moreover, detectable symptoms of CRC include a persistent change of the normal bowel habits, bleeding through the back passage, feeling a lump in the abdomen, and unexplained extreme tiredness. [4]

The literature has revealed that CRC incidence can be reduced through a comprehensive approach that entails dietary modifications, regular physical activity and family- or community-based interventions for cancer prevention. [5] For instance, it has been estimated that more than a quarter (27%) of CRC cases could have been prevented through increasing fiber intake and decreasing red or processed meat consumption. In addition, almost one-seventh (14%) and one-fifth (12%) of CRC cases could have been avoided through the proper management of excess weight and physical inactivity. [6] Thus, public awareness about such modifiable risk factors is crucial for any public health strategies aimed at reduction or prevention of CRC.

Several studies have shown that the awareness and knowledge of CRC risk factors and symptoms are positively linked to an increased likelihood of adherence to CRC screening recommendations. [7, 8, 9] Despite growing evidence on the association between lifestyle factors and CRC incidence, the awareness of such risk factors among the high-risk population group (aged 50-74 years old) remains low. [10]

In the State of Qatar, the latest data shows that CRC is the second most commonly diagnosed cancer (10.23%) among different nationalities and both genders. Moreover, more than two-thirds (68%) of the relevant cases were diagnosed at an advanced stage. In 2016, Qatar launched its national colorectal cancer-screening program. The program is a life-saving population-based initiative that aims at promoting education, awareness, and early detection of bowel cancer to those aged 50-74 years old. [11] It is in line with the Public Health Strategy 2017-2022 which focuses on preventive and community-based care. [12] Given the diverse population of the country, heterogeneous knowledge regarding CRC is expected. Thus, the current study aimed to assess the awareness of clients (aged 50-74 years) regarding CRC risk factors, symptoms, and its predictors.

4METHODS

Study design and setting

This was a cross-sectional study design conducted at the Primary Health Centers (PHCs) in the state of Qatar. The PHCs are the first line of contact between the population and the national health care system. Moreover, each PHC serves a large population of different ethnic, cultural, social and educational backgrounds; which is representative of the community in Qatar.

The data was collected during both morning and evening work shifts of the health centers and the data collection lasted from September 2018 till January 2019.

Participants

The target population included clients of the selected PHC centers aged 50-74 years old, both Arabic and English speaking, regardless of their gender or nationality. The study excluded clients who previously underwent screening for CRC and those not capable of communicating or providing consent due to any disability (mental or physical). The former were excluded because they received education about CRC symptoms and risk factors as part of their CRC screening procedure. As a result, their participation in the present study would have interfered with the study's main objectives.

Patient and public involvement

We did not involve patients or the public in our work.

Sample size

According to Qatar's 2015 Census, there were 211,207 individuals aged 50 years and above in the country. Thus, the estimated sample size was 384 clients given a 95% confidence interval, a precision of 5%, and a hypothesis that 50% (+/-5%) of clients were aware of CRC.

Sampling method

At the time of the study, there were 23 PHC in the country. The study was conducted across six PHCs chosen from the three operational health regions (North, West, and Central region) in the country; the two busiest health centers from each region. Then, the participants were chosen through convenient sampling, which included those aged 50-74 years who attend the selected primary health centers.

Research Protocol

The data collection was done through face-to-face structured interviews using the questionnaire described below. The eligible participants were approached by trained interviewers (resident physicians) at the main waiting areas of the selected PHCs. After that, they were given a brief

orientation about the study and invited to participate in the survey. All those, who consented, were interviewed in their preferred language and the duration of the interview lasted between 15 to 20 minutes. Upon completing the interview, the respondents were encouraged to ask any question and then were provided with an educational booklet on bowel cancer in both languages (Arabic and English). Additionally, the data collectors counseled all participants about bowel cancer and invited them to participate in the national bowel cancer screening program. Those who had concerns or who showed any potential symptoms or signs of bowel cancer were asked to inform their primary care physician for further assessment and follow up.

Data collection tool

The current study utilized a validated questionnaire based on a modified version of the Cancer Awareness Measures-Cancer Research UK survey (bowel cancer). The survey was designed to examine the general public's awareness of CRC. The questionnaire possesses a satisfactory internal reliability with Cronbach's alpha of 0.84 for all components and the test-retest reliability was r = 0.7. Further details about the questionnaire have been described elsewhere. [13] Subsequently, the study's questionnaire was translated and back-translated (English-Arabic) by two independent professional translators and any aberrancy was corrected accordingly. Furthermore, it was piloted on a number of participants similar to the study population and modifications were done based where necessary.

As a result, the current questionnaire composed of three main sections. Section A consisted of six questions exploring the background characteristics of the participants (age, gender, nationality, marital status, level of education, employment status). Section B consisted of nine closed-ended questions designed to measure the participants' awareness regarding CRC warning symptoms. Section C encompassed eleven closed-ended questions that identified the participants' awareness

of CRC risk factors. Regarding sections B and C, the participants were instructed to select one of three choices (Yes, No, I don't know). The answers to the aforementioned questions were coded as correct or incorrect, where the researchers assigned one point for each "correct" response and null for the "incorrect or I don't know" responses. As a result, the correct answers were summed and the percentage score was calculated accordingly. Thus, the total scores for sections B and C ranged from 0 to 9 and 11 respectively.

Statistical analysis

The collected data was analyzed using the Statistical Package for the Social Sciences-SPSS version 22. Both descriptive and analytic statistics were applied when appropriate. The level of statistical significance was set at 0.05. We used parametric testing including the independent t-test and ANOVA test to compare subgroups and detect any statistically significant difference in the individual and total mean score of CRC awareness. A multivariate linear regression model was constructed to identify the independent predictors of CRC awareness and tested for interactions and collinearity. Variables were included in the final model if they were deemed to be clinically important or if they were found to have a P value of < 0.25 on bivariable analysis. Unstandardized Beta coefficients with 95% CIs and P values were reported for each of the predictors based on the above regression model.

RESULTS

Demographic characteristics

Five hundred and fifteen (515) eligible candidates were approached for enrolment in the study, 67 of whom refused to participate. As a result, 448 clients participated in the present study (response rate: 87%). Table 1 presents the background characteristics of the study participants, where most respondents were females (53.5%), non-Qatari Arabs (52.2%), married (86.8%), with Diploma or

University degree (43.6%), and unemployed (54.4%). The mean age of the participants was 58.48 years (SD=6.37 years).

Table 1. Background characteristics of participants (n=448)

Variable	N (%)
Age	
50-59	254 (56.7)
60 or more	194 (43.3)
Gender	
Male	208 (46.5)
Female	239 (53.5)
Nationality	
Qatari	107 (24)
Non-Qatari Arab	233 (52.2)
Non-Arab	106 (23.8)
Marital status	
Married	389 (86.8)
Divorced/Widow	51 (11.4)
Single	8 (1.8)
Level of education	
No formal education	69 (15.4)
Primary	82 (18.3)
Secondary	101 (22.6)
Diploma or University	195 (43.6)
Employment	
Employed	204(45.6)
Unemployed	243(54.4)

** Non-Arab includes Asian, Western and African

Awareness of colorectal cancer symptoms and risk factors

Table 2 describes the percentages of participants who correctly identified the symptoms and risk factors of CRC. Out of nine symptoms related to CRC, the most commonly reported symptom by the respondents was a "lump in abdomen" (56.5 %) followed by "unexplained weight loss" (54.5 %) and "blood in stool" (46.9%). On the other hand, the least commonly reported symptoms were "pain in back passage" (22.5%) and "bowel doesn't empty" (27.9%).

Regarding the risk factors of CRC, the most commonly identified were the daily consumption of processed meat (71.7%), tobacco use (69.2%), and alcohol use (63.6 %). However, only about one

third of participants (34.4%) correctly identified low intake of fruit and vegetables as a risk factor of CRC. Diabetes (23.7 %) was the least identified risk factors.

Additionally, women were more likely to aware of the link between lifestyle behaviors and CRC than their male counterparts. In that regards, a statistically significant gender difference was noted in which women were more knowledgeable than men about the association of CRC with the following factors: eating less than five servings of fruit and vegetables (46% vs. 21%; P = 0.000), eating processed meat daily (76% vs. 67%; P = 0.02), drinking alcohol (69% vs. 58%; P= 0.01), and smoking (75% vs. 64%; P = 0.01). On the other hand, non-Arabic participants were more likely to report that being overweight could increase the risk of CRC compared to the Qatari and Arab participants (51% vs. 27% vs 45%; P = 0.001). However, Arab respondents were more likely to acknowledge that consuming a low-fiber diet was a risk factor for CRC than their Qatari peers (53% vs. 26% P = 0.000).

Table 2. Frequency distribution regarding the awareness of colorectal cancer symptoms and risk factors among of participants (n=448)

CRC symptoms	**% (n)**
Lump in abdomen	56.5 (253)
Unexplained weight loss	54.5 (244)
Blood in stools	46.9 (210)
Pain in abdomen	42.2 (189)
Change in bowel habit	38.6 (173)
Bleeding back passage	38.2 (171)
Tiredness	35.3 (158)
Bowel does not empty	27.9 (125)
Pain in back passage	22.5 (101)
CRC risk factors	
Daily eating of processed meat	71.7 (321)
Tobacco smoking	69.2 (310)
Drinking Alcohol	63.6 (285)
Chronic bowel disease	54 (242)

Daily eating of red meat	53.3 (239)
Close relative with CRC	46 (206)
Diet low in fiber	45.5 (204)
Overweight (BMI>25)	41.7 (187)
Older age	37.7 (169)
Low fruit & vegetables (<5 servings/day)	34.4 (154)
Diabetes	23.7 (106)

Mean score awareness of colorectal cancer

Figure 1 portrays the mean score of CRC awareness among participants in general and specific to its symptoms and risk factors**.** The level of awareness regarding the symptoms and risk factors of CRC was calculated as a score in percentage. While the mean score of the participants' awareness about CRC symptoms was 3.63/9 (40.3%), the corresponding mean score of their awareness on risk factors was 5.43/11 (49.3%). Subsequently, the overall score of awareness about both the symptoms and risk factors of CRC was 9.04/20 (45.2%).

The relationship between background characteristics and the CRC awareness mean score

Table 3 describes the relationship between the participants' background characteristics and their awareness mean score about CRC. Upon bivariate analyses, the respondents' gender, nationality, and educational level were significantly associated with the component (symptoms, risk factors) and total awareness scores ($P < 0.05$).

Table 3. The association between participants' background characteristics and their awareness regarding CRC symptoms, risk factors and overall. (n=448)

Variable	Awareness				Overall awareness	
	Symptoms		Risk factors			
	Mean score (95% CI)	*p*-value	Mean score (95% CI)	*p*-value	Mean score (95% CI)	*p-value*
Age		0.201		0.082		0.075
50-59	3.77 (3.42, 4.12)		5.67 (5.26, 6.08)		9.44 (8.76, 10.12)	
60 or more	3.43 (3.05, 3.82)		5.12 (4.65, 5.59)		8.50 (7.72, 9.28)	
Gender		0.146		0.003*		0.012*

Male	3.41 (3.01, 3.80)		4.92 (4.44, 5.40)		8.31 (7.51, 9.10)	
Female	3.79 (3.45, 4.13)		5.85 (5.46, 6.24)		9.62 (8.96, 10.28)	
Nationality		<0.001*		<0.001*		<0.001*
Qatari	2.71 (2.25, 3.18)		4.63 (4.03, 5.23)		7.30 (6.33, 8.27)	
Arab	4.20 (3.85, 4.54)		5.81 (5.42, 6.21)		9.99 (9.33, 10.65)	
Non-Arab**	3.30 (2.71, 3.89)		5.42 (4.67, 6.16)		8.72 (7.48, 9.95)	
Marital status		0.846		0.668		0.651
Married	3.63 (3.35, 3.92)		5.46 (5.12, 5.80)		9.08 (8.52, 9.64)	
Non-married$	3.56 (2.90, 4.22)		5.26 (4.54, 5.98)		8.73 (7.47, 9.99)	
Level of education		<0.001*		0.003*		<0.001*
No formal education	2.00 (1.45, 2.55)		4.07 (3.22, 4.92)		6.01 (4.73, 7.30)	
Primary	3.55 (2.95, 4.15)		5.72 (5.12, 6.32)		9.27 (8.21, 10.32)	
Secondary	3.61 (3.10, 4.13)		5.80 (5.15, 6.45)		9.42 (8.39, 10.45)	
Diploma/university	4.26 (3.86, 4.65)		5.58 (5.10, 6.06)		9.81 (8.99, 10.62)	
Employment		0.319		0.04*		0.083
Employed	3.49 (3.08, 3.90)		5.09 (4.61, 5.58)		8.56 (7.75, 9.37)	
Unemployed	3.75 (3.43, 4.08)		5.74 (5.35, 6.13)		9.47 (8.82, 10.12)	

* Statistically significant at $p \leq 0.05$.

** Non-Arab includes Asian, Western and African

$ Non-married (single, divorced, or widow)

Predictors of colorectal cancer awareness

Table 4 shows the predictors of the total awareness score (out of 100) based on a multiple linear regression model of the aforementioned significant variables from the bivariate analysis. Significant associations were detected between the CRC mean awareness score and gender (higher awareness among females), nationality (higher awareness among non-Qatari Arab), and education (higher awareness among those with Diploma or university degree).

Table 4: The predictors of overall awareness regarding colorectal cancer among the study participants (n=448)

Variables entered in model	β- Coefficient	95% C.I.	*p*-value
Gender			<0.0001*
Male (referent)	1.00	1.00	
Female	13.5	(8.3, 18.7)	
Nationality			<0.0001*
Qatari (referent)	1.00	1.00	
Non-Qatari Arab	13.8	(7.5, 20.0)	
Non-Arab	8.0	(0.65, 15.3)	

Education			<0.0001*
No formal school (referent)	1.00	1.00	
Up to secondary level	16.3	(8.9, 23.7)	
Diploma/university level	20.5	(13.0, 28.0)	

Dependent variable: Overall awareness mean score (out of 100). Enter multiple linear regression applied.
Model assumption is fulfilled. No interactions and no multi-collinearity were detected. R2= 14.0%.
C.I.: Confidence Interval
*Statistically significant at $p < 0.05$.

DISCUSSION

The current study represents the first to assess the awareness regarding CRC symptoms and risk factors among a high-risk population in the State of Qatar.

The study revealed a poor awareness about CRC symptoms (40%), risk factors (49.3%), and in general (45.2%). Another key finding was that the female gender, non-Qatari Arab nationality, and having any formal education are significant predictors of higher CRC awareness.

The decreased awareness about the symptoms and risk factors of CRC among the study participants are similar to findings from earlier studies in the region. A study conducted by Nasaif and Al Qallaf in Bahrain among the general population revealed similar yet slightly higher awareness about the symptoms (59%) and risk factors (51%) of CRC. [14] Also, a recent national study in the Kingdom of Saudi Arabia among 5732 participants examined the awareness of respondents on CRC-related symptoms, risk factors, types, and screening tests. As a result, the mean score of the participants' awareness was low at 11.05/26. [15] In addition, the results of the current study are comparable to findings of international studies. A population survey in the United Kingdom has revealed a low awareness regarding multiple bowel cancer signs and risk factors. The participants showed low awareness about the association between certain lifestyle behaviors and the risk of CRC. [13] Another cross-sectional survey of patients attending a tertiary outpatient clinic in the Nation of Brunei revealed that the mean knowledge scores for CRC symptoms (21.6%)

and risk factors (12%) were poor. [16] Subsequently, such low level of awareness might translate into a decreased uptake of screening among the target population. [15] On the other hand, a telephone-based survey among American residents in South Carolina described a high level of awareness regarding CRC despite a relatively low uptake of bowel cancer screening. [17]

One more significant finding was that the female gender, non-Qatari Arab nationality, and having any formal education were significant predictors for higher CRC awareness. Such results correlate well with an earlier regional study among individuals aged ≥ 50 years-old in the United Arab Emirates. As a result, it was found that the male gender and low level of education were significant predictors of low awareness about the risk factors as well as signs and symptoms of bowel cancer. [18] Also, a survey of more than ten thousand participants in Hong Kong revealed that the male gender was associated was low awareness about bowel cancer symptoms and risk factors. [19] On the other hand, a community-based survey in Jordan reported no significant gender association with the knowledge of CRC, where both men and women had low knowledge scores.[20] In addition, a cross-sectional study among hospital employees aged 50 years and above in Greece revealed that university education was the sole independent determinant of bowel cancer screening. [21]

The current study has several strengths and limitations. First of all, the study was the first of its kind to evaluate the CRC awareness and its predictors among a high-risk population in the State of Qatar. The study achieved a high response rate (87%) and the sample included a variety of nationalities that represents the diversity of the community in Qatar. In addition, the use of a validated questionnaire to collect data from the target population strengthen the validity of the study. However, the research at hand was not without limitation. Recruiting the participants from healthcare settings may over-estimate the awareness level of CRC, as it's expected that those participants would have better awareness than those who don't seek healthcare services. In

addition, the non-probability sampling method utilized in the study may affect the generalizability of the results.

CONCLUSION

In conclusion, the present study has shown a decreased awareness regarding the symptoms, signs, and risk factors of CRC among the elderly population in Qatar. Given the presence of earlier awareness campaigns on bowel cancer in Qatar, the observed awareness among the elderly population in the current study underlines the importance of tailoring future educational campaigns that are relevant, specific (special focus on the association between certain lifestyle behaviours and CRC), and appealing to such cohort (especially the nationals). Also, any planned intervention to heighten the elderly's awareness of CRC as well as its national screening program must be based on local evidence of the status quo and rely on an effective engagement of this population, given the delicate nature of any public health message related to such disease.

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None.

Competing Interests

The authors declare no conflict of interest.

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Ethical

This study was approved by the Institutional Review Board of the Primary Health Care Corporation under protocol ID (PHCC/RC/18/05/001).

Author contributorship

AA, MC, and MB contributed to the conception and planning of the research. AA conducted the analysis. All authors contributed equally to the conduct and reporting of the work described in the article.

Data sharing

All data relevant to the study are included in the article.

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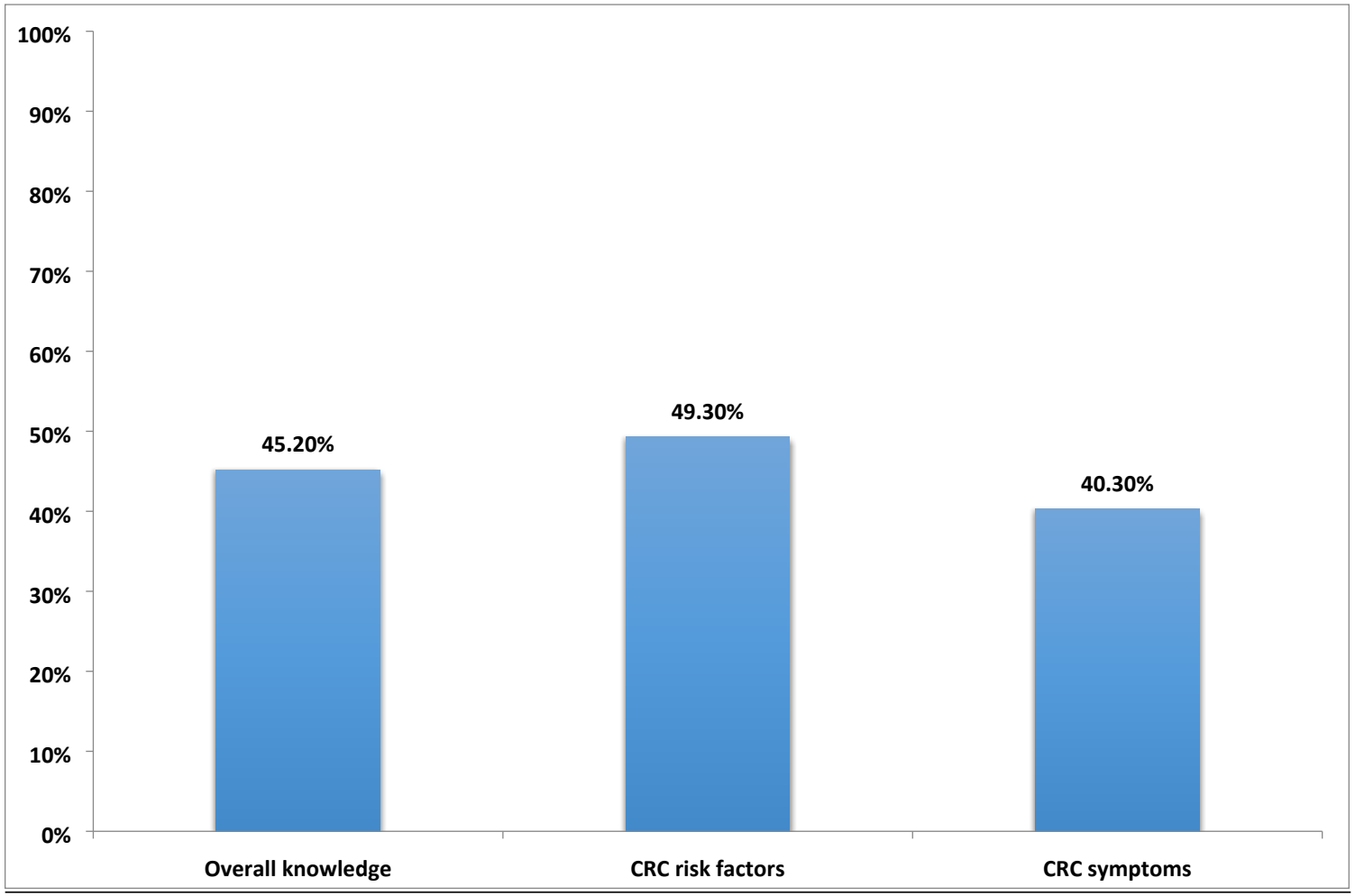

Figure 1. Mean score (%) of CRC awareness components (overall, symptoms, risk factor)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	*7-8*
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-9
		(*b*) Describe any methods used to examine subgroups and interactions	8-9
		(*c*) Explain how missing data were addressed	8-9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	11
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-13
		(*b*) Report category boundaries when continuous variables were categorized	10-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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A Colorectal cancer awareness and its predictors among adults aged 50 to 74 years attending primary health care in the State of Qatar: a cross-sectional study

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Abstract

Objective: The current study aimed to assess the awareness of colorectal cancer (CRC) symptoms and risk factors among the at-risk population. The secondary objective was to assess the differences in awareness among population subgroups.

Design: A cross-sectional study design was employed.

Setting: The study was conducted across 6 primary healthcare (PHC) centres in Qatar.

Participants: Patients, or their accompanying people, aged 50-74 years and Arabic or English speakers, were recruited from the main waiting areas of the selected PHC centres.

Data collection and analysis: Participants were interviewed using the validated Bowel/Colorectal Cancer Awareness Measure (Bowel/Colorectal CAM) questionnaire. A non-probability convenient sampling technique was applied to recruit participants. Data were analyzed using SPSS version 23. Descriptive and analytic statistics were utilized when appropriate. A multivariate linear regression model was constructed to identify the independent predictors of CRC awareness.

Results: The study includes 448 participants (response rate= 87%). The mean age of the participants was 58.48 years (SD ± 6.37). The mean awareness score among the participants was 3.63 /9 (SD ±2.7) for CRC symptoms and 5.43/11 (SD ±3.3) for CRC risk factors. The overall mean awareness score was 9.03/20 (SD ±5.5). Multivariate linear regression identified the female gender (B=2.6; $P \leq 0.001$), non-Qatari or non-Arab nationalities (B= 2.81 and 1.6; $P \leq 0.001$), and educational level (B=3.02 to 4.08; $P \leq 0.001$) as independent predictors of higher CRC awareness.

Conclusion: In conclusion, the present study has shown low awareness regarding the symptoms and risk factors of CRC. Such results emphasize the importance of tailoring future educational campaigns that are relevant, specific, and appealing to such cohort.

Strengths and limitations of this study

- This was the first cross-sectional study to evaluate CRC awareness and its predictors among the population at risk in Qatar.
- The use of a validated questionnaire to collect data from the target population strengthened the validity of the study.
- The interviews were conducted using a structured face-to-face interview by trained data collectors.
- The non-probability sampling method utilized in the study may affect the generalizability of the results.
- Despite not being a population-based study, the current research recruited participants from PHC centres and offers a good representation of the different ethnic, cultural, and social backgrounds in Qatar.

Keywords: colorectal cancer; awareness; symptoms; risk factors

INTRODUCTION

Colorectal cancer (CRC) is the third-most commonly diagnosed cancer and the second leading cause of cancer-related deaths worldwide. CRC accounted for almost 1.8 million new cases and 860,000 deaths during 2018. By 2030, the global burden of CRC is expected to increase by 60% and results in more than 2.2 million new cases and 1.1 million deaths. [1] In addition, there has been a rapid rise of CRC incidence and mortality across several middle-to-high income countries in Asia, Eastern Europe, and South America. [2] On the other hand, a decline in CRC-related mortality has been witnessed among western countries; partly attributed to their effective national screening programs. [3]

Like other non-communicable diseases, CRC has modifiable risk factors such as obesity, low-fibre diet, low fruit and vegetable intake, consumption of red or processed meat, excessive alcohol intake, and smoking. Moreover, detectable symptoms of CRC include a persistent change of the normal bowel habits, bleeding through the back passage, feeling a lump in the abdomen, and unexplained extreme tiredness. [4]

The incidence of CRC can be reduced through a comprehensive approach that entails dietary modifications, regular physical activity, and family- or community-based interventions for cancer prevention. [5] For instance, it has been estimated that more than a quarter (27%) of CRC cases could have been prevented through increasing the intake of fibre and decreasing the consumption of red or processed meat. In addition, almost one-seventh (14%) and one-fifth (12%) of CRC cases could have been avoided through the proper management of excess weight. [6] Thus, the awareness about these modifiable risk factors is crucial for any public health strategies aimed at the reduction or prevention of CRC.

Several studies have shown that the awareness of CRC symptoms and risk factors is positively linked to the uptake of CRC screening. [7, 8, 9] Despite growing evidence on the association between lifestyle factors and CRC, the awareness of such risk factors among the population at risk (aged 50-74 years old) remains low. [10]

Qatar is a country located in Western Asia on the Arabian Peninsula. The population in Qatar is largely diverse and comprised of many ethnicities; Arabs, Asians, Africans and westerns). The majority of the country's workforce are expatriates with different cultural and educational backgrounds. [11]

In Qatar, the latest data shows that CRC is the second most commonly diagnosed cancer (11.71%) among males and the third most commonly diagnosed cancer (8.63%) among females, Moreover, more than two-thirds (68%) of the relevant cases were diagnosed at an advanced stage. [12] In 2016, Qatar launched its national colorectal cancer screening program. The program is a population-based initiative that aims at promoting education, awareness, and early detection of bowel cancer among those at risk (aged 50-74 years). [13] It is in line with the Public Health Strategy 2017-2022 which focuses on preventive and community-based care. [14] Given the diverse population of the country, heterogeneous knowledge regarding CRC is expected. Thus, the primary objective of the current study was to assess the awareness of CRC symptoms and risk factors among individuals at risk. The secondary objective was to assess the differences in awareness among population subgroups.

METHODS

Study design and setting

This was a cross-sectional study conducted at the primary healthcare (PHC) centres in Qatar between September 2018 and January 2019. A network of PHC centres is distributed across the

country through which a comprehensive promotive, preventive, and curative care is provided free of charge. They are the first line of contact with the community and each health centre has a well-defined catchment population from different ethnic, cultural, social and educational backgrounds; which offers a good representation of the community. At the time of the study, there were 23 PHC centres distributed across the country's 3 administrative health regions (North, West, and Central). The study was conducted across 6 PHC centres, where two health centres were chosen from each region.

Study population and sampling

The inclusion criteria were patients or accompanying people, aged 50-74 years, Arabic or English speakers, visiting one of the selected PHC centres during the study period. The study excluded individuals who previously underwent CRC screening because they have already received counselling about CRC symptoms and risk factors as part of their CRC screening procedure. Thus, their enrollment would interfere with the study main objective. Individuals with cognitive/ communication difficulties were excluded. The participants were chosen through a non-probability convenient sampling technique.

Patient and public involvement

We did not involve patients or the public in our work.

Sample size

According to Qatar's 2015 Census, there were 211,207 individuals aged 50 years and above in the country. Thus, the estimated sample size was 384 individuals based on a 95% confidence interval, precision of 5%, a hypothesis that 50% (+/-5%) of participants were aware of CRC symptoms and risk factors and a non-response of 20%.

Data collection

The data collection was done through face-to-face structured interviews using the questionnaire described below. The eligible participants were approached by trained interviewers (resident physicians) at the main waiting areas of the selected PHC centres. After that, they were given a brief orientation about the study and invited to participate. All consenting individuals were interviewed in their preferred language (English or Arabic). The duration of the interview ranged from 15 to 20 minutes. Upon completing the interview, the participants were encouraged to ask any questions. They were provided with an educational booklet on CRC. Additionally, all participants were counselled about CRC and encouraged to take part in bowel cancer screening. Those who reported any concerns or potential symptoms of bowel cancer were referred to their primary care physician for further assessment.

Questionnaire

The current study utilized the validated Bowel/Colorectal Cancer Awareness Measure (Bowel/Colorectal CAM) survey. The questionnaire was designed to evaluate the awareness of CRC among the public. This survey instrument was developed by University College London and Cancer Research United Kingdom (UK). It is based on a generic CAM developed by Cancer Research UK, University College London, Kings College London and Oxford University in 2007-08.[15] It possesses satisfactory internal reliability with a Cronbach's alpha of 0.84 across all components and test-retest reliability of r = 0.7. The questionnaire is composed of prompted (closed-ended) and unprompted (open-ended) questions. However, we used the prompted section of the questionnaire because it satisfies the study's objectives. Further details about the questionnaire have been described elsewhere. [16]

The study's questionnaire was translated and back-translated (English-Arabic) by two independent translators and any aberrancy was corrected accordingly. Additionally, one item on tobacco use

was added to the list of CRC risk factors. The study questionnaire consisted of three main sections. Section A included 6 questions about the background characteristics (age, gender, nationality, marital status, level of education, employment status). Section B consisted of 9 closed-ended questions that measure the participants' awareness of CRC symptoms. Section C encompassed 11 closed-ended questions related to the participants' awareness of CRC risk factors. Regarding sections B and C, the researchers assigned one point for each "correct" response and null for the "incorrect or I don't know" responses. As a result, the total score ranged from 0 to 9 for section B and 0 to 11 for section C. Furthermore, the overall awareness score ranged from 0 to 20 by combining the scores of sections B and C. The instrument was piloted on 30 participants from the study population to assess its comprehensiveness and clarity.

Statistical analysis

The collected data were analyzed using the Statistical Package for the Social Sciences-SPSS version 23. Descriptive statistics were calculated for continuous and categorical variables where appropriate. Pearson's chi-squared test was used to assess the association between categorical variables. ANOVA test was used to analyse the differences among group means in the sample. A multivariate linear regression model was constructed to identify the independent predictors of CRC awareness and tested for interactions and collinearity. Unstandardized beta coefficients were reported for each predictor. The level of statistical significance was set at 0.05.

RESULTS

Demographic characteristics

A total of 448 participants were enrolled in the study (response rate: 87%) with time constraint being the main reason for non-participation. Table 1 presents the participants' background characteristics. The participants' mean age was 58.48 years (SD±6.37). More than half of the

respondents were females (53.5%), non-Qatari Arabs (52.2%), married (86.8%), and unemployed (54.4%).

Table 1: Background characteristics of participants (n=448)

Variable	N (%)
Age	
50-59	254 (56.7)
60 or more	194 (43.3)
Gender	
Male	208 (46.5)
Female	239 (53.5)
Nationality	
Qatari	107 (24)
Non-Qatari Arab	233 (52.2)
Non-Arab*	106 (23.8)
Marital status	
Married	389 (86.8)
Divorced/Widow	51 (11.4)
Single	8 (1.8)
Level of education	
No formal education	69 (15.4)
Primary	82 (18.3)
Secondary	101 (22.6)
Diploma or University	195 (43.6)
Employment	
Employed	204(45.6)
Unemployed	243(54.4)

* Non-Arab includes Asian, Western and African

Awareness of colorectal cancer symptoms and risk factors

The mean awareness score of CRC symptoms among study participants was 3.63 /9 (SD ±2.7), while that of risk factors was 5.43/11 (SD ±3.3). Thus, the overall mean awareness score was 9.03/20 (SD ±5.5).

Table 2 describes the percentages of participants who identified the symptoms and risk factors of CRC. Out of 9 symptoms related to CRC, the most commonly recognised symptoms were “lump in abdomen” (56.5 %), “unexplained weight loss” (54.5 %), and “blood in stool” (46.9%). On the

other hand, the least commonly recognised symptoms were "pain in back passage" (22.5%) and "bowel doesn't empty" (27.9%).

Furthermore, the most commonly recognised CRC risk factors were the "daily eating of processed meat" (71.7%), "tobacco use" (69.2%), and "alcohol use" (63.6 %). However, "diabetes" (23.7 %) and "low fruit and vegetables" (34.4%) were less commonly recognised risk factors.

Table 2: Frequency distribution regarding the awareness of colorectal cancer symptoms and risk factors among participants (n=448)

CRC symptoms	**% (n)**
Lump in abdomen	56.5 (253)
Unexplained weight loss	54.5 (244)
Blood in stools	46.9 (210)
Pain in abdomen	42.2 (189)
Change in bowel habit	38.6 (173)
Bleeding back passage	38.2 (171)
Tiredness	35.3 (158)
Bowel does not empty	27.9 (125)
Pain in back passage	22.5 (101)
CRC risk factors	**% (n)**
Daily eating of processed meat	71.7 (321)
Tobacco use	69.2 (310)
Drinking Alcohol	63.6 (285)
Chronic bowel disease	54 (242)
Daily eating of red meat	53.3 (239)
Close relative with CRC	46 (206)
Diet low in fibre	45.5 (204)
Overweight (BMI≥ 25 kg/m^2)	41.7 (187)
Older age	37.7 (169)
Low fruit & vegetables (<5 servings/day)	34.4 (154)
Diabetes	23.7 (106)

Females were more likely to recognise the link between unhealthy lifestyle behaviours and CRC than their male counterparts as shown in table 3. For instance, females were more aware about the association of CRC with the following factors: daily consumption of processed meat (76.5% vs.

66.7%; P = 0.01), tobacco use (74.8% vs. 63.6%; P = 0.007), drinking alcohol (69.3% vs. 57.8%; P= 0.008), and daily consumption of red meat (62.6% vs. 43.0%; P <0.001).

Table 3: The relationship between gender and awareness of lifestyle risk factors for colorectal cancer (n=448)

Lifestyle risk factor	Female % (n)	Male % (n)	X^2 value	*p*-value
Daily eating of processed meat	76.5 (182)	66.7 (138)	5.26	0.014*
Tobacco use	74.8 (178)	63.6 (131)	6.54	0.007*
Drinking alcohol	69.3 (165)	57.8 (119)	6.40	0.008*
Daily eating of red meat	62.6 (149)	43.0 (89)	17.11	<0.001*
Low fruit & vegetables (<5 servings/day)	46.2 (110)	20.9 (43)	31.40	<0.001*
Diet low in fibre	47.5 (113)	43.7 (90)	0.63	0.24
Overweight (BMI≥25 kg/m^2)	39.9 (95)	44.2 (91)	0.82	0.20

BMI: Body Mass Index
* Statistically significant at $p \leq 0.05$.

The relationship between background characteristics and the CRC awareness mean score

Table 4 describes the relationship between the participants' background characteristics and their CRC awareness mean score. Upon bivariate analyses, the respondents' gender, nationality, and educational level were significantly associated with the component (symptoms, risk factors) and overall awareness scores (P < 0.05).

Table 4: The association between participants' background characteristics and their awareness regarding CRC symptoms, risk factors and overall. (n=448)

Variable	Awareness				Overall awareness	
	Symptoms		Risk factors			
	Mean score (95% CI)	*p*-value	Mean score (95% CI)	*p*-value	Mean score (95% CI)	*p-value*
Age		0.201		0.082		0.075
50-59	3.77 (3.42, 4.12)		5.67 (5.26, 6.08)		9.44 (8.76, 10.12)	
60 or more	3.43 (3.05, 3.82)		5.12 (4.65, 5.59)		8.50 (7.72, 9.28)	
Gender		0.146		0.003*		0.012*
Male	3.41 (3.01, 3.80)		4.92 (4.44, 5.40)		8.31 (7.51, 9.10)	
Female	3.79 (3.45, 4.13)		5.85 (5.46, 6.24)		9.62 (8.96, 10.28)	

Nationality		<0.001*		<0.001*		<0.001*
Qatari	2.71 (2.25, 3.18)		4.63 (4.03, 5.23)		7.30 (6.33, 8.27)	
Non-Qatari Arab	4.20 (3.85, 4.54)		5.81 (5.42, 6.21)		9.99 (9.33, 10.65)	
Non-Arab[a]	3.30 (2.71, 3.89)		5.42 (4.67, 6.16)		8.72 (7.48, 9.95)	
Marital status		0.846		0.668		0.651
Married	3.63 (3.35, 3.92)		5.46 (5.12, 5.80)		9.08 (8.52, 9.64)	
Non-married[b]	3.56 (2.90, 4.22)		5.26 (4.54, 5.98)		8.73 (7.47, 9.99)	
Level of education		<0.001*		0.003*		<0.001*
No formal education	2.00 (1.45, 2.55)		4.07 (3.22, 4.92)		6.01 (4.73, 7.30)	
Primary	3.55 (2.95, 4.15)		5.72 (5.12, 6.32)		9.27 (8.21, 10.32)	
Secondary	3.61 (3.10, 4.13)		5.80 (5.15, 6.45)		9.42 (8.39, 10.45)	
Diploma/university	4.26 (3.86, 4.65)		5.58 (5.10, 6.06)		9.81 (8.99, 10.62)	
Employment		0.319		0.04*		0.083
Employed	3.49 (3.08, 3.90)		5.09 (4.61, 5.58)		8.56 (7.75, 9.37)	
Unemployed	3.75 (3.43, 4.08)		5.74 (5.35, 6.13)		9.47 (8.82, 10.12)	

* Statistically significant at $p \leq 0.05$.

[a] Non-Arab includes Asian, Western and African

[b] Non-married (single, divorced, or widow)

Predictors of colorectal cancer awareness

Multivariate linear regression identified the following predictors of higher overall CRC awareness: female gender (B=2.6; P ≤ 0.001), non-Qatari or non-Arab nationalities (B= 2.81 or 1.6; P ≤ 0.001), and educational level (B=3.02 to 4.08; P ≤ 0.001) (table 5).

Table 5: The predictors of overall awareness of colorectal cancer among the study participants (n=448)

Variables entered in the model	Unstandardized beta coefficient	Standardized beta coefficient	(95% CI)	*p*-value
Gender				<0.001*
Male (referent)	1.00	1.00	1.00	
Female	2.60	0.24	(1.66 - 3.76)	
Nationality				<0.001*
Qatari (referent)	1.00	1.00	1.00	
Non-Qatari Arab	2.81	0.25	(1.54 - 4.08)	
Non-Arab	1.62	0.12	(0.15- 3.08)	
Level of education				<0.001*
No formal school (referent)	1.00	1.00	1.00	
Primary	3.51	0.24	(1.83 – 5.20)	
Secondary	3.02	0.22	(1.37 – 4.67)	
Diploma/university	4.08	0.36	(2.57 – 5.59)	

Dependent variable: Overall awareness mean score. Enter multiple linear regression applied.

Model assumption is fulfilled. No interactions and no multi-collinearity were detected. R2= 14.0%.

CI= Confidence Interval.

*Statistically significant at $p < 0.05$.

DISCUSSION

The is the first study to assess the awareness of CRC symptoms and risk factors among adults aged 50 to 74 years in Qatar. The mean awareness score of CRC symptoms among study participants was 3.63 /9 (SD ±2.7), while that of risk factors was 5.43/11 (SD ±3.3). Thus, the overall mean awareness score was 9.03/20 (SD ±5.5).

This is in line with earlier studies in the region. A study in Bahrain among the general population revealed low awareness about the symptoms and risk factors of CRC. [17] Also, a recent national study in Saudi Arabia examined the awareness of 5732 participants on CRC-related symptoms and risk factors. As a result, the mean score of the respondents' awareness was low at 11.05/23. [18]

In comparison to our study, a population survey in the United Kingdom using the bowel/colorectal CAM instrument showed higher awareness regarding CRC symptoms and risk factors. Specifically, the most recognised symptom and risk factor in the British study were "blood in stools" (88.6%) and "close relative with bowel cancer" (65%). However, our study identified "lump in abdomen" (56.5%) and "daily eating of processed meat" (71%) to be the most recognised symptom and risk factor. The least recognised symptom in the UK study was "bowel does not empty" (47%). On the other hand, "pain in back passage" (22.5%) was the least recognised symptom in our study. "Diabetes" was the least recognised risk factor in both studies and was recalled by only a quarter of the participants. [16] The level of education among our study population (43.6% with a diploma/university) was higher than that of the UK study (25.6%). However, this observation did not reflect on the level of CRC awareness. Subsequently, the level of education may not be associated with the level of health literacy. The observed difference in the awareness might be explained by the relatively recent introduction of the national bowel cancer screening program and awareness campaigns in Qatar.

Another survey in Malaysia, using the bowel/colorectal CAM tool, revealed lower CRC awareness in comparison to our findings. In the Malaysian study, the mean awareness scores for CRC symptoms and risk factors was 2.89 (SD 2.96) and 3.49 (SD 3.17).[19] This could be explained by the difference in the study settings and the characteristics of the participants.

The present study identified the female gender and formal education as significant predictors of higher CRC awareness. Such results are in line with findings of a regional study conducted in the United Arab Emirates.[20] Another survey of more than 10,000 participants in Hong Kong revealed that male gender was associated with low CRC awareness.[21] On the other hand, a study in Saudi Arabia and a community-based survey in Jordan reported no significant association between gender and knowledge of CRC. [18, 22]

The current study has strengths and limitations. First, the study was the first of its kind to evaluate CRC awareness and its predictors among the at-risk population in Qatar. The study achieved a high response rate (87%) and the sample included a variety of nationalities that represents the diversity of the community in Qatar. In addition, the use of a validated questionnaire through face-to-face interviews by trained data collectors strengthened the validity of the study results. However, the research has some limitations. First, we did not use the unprompted (open-ended) items of the CAM questionnaire to satisfy the study's objectives and due to time constraint. Secondly, we did not assess the participants' family history for CRC. Lastly, the non-probability sampling method utilized in the study may affect the generalizability of the results.

CONCLUSION

In conclusion, the awareness of CRC symptoms and risk factors was low among the at-risk population in Qatar. This underlines the importance of tailoring future educational campaigns that

are relevant, specific (with focus on the male gender and those with low education) and are based on local evidence and effective engagement of the target population.

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Competing Interests

The authors declare no conflict of interest.

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Ethics

This study was approved by the Institutional Review Board of the Primary Health Care Corporation under protocol ID (PHCC/RC/18/05/001).

Contributors

AA conceived and designed the study. AA, MC, MB, MO and OA contributed to the recruitment of the participants and to the acquisition of the data. AA analysed the data. NS and NA contributed to the design of the work and interpretation of the findings. AA, MC, MB evaluated the results and wrote the manuscript. All authors revised and approved the final manuscript.

Data availability

Data are available upon reasonable request.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-13
		(*b*) Report category boundaries when continuous variables were categorized	11-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Colorectal cancer awareness and its predictors among adults aged 50 to 74 years attending primary health care in the State of Qatar: a cross-sectional study

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Colorectal cancer awareness and its predictors among adults aged 50 to 74 years attending primary health care in the State of Qatar: a cross-sectional study

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Abstract

Objective: The current study aimed to assess the awareness of colorectal cancer (CRC) symptoms and risk factors among the at-risk population visiting the primary healthcare (PHC) centres in Qatar. The secondary objective was to assess the differences in awareness among population subgroups.

Design: A cross-sectional study design was employed.

Setting: The study was conducted across six PHC centres in Qatar.

Participants: Patients, or their accompanying people, aged 50-74 years and Arabic or English speakers, were recruited from the main waiting areas of the selected PHC centres.

Data collection and analysis: Participants were interviewed using the validated Bowel/Colorectal Cancer Awareness Measure (Bowel/Colorectal CAM) questionnaire. A non-probability convenient sampling technique was applied to recruit participants. Descriptive and analytic statistics were utilized when appropriate. A multivariate linear regression model was constructed to identify the independent predictors of CRC awareness.

Results: The study includes 448 participants (response rate= 87%). The mean age of the participants was 58.48 years (SD ± 6.37). The mean awareness score among the participants was 3.63 /9 (SD ±2.7) for CRC symptoms and 5.43/11 (SD ±3.3) for CRC risk factors. The overall mean awareness score was 9.03/20 (SD ±5.5). Multivariate linear regression identified the female gender [2.52 (95% CI: 1.15 – 3.88)], non-Qatari Arab [2.91 (95% CI: 1.64 – 4.18)] or non-Arab nationalities [1.76 (95% CI: 0.28 – 3.24)], and tertiary education [4.10 (95% CI: 2.55 – 5.66)] as independent predictors of higher CRC awareness.

Conclusion: In general, the awareness of CRC symptoms and risk factors was low among the at-risk population in Qatar. Specifically, the regression analysis showed males, Qataris, and those with no formal education had low awareness of CRC symptoms and risk factors. Such results emphasize the importance of tailoring future educational campaigns that are relevant, specific, and appealing to such cohort.

Strengths and limitations of this study

- This was the first cross-sectional study to evaluate CRC awareness and its predictors among the population at risk in Qatar.
- The use of a validated questionnaire to collect data from the target population strengthened the validity of the study.
- The interviews were conducted using a structured face-to-face interview by trained data collectors.
- The non-probability sampling method utilized in the study may affect the generalizability of the results.
- Despite not being a population-based study, the current research recruited participants from PHC centres and offers a good representation of the different ethnic, cultural, and social backgrounds in Qatar.

Keywords: colorectal cancer; awareness; symptoms; risk factors

INTRODUCTION

Colorectal cancer (CRC) is the third-most commonly diagnosed cancer and the second leading cause of cancer-related deaths worldwide. CRC accounted for almost 1.8 million new cases and 860,000 deaths during 2018. By 2030, the global burden of CRC is expected to increase by 60% and results in more than 2.2 million new cases and 1.1 million deaths. [1] In addition, there has been a rapid rise of CRC incidence and mortality across several middle-to-high income countries in Asia, Eastern Europe, and South America. [2] On the other hand, a decline in CRC-related mortality has been witnessed among western countries; partly attributed to their effective national screening programs. [3]

Like other non-communicable diseases, CRC has modifiable risk factors such as obesity, low-fibre diet, low fruit and vegetable intake, consumption of red or processed meat, excessive alcohol intake, and smoking. Moreover, detectable symptoms of CRC include a persistent change of the normal bowel habits, bleeding through the back passage, feeling a lump in the abdomen, and unexplained extreme tiredness. [4]

The incidence of CRC can be reduced through a comprehensive approach that entails dietary modifications, regular physical activity, and family- or community-based interventions for cancer prevention. [5] For instance, it has been estimated that more than a quarter (27%) of CRC cases could have been prevented through increasing the intake of fibre and decreasing the consumption of red or processed meat. In addition, almost one-seventh (14%) and one-fifth (12%) of CRC cases could have been avoided through the proper management of excess weight. [6] Thus, the awareness about these modifiable risk factors is crucial for any public health strategies aimed at the reduction or prevention of CRC.

Several studies have shown that the awareness of CRC symptoms and risk factors is positively linked to the uptake of CRC screening. [7, 8, 9] Despite growing evidence on the association between lifestyle factors and CRC, the awareness of such risk factors among the population at risk (aged 50-74 years old) remains low. [10]

Qatar is a country located in Western Asia on the Arabian Peninsula. The population in Qatar is largely diverse and comprised of many ethnicities; Arabs, Asians, Africans and westerns. The majority of the country's workforce are expatriates with different cultural and educational backgrounds. [11]

In Qatar, the latest data shows that CRC is the second most commonly diagnosed cancer (11.71%) among males and the third most commonly diagnosed cancer (8.63%) among females. Moreover, more than two-thirds (68%) of the relevant cases were diagnosed at an advanced stage. [12] Given the diverse population of the country, heterogeneous knowledge regarding CRC is expected. Thus, the primary objective of the current study was to assess the awareness of CRC symptoms and risk factors among the at-risk population (aged 50-74) visiting the primary health care centres in Qatar. The secondary objective was to assess the differences in awareness among population subgroups.

METHODS

Study design and setting

This was a cross-sectional study conducted at the primary healthcare (PHC) centres in Qatar between September 2018 and January 2019. A network of PHC centres is distributed across the country through which a comprehensive promotive, preventive, and curative care is provided free of charge. They are the first line of contact with the community and each health centre has a well-defined catchment population from different ethnic, cultural, social and educational backgrounds; which offers a good representation of the community. At the time of the study, there were 23 PHC

centres distributed across the country's three administrative health regions (North, West, and Central). The study was conducted across six PHC centres, where two health centres were chosen from each region.

Study population and sampling

The inclusion criteria were patients or accompanying people, aged 50-74 years, Arabic or English speakers, visiting one of the selected PHC centres during the study period. The study excluded individuals who previously underwent CRC screening because they have already received counselling about CRC symptoms and risk factors as part of their CRC screening procedure. Thus, their enrollment would interfere with the study main objective. Individuals with cognitive/ communication difficulties were also excluded. The participants were chosen through a non-probability convenient sampling technique.

Patient and public involvement

We did not involve patients or the public in our work.

Sample size

According to Qatar's 2015 Census, there were 211,207 individuals aged 50 years and above in the country. Thus, the estimated sample size was 384 individuals based on a 95% confidence interval, precision of 5%, a hypothesis that 50% (+/-5%) of participants were aware of CRC symptoms and risk factors and a non-response of 20%. The calculation of sample size was performed to obtain a sufficiently precise estimate of the minimum number of study participants to ensure study power.

Data collection

The data collection was done through face-to-face structured interviews using the questionnaire described below. The eligible participants were approached by trained interviewers (resident physicians) at the main waiting areas of the selected PHC centres. After that, they were given a

brief orientation about the study and were invited to participate. All consented individuals were interviewed in their preferred language (English or Arabic). The duration of the interview ranged from 15 to 20 minutes. Upon completing the interview, the participants were encouraged to ask any question. They were provided with an educational booklet on CRC prepared already by primary health care cancer screening department. Additionally, all participants were counselled about CRC and encouraged to take part in bowel cancer screening. Those who reported any concerns or potential symptoms of bowel cancer were referred to their primary care physician for further assessment.

Questionnaire

The current study utilized the validated Bowel/Colorectal Cancer Awareness Measure (Bowel/Colorectal CAM) survey. The questionnaire was designed to evaluate the awareness of CRC among the public. This survey instrument was developed by University College London and Cancer Research United Kingdom (UK). It is based on a generic CAM developed by Cancer Research UK, University College London, Kings College London and Oxford University in 2007-2008.[13] It possesses satisfactory internal reliability with a Cronbach's alpha of 0.84 across all components and test-retest reliability of r = 0.7. The questionnaire is composed of prompted (closed-ended) and unprompted (open-ended) questions. However, we used the prompted section of the questionnaire because it satisfies the study's objectives. Further details about the questionnaire have been described elsewhere. [14]

The study's questionnaire was translated and back-translated (English-Arabic) by two independent translators and any aberrancy was corrected accordingly. Additionally, one item on tobacco use was added to the list of CRC risk factors. The study questionnaire consisted of three main sections. Section A included 6 questions about the background characteristics (age, gender, nationality,

marital status, level of education, employment status). Section B consisted of 9 closed-ended questions that measure the participants' awareness of CRC symptoms. Section C encompassed 11 closed-ended questions related to the participants' awareness of CRC risk factors. Regarding sections B and C, the researchers assigned one point for each "correct" response and null for the "incorrect or I don't know" responses. As a result, the total score ranged from 0 to 9 for section B and 0 to 11 for section C. Furthermore, the overall awareness score ranged from 0 to 20 by combining the scores of sections B and C. The instrument was piloted on 30 participants from the study population to assess its comprehensiveness and clarity.

Statistical analysis

The collected data were analyzed using the Statistical Package for the Social Sciences-SPSS version 23. Descriptive statistics were calculated for continuous and categorical variables where appropriate. Pearson's chi-squared test was used to assess the association between categorical variables. ANOVA test was used to analyse the differences among group means in the sample. A multivariate linear regression model was constructed to identify the independent predictors of CRC awareness and tested for interactions and collinearity. The unadjusted and adjusted differences in means were reported for all potential predictors (age, gender, nationality, marital status, level of education and employment). The level of statistical significance was set at 0.05.

RESULTS

Demographic characteristics

A total of 448 out of 566 invited individuals participated in the study (response rate: 87%) with time constraint being the main reason for non-participation. Table 1 presents the participants' background characteristics. The participants' mean age was 58.48 years (SD±6.37). More than

half of the respondents were females (53.5%), non-Qatari Arabs (52.2%), married (86.8%), and unemployed (54.4%).

Table 1: Background characteristics of participants (N=448)

Variable	n (%)
Age	
50-59	254 (56.7)
60 or more	194 (43.3)
Gender	
Male	208 (46.5)
Female	239 (53.5)
Nationality	
Qatari	107 (24.0)
Non-Qatari Arab	233 (52.2)
Non-Arab[a]	106 (23.8)
Marital status	
Married	389 (86.8)
Divorced/Widow	51 (11.4)
Unmarried [b]	8 (1.8)
Level of education	
No formal education	69 (15.4)
Primary	82 (18.3)
Secondary	101 (22.6)
Tertiary	195 (43.6)
Employment	
Employed	204 (45.6)
Unemployed	243 (54.4)

Missing information: Gender (n = 1), Nationality (n = 2), Level of education (n = 1), Employment (n = 1)

[a] Non-Arab includes Asian, Western and African

[b] Unmarried (single, divorced, or widow)

Awareness of colorectal cancer symptoms and risk factors

The mean awareness score of CRC symptoms among study participants was 3.63 /9 (SD ±2.7), while that of risk factors was 5.43/11 (SD ±3.3). Thus, the overall mean awareness score was 9.03/20 (SD ±5.5).

Table 2 describes the percentages of participants who identified the symptoms and risk factors of CRC. Out of 9 symptoms related to CRC, the most commonly recognised symptoms were “lump

in abdomen" (56.5 %), "unexplained weight loss" (54.5 %), and "blood in stool" (46.9%). On the other hand, the least commonly recognised symptoms were "pain in back passage" (22.5%) and "bowel doesn't empty" (27.9%). Furthermore, the most commonly recognised CRC risk factors were the "daily eating of processed meat" (71.7%), "tobacco use" (69.2%), and "alcohol use" (63.6 %). However, "diabetes" (23.7 %) , "low fruit and vegetables intake" (34.4%), and "older age" (37.7%) were less commonly recognised risk factors.

Table 2: Frequency distribution regarding the awareness of colorectal cancer symptoms and risk factors among participants (N=448)

CRC symptoms	**n (%)**
Lump in abdomen	253 (56.5)
Unexplained weight loss	244 (54.5)
Blood in stools	210 (46.9)
Pain in abdomen	189 (42.2)
Change in bowel habit	173 (38.6)
Bleeding back passage	171 (38.2)
Tiredness	158 (35.3)
Bowel does not empty	125 (27.9)
Pain in back passage	101 (22.5)
CRC risk factors	**n (%)**
Daily eating of processed meat	321 (71.7)
Tobacco use	310 (69.2)
Drinking Alcohol	285 (63.6)
Chronic bowel disease	242 (54.0)
Daily eating of red meat	239 (53.3)
Close relative with CRC	206 (46.0)
Diet low in fibre	204 (45.5)
Overweight (BMI≥ 25 kg/m^2)	187 (41.7)
Older age	169 (37.7)
Low fruit & vegetables (<5 servings/day)	154 (34.4)
Diabetes	106 (23.7)

Females were more likely to recognise the link between unhealthy lifestyle behaviours and CRC than their male counterparts as shown in table 3. For instance, females were more aware about the association of CRC with the following factors: daily consumption of processed meat (76.5% vs. 66.7%; P = 0.01), tobacco use (74.8% vs. 63.6%; P = 0.007), drinking alcohol (69.3% vs. 57.8%; P= 0.008), and daily consumption of red meat (62.6% vs. 43.0%; P <0.001).

Table 3: The relationship between gender and awareness of lifestyle risk factors for colorectal cancer (N=448)

Lifestyle risk factor	**Female n (%)**	**Male n (%)**	***p*-value**
Daily eating of processed meat	182 (76.5)	138 (66.7)	0.014*
Tobacco use	178 (74.8)	131 (63.6)	0.007*
Drinking alcohol	165 (69.3)	119 (57.8)	0.008*
Daily eating of red meat	149 (62.6)	89 (43.0)	<0.001*
Low fruit & vegetables (<5 servings/day)	110 (46.2)	43 (20.9)	<0.001*
Diet low in fibre	113 (47.5)	90 (43.7)	0.24
Overweight (BMI≥25 kg/m^2)	95 (39.9)	91 (44.2)	0.20

BMI: Body Mass Index

* Statistically significant.

The relationship between background characteristics and the CRC awareness mean score

Table 4 describes the relationship between the participants' background characteristics and their CRC awareness mean score. Upon bivariate analyses, the respondents' gender, nationality, and educational level were significantly associated with the awareness regarding CRC symptoms and risk factors.

Table 4: The association between participants' background characteristics and their awareness regarding CRC symptoms and risk factors. (N=448)

Variable	Awareness			
	Symptoms		Risk factors	
	Mean score (95% CI)	*p*-value	Mean score (95% CI)	*p*-value
Age		0.201		0.082
50-59	3.77 (3.42, 4.12)		5.67 (5.26, 6.08)	
60 or more	3.43 (3.05, 3.82)		5.12 (4.65, 5.59)	
Gender		0.146		0.003*
Male	3.41 (3.01, 3.80)		4.92 (4.44, 5.40)	
Female	3.79 (3.45, 4.13)		5.85 (5.46, 6.24)	
Nationality		<0.001*		<0.001*
Qatari	2.71 (2.25, 3.18)		4.63 (4.03, 5.23)	
Non-Qatari Arab	4.20 (3.85, 4.54)		5.81 (5.42, 6.21)	
Non-Arab	3.30 (2.71, 3.89)		5.42 (4.67, 6.16)	
Marital status		0.846		0.668
Married	3.63 (3.35, 3.92)		5.46 (5.12, 5.80)	
Unmarried	3.56 (2.90, 4.22)		5.26 (4.54, 5.98)	
Level of education		<0.001*		0.003*
No formal education	2.00 (1.45, 2.55)		4.07 (3.22, 4.92)	
Primary	3.55 (2.95, 4.15)		5.72 (5.12, 6.32)	
Secondary	3.61 (3.10, 4.13)		5.80 (5.15, 6.45)	
Tertiary	4.26 (3.86, 4.65)		5.58 (5.10, 6.06)	
Employment		0.319		0.04*
Employed	3.49 (3.08, 3.90)		5.09 (4.61, 5.58)	
Unemployed	3.75 (3.43, 4.08)		5.74 (5.35, 6.13)	

* Statistically significant.

Predictors of colorectal cancer awareness

The univariate analysis showed that gender, nationality, and level of education were associated with the overall awareness of CRC among our study participants (Table 5).

The fully adjusted regression model (Table 5) showed that female participants possessed higher overall awareness of CRC by a score of 2.52 (95% CI: 1.15 – 3.88) compared to males. Furthermore, non-Qatari Arabs and non-Arabs were significantly more likely to be aware of CRC compared to Qataris by a score of 2.91 (95% CI: 1.64 – 4.18) and 1.76 (95% CI: 0.28 – 3.24) respectively. Moreover, participants with primary, secondary and tertiary education were

significantly more likely to have a high awareness of CRC compared to participants without formal education by a score of 3.53 (95% CI: 1.85 – 5.23), 2.97 (95% CI: 1.29 – 4.66), and 4.10 (95% CI: 2.55 – 5.66) respectively. On the other hand, age, marital status and employment did not show significant difference of the overall score in the regression model.

Table 5: The predictors of overall awareness of colorectal cancer among the study participants (linear regression) (N=448)

Variable	Univariate linear analysis			Multiple linear regression	
	Mean (SD)	Unadjusted difference in mean (95% CI)	*p*-value	Adjusted difference in mean (95% CI)	*p-value*
Age					
50-59	9.44 (5.50)	Reference		Reference	
60 or more	8.50 (5.54)	-0.94 (-1.97 - 0.09)	0.07	0.33 (-0.74 – 1.41)	0.53
Gender					
Male	8.31 (5.80)	Reference		Reference	
Female	9.62 (5.19)	1.31 (0.30 - 2.33)	0.01*	2.52 (1.15 – 3.88)	0.001*
Nationality					
Qatari	7.30 (5.05)	Reference		Reference	
Non-Qatari Arab	9.99 (5.12)	2.68 (1.44 - 3.92)	<0.001*	2.91 (1.64 – 4.18)	<0.001*
Non-Arab	8.72 (6.40)	1.41 (-0.43 – 2.87)	0.05*	1.76 (0.28 – 3.24)	0.02*
Marital status					
Married	9.08 (5.63)	Reference		Reference	
Unmarried	8.73 (4.84)	0.35 (-1.17 – 1.87)	0.61	-0.62 (-2.13 – 0.88)	0.41
Level of education					
No formal education	6.01 (5.34)	Reference		Reference	
Primary	9.27 (4.80)	3.25 (1.62 – 4.88)	<0.001*	3.53 (1.85 – 5.23)	<0.001*
Secondary	9.42 (5.21)	3.40 (1.77 – 5.02)	<0.001*	2.97 (1.29 – 4.66)	<0.001*
Tertiary	9.81 (5.74)	3.79 (2.27 – 5.30)	<0.001*	4.10 (2.55 – 5.66)	<0.001*
Employment					
Employed	8.56 (5.89)	Reference		Reference	
Unemployed	9.47 (5.17)	-0.91 (-1.93 – 0.11)	0.08	0.79 (-0.62 – 2.20)	0.27

Dependent variable: Overall awareness mean score. Enter multiple linear regression applied. Model assumption is fulfilled. No interactions and no multi-collinearity were detected. R^2= 14.0%. * Statistically significant.

DISCUSSION

The current study aimed to assess the awareness of CRC symptoms and risk factors among adults aged 50 to 74 years in Qatar. The mean awareness score of CRC symptoms among study

participants was 3.63 /9 (SD ±2.7), while that of risk factors was 5.43/11 (SD ±3.3). Thus, the overall mean awareness score was 9.03/20 (SD ±5.5).

This is in line with earlier studies in the region. A study in Bahrain among the general population revealed low awareness about the symptoms and risk factors of CRC. It was found that the score of overall CRC knowledge was 56 % and that of symptoms and risk factors was 59 % and 53 % respectively. [15] Also, a recent national study in Saudi Arabia examined the awareness of 5720 participants on CRC-related symptoms and risk factors. As a result, the mean score of the respondents' awareness was low at 11.05/23. [16]

In comparison to our study, a population survey in the United Kingdom using the bowel/colorectal CAM instrument showed higher awareness regarding CRC symptoms and risk factors. Specifically, the most recognised symptom and risk factor in the British study were "blood in stools" (88.6%) and "close relative with bowel cancer" (65%). However, our study identified "lump in abdomen" (56.5%) and "daily eating of processed meat" (71%) to be the most recognised symptom and risk factor. The least recognised symptom in the UK study was "bowel does not empty" (47%). On the other hand, "pain in back passage" (22.5%) was the least recognised symptom in our study. "Diabetes" was the least recognised risk factor in both studies and was recalled by only a quarter of the participants. [14] The level of education among our study population (43.6% had tertiary education) was higher than that of the UK study (25.6%). However, this observation did not reflect on the level of CRC awareness. Subsequently, the level of education may not be associated with the level of health literacy. The observed difference in the awareness might be explained by the relatively recent introduction of the national bowel cancer screening program and awareness campaigns in Qatar. The program is a population-based initiative that aims at promoting education, awareness, and early detection of bowel cancer among those at risk (aged

50-74 years). [17] It is in line with the Public Health Strategy 2017-2022 which focuses on preventive and community-based care. [18]

Another survey in Malaysia, using the bowel/colorectal CAM tool, revealed lower CRC awareness in comparison to our findings. In the Malaysian study, the mean awareness scores for CRC symptoms and risk factors was 2.89 (SD 2.96) and 3.49 (SD 3.17).[19] This could be explained by the difference in the study settings and the characteristics of the participants. In our study, almost half (43.6%) of the participants reported having a tertiary level of education. On the other hand, the Malaysian survey was conducted in a rural area where only a minority of participants (6.6%) had attained a tertiary level of education.

The present study identified the female gender and formal education as significant predictors of higher CRC awareness. Such results are in line with findings of a regional study conducted in the United Arab Emirates.[20] Another survey of more than 10,000 participants in Hong Kong revealed that male gender was associated with low CRC awareness.[21] On the other hand, a study in Saudi Arabia and a community-based survey in Jordan reported no significant association between gender and knowledge of CRC. [16, 22]

The current study has strengths and limitations. First, the study was the first of its kind to evaluate CRC awareness and its predictors among the at-risk population in Qatar. The study achieved a high response rate (87%) and the sample included a variety of nationalities that represents the diversity of the community in Qatar. In addition, the use of a validated questionnaire through face-to-face interviews by trained data collectors strengthened the validity of the study results. However, the research has some limitations. First, we did not use the unprompted (open-ended) items of the CAM questionnaire to satisfy the study's objectives and due to time constraint.

Secondly, we did not assess the participants' family history for CRC. Lastly, the non-probability sampling method utilized in the study may affect the generalizability of the results.

CONCLUSION

In general, the awareness of CRC symptoms and risk factors was low among the at-risk (50-74 years old) population in Qatar. Specifically, the regression analysis showed males, Qataris, and those with no formal education had low awareness of CRC symptoms and risk factors. This underlines the importance of tailoring future educational campaigns that are relevant, specific (with focus on the male gender and those with low education) and are based on local evidence and effective engagement of the target population.

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Competing Interests

The authors declare no conflict of interest.

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Ethics

This study was approved by the Institutional Review Board of the Primary Health Care Corporation under protocol ID (PHCC/RC/18/05/001).

Contributors

AA conceived and designed the study. AA, MC, MB, MO and OA contributed to the recruitment of the participants and to the acquisition of the data. AA analysed the data. NS and NA contributed

to the design of the work and interpretation of the findings. AA and MC evaluated the results and wrote the manuscript. All authors revised and approved the final manuscript.

Data availability

Data are available upon reasonable request.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-13
		(*b*) Report category boundaries when continuous variables were categorized	11-13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.