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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-035651
Article Type:	Original research
Date Submitted by the Author:	10-Nov-2019
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Keywords:	EPIDEMIOLOGY, Gastrointestinal tumours < GASTROENTEROLOGY, PRIMARY CARE, PREVENTIVE MEDICINE, PUBLIC HEALTH

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3 1 **Colorectal Cancer Awareness and Its Predictors among adults aged 50 to 74 years in the**
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5 2 **State of Qatar, 2019**
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38 15 Word count: 2637
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3 **23 Abstract**
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5 **24 Objective:** The current study aimed to assess the elderly's awareness regarding CRC risk factors,
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8 **25** symptoms, and its predictors.
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11 **26 Design:** A cross-sectional study design was employed.
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13
14 **27 Setting:** Across six primary health centers in Qatar
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17 **28 Participants:** Clients (n=448), aged 50-74 years, attending at the main waiting areas of the
18
19 selected health centers and are Arabic or English speakers.
20
21

22 **30 Data collection and analysis:** Participants were interviewed using a modified version of the
23
24 **31** Cancer Awareness Measures (CAM) tool - Cancer Research UK. A non-probability sampling
25
26 **32** technique was applied to recruit participants. Data was analyzed using the SPSS version 22.
27
28 **33** Descriptive and analytic statistics were applied when appropriate. Multivariate linear regression
29
30 **34** was applied.
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32

33
34 **35 Results:** A total of 448 clients have participated in the study (response rate 87%). The mean age
35
36 **36** of the participants was 58.48 years (SD=6.37 years). The participants' mean awareness score (%)
37
38 **37** regarding CRC symptoms, risk factors, and overall were 40.3%, 49.3%, and 45.2% respectively.
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40 **38** A multivariate linear regression analysis identified that being a female, a non-Qatari Arab, and
41
42 **39** having a formal education were independent predictors of higher CRC awareness.
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45
46 **40 Conclusion:** In conclusion, the present study has shown a low awareness regarding the symptoms
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48 **41** and risk factors of CRC as well as the related national screening program in Qatar. Such results
49
50 **42** underline the importance of tailoring future educational campaigns that are relevant, specific, and
51
52 **43** appealing to such cohort, especially the nationals.
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56 **44**

45 **Strengths and limitations of this study**

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

56 **Keywords:** colorectal cancer; awareness; symptoms; risk factors

66 INTRODUCTION

67 Colorectal cancer (CRC) is the second leading cause of cancer-related deaths and the third-most
68 commonly diagnosed cancer globally. CRC accounted for almost 1.8 million new cases and about
69 860,000 deaths during 2018. By 2030, the global burden of CRC is expected to increase by 60%
70 and result in more than 2.2 million new cases and 1.1 million deaths. ¹ In addition, a rapid rise in
71 the incidence and mortality of CRC has been witnessed in several middle-to-high income countries
72 in Asia, Eastern Europe, and South America. ² On the other hand, there has been a decline in CRC-
73 related mortality among western countries; partly attributed to their effective national screening
74 programs. ³

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

80 The literature has revealed that CRC incidence can be reduced through a comprehensive approach
81 that entails dietary modifications, regular physical activity and family- or community-based
82 interventions for cancer prevention. ⁵ For instance, it has been estimated that more than a quarter
83 (27%) of CRC cases could have been prevented through increasing fiber intake and decreasing red
84 or processed meat consumption. In addition, almost one-seventh (14%) and one-fifth (12%) of
85 CRC cases could have been avoided through the proper management of excess weight and physical
86 inactivity. ⁶ Thus, public awareness about such modifiable risk factors is crucial for any public
87 health strategies aimed at reduction or prevention of CRC.

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3 88 Several studies have shown that the awareness and knowledge of CRC risk factors and symptoms
4
5 89 are positively linked to an increased likelihood of adherence to CRC screening recommendations.
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7 90 ^{7, 8, 9} Despite growing evidence on the association between lifestyle factors and CRC incidence,
8
9 91 the awareness of such risk factors among the high-risk population group (aged 50-74 years old)
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11 92 remains low. ¹⁰

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15 93 In the State of Qatar, the latest data shows that CRC is the second most commonly diagnosed
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17 94 cancer (10.23%) among different nationalities and both genders. Moreover, more than two-thirds
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19 95 (68%) of the relevant cases were diagnosed at an advanced stage. In 2016, Qatar launched its
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21 96 national colorectal cancer-screening program. The program is a life-saving population-based
22
23 97 initiative that aims at promoting education, awareness, and early detection of bowel cancer to those
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25 98 aged 50-74 years old. ¹¹ It is in line with the Public Health Strategy 2017-2022 which focuses on
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27 99 preventive and community-based care. ¹² Given the diverse population of the country,
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29 100 heterogeneous knowledge regarding CRC is expected. Thus, the current study aimed to assess the
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31 101 awareness of clients (aged 50-74 years) regarding CRC risk factors, symptoms, and its predictors.
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36 102 **4METHODS**

37 38 39 103 **Study design and setting**

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41 104 This was a cross-sectional study design conducted at the Primary Health Centers (PHCs) in the
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43 105 state of Qatar. The PHCs are the first line of contact between the population and the national health
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45 106 care system. Moreover, each PHC serves a large population of different ethnic, cultural, social and
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47 107 educational backgrounds; which is representative of the community in Qatar.

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49
50 108 The data was collected during both morning and evening work shifts of the health centers and the
51
52 109 data collection lasted from September 2018 till January 2019.

53 54 55 56 110 **Participants**

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3 111 The target population included clients of the selected PHC centers aged 50-74 years old, both
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5 112 Arabic and English speaking, regardless of their gender or nationality. The study excluded clients
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7 113 who previously underwent screening for CRC and those not capable of communicating or
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9 114 providing consent due to any disability (mental or physical). The former were excluded because
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11 115 they received education about CRC symptoms and risk factors as part of their CRC screening
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14 116 procedure. As a result, their participation in the present study would have interfered with the
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16 117 study's main objectives.

19 118 **Patient and public involvement**

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22 119 We did not involve patients or the public in our work.

24 120 **Sample size**

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27 121 According to Qatar's 2015 Census, there were 211,207 individuals aged 50 years and above in the
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29 122 country. Thus, the estimated sample size was 384 clients given a 95% confidence interval, a
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31 123 precision of 5%, and a hypothesis that 50% (+/-5%) of clients were aware of CRC.

34 124 **Sampling method**

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37 125 At the time of the study, there were 23 PHC in the country. The study was conducted across six
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39 126 PHCs chosen from the three operational health regions (North, West, and Central region) in the
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41 127 country; the two busiest health centers from each region. Then, the participants were chosen
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43 128 through convenient sampling, which included those aged 50-74 years who attend the selected
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45 129 primary health centers.

49 130 **Research Protocol**

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51 131 The data collection was done through face-to-face structured interviews using the questionnaire
52
53 132 described below. The eligible participants were approached by trained interviewers (resident
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55 133 physicians) at the main waiting areas of the selected PHCs. After that, they were given a brief

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2
3 134 orientation about the study and invited to participate in the survey. All those, who consented, were
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5 135 interviewed in their preferred language and the duration of the interview lasted between 15 to 20
6
7 136 minutes. Upon completing the interview, the respondents were encouraged to ask any question and
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9 137 then were provided with an educational booklet on bowel cancer in both languages (Arabic and
10
11 138 English). Additionally, the data collectors counseled all participants about bowel cancer and
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13
14 139 invited them to participate in the national bowel cancer screening program. Those who had
15
16 140 concerns or who showed any potential symptoms or signs of bowel cancer were asked to inform
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18 141 their primary care physician for further assessment and follow up.
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21 142 **Data collection tool**

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23
24 143 The current study utilized a validated questionnaire based on a modified version of the Cancer
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26 144 Awareness Measures-Cancer Research UK survey (bowel cancer). The survey was designed to
27
28 145 examine the general public's awareness of CRC. The questionnaire possesses a satisfactory
29
30 146 internal reliability with Cronbach's alpha of 0.84 for all components and the test-retest reliability
31
32 147 was $r = 0.7$. Further details about the questionnaire have been described elsewhere.¹³
33
34 148 Subsequently, the study's questionnaire was translated and back-translated (English-Arabic) by
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36 149 two independent professional translators and any aberrancy was corrected accordingly.
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38 150 Furthermore, it was piloted on a number of participants similar to the study population and
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40 151 modifications were done based where necessary.
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42 152 As a result, the current questionnaire composed of three main sections. Section A consisted of six
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44 153 questions exploring the background characteristics of the participants (age, gender, nationality,
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46 154 marital status, level of education, employment status). Section B consisted of nine closed-ended
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48 155 questions designed to measure the participants' awareness regarding CRC warning symptoms.
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50 156 Section C encompassed eleven closed-ended questions that identified the participants' awareness
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3 157 of CRC risk factors. Regarding sections B and C, the participants were instructed to select one of
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5 158 three choices (Yes, No, I don't know). The answers to the aforementioned questions were coded
6
7 159 as correct or incorrect, where the researchers assigned one point for each "correct" response and
8
9 160 null for the "incorrect or I don't know" responses. As a result, the correct answers were summed
10
11 161 and the percentage score was calculated accordingly. Thus, the total scores for sections B and C
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13
14 162 ranged from 0 to 9 and 11 respectively.

17 163 **Statistical analysis**

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19 164 The collected data was analyzed using the Statistical Package for the Social Sciences-SPSS version
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21
22 165 22. Both descriptive and analytic statistics were applied when appropriate. The level of statistical
23
24 166 significance was set at 0.05. We used parametric testing including the independent t-test and
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26 167 ANOVA test to compare subgroups and detect any statistically significant difference in the
27
28 168 individual and total mean score of CRC awareness. A multivariate linear regression model was
29
30
31 169 constructed to identify the independent predictors of CRC awareness and tested for interactions
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33 170 and collinearity. Variables were included in the final model if they were deemed to be clinically
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35 171 important or if they were found to have a P value of < 0.25 on bivariable analysis. Unstandardized
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37 172 Beta coefficients with 95% CIs and P values were reported for each of the predictors based on the
38
39 173 above regression model.

42 43 174 **RESULTS**

44 45 46 175 **Demographic characteristics**

47
48 176 Five hundred and fifteen (515) eligible candidates were approached for enrolment in the study, 67
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50 177 of whom refused to participate. As a result, 448 clients participated in the present study (response
51
52 178 rate: 87%). Table 1 presents the background characteristics of the study participants, where most
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54 179 respondents were females (53.5%), non-Qatari Arabs (52.2%), married (86.8%), with Diploma or
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180 University degree (43.6%), and unemployed (54.4%). The mean age of the participants was 58.48
 181 years (SD=6.37 years).

182 **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)

183 ** Non-Arab includes Asian, Western and African

184 **Awareness of colorectal cancer symptoms and risk factors**

185 Table 2 describes the percentages of participants who correctly identified the symptoms and risk
 186 factors of CRC. Out of nine symptoms related to CRC, the most commonly reported symptom by
 187 the respondents was a “lump in abdomen” (56.5 %) followed by “unexplained weight loss” (54.5
 188 %) and “blood in stool” (46.9%). On the other hand, the least commonly reported symptoms were
 189 “pain in back passage” (22.5%) and “bowel doesn’t empty” (27.9%).

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

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

194 Additionally, women were more likely to aware of the link between lifestyle behaviors and CRC
 195 than their male counterparts. In that regards, a statistically significant gender difference was noted
 196 in which women were more knowledgeable than men about the association of CRC with the
 197 following factors: eating less than five servings of fruit and vegetables (46% vs. 21%; P = 0.000),
 198 eating processed meat daily (76% vs. 67%; P = 0.02), drinking alcohol (69% vs. 58%; P= 0.01),
 199 and smoking (75% vs. 64%; P = 0.01). On the other hand, non-Arabic participants were more
 200 likely to report that being overweight could increase the risk of CRC compared to the Qatari and
 201 Arab participants (51% vs. 27% vs 45%; P = 0.001). However, Arab respondents were more likely
 202 to acknowledge that consuming a low-fiber diet was a risk factor for CRC than their Qatari peers
 203 (53% vs. 26% P = 0.000).

204 **Table 2.** Frequency distribution regarding the awareness of colorectal cancer symptoms and risk
 205 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)

206

207 Mean score awareness of colorectal cancer

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

214 The relationship between background characteristics and the CRC awareness mean score

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

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

Variable	Awareness				Overall awareness	
	Symptoms		Risk factors		Mean score (95% CI)	<i>p</i> -value
	Mean score (95% CI)	<i>p</i> -value	Mean score (95% CI)	<i>p</i> -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.	<i>p</i> -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)	

233 Dependent variable: Overall awareness mean score (out of 100). Enter multiple linear regression applied.

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

235 C.I.: Confidence Interval

236 *Statistically significant at p < 0.05.

237

238 **DISCUSSION**

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

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

244 The decreased awareness about the symptoms and risk factors of CRC among the study
245 participants are similar to findings from earlier studies in the region. A study conducted by Nasaif
246 and Al Qallaf in Bahrain among the general population revealed similar yet slightly higher
247 awareness about the symptoms (59%) and risk factors (51%) of CRC.¹⁴ Also, a recent national
248 study in the Kingdom of Saudi Arabia among 5732 participants examined the awareness of
249 respondents on CRC-related symptoms, risk factors, types, and screening tests. As a result, the
250 mean score of the participants' awareness was low at 11.05/26.¹⁵ In addition, the results of the
251 current study are comparable to findings of international studies. A population survey in the United
252 Kingdom has revealed a low awareness regarding multiple bowel cancer signs and risk factors.
253 The participants showed low awareness about the association between certain lifestyle behaviors
254 and the risk of CRC.¹³ Another cross-sectional survey of patients attending a tertiary outpatient
255 clinic in the Nation of Brunei revealed that the mean knowledge scores for CRC symptoms (21.6%)

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3 256 and risk factors (12%) were poor.¹⁶ Subsequently, such low level of awareness might translate
4
5 257 into a decreased uptake of screening among the target population.¹⁵ On the other hand, a
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7 258 telephone-based survey among American residents in South Carolina described a high level of
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9 259 awareness regarding CRC despite a relatively low uptake of bowel cancer screening.¹⁷

11
12 260 One more significant finding was that the female gender, non-Qatari Arab nationality, and having
13
14 261 any formal education were significant predictors for higher CRC awareness. Such results correlate
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16 262 well with an earlier regional study among individuals aged ≥ 50 years-old in the United Arab
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18 263 Emirates. As a result, it was found that the male gender and low level of education were significant
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20 264 predictors of low awareness about the risk factors as well as signs and symptoms of bowel cancer.

21
22 265 ¹⁸ Also, a survey of more than ten thousand participants in Hong Kong revealed that the male
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24 266 gender was associated with low awareness about bowel cancer symptoms and risk factors.¹⁹ On
25
26 267 the other hand, a community-based survey in Jordan reported no significant gender association
27
28 268 with the knowledge of CRC, where both men and women had low knowledge scores.²⁰ In addition,
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30 269 a cross-sectional study among hospital employees aged 50 years and above in Greece revealed that
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32 270 university education was the sole independent determinant of bowel cancer screening.²¹

33
34 271 The current study has several strengths and limitations. First of all, the study was the first of its
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36 272 kind to evaluate the CRC awareness and its predictors among a high-risk population in the State
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38 273 of Qatar. The study achieved a high response rate (87%) and the sample included a variety of
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40 274 nationalities that represents the diversity of the community in Qatar. In addition, the use of a
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42 275 validated questionnaire to collect data from the target population strengthen the validity of the
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44 276 study. However, the research at hand was not without limitation. Recruiting the participants from
45
46 277 healthcare settings may over-estimate the awareness level of CRC, as it's expected that those
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48 278 participants would have better awareness than those who don't seek healthcare services. In
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3 279 addition, the non-probability sampling method utilized in the study may affect the generalizability
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5 280 of the results.
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8 281 **CONCLUSION**

9
10 282 In conclusion, the present study has shown a decreased awareness regarding the symptoms, signs,
11
12 283 and risk factors of CRC among the elderly population in Qatar. Given the presence of earlier
13
14 284 awareness campaigns on bowel cancer in Qatar, the observed awareness among the elderly
15
16 285 population in the current study underlines the importance of tailoring future educational campaigns
17
18 286 that are relevant, specific (special focus on the association between certain lifestyle behaviours and
19
20 287 CRC), and appealing to such cohort (especially the nationals). Also, any planned intervention to
21
22 288 heighten the elderly's awareness of CRC as well as its national screening program must be based
23
24 289 on local evidence of the status quo and rely on an effective engagement of this population, given
25
26 290 the delicate nature of any public health message related to such disease.
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31 291 **Acknowledgments**

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34 292 None.
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37 293 **Competing Interests**

38
39 294 The authors declare no conflict of interest.
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41

42 295 **Funding**

43
44 296 This study was approved was funded by the Research Department of the Primary Health Care
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46 297 Corporation under protocol ID (PHCC/RC/18/05/001).
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49 298 **Ethical**

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52 299 This study was approved by the Institutional Review Board of the Primary Health Care
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54 300 Corporation under protocol ID (PHCC/RC/18/05/001).
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3 301 **Author contributorship**

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5 302 AA, MC, and MB contributed to the conception and planning of the research. AA conducted the
6
7 303 analysis. All authors contributed equally to the conduct and reporting of the work described in the
8
9 304 article.

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12 305 **Data sharing**

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14 306 All data relevant to the study are included in the article.

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17 307 **References**

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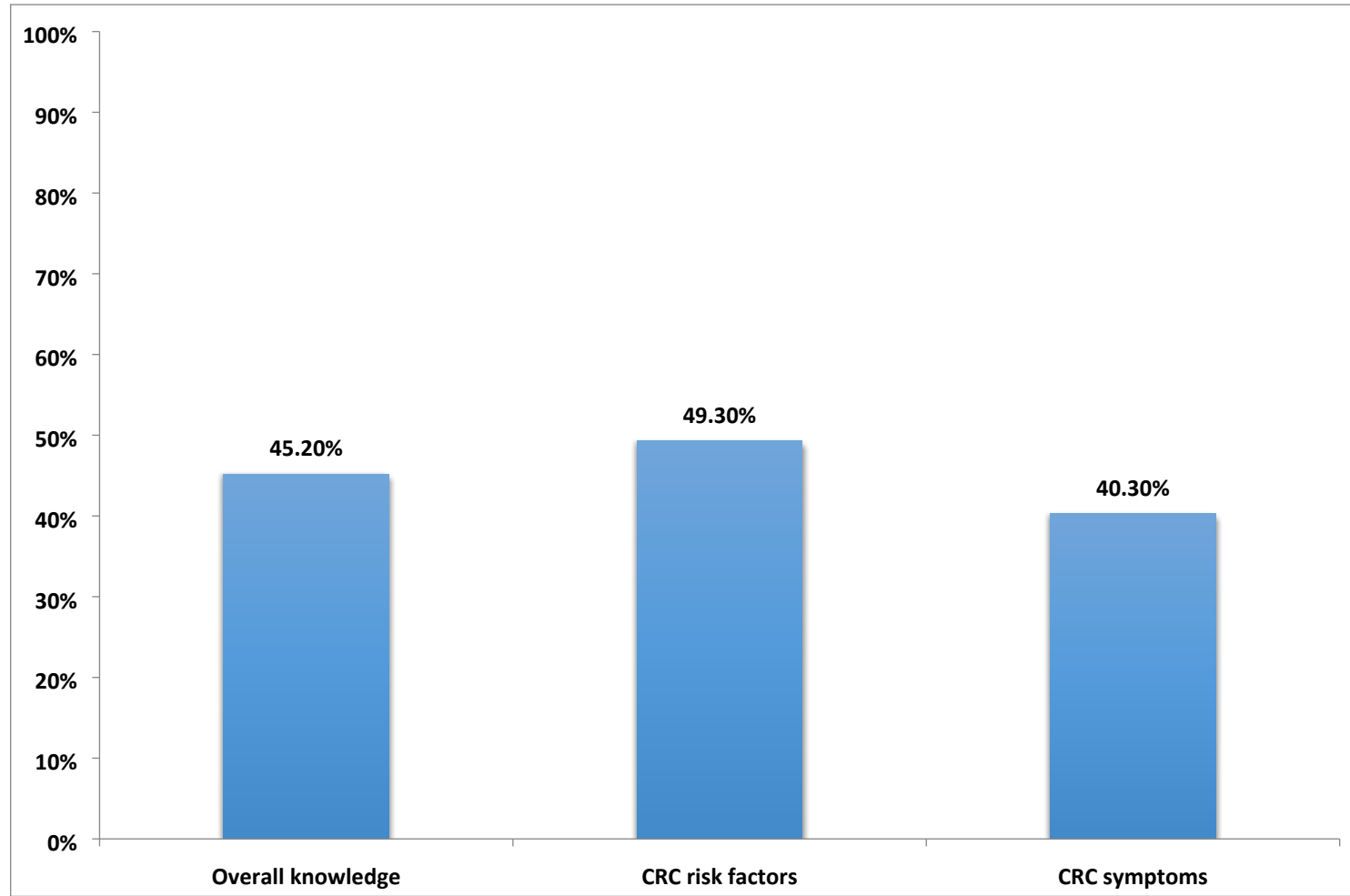


Figure 1. Mean score (%) of CRC awareness components (overall, symptoms, risk factor)

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.

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-035651.R1
Article Type:	Original research
Date Submitted by the Author:	03-Mar-2020
Complete List of Authors:	AL DAHSHAN, AYMAN; Hamad Medical Corporation Department of Medical Education, Chehab, Mohamad; Hamad Medical Corp, Community Medicine Bala, Mohamed; Hamad Medical Corporation, Omer , Mieaad ; Hamad Medical Corporation, Community medicine AlMohamed, Omayma; Primary Health Care Corporation Al-Kubaisi, Noora; Primary Health Care Corporation, clinical affairs Selim, Nagah; Cairo University
Primary Subject Heading:	Public health
Secondary Subject Heading:	Gastroenterology and hepatology
Keywords:	EPIDEMIOLOGY, Gastrointestinal tumours < GASTROENTEROLOGY, PRIMARY CARE, PREVENTIVE MEDICINE, PUBLIC HEALTH

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3 1 **A Colorectal cancer awareness and its predictors among adults aged 50 to 74 years**
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5 2 **attending primary health care in the State of Qatar: a cross-sectional study**
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38 15 Word count: 2293
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3 **23 Abstract**
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5 **24 Objective:** The current study aimed to assess the awareness of colorectal cancer (CRC) symptoms
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8 **25** and risk factors among the at-risk population. The secondary objective was to assess the
9
10 **26** differences in awareness among population subgroups.

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13 **27 Design:** A cross-sectional study design was employed.
14
15

16 **28 Setting:** The study was conducted across 6 primary healthcare (PHC) centres in Qatar.
17
18

19 **29 Participants:** Patients, or their accompanying people, aged 50-74 years and Arabic or English
20
21 **30** speakers, were recruited from the main waiting areas of the selected PHC centres.
22
23

24 **31 Data collection and analysis:** Participants were interviewed using the validated Bowel/Colorectal
25
26 **32** Cancer Awareness Measure (Bowel/Colorectal CAM) questionnaire. A non-probability
27
28 **33** convenient sampling technique was applied to recruit participants. Data were analyzed using SPSS
29
30 **34** version 23. Descriptive and analytic statistics were utilized when appropriate. A multivariate linear
31
32 **35** regression model was constructed to identify the independent predictors of CRC awareness.
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36 **36 Results:** The study includes 448 participants (response rate= 87%). The mean age of the
37
38 **37** participants was 58.48 years (SD \pm 6.37). The mean awareness score among the participants was
39
40 **38** 3.63 /9 (SD \pm 2.7) for CRC symptoms and 5.43/11 (SD \pm 3.3) for CRC risk factors. The overall
41
42 **39** mean awareness score was 9.03/20 (SD \pm 5.5). Multivariate linear regression identified the female
43
44 **40** 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
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46 **41** educational level (B=3.02 to 4.08; $P \leq 0.001$) as independent predictors of higher CRC awareness.
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51 **42 Conclusion:** In conclusion, the present study has shown low awareness regarding the symptoms
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53 **43** and risk factors of CRC. Such results emphasize the importance of tailoring future educational
54
55 **44** campaigns that are relevant, specific, and appealing to such cohort.
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45 **Strengths and limitations of this study**

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

57 **Keywords:** colorectal cancer; awareness; symptoms; risk factors

67 INTRODUCTION

68 Colorectal cancer (CRC) is the third-most commonly diagnosed cancer and the second leading
69 cause of cancer-related deaths worldwide. CRC accounted for almost 1.8 million new cases and
70 860,000 deaths during 2018. By 2030, the global burden of CRC is expected to increase by 60%
71 and results in more than 2.2 million new cases and 1.1 million deaths. ¹ In addition, there has been
72 a rapid rise of CRC incidence and mortality across several middle-to-high income countries in
73 Asia, Eastern Europe, and South America. ² On the other hand, a decline in CRC-related mortality
74 has been witnessed among western countries; partly attributed to their effective national screening
75 programs. ³

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

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

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3 89 Several studies have shown that the awareness of CRC symptoms and risk factors is positively
4
5 90 linked to the uptake of CRC screening.^{7,8,9} Despite growing evidence on the association between
6
7 91 lifestyle factors and CRC, the awareness of such risk factors among the population at risk (aged
8
9 92 50-74 years old) remains low.¹⁰

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12 93 Qatar is a country located in Western Asia on the Arabian Peninsula. The population in Qatar is
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14 94 largely diverse and comprised of many ethnicities; Arabs, Asians, Africans and westerns). The
15
16 95 majority of the country's workforce are expatriates with different cultural and educational
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18 96 backgrounds.¹¹

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22 97 In Qatar, the latest data shows that CRC is the second most commonly diagnosed cancer (11.71%)
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24 98 among males and the third most commonly diagnosed cancer (8.63%) among females, Moreover,
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26 99 more than two-thirds (68%) of the relevant cases were diagnosed at an advanced stage.¹² In 2016,
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29 100 Qatar launched its national colorectal cancer screening program. The program is a population-
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31 101 based initiative that aims at promoting education, awareness, and early detection of bowel cancer
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33 102 among those at risk (aged 50-74 years).¹³ It is in line with the Public Health Strategy 2017-2022
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35 103 which focuses on preventive and community-based care.¹⁴ Given the diverse population of the
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37 104 country, heterogeneous knowledge regarding CRC is expected. Thus, the primary objective of the
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39 105 current study was to assess the awareness of CRC symptoms and risk factors among individuals
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41 106 at risk. The secondary objective was to assess the differences in awareness among population
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43 107 subgroups.

44 45 46 47 48 108 **METHODS**

49 50 51 109 **Study design and setting**

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53 110 This was a cross-sectional study conducted at the primary healthcare (PHC) centres in Qatar
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55 111 between September 2018 and January 2019. A network of PHC centres is distributed across the

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3 112 country through which a comprehensive promotive, preventive, and curative care is provided free
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5 113 of charge. They are the first line of contact with the community and each health centre has a well-
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7 114 defined catchment population from different ethnic, cultural, social and educational backgrounds;
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9 115 which offers a good representation of the community. At the time of the study, there were 23 PHC
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11 116 centres distributed across the country's 3 administrative health regions (North, West, and Central).
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13
14 117 The study was conducted across 6 PHC centres, where two health centres were chosen from each
15
16 118 region.

18 119 **Study population and sampling**

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21 120 The inclusion criteria were patients or accompanying people, aged 50-74 years, Arabic or English
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23 121 speakers, visiting one of the selected PHC centres during the study period. The study excluded
24
25 122 individuals who previously underwent CRC screening because they have already received
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27 123 counselling about CRC symptoms and risk factors as part of their CRC screening procedure. Thus,
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29 124 their enrollment would interfere with the study main objective. Individuals with cognitive/
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31 125 communication difficulties were excluded. The participants were chosen through a non-probability
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33 126 convenient sampling technique.
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37 127 **Patient and public involvement**

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40 128 We did not involve patients or the public in our work.
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43 129 **Sample size**

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45 130 According to Qatar's 2015 Census, there were 211,207 individuals aged 50 years and above in the
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47 131 country. Thus, the estimated sample size was 384 individuals based on a 95% confidence interval,
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49 132 precision of 5%, a hypothesis that 50% (+/-5%) of participants were aware of CRC symptoms and
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51 133 risk factors and a non-response of 20%.
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55 134 **Data collection**

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3 135 The data collection was done through face-to-face structured interviews using the questionnaire
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5 136 described below. The eligible participants were approached by trained interviewers (resident
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7 137 physicians) at the main waiting areas of the selected PHC centres. After that, they were given a
8
9 138 brief orientation about the study and invited to participate. All consenting individuals were
10
11 139 interviewed in their preferred language (English or Arabic). The duration of the interview ranged
12
13
14 140 from 15 to 20 minutes. Upon completing the interview, the participants were encouraged to ask
15
16 141 any questions. They were provided with an educational booklet on CRC. Additionally, all
17
18 142 participants were counselled about CRC and encouraged to take part in bowel cancer screening.
19
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21 143 Those who reported any concerns or potential symptoms of bowel cancer were referred to their
22
23 144 primary care physician for further assessment.

24 25 26 145 **Questionnaire**

27
28 146 The current study utilized the validated Bowel/Colorectal Cancer Awareness Measure
29
30 147 (Bowel/Colorectal CAM) survey. The questionnaire was designed to evaluate the awareness of
31
32 148 CRC among the public. This survey instrument was developed by University College London and
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34 149 Cancer Research United Kingdom (UK). It is based on a generic CAM developed by Cancer
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36 150 Research UK, University College London, Kings College London and Oxford University in 2007-
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38 151 08.¹⁵ It possesses satisfactory internal reliability with a Cronbach's alpha of 0.84 across all
39
40 152 components and test-retest reliability of $r = 0.7$. The questionnaire is composed of prompted
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42 153 (closed-ended) and unprompted (open-ended) questions. However, we used the prompted section
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44 154 of the questionnaire because it satisfies the study's objectives. Further details about the
45
46 155 questionnaire have been described elsewhere.¹⁶

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51 156 The study's questionnaire was translated and back-translated (English-Arabic) by two independent
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53 157 translators and any aberrancy was corrected accordingly. Additionally, one item on tobacco use

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3 158 was added to the list of CRC risk factors. The study questionnaire consisted of three main sections.
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5 159 Section A included 6 questions about the background characteristics (age, gender, nationality,
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7 160 marital status, level of education, employment status). Section B consisted of 9 closed-ended
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9 161 questions that measure the participants' awareness of CRC symptoms. Section C encompassed 11
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11 162 closed-ended questions related to the participants' awareness of CRC risk factors. Regarding
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14 163 sections B and C, the researchers assigned one point for each "correct" response and null for the
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16 164 "incorrect or I don't know" responses. As a result, the total score ranged from 0 to 9 for section B
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18 165 and 0 to 11 for section C. Furthermore, the overall awareness score ranged from 0 to 20 by
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21 166 combining the scores of sections B and C. The instrument was piloted on 30 participants from the
22
23 167 study population to assess its comprehensiveness and clarity.

168 **Statistical analysis**

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

176 **RESULTS**

177 **Demographic characteristics**

178 A total of 448 participants were enrolled in the study (response rate: 87%) with time constraint
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180 being the main reason for non-participation. Table 1 presents the participants' background
181
182 characteristics. The participants' mean age was 58.48 years (SD±6.37). More than half of the

181 respondents were females (53.5%), non-Qatari Arabs (52.2%), married (86.8%), and unemployed
 182 (54.4%).

183 **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)

184 * Non-Arab includes Asian, Western and African

185 **Awareness of colorectal cancer symptoms and risk factors**

186 The mean awareness score of CRC symptoms among study participants was 3.63 /9 (SD ±2.7),
 187 while that of risk factors was 5.43/11 (SD ±3.3). Thus, the overall mean awareness score was
 188 9.03/20 (SD ±5.5).

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

192 other hand, the least commonly recognised symptoms were “pain in back passage” (22.5%) and
 193 “bowel doesn’t empty” (27.9%).

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

197 **Table 2:** Frequency distribution regarding the awareness of colorectal cancer symptoms and risk
 198 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 \geq 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)

199
 200 Females were more likely to recognise the link between unhealthy lifestyle behaviours and CRC
 201 than their male counterparts as shown in table 3. For instance, females were more aware about the
 202 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 \geq 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 ($B=2.6$; $P \leq 0.001$), non-Qatari or non-Arab nationalities ($B= 2.81$ or 1.6 ; $P \leq 0.001$), and educational level ($B=3.02$ to 4.08 ; $P \leq 0.001$) (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. $R^2= 14.0\%$.

CI= Confidence Interval.

229 *Statistically significant at $p < 0.05$.

230

231 **DISCUSSION**

232 This is the first study to assess the awareness of CRC symptoms and risk factors among adults aged
233 50 to 74 years in Qatar. The mean awareness score of CRC symptoms among study participants
234 was 3.63 /9 (SD ± 2.7), while that of risk factors was 5.43/11 (SD ± 3.3). Thus, the overall mean
235 awareness score was 9.03/20 (SD ± 5.5).

236 This is in line with earlier studies in the region. A study in Bahrain among the general population
237 revealed low awareness about the symptoms and risk factors of CRC.¹⁷ Also, a recent national
238 study in Saudi Arabia examined the awareness of 5732 participants on CRC-related symptoms and
239 risk factors. As a result, the mean score of the respondents' awareness was low at 11.05/23.¹⁸

240 In comparison to our study, a population survey in the United Kingdom using the bowel/colorectal
241 CAM instrument showed higher awareness regarding CRC symptoms and risk factors.
242 Specifically, the most recognised symptom and risk factor in the British study were "blood in
243 stools" (88.6%) and "close relative with bowel cancer" (65%). However, our study identified
244 "lump in abdomen" (56.5%) and "daily eating of processed meat" (71%) to be the most recognised
245 symptom and risk factor. The least recognised symptom in the UK study was "bowel does not
246 empty" (47%). On the other hand, "pain in back passage" (22.5%) was the least recognised
247 symptom in our study. "Diabetes" was the least recognised risk factor in both studies and was
248 recalled by only a quarter of the participants.¹⁶ The level of education among our study population
249 (43.6% with a diploma/university) was higher than that of the UK study (25.6%). However, this
250 observation did not reflect on the level of CRC awareness. Subsequently, the level of education
251 may not be associated with the level of health literacy. The observed difference in the awareness
252 might be explained by the relatively recent introduction of the national bowel cancer screening
253 program and awareness campaigns in Qatar.

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3 254 Another survey in Malaysia, using the bowel/colorectal CAM tool, revealed lower CRC awareness
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5 255 in comparison to our findings. In the Malaysian study, the mean awareness scores for CRC
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7 256 symptoms and risk factors was 2.89 (SD 2.96) and 3.49 (SD 3.17).¹⁹ This could be explained by
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9 257 the difference in the study settings and the characteristics of the participants.

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12 258 The present study identified the female gender and formal education as significant predictors of
13
14 259 higher CRC awareness. Such results are in line with findings of a regional study conducted in the
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16 260 United Arab Emirates.²⁰ Another survey of more than 10,000 participants in Hong Kong revealed
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18 261 that male gender was associated with low CRC awareness.²¹ On the other hand, a study in Saudi
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20 262 Arabia and a community-based survey in Jordan reported no significant association between
21
22 263 gender and knowledge of CRC. ^(18, 22)

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27 264 The current study has strengths and limitations. First, the study was the first of its kind to evaluate
28
29 265 CRC awareness and its predictors among the at-risk population in Qatar. The study achieved a
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31 266 high response rate (87%) and the sample included a variety of nationalities that represents the
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33 267 diversity of the community in Qatar. In addition, the use of a validated questionnaire through face-
34
35 268 to-face interviews by trained data collectors strengthened the validity of the study results.
36
37 269 However, the research has some limitations. First, we did not use the unprompted (open-ended)
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39 270 items of the CAM questionnaire to satisfy the study's objectives and due to time constraint.
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41 271 Secondly, we did not assess the participants' family history for CRC. Lastly, the non-probability
42
43 272 sampling method utilized in the study may affect the generalizability of the results.

44 45 46 47 48 273 **CONCLUSION**

49
50 274 In conclusion, the awareness of CRC symptoms and risk factors was low among the at-risk
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52 275 population in Qatar. This underlines the importance of tailoring future educational campaigns that

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

278 **Acknowledgements**

279 We would like to acknowledge Dr. Eman Radwan for her effort in reviewing the manuscript.

280 **Competing Interests**

281 The authors declare no conflict of interest.

282 **Funding**

283 This study was funded by the Research Department of the Primary Health Care Corporation under
284 protocol ID (PHCC/RC/18/05/001).

285 **Ethics**

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

288 **Contributors**

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

293 **Data availability**

294 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.

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-035651.R2
Article Type:	Original research
Date Submitted by the Author:	20-May-2020
Complete List of Authors:	AL DAHSHAN, AYMAN; Hamad Medical Corporation Department of Medical Education, Chehab, Mohamad; Hamad Medical Corp, Community Medicine Bala, Mohamed; Hamad Medical Corporation, Omer , Mieaad ; Hamad Medical Corporation, Community medicine AlMohamed, Omayma; Primary Health Care Corporation Al-Kubaisi, Noora; Primary Health Care Corporation, clinical affairs Selim, Nagah; Cairo University
Primary Subject Heading:	Public health
Secondary Subject Heading:	Gastroenterology and hepatology
Keywords:	EPIDEMIOLOGY, Gastrointestinal tumours < GASTROENTEROLOGY, PRIMARY CARE, PREVENTIVE MEDICINE, PUBLIC HEALTH

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3 1 **Colorectal cancer awareness and its predictors among adults aged 50 to 74 years attending**
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5 2 **primary health care in the State of Qatar: a cross-sectional study**
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8 3 Ayman Al-Dahshan ^{(1)*}, Mohamad Chehab ⁽¹⁾, Mohamed Bala ⁽¹⁾, Mieaad Omer ⁽¹⁾, Omayma
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15 Word count: 2744

1
2
3 **Abstract**

4
5 **Objective:** The current study aimed to assess the awareness of colorectal cancer (CRC) symptoms
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7
8 and risk factors among the at-risk population visiting the primary healthcare (PHC) centres in
9
10
11 Qatar. The secondary objective was to assess the differences in awareness among population
12
13 subgroups.

14
15 **Design:** A cross-sectional study design was employed.

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

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

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

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42 **Results:** The study includes 448 participants (response rate= 87%). The mean age of the
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45 participants was 58.48 years (SD \pm 6.37). The mean awareness score among the participants was
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48 3.63 /9 (SD \pm 2.7) for CRC symptoms and 5.43/11 (SD \pm 3.3) for CRC risk factors. The overall
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50
51 mean awareness score was 9.03/20 (SD \pm 5.5). Multivariate linear regression identified the female
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54 gender [2.52 (95% CI: 1.15 – 3.88)], non-Qatari Arab [2.91 (95% CI: 1.64 – 4.18)] or non-Arab
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57 nationalities [1.76 (95% CI: 0.28 – 3.24)], and tertiary education [4.10 (95% CI: 2.55 – 5.66)] as
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60 independent predictors of higher CRC awareness.

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3 44 **Conclusion:** In general, the awareness of CRC symptoms and risk factors was low among the at-
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5 45 risk population in Qatar. Specifically, the regression analysis showed males, Qataris, and those
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7 46 with no formal education had low awareness of CRC symptoms and risk factors. Such results
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9 47 emphasize the importance of tailoring future educational campaigns that are relevant, specific, and
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11 48 appealing to such cohort.
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14 15 49 **Strengths and limitations of this study**

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17
18 50 • This was the first cross-sectional study to evaluate CRC awareness and its predictors
19
20 51 among the population at risk in Qatar.
- 21
22 52 • The use of a validated questionnaire to collect data from the target population strengthened
23
24 53 the validity of the study.
- 25
26
27 54 • The interviews were conducted using a structured face-to-face interview by trained data
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29 55 collectors.
- 30
31 56 • The non-probability sampling method utilized in the study may affect the generalizability
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33 57 of the results.
- 34
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36 58 • Despite not being a population-based study, the current research recruited participants from
37
38 59 PHC centres and offers a good representation of the different ethnic, cultural, and social
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40 60 backgrounds in Qatar.

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44 61 **Keywords:** colorectal cancer; awareness; symptoms; risk factors
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66 INTRODUCTION

67 Colorectal cancer (CRC) is the third-most commonly diagnosed cancer and the second leading
68 cause of cancer-related deaths worldwide. CRC accounted for almost 1.8 million new cases and
69 860,000 deaths during 2018. By 2030, the global burden of CRC is expected to increase by 60%
70 and results in more than 2.2 million new cases and 1.1 million deaths. ¹ In addition, there has been
71 a rapid rise of CRC incidence and mortality across several middle-to-high income countries in
72 Asia, Eastern Europe, and South America. ² On the other hand, a decline in CRC-related mortality
73 has been witnessed among western countries; partly attributed to their effective national screening
74 programs. ³

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

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

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3 88 Several studies have shown that the awareness of CRC symptoms and risk factors is positively
4
5 89 linked to the uptake of CRC screening.^{7,8,9} Despite growing evidence on the association between
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7 90 lifestyle factors and CRC, the awareness of such risk factors among the population at risk (aged
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9 91 50-74 years old) remains low.¹⁰

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12 92 Qatar is a country located in Western Asia on the Arabian Peninsula. The population in Qatar is
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14 93 largely diverse and comprised of many ethnicities; Arabs, Asians, Africans and westerns. The
15
16 94 majority of the country's workforce are expatriates with different cultural and educational
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18 95 backgrounds.¹¹

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22 96 In Qatar, the latest data shows that CRC is the second most commonly diagnosed cancer (11.71%)
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24 97 among males and the third most commonly diagnosed cancer (8.63%) among females. Moreover,
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26 98 more than two-thirds (68%) of the relevant cases were diagnosed at an advanced stage.¹² Given
27
28 99 the diverse population of the country, heterogeneous knowledge regarding CRC is expected. Thus,
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31 100 the primary objective of the current study was to assess the awareness of CRC symptoms and risk
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33 101 factors among the at-risk population (aged 50-74) visiting the primary health care centres in Qatar.
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36 102 The secondary objective was to assess the differences in awareness among population subgroups.

37 38 39 103 **METHODS**

40 41 42 104 **Study design and setting**

43
44 105 This was a cross-sectional study conducted at the primary healthcare (PHC) centres in Qatar
45
46 106 between September 2018 and January 2019. A network of PHC centres is distributed across the
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48 107 country through which a comprehensive promotive, preventive, and curative care is provided free
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50 108 of charge. They are the first line of contact with the community and each health centre has a well-
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52 109 defined catchment population from different ethnic, cultural, social and educational backgrounds;
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54 110 which offers a good representation of the community. At the time of the study, there were 23 PHC
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3 111 centres distributed across the country's three administrative health regions (North, West, and
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5 112 Central). The study was conducted across six PHC centres, where two health centres were chosen
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7 113 from each region.

9 114 **Study population and sampling**

11 115 The inclusion criteria were patients or accompanying people, aged 50-74 years, Arabic or English
13 116 speakers, visiting one of the selected PHC centres during the study period. The study excluded
15 117 individuals who previously underwent CRC screening because they have already received
17 118 counselling about CRC symptoms and risk factors as part of their CRC screening procedure. Thus,
19 119 their enrollment would interfere with the study main objective. Individuals with cognitive/
21 120 communication difficulties were also excluded. The participants were chosen through a non-
23 121 probability convenient sampling technique.

27 122 **Patient and public involvement**

28 123 We did not involve patients or the public in our work.

32 124 **Sample size**

33 125 According to Qatar's 2015 Census, there were 211,207 individuals aged 50 years and above in the
35 126 country. Thus, the estimated sample size was 384 individuals based on a 95% confidence interval,
37 127 precision of 5%, a hypothesis that 50% (+/-5%) of participants were aware of CRC symptoms and
39 128 risk factors and a non-response of 20%. The calculation of sample size was performed to obtain a
41 129 sufficiently precise estimate of the minimum number of study participants to ensure study power.

45 130 **Data collection**

46 131 The data collection was done through face-to-face structured interviews using the questionnaire
48 132 described below. The eligible participants were approached by trained interviewers (resident
50 133 physicians) at the main waiting areas of the selected PHC centres. After that, they were given a

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3 134 brief orientation about the study and were invited to participate. All consented individuals were
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5 135 interviewed in their preferred language (English or Arabic). The duration of the interview ranged
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7 136 from 15 to 20 minutes. Upon completing the interview, the participants were encouraged to ask
8
9 137 any question. They were provided with an educational booklet on CRC prepared already by
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11 138 primary health care cancer screening department. Additionally, all participants were counselled
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14 139 about CRC and encouraged to take part in bowel cancer screening. Those who reported any
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16 140 concerns or potential symptoms of bowel cancer were referred to their primary care physician for
17
18 141 further assessment.

21 142 **Questionnaire**

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23
24 143 The current study utilized the validated Bowel/Colorectal Cancer Awareness Measure
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26 144 (Bowel/Colorectal CAM) survey. The questionnaire was designed to evaluate the awareness of
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28 145 CRC among the public. This survey instrument was developed by University College London and
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30 146 Cancer Research United Kingdom (UK). It is based on a generic CAM developed by Cancer
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32 147 Research UK, University College London, Kings College London and Oxford University in 2007-
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34 148 2008.¹³ It possesses satisfactory internal reliability with a Cronbach's alpha of 0.84 across all
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36 149 components and test-retest reliability of $r = 0.7$. The questionnaire is composed of prompted
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38 150 (closed-ended) and unprompted (open-ended) questions. However, we used the prompted section
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40 151 of the questionnaire because it satisfies the study's objectives. Further details about the
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42 152 questionnaire have been described elsewhere.¹⁴

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47 153 The study's questionnaire was translated and back-translated (English-Arabic) by two independent
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49 154 translators and any aberrancy was corrected accordingly. Additionally, one item on tobacco use
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51 155 was added to the list of CRC risk factors. The study questionnaire consisted of three main sections.
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53 156 Section A included 6 questions about the background characteristics (age, gender, nationality,

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3 157 marital status, level of education, employment status). Section B consisted of 9 closed-ended
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5 158 questions that measure the participants' awareness of CRC symptoms. Section C encompassed 11
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7 159 closed-ended questions related to the participants' awareness of CRC risk factors. Regarding
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9 160 sections B and C, the researchers assigned one point for each "correct" response and null for the
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11 161 "incorrect or I don't know" responses. As a result, the total score ranged from 0 to 9 for section B
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13 162 and 0 to 11 for section C. Furthermore, the overall awareness score ranged from 0 to 20 by
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15 163 combining the scores of sections B and C. The instrument was piloted on 30 participants from the
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17 164 study population to assess its comprehensiveness and clarity.

21 165 **Statistical analysis**

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23 166 The collected data were analyzed using the Statistical Package for the Social Sciences-SPSS
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25 167 version 23. Descriptive statistics were calculated for continuous and categorical variables where
26
27 168 appropriate. Pearson's chi-squared test was used to assess the association between categorical
28
29 169 variables. ANOVA test was used to analyse the differences among group means in the sample. A
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31 170 multivariate linear regression model was constructed to identify the independent predictors of CRC
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33 171 awareness and tested for interactions and collinearity. The unadjusted and adjusted differences in
34
35 172 means were reported for all potential predictors (age, gender, nationality, marital status, level of
36
37 173 education and employment). The level of statistical significance was set at 0.05.

42 174 **RESULTS**

45 175 **Demographic characteristics**

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47 176 A total of 448 out of 566 invited individuals participated in the study (response rate: 87%) with
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49 177 time constraint being the main reason for non-participation. Table 1 presents the participants'
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51 178 background characteristics. The participants' mean age was 58.48 years (SD±6.37). More than
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179 half of the respondents were females (53.5%), non-Qatari Arabs (52.2%), married (86.8%), and
 180 unemployed (54.4%).

181 **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)

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

183 ^a Non-Arab includes Asian, Western and African

184 ^b Unmarried (single, divorced, or widow)

185 **Awareness of colorectal cancer symptoms and risk factors**

186 The mean awareness score of CRC symptoms among study participants was 3.63 /9 (SD ±2.7),
 187 while that of risk factors was 5.43/11 (SD ±3.3). Thus, the overall mean awareness score was
 188 9.03/20 (SD ±5.5).

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

191 in abdomen” (56.5 %), “unexplained weight loss” (54.5 %), and “blood in stool” (46.9%). On the
 192 other hand, the least commonly recognised symptoms were “pain in back passage” (22.5%) and
 193 “bowel doesn’t empty” (27.9%). Furthermore, the most commonly recognised CRC risk factors
 194 were the “daily eating of processed meat” (71.7%), “tobacco use” (69.2%), and “alcohol use” (63.6
 195 %). However, “diabetes” (23.7 %) , “low fruit and vegetables intake” (34.4%), and “older age”
 196 (37.7%) were less commonly recognised risk factors.

197 **Table 2:** Frequency distribution regarding the awareness of colorectal cancer symptoms and risk
 198 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 \geq 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)

199 Females were more likely to recognise the link between unhealthy lifestyle behaviours and CRC
 200 than their male counterparts as shown in table 3. For instance, females were more aware about the
 201 association of CRC with the following factors: daily consumption of processed meat (76.5% vs.
 202 66.7%; $P = 0.01$), tobacco use (74.8% vs. 63.6%; $P = 0.007$), drinking alcohol (69.3% vs. 57.8%;
 203 $P = 0.008$), and daily consumption of red meat (62.6% vs. 43.0%; $P < 0.001$).

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

Lifestyle risk factor	Female n (%)	Male n (%)	<i>p</i> -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 \geq 25 kg/m ²)	95 (39.9)	91 (44.2)	0.20

206 BMI: Body Mass Index

207 * Statistically significant.

208 **The relationship between background characteristics and the CRC awareness mean score**

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

213

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

Variable	Awareness			
	Symptoms		Risk factors	
	Mean score (95% CI)	<i>p</i> -value	Mean score (95% CI)	<i>p</i> -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)	

216 * Statistically significant.

218 Predictors of colorectal cancer awareness

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

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

226 significantly more likely to have a high awareness of CRC compared to participants without formal
 227 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:
 228 2.55 – 5.66) respectively. On the other hand, age, marital status and employment did not show
 229 significant difference of the overall score in the regression model.

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

Variable	Univariate linear analysis			Multiple linear regression	
	Mean (SD)	Unadjusted difference in mean (95% CI)	<i>p</i> -value	Adjusted difference in mean (95% CI)	<i>p</i> -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

232 Dependent variable: Overall awareness mean score. Enter multiple linear regression applied. Model assumption is
 233 fulfilled. No interactions and no multi-collinearity were detected. R²= 14.0%. * Statistically significant.

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235

236 DISCUSSION

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

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

241 This is in line with earlier studies in the region. A study in Bahrain among the general population
242 revealed low awareness about the symptoms and risk factors of CRC. It was found that the score
243 of overall CRC knowledge was 56 % and that of symptoms and risk factors was 59 % and 53 %
244 respectively.¹⁵ Also, a recent national study in Saudi Arabia examined the awareness of 5720
245 participants on CRC-related symptoms and risk factors. As a result, the mean score of the
246 respondents' awareness was low at 11.05/23.¹⁶

247 In comparison to our study, a population survey in the United Kingdom using the bowel/colorectal
248 CAM instrument showed higher awareness regarding CRC symptoms and risk factors.
249 Specifically, the most recognised symptom and risk factor in the British study were “blood in
250 stools” (88.6%) and “close relative with bowel cancer” (65%). However, our study identified
251 “lump in abdomen” (56.5%) and “daily eating of processed meat” (71%) to be the most recognised
252 symptom and risk factor. The least recognised symptom in the UK study was “bowel does not
253 empty” (47%). On the other hand, “pain in back passage” (22.5%) was the least recognised
254 symptom in our study. “Diabetes” was the least recognised risk factor in both studies and was
255 recalled by only a quarter of the participants.¹⁴ The level of education among our study population
256 (43.6% had tertiary education) was higher than that of the UK study (25.6%). However, this
257 observation did not reflect on the level of CRC awareness. Subsequently, the level of education
258 may not be associated with the level of health literacy. The observed difference in the awareness
259 might be explained by the relatively recent introduction of the national bowel cancer screening
260 program and awareness campaigns in Qatar. The program is a population-based initiative that aims
261 at promoting education, awareness, and early detection of bowel cancer among those at risk (aged

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3 262 50-74 years).¹⁷ It is in line with the Public Health Strategy 2017-2022 which focuses on preventive
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5 263 and community-based care.¹⁸
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8 264 Another survey in Malaysia, using the bowel/colorectal CAM tool, revealed lower CRC awareness
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10 265 in comparison to our findings. In the Malaysian study, the mean awareness scores for CRC
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12 266 symptoms and risk factors was 2.89 (SD 2.96) and 3.49 (SD 3.17).¹⁹ This could be explained by
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14 267 the difference in the study settings and the characteristics of the participants. In our study, almost
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16 268 half (43.6%) of the participants reported having a tertiary level of education. On the other hand,
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18 269 the Malaysian survey was conducted in a rural area where only a minority of participants (6.6%)
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20 270 had attained a tertiary level of education.
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24 271 The present study identified the female gender and formal education as significant predictors of
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26 272 higher CRC awareness. Such results are in line with findings of a regional study conducted in the
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28 273 United Arab Emirates.²⁰ Another survey of more than 10,000 participants in Hong Kong revealed
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30 274 that male gender was associated with low CRC awareness.²¹ On the other hand, a study in Saudi
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32 275 Arabia and a community-based survey in Jordan reported no significant association between
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34 276 gender and knowledge of CRC.^(16, 22)
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39 277 The current study has strengths and limitations. First, the study was the first of its kind to evaluate
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41 278 CRC awareness and its predictors among the at-risk population in Qatar. The study achieved a
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43 279 high response rate (87%) and the sample included a variety of nationalities that represents the
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45 280 diversity of the community in Qatar. In addition, the use of a validated questionnaire through face-
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47 281 to-face interviews by trained data collectors strengthened the validity of the study results.
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49 282 However, the research has some limitations. First, we did not use the unprompted (open-ended)
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51 283 items of the CAM questionnaire to satisfy the study's objectives and due to time constraint.
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284 Secondly, we did not assess the participants' family history for CRC. Lastly, the non-probability
285 sampling method utilized in the study may affect the generalizability of the results.

286 **CONCLUSION**

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

293 **Acknowledgements**

294 We would like to acknowledge Dr. Eman Radwan for her effort in reviewing the manuscript.

295 **Competing Interests**

296 The authors declare no conflict of interest.

297 **Funding**

298 This study was funded by the Research Department of the Primary Health Care Corporation under
299 protocol ID (PHCC/RC/18/05/001).

300 **Ethics**

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

303 **Contributors**

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

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3 306 to the design of the work and interpretation of the findings. AA and MC evaluated the results and
4
5 307 wrote the manuscript. All authors revised and approved the final manuscript.
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8 308 **Data availability**

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10 309 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.