



Barriers of colorectal cancer screening test among adults in the Saudi Population: A Cross-Sectional study

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ABSTRACT

Colorectal cancer (CRC) is the third most common cancer and the second most common cause of cancer death worldwide. CRC can be completely cured if detected at an early stage with screening. However, many barriers to screening have been reported. This study aimed to identify the potential barriers to CRC screening among the Saudi population aged ≥ 45 years. A cross-sectional study of randomly selected adults (aged ≥ 45 years) attending primary care clinics at KKHU in Saudi Arabia was conducted. A self-administered questionnaire was used to collect data. A total of 448 participants were included. In general, the most commonly reported barrier to CRC screening was a lack of physician recommendation (77.1%). Moreover, fear of painful colonoscopy procedures and a lack of knowledge regarding the availability of the fecal occult blood test (FOBT) were reported by 51.6% and 57.8% of patients, respectively. Significant gender differences were observed, with females reporting more barriers to CRC screening than males (general barriers [$p < 0.001$] and colonoscopy-specific barriers [$p = 0.003$]). Participants who had not undergone any previous CRC screening reported significantly more barriers compared to those who had undergone a previous CRC screening (general barriers [$p = 0.015$], colonoscopy-specific barriers [$p = 0.006$], and FOBT specific barriers [$p = 0.024$]). Because a lack of physician recommendation was the most commonly reported general barrier, we recommend that physicians emphasize the need for CRC screening, particularly to high-risk patients. Extensive campaigns and programs must be launched to raise awareness about the importance of screening for CRC. Additionally, gender-specific strategies need to be formulated to promote CRC screening in females.

1. Background

Colorectal cancer (CRC) is the third most common cancer and the second most common cause of cancer death worldwide (Colorectal cancer statistics, 2018). In Saudi Arabia, it is the first most common cancer among males and the third most common among females, according to the Saudi Cancer Registry (SCR) which estimated the incidence of CRC between January and December 2015, to be 12.2%, which accounts for 1465 newly diagnosed cases, with a predominance in males. The highest prevalence of CRC in Saudi Arabia has been reported in the capital, Riyadh (Annual, 2018). The mortality rate of CRC in Saudi Arabia is high in comparison to that in other countries. For example, in

2018, the estimated worldwide mortality rate for both genders was 9.2%, while it was 15.2% in Saudi Arabia (Estimated number of deaths in, 2018). A retrospective analysis of cancer registry data in 2015 reported that the 5-year survival rate of patients with CRC in Saudi Arabia was 44.6%, which is lower than the reported rate in the US (65.9%) (Zubaidi et al., 2015). However, CRC can be prevented by detecting and removing precancerous polyps. It can also be completely cured if diagnosed at an early stage (Aljumah and Aljebreen, 2017).

Previous studies have reported several factors associated with an increased risk of CRC, including family history of CRC, old age, smoking, male gender, obesity, physical inactivity, and heavy alcohol consumption (Lee et al., 2014; Cho et al., 2019). It has also been shown that

Abbreviations: CRC, Colorectal cancer.; CRCS, Colorectal cancer screening; FOBT, Fecal occult blood test; KKHU, King Khalid University Hospital.

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inflammatory bowel disease is associated with a higher risk of CRC (Herszényi et al., 2014). Typical symptoms of CRC, including changes in bowel habits, rectal bleeding, dark stool, abdominal pain, fatigue, and unintentional weight loss, usually appear at the late stage of the disease. Therefore, screening is recommended for those at risk of developing CRC to detect the disease at an early stage (Signs and Symptoms of Colon Cancer).

A regional study from Saudi Arabia has demonstrated a late presentation of the disease among a Saudi population compared to that in western countries (Alamri et al., 2017). Screening for CRC is an important method for the prevention and early detection of the disease, which can result in more treatment options and better outcomes. Moreover, early detection reduces the financial burden associated with treatment costs, which strongly correlates with the stage of the cancer (Kriza et al., 2013). Additionally, it has been shown that CRC screening reduces both incidence and mortality rates of the disease (Almadi et al., 2015). Considering the high incidence rate and the long duration between early and advanced stages of the disease, a CRC screening program may prove to be effective if implemented in Saudi Arabia (Galal et al., 2016).

However, certain barriers to implementing CRC screening have been reported, such as a lack of awareness, absence of symptoms, lack of doctor recommendation, and fear of the test results (Alamri et al., 2017; Almadi et al., 2015; Fenton et al., 2011). Identifying barriers in the screening of CRC is important for the successful implementation of the program. Although extensive research has been conducted in other nations, there is limited evidence available from the region of Saudi Arabia (Alamri et al., 2017; Almadi et al., 2015; Fenton et al., 2011). The results from this study may assist policy makers and healthcare practitioners in implementing a national screening program for CRC. Such a program would support one of the Saudi (Vision, 2030) pillars, which is “a vibrant society with fulfilling lives” that focuses on providing preventive medicine services for citizens and encouraging them to benefit from primary healthcare (Vision, 2030). The present study was conducted with the objective of identifying potential barriers to CRC screening in the Saudi population aged ≥ 45 years.

2. Methods

2.1. Study setting and population

An observational cross-sectional study was conducted. Study subjects were chosen from the primary care clinics of King Khalid University Hospital (KKUH), which is a large 1000 bed tertiary care referral center in the northern part of Riyadh, Saudi Arabia. It is government-funded and provides primary, secondary, and tertiary care services to a large patient population. Data collection was carried out from January to March 2019. All patients attending primary care clinics at KKUH were considered for enrollment. Patients were identified for invitation using a simple random selection based on patient medical record numbers. The random number generation was performed using Microsoft Excel software. The identified patients were assessed for eligibility using the inclusion and exclusion criteria. The inclusion criteria included Saudi males and females aged ≥ 45 years. Patients with a current or previous diagnosis of CRC were excluded from the study. Participants were voluntarily enrolled in the study, and no honorarium or gifts were given to participants for their enrollment into the study.

Ethical approval was obtained from the Institutional Review Board of KKUH. Informed consent was obtained from each participant, and the confidentiality of information and privacy of the participants were maintained throughout the study.

2.2. Sample size estimation

According to a previously published paper, the prevalence of barriers for CRC screening was 41.1% (Galal et al., 2016), with a 95% confidence

interval and a precision of $\pm 5\%$, in which the minimal sample size required was estimated to be 372 participants. Considering an additional 30% participants to compensate for potential non-response and incomplete data, the final sample size of the current study was estimated to be 484 participants.

2.3. Description of the questionnaire

Data were collected using a paper-based self-administered questionnaire or an interview in cases where the participant was illiterate. The questionnaire consisted of the consent form and three main parts, including (i) sociodemographic characteristics of the participants, (ii) personal information relevant to colorectal cancer history and screening (e.g., history of CRC screening, and the number of and reasons for previous screening), and (iii) assessment of the potential barriers to CRC screening in general and for each of the two screening tests (fecal occult blood test [FOBT] and colonoscopy). Questions in section 3 were adapted from a set of known barriers (Galal et al., 2016; Yong et al., 2016) and had a close-ended multiple-option format for responses (strongly agree, agree, not sure, disagree, strongly disagree). In addition, there were 3 domains of barriers that were assessed: personal barriers (including emotional and financial barriers), healthcare provider-related barriers (services), and lack of knowledge. A brief explanation of each domain was provided in the questionnaire. The original copy was written in English, translated by two experts into Arabic, and translated back to English by another expert. The interviews were conducted in Arabic, and the questionnaire was reviewed by a colorectal surgeon. A pilot study was conducted on 15 subjects to assess the validity, comprehensibility, and time needed to complete the questionnaire. Issues that were identified in the pilot of the questionnaire included; the inability to understand some terms, time taken to complete the questionnaire, and the sequencing of the questions. All comments were assessed and re-piloted twice on different groups of 10 participants until no further modifications were necessary.

2.4. Statistical analyses

Data were analyzed using Statistical Package for Social Sciences (SPSS 22; IBM Corp., New York, NY, USA). Continuous variables were expressed as mean \pm standard deviation, and categorical variables were expressed as percentages. The *Mann-Whitney* test was used for continuous variables without normal distribution, and the *chi-square* test and *Fisher's* exact test were used for categorical variables. The *Shapiro-Wilk* test was used to assess the normality of the data. A *p*-value < 0.05 was considered statistically significant.

To compare the CRC screening barriers between different groups, we analyzed the questionnaire's Likert scale responses by specifying the responders' level of agreement to each barrier and assigned points for each answer as follows: strongly disagree, 1 point; disagree, 2 points; neither agree nor disagree, 3 points; agree, 4 points; and strongly agree, 5 points. Additionally, zero points were not assigned. The scores for each barrier were calculated separately by multiplying the value of the points for each agreement level with the number of responders. Subsequently, the sum of the points for each barrier was divided by the total population to assign the mean points for each barrier. A high mean indicates that a greater number of people agree regarding a specific barrier.

3. Results

3.1. Characteristics of the study participants

Among the 484 participants, only 448 (92.56%) completed the questionnaires and were included in the final analysis, 69 (15.4%) of them were interviewed due to their inability to read or write. The sociodemographic and clinical characteristics of participants are presented in Table 1. We had a near equal number of males and females

Table 1
Socio-demographic and clinical characteristics of study participants.

Characteristics	Participants (N = 448) n (%)
Gender	
Male	215 (48.0)
Age Groups	
45–50	141 (31.5)
51–55	93 (20.8)
56–60	84 (18.8)
61–65	68 (15.2)
≥ 66	62 (13.8)
Educational level	
Primary school	54 (12.1)
Intermediate school	61 (13.6)
High school	76 (17.0)
Diploma, College or higher	188 (42.0)
Illiterate	69 (15.4)
Residency area	
Urban	377(84.2)
Rural	71(15.8)
Marital status	
Married	380 (84.8)
Single	13 (2.9)
Divorced or widow	55 (12.3)
Income (SR*/Month)	
<5000	114 (25.4)
5000–10000	145 (32.4)
>10,000	189 (42.2)
Had History of Chronic diseases	302(67.6)
Heard about colorectal cancer	309 (69.0)
Positive family history of colorectal cancer	90 (20.1)
Previously Performed colorectal cancer screening test	56 (12.5)

* Saudi Riyals.

(48% male) and more participants in the youngest age group (31.5%, aged 45–50 years); the number of participants declined with increasing age.

The majority (67.6%) of participants had chronic diseases, the most common being diabetes mellitus (63.1%), followed by hypertension (55.4%), hyperlipidemia (19.5%), cardiovascular diseases (10.4%), and cancers (1.7%).

Approximately 12.5% of participants had undergone CRC screening at least once in their lives. Among those who had undergone screening, 55.4% stated that the reason for screening was regular checkup, while 26.8% said that it was due to pre-existing complaints of abdominal pain or pain during defecation. Approximately 21.4% of participants reported that they underwent screening for inflammatory bowel disease. A total of 36.4% of participants who underwent screening belonged to the age group of 41–50 years, while only 16.1% initiated their screening before 40 years of age. Slightly more than half (55%) of the participants were screened only once, 12.5% were screened twice, and 32.2% were screened three times or more. The most common screening method was colonoscopy (73.2%), which was followed by FOBT (57%).

3.2. Barriers to CRC screening

The perceived general barriers to CRC screening are reported in Table 2. Lack of physician recommendation was considered the most common barrier reported by 77.1% of participants, closely followed by absence of signs and symptoms (73.4%). Fear of medical procedures and fear of results were not reported as very common barriers to CRC screening (31.7% and 36.4%, respectively).

3.3. Stratification by method of screening

The perceived barriers to CRC screening, stratified by method of screening (colonoscopy and fecal occult blood tests), are presented in Table 3. For colonoscopy, the three most common perceived barriers were fear of the painful procedure (51.6%), lack of knowledge regarding

Table 2
Perceived barriers to CRC screening in general.

General Barriers	Participants Responses (N = 448)				
	Strongly Agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly Disagree n (%)
1. Lack of knowledge about CRC	138 (30.8)	94 (21.0)	51 (11.4)	106 (23.7)	59 (13.2)
2. Lack of knowledge about the importance of CRCs	44 (9.8)	42 (9.4)	28 (6.3)	150 (33.5)	184 (41.1)
3. Lack of knowledge about CRC symptoms and signs	200 (44.6)	121 (27.1)	40 (8.9)	62 (13.8)	25 (5.6)
4. Lack of family and/or friends' support	143 (31.9)	79 (17.6)	45 (10.0)	108 (24.1)	73 (16.6)
5. Lack of physician's recommendation for CRC screening	222 (49.6)	123 (27.5)	16 (3.6)	52 (11.6)	35 (7.8)
6. Absence of symptoms and signs	203 (45.3)	126 (28.1)	66 (14.7)	35 (7.8)	18 (4.0)
7. Fear of medical procedures	68 (15.2)	74 (16.5)	18 (4.0)	124 (27.7)	164 (36.6)
8. Fear of results	90 (20.1)	73 (16.3)	34 (7.6)	116 (25.9)	135 (30.1)
9. Fatalism and religion believe	77 (17.2)	52 (11.6)	30 (6.7)	129 (28.8)	160 (35.7)
10. CRC screening is not mandatory	157 (35.0)	134 (29.9)	61 (13.6)	60 (13.4)	36 (8.0)
11. Health care providers are not trustworthy	42 (9.4)	28 (6.3)	74 (16.5)	131 (29.2)	173 (38.6)
12. Lack of transportation	67 (14.9)	50 (11.2)	25 (5.6)	128 (28.6)	178 (39.7)

how the test is conducted for cancer screening (50.9%), and the availability of tests (43.8%). For FOBT, the most commonly perceived barriers were unavailability of the test and lack of time (57.8% and 34.2%, respectively).

3.4. Stratification by gender

The differences in reported barriers to CRC screening between males and females are presented in Table 4. In general, females reported more barriers to CRC screening compared to males. The differences in mean total scores were significant for all 3 categories: general barriers ($p < 0.001$), colonoscopy barriers ($p = 0.003$), and FOBT barriers ($p = 0.047$).

3.5. Stratification by residency area

There were differences in the reported barriers to CRC screening based on the area of residency. Those living in rural areas reported more barriers to CRC screening compared to those living in urban areas. A general lack of transportation and unavailability of FOBT were the only significant barriers that were reported ($p = 0.003$ and $p = 0.006$, respectively).

3.6. Stratification by history of CRC screening

The differences in reported barriers to CRC screening between those who had and those who had not undergone CRC screening are shown in Table 5. The findings show that those who had not had any screening reported significantly more barriers to CRC screening than those who had previously undergone screening, in all 3 categories: general barriers ($p = 0.015$), colonoscopy barriers ($p = 0.006$), and FOBT barriers ($p = 0.024$).

For the general barriers, the most significant difference in barriers among the groups was lack of physician recommendation for CRC screening among those who had not performed screening, with a mean

Table 3
Perceived barriers to CRC screening by method of screening (Colonoscopy and FOBT) (N = 448).

Colonoscopy Specific Barriers	Participants Responses (N = 448)				
	Strongly Agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly Disagree n (%)
1. Lack of knowledge about the availability of the CRCS using colonoscopy	133 (29.7)	63 (14.1)	35 (7.8)	133 (29.7)	84 (18.8)
2. Not knowing how to do the CRCS by colonoscopy	164 (36.6)	64 (14.3)	43 (9.6)	119 (26.6)	58 (12.9)
3. Fear of painful procedure	112 (25.0)	119 (26.6)	68 (15.2)	87 (19.4)	62 (13.8)
4. Fear of colonoscopy complications	85 (19.0)	102 (22.8)	81 (18.1)	103 (23.0)	77 (17.2)
5. Bad previous experience of colonoscopy	35 (7.8)	34 (7.6)	25 (5.6)	138 (30.8)	216 (48.2)
6. Embarrassment during the test	52 (11.6)	67 (15.0)	41 (9.2)	134 (29.9)	154 (34.4)
7. Financial problems and high-costed procedure	70 (15.6)	74 (16.5)	40 (8.9)	146 (32.6)	118 (26.3)
8. Unavailability of CRCS using colonoscopy in the nearby hospital	32 (7.1)	37 (8.3)	141 (31.5)	122 (27.2)	116 (25.9)
9. Lack of time (busy)	55 (12.3)	109 (24.3)	29 (6.5)	129 (28.8)	126 (28.1)
FOBT Specific Barriers	Participants responses (N = 448)				
	Strongly Agree n (%)	Agree n (%)	Not sure n (%)	Disagree n (%)	Strongly Disagree n (%)
1. Lack of knowledge about the availability of the CRCS using FOBT	181 (40.4)	78 (17.)	35 (7.8)	86 (19.2)	68 (15.2)
2. Unavailability of CRCS by giving a stool sample in the nearby hospitals	35 (7.8)	37 (8.3)	176 (39.3)	104 (23.2)	96 (21.4)
3. Fecal aversion (messy, unhygienic)	19 (4.2)	37 (8.3)	28 (6.3)	155 (34.6)	209 (46.7)
4. Embarrassed from giving a stool sample	26 (5.8)	55 (12.0)	16 (3.6)	143 (31.9)	208 (46.4)
5. Financial problems and high-costed procedure	68 (15.2)	56 (12.0)	42 (9.4)	146 (32.6)	136 (30.4)
6. Lack of time (busy)	54 (12.1)	99 (22.1)	26 (5.8)	125 (27.9)	144 (32.1)

of 4.16 (p < 0.001). For colonoscopy-specific barriers, the most significant barrier difference among the groups was not knowing how to do the CRC screening by colonoscopy, a lack of knowledge about the availability of the test, and unavailability of the test in the nearby hospital reported by those who had not performed screening in their life, with means of 3.46 (p < 0.001), 3.13 (p = 0.010), and 2.48 (p = 0.011), respectively. For FOBT specific barriers, lack of knowledge about the availability of the test was the highest reported barrier among those who had not undergone any screening, with a mean of 3.58 (p < 0.001).

Table 4
Reported barriers to CRC screening, by gender.

Reported Barriers	Male N = 215		Female N = 233		p-value*
	Mean	SD	Mean	SD	
General Barriers					
■ Lack of knowledge about colorectal cancer	3.13	1.43	3.51	1.45	0.003
■ Lack of knowledge about the importance of CRCS	2.13	1.24	2.14	1.38	0.495
■ Lack of knowledge about CRC symptoms and signs	3.87	1.17	3.96	1.34	0.069
■ Lack of family and/or friends' support	3.31	1.45	3.19	1.57	0.588
■ Lack of physician's recommendation screening for CRC	2.93	1.26	4.05	1.34	0.075
■ Absence of symptoms and signs	3.97	1.06	4.09	1.19	0.038
■ Fear of medical procedures	2.24	1.28	2.66	1.64	0.050
■ Fear of results	2.38	1.32	3.00	1.65	<0.001
■ Fatalism and religion believe	2.28	1.38	2.62	1.58	0.085
■ CRC screening is not mandatory	3.60	1.25	3.80	1.32	0.036
■ Health care providers are not trustworthy	2.20	1.21	2.17	1.33	0.326
■ Lack of transportation	2.13	1.30	2.52	1.58	0.061
■ Total score for barriers of doing CRCS	35.17	6.66	37.70	7.75	<0.001
■ (Out of 60)					
Colonoscopy Specific Barriers					
■ Lack of knowledge about the availability of the test	3.05	1.50	3.08	1.58	0.981
■ Not knowing how to do the CRCS by colonoscopy	3.34	1.43	3.36	1.58	0.809
■ Fear of painful procedure	2.94	1.31	3.62	1.38	<0.001
■ Fear of colonoscopy complications	2.87	1.25	3.18	1.48	0.018
■ Previous bad experience of colonoscopy	1.90	1.03	2.01	1.42	0.229
■ Embarrassment during the test	2.06	1.08	2.71	1.56	<0.001
■ Financial problems and high-costed procedure	2.58	1.35	2.67	1.50	0.807
■ Unavailability of test in the nearby hospital	2.49	1.14	2.39	1.19	0.375
■ Lack of time (busy)	2.63	1.35	2.65	1.48	0.860
■ Total score for barriers of doing CRCS by colonoscopy test (out of 45)	23.85	5.67	25.67	6.52	0.003
FOBT Specific Barriers					
■ Lack of knowledge about the availability of the test	3.45	1.43	3.52	1.63	0.316
■ Unavailability of test in the nearby hospital	2.58	1.13	2.58	1.16	0.994
■ Fecal aversion (messy, unhygienic)	1.81	0.90	1.96	1.27	0.679
■ Embarrassment during the test	1.82	0.94	2.15	1.44	0.557
■ Financial problems and high-costed procedure	2.43	1.30	2.55	1.53	0.859
■ Lack of time (busy)	2.50	1.36	2.58	1.51	0.833
■ Total score for barriers of doing CRCS by fecal occult blood test (FOBT) (out of 30)	14.59	3.86	15.34	4.67	0.047

4. Discussion

This study identified a number of barriers to perform CRC screening among the Saudi population aged ≥ 45 years. The most common barrier reported was a lack of physician recommendation. Absence of CRC signs and symptoms and a lack of knowledge regarding CRC were other major barriers preventing participants from undergoing CRC screening tests.

Table 5
Differences in barriers to CRC screening between those who had previously performed CRC screening and those who had not previously performed CRC screening.

General Barriers	Had previously performed CRC screening n = 56		Had not previously performed CRC screening n = 391		p-value
	Mean	SD	Mean	SD	
■ Lack of knowledge about colorectal cancer	3.15	1.50	3.35	1.44	0.334
■ Lack of knowledge about the importance of CRCS	2.02	1.22	2.15	1.32	0.668
■ Lack of knowledge about CRC symptoms and signs	3.53	1.40	3.97	1.23	0.017
■ Lack of family and/or friends' support	3.16	1.54	3.26	1.51	0.581
■ Lack of physician's recommendation screening for CRC	2.78	1.55	4.16	1.17	<0.001
■ Absence of symptoms and signs	3.78	1.27	4.06	1.11	0.120
■ Fear of medical procedures	2.29	1.40	2.48	1.51	0.426
■ Fear of results	2.75	1.60	2.70	1.52	0.842
■ Fatalism and religion believe	2.27	1.39	2.48	1.51	0.471
■ CRC screening is not mandatory	3.80	1.27	3.69	1.29	0.569
■ Health care providers are not trustworthy	2.11	1.34	2.20	1.26	0.441
■ Lack of transportation	2.62	1.51	2.29	1.45	0.116
■ Total score for barriers of doing CRCS (Out of 60)	34.25	7.38	36.80	7.30	0.015
Colonoscopy Specific Barriers	Had previously performed CRC screening n = 56		Had not previously performed CRC screening n = 391		p-value
	Mean	SD	Mean	SD	
■ Lack of knowledge about the availability of the test	2.55	1.46	3.13	1.54	0.010
■ Not knowing how to do the CRCS by colonoscopy	2.56	1.45	3.46	1.48	<0.001
■ Fear of painful procedure	3.15	1.56	3.32	1.37	0.476
■ Fear of colonoscopy complications	2.87	1.50	3.06	1.36	0.362
■ Previous bad experience of colonoscopy	2.40	1.55	1.90	1.18	0.036
■ Embarrassment during the test	2.24	1.32	2.42	1.40	0.419
■ Financial problems and high-costed procedure	2.49	1.45	2.64	1.42	0.463
■ Unavailability of test in the nearby hospital	2.11	1.20	2.48	1.16	0.011
■ Lack of time (busy)	2.33	1.26	2.68	1.44	0.114
■ Total score for barriers of doing CRCS by colonoscopy test (out of 45)	22.69	6.59	25.09	6.08	0.006
FOBT Specific Barriers	Had previously performed CRC screening n = 56		Had not previously performed CRC screening n = 391		p-value
	Mean	SD	Mean	SD	
■ Lack of knowledge about the availability of the test	2.84	1.58	3.58	1.51	<0.001
■ Unavailability of test in the nearby hospital	2.35	1.32	2.61	1.12	0.050
	1.82	1.09	1.90	1.11	0.652

Table 5 (continued)

General Barriers	Had previously performed CRC screening n = 56		Had not previously performed CRC screening n = 391		p-value
	Mean	SD	Mean	SD	
■ Fecal aversion (messy, unhygienic)					
■ Embarrassment during the test	2.00	1.25	1.99	1.23	0.762
■ Financial problems and high-costed procedure	2.51	1.51	2.49	1.41	0.941
■ Lack of time (busy)	2.36	1.31	2.56	1.45	0.457
■ Total score for barriers of doing CRCS by fecal occult blood test (FOBT) (out of 30)	13.87	4.62	15.13	4.25	0.024

Females tended to report more barriers than males. Participants who had not undergone any CRC screening reported significantly more barriers compared to those who had undergone previous CRC screening.

These findings reflect the poor level of awareness and education among those at risk of CRC due to their age. Additionally, these results are consistent with those of a recent national study conducted by Galal et al. in the eastern region of Saudi Arabia (Galal et al., 2016) which found that a lack of providers' knowledge regarding the recommended screening for CRC and a lack of public awareness on CRC screening programs were the most common barriers. Moreover, studies from Western countries have reported different barriers, such as a fear of results and of the screening procedure, which were reported as the main barriers to CRC screening, in addition to a lack of providers' recommendation to perform CRC screening, which was also reported in the United States (Basch et al., 2016; Nagelhout et al., 2017). Physician recommendations can guide patients regarding health-related decision-making. That is why physicians must pay attention and explain the reasons for their recommendations by justifying both potential benefits and risks. Furthermore, they should consider patients' preferences and their socio-cultural background when making recommendations (Wilkes et al., 2013). We highly encourage physicians to improve their professionalism and expand their knowledge of conservative healthcare. As a further application of our findings, using mass media to promote physicians' recommendations may have a larger effect on people's attitudes toward cancer screening.

Colonoscopy and FOBT are the 2 most common screening tests for CRC (Wong et al., 2013). For colonoscopy-specific barriers, we found that having a fear of painful procedures was one of the leading barriers, a finding that is consistent with that of other regional and global studies (Galal et al., 2016; Basch et al., 2016; Rawl et al., 2005). However, the difference in the findings between the present study and western reports is the issue of financial burden associated with high costs of the procedures. In Saudi Arabia, healthcare services and screening tests are covered by the Ministry of Health, due to which a large proportion of the population has access to free healthcare services (Colonoscopy - Mayo Clinic., 2018). Hence, the present study reported a lower cost burden in contrast to the Western population (Rawl et al., 2005). The findings related to fecal aversion (messy, unhygienic, embarrassment) were relatively similar to other reports from Singapore and the US (Yong et al., 2016; Rawl et al., 2005).

Another important finding of the study relates to the significant gender differences in the perceived barriers for screening CRC, with females reporting more barriers. These findings highlight the need for a gender-specific approach to address each barrier to CRC screening. In general, females are more likely to undergo CRC screening if they have had prior experience with other cancer screening techniques. Furthermore, women appreciate the value of self-care more than men due to

their substantial role in families (Honein-AbouHaidar et al., 2016). In this study, a fear of results, a fear of painful procedures, and embarrassment from colonoscopy procedures were the most common barriers to CRC screening reported by women. These findings are consistent with other studies that reported a fear of test results, a fear of medical procedures, and shyness to be more commonly reported barriers by females (Alamri et al., 2017; Galal et al., 2016; Wong et al., 2013). In order to overcome these barriers in females, we suggest that the screening be performed by a female provider and that counselling sessions be arranged to increase the level of comfort of female patients and meet their concerns. We believe these minor measures will have an important impact on reducing the barriers reported by females and increasing female adherence to screening in future.

Our study revealed that those who live in rural areas report more barriers to CRC screening compared to those who live in urban areas. A general lack of transportation and unavailability of FOBT were the only significant barriers that were reported. These findings could be explained by the fact that there are restrictions in local transportation between rural and urban areas, which may be expensive and time consuming to use. Moreover, rural areas lack fully equipped clinics, which explains the unavailability of FOBT in these areas.

This study also showed that for those who had not previously undergone CRC screening tests, a lack of physician recommendation and a lack of knowledge regarding CRC signs and symptoms were the chief barriers to screening in comparison to those who had undergone screening. These results are consistent with a previous study conducted in Saudi Arabia (Alamri et al., 2017), where the group that had not had previous CRC screening reported a lack of knowledge, an absence of CRC signs and symptoms, and a lack of physician recommendation as the main barriers. Thus, many studies have emphasized the importance of a physician's role in advising patients to increase adherence to screening (Cho et al., 2019; Alamri et al., 2017). Lack of knowledge regarding the availability of using FOBT as a screening tool was an important barrier among those who had not undergone any CRC screening in the past. Similarly, a US study showed that the group that had not had previous CRC screening reported that healthcare providers never recommending FOBT and a lack of knowledge regarding how a stool blood test is performed were the main barriers (Rawl et al., 2005).

Although these barriers relate to patient knowledge and attitude, they can, however, be overcome by increasing public awareness via mass campaigns and awareness programs. In 2012, a study assessed the general cancer knowledge of Hispanics living in the lower Yakima Valley of Washington state through a baseline CRC survey. Participants were recruited to attend home-based group educational interventions, conducted by trained bilingual health promoters. Six months later, participants were contacted again to take a follow-up survey, which showed an increase in the proportion of participants undergoing CRC screening by sigmoid/colonoscopy from 29.5% to 39.4% ($p = 0.014$) (Morales et al., 2012).

Finally, our results are in line with those of previous regional studies, although they were published a couple of years ago, which reflects the poor effect of current measures to increase the screening uptake in the study population. We assume that these findings will remain constant in future studies, unless a significant shift in screening awareness activities occurs or a massive national screening program is implemented.

4.1. Strengths and limitations

This study was conducted in Riyadh city, which is the capital of Saudi Arabia. Additionally, the setting was a tertiary hospital serving many populations from different regions. Our study investigated the patients' perceived barriers to CRC screening associated with multiple levels such as physicians and healthcare systems. In addition, we assessed these barriers in different ways, for example, by stratifying results according to those who had previously undergone CRC screening and those who had not; furthermore, we used a scoring system to precisely evaluate the

barriers. However, study generalizability is limited, as the data were collected from a single center, which may not be representative of the population. Larger populations with community-based studies are recommended to understand the perceptions of the general population.

5. Conclusion

In conclusion, a lack of physician recommendation was identified as the most common barrier to CRC screening in general. Fear of painful procedures was the most common specific barrier to colonoscopy. Females and those who had not undergone any prior CRC screening reported more barriers compared to males and those who had undergone previous CRC screening.

It is essential to address the perceived barriers to CRC screening identified in this study before implementing a screening program at the national level. Further national qualitative and descriptive studies are required to explore more specific barriers among the Saudi population. In addition, more studies investigating healthcare system barriers regarding CRC screening are needed. We encourage stakeholders and decision-makers to implement more educational programs for physicians to promote CRC screening and launch campaigns to raise awareness about CRC screening and its importance.

CRediT authorship contribution statement

Shatha A. Alduraywish: Conceptualization, Methodology, Supervision. **Leen A. Altamimi:** Writing - original draft. **Ashwaq A. Almajed:** Writing - original draft. **Bushra A. Kokandi:** Writing - original draft. **Rawan S. Alqahtani:** Writing - original draft. **Shatha G. Alghaihb:** Writing - original draft. **Fahad M. Aldakheel:** Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board of the KKHU. Informed consent was obtained from each participant, and the confidentiality of information and privacy of the participants was protected throughout the study.

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