RESEARCH ARTICLE

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Colorectal Cancer Detection during a Screening Awareness Campaign in a High-Risk Region in Oman

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Abstract

Introduction: Colorectal cancer (CRC) constitutes the third most frequently diagnosed cancer in Oman. This study report the result of a community based screening campaign to promote the early detection and explore the associated risk factors of CRC amongst Omani population. **Methods:** We launched a colorectal cancer awareness campaign in Oman's South Ash Sharqiyah Governorate between January and March, 2023. We conducted a stratified random study including 688 adult Omani participants aged over 40 years old. Local Health Centers collected the questionnaire forms. Fecal occult blood tests (FOBTs) were carried out at Local Health Centers; while medical professionals performed the colonoscopy examination in Sur University Hospital. **Results:** Overall, the screening response rate was 68.8%. The data indicated that 8.1% of the total sample yielded positive FOBTs; of whom, 85.7% were aged 40-59 years old and 67.9% were obese or overweight. Abnormal colonoscopy was reported in 7 participants. One participant had a confirmed CRC of stage I. **Conclusion:** Screening and early detection campaign can have effect and increase the rate of early detection among population in Oman.

Keywords: Colorectal cancer- screening- colonoscopy- FOBTs- Oman

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Introduction

Colorectal cancer (CRC) represents the third most common tumor that affects men and women and the second leading cause of cancer-related mortality worldwide [1]. In Oman, the estimated age-standardized incidence of CRC was 9.9 per 100,000 in 2020 [2]. Additionally, it is the fourth most common cause of cancer mortality with an estimated age-standardized rate of 5.7 per 100,000, with most cases diagnosed at delayed stages [2]. In 2012, CRC was the most prevalent type of cancer diagnosed among men and the second in women, after breast cancer in Oman [3]. In the younger population, the CRC prevalence is increasing and new cases are expected to increase among those aged 20-49 years by 2030 due to the influence of Western lifestyle such as poor dietary practice [4]. Furthermore, CRC incidence and prevalence have dramatically increased over the past years and several critical cases were missed since CRC is an asymptomatic disease and around 60% of patients were diagnosed at advanced stages (namely, stage III and stage IV) [5]. Delays in diagnosis may cost patients their lives and incur major costs. Several causes contribute to the increase in the incidence of CRC related to westernized lifestyle such as the sedentary lifestyle, cultural, social and dietary habits, obesity, cigarette smoking, heavy alcohol consumption, inadequate intake of fruits and vegetables, and embarrassment to see doctors [2]. On the other hand, researchers have identified certain non-modifiable risk factors, such as aging, inflammatory bowel disease, the presence of adenomatous polyps, a family history of CRC, and inherited genetic defects [6].

A recent study carried out in the Omani population showed that public knowledge and awareness of CRC symptoms were below 56% and that CRC cases had dramatically increased in the community [7]. Therefore,

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establishing an efficient CRC screening program in Oman could help control the risk factors of this malignancy. In fact, the absence of a well-organized screening program leads to the diagnosis delay as well as difficulties in the treatment and management of the advanced stage tumors. Other barriers that may delay diagnosis are religion, unfamiliarity with the screening process, healthcare professionals and lack of education [8]. Additionally, another challenge to the diagnosis of the early stages of CRC is asymptomatic manifestations, which often remain undiagnosed. As the early stages of CRC often have no symptoms, the tumor will continue to grow, and it may bleed or block the intestine. The most clinical symptoms are bleeding from the rectum, blood in the stool or in the toilet after having a bowel movement, and dark or black stool [9]. Therefore, a proficient CRC screening program could help detecting early stages of CRC, which leads to more successful patient treatment and a higher probability of survival. Furthermore, the awareness promoted by such a program may help reduce psychological distress for affected patients and their families, easing their depression, anxiety and stress, which are related to diagnosis and treatment [10].

Screening methods for CRC include fecal occult blood tests (FOBTs), which have high sensibility when based on the guaiac or immunologic test and should be performed yearly on two samples each from three consecutive bowel movements, followed by a colonoscopy in the case of positive results [11]. Colonoscopy is the best screening method for both distal and proximal CRC. Researchers have found that the combination of yearly FOBTs and colonoscopies every five years reduces CRC-related deaths. Interestingly, in the United States of America (USA), CRC screening programs recommend that people begin colonoscopy examinations at age 50 years and continue on a 10-year routine basis until the age of 75 years [12].

The aim of the current study was to detect early stage CRC on Omani adults from South Ash Sharqiya Governorate, where the highest CRC incidence rate was reported in 2019 (11.2 per 100,000) [13]. Accordingly, we conducted a CRC screening program campaign including questionnaires, FOBTs and colonoscopy examinations in order to further explore the risk factors associated with the increase of CRC cases and to raise awareness about CRC risk factors and symptoms via an efficient screening program amongst Omani population.

Materials and Methods

The current campaign started by organizing a large team included directorate of South Ash Sharqiya Health Services staffs (such as Director general, Doctors, paramedical staffs), volunteers and supported private sectors. The campaign team prepared the screening details such as the sample size, covering areas, workers, social media advertisements, facilities, required materials, challenging tools, output products, leaflets, campaign how-to videos, animation video clips illustrating the benefits of the early CRC screening and the CRC risk factors. The final proposal was approved by the office of the World Health Organization (WHO) in Oman and funded by the Oman Liquefied Natural Gas LLC (Oman LNG).

The CRC screening campaign was conducted between January 1st, 2023 and March 22nd, 2023. To properly perform this campaign, posters and leaflets were distributed and fixed in front of hospitals, polyclinics, health centers, universities, roundabouts and wherever people assembling, such as markets and even small shops. Furthermore, animation videos were posted via television channels, WhatsApp groups and social Media. Early CRC screening community awareness symposium and CRC risk factors exhibition at Al-Sharqiya Hall at University of Technology and Applied Sciences, Sur, Oman.

Figure 1 detailed the CRC screening campaign organized in the South Ash Sharqiya Governorate. All local health centers (LHCs) in South Ash Sharqiyah Governorate participated in this survey in order to cover the whole region. We recruited the subjects by administering a stratified systematic random sampling study based on suspected CRC-free Omani adults over 40 years old, in each LHC catchment area. We requested and collected the responses of all adult volunteers who visited the LHCs during the study period. After explaining the aims of the study to the attendance participants who agreed to take part in this survey and who could read and write, the volunteers signed a consent form to participate in this screening campaign.

In this study, the population included Omani people, males and females, above 40 years old in South Ash Sharqiyah Governorate. The population was distributed according to the catchment area of the LHCs. According to Steven Thompson equation [14], the minimum sample size was 452 with Alpha = 0.05. However, we raised the sample size to 1000 participants in order to increase the data power, reduce errors and obtain good estimates. Additionally, we developed the tools used to evaluate the CRC screening program with reference to a similar study that was conducted previously at the Royal Hospital, Oman [15]. The validity and reliability of the questionnaire form were already evaluated by Bondre et al. [15]. The questionnaire forms were available in English and Arabic, and each form composed of three sections. The first part included the collection of data on the sociodemographic characteristics of the participants; While the second section measured general knowledge of CRC screening such as habits, medical history, gastrointestinal diseases, screening, family history and occult blood results. The third section explained sample collection method and other procedures. Finally, we sent the stool samples to laboratories and explained subsequent procedures to participants based on the FOBTs results. Participants with positive FOBTs were encouraged to visit a local surgeon and then are referred to the Sur University Hospital for colonoscopy examination. During the survey period, confidentiality of the data collection and test results was mandatory in this screening campaign. We excluded emergency cases and illiterate participants.

In this study, body mass index (BMI) was categorized into three levels according to the World Health Organization (WHO) criteria, with 18.5-24.99 kg/m^2, 25-29.99 kg/m^2,

and ≥30 kg/m^2 representing normal weight, overweight and obesity, respectively [16].

The survey data were summarized and presented in tables according to the specific categories. We analyzed the data using the Statistical Package for the Social Sciences (SPSS), version 22 (IBM Corp., Armonk, NY, USA), and calculated descriptive statistics for all survey items. Bivariate analyses were conducted using the Chi-square test to examine the relationships between categorical variables. A P-value of <0.050 was considered as the cutoff value for statistical significance.

This study was approved by the Medical Research and Ethics Committee of Ministry of Health of Oman/ Centre of Studies and Research/22/26041. We explained the purpose of the study to all potential participants and received their written informed consent prior to participation in the screening campaign.

Results

Overall, 688 participants were included in this survey with a response rate of 68.8%. Table 1 summarized the characteristics of all participants. The demographic data analysis showed that 41.6% of the participants were from Sur; While, the remaining volunteers were from Jalaan Bani Bu Ali (24.4%), Jalaan Bani Bu Hassan (21.2%), Alkamil and Alwafi (12.3%) and Masirah (0.6%). There were more female than male participants with a sex-ration of 0.9. Furthermore, 71.2% of participants were aged under 60 years. Obesity and overweight were identified in 24% and 21.5% of participants, respectively.

Regarding the habits, 39.5% of volunteers had physical activities and only 22.2% follow good dietary practices. Medical history of hypertension and diabetes were reported in 27.8% and 23.4% of volunteers, respectively. Moreover, 232 participants presented gastrointestinal diseases, such as hemorrhoids (26.3%), perianal fistula (19.4%) and anal fissure (18.5%). Only 32 participants had a CRC family history (Table 1).

Table 2 detailed characteristics of participants according to the FOBTs results. Overall 56 participants showed positive FOBTs (8.1%). Among these FOBTs-positive participants, almost 85.7% were aged 40-59 years old and the sex-ratio was 1.0. Most of FOBTs-positive volunteers displayed overweight (39.3%) or obesity (28.6%). No statistical difference was found between FOBTs-positive and FOBTs-negative volunteers according to the participant habits, medical history, gastrointestinal diseases, and CRC family history (p>0.05).

Twenty-six FOBTs-positive participants received colonoscopy examination (Table 3). The remaining participants abstained from undergoing colonoscopy due to personal refusal (n=19) or missing the appointment (n=6) or inability to set an appointment (n=5). Overall, 7 individuals had abnormal colonoscopy results. There were four males and three females, which were aged under 60 years old (Table 3). When compared to participants with normal colonoscopy, no significant difference was observed according to BMI, patient habits, medical history, gastrointestinal diseases and CRC family history (p>0.05). The histopathological diagnosis of samples with abnormal colonoscopy results was adenomatous polyps (n=5), other polyps (n=1), and CRC of stage I (n=1). Participant diagnosed with CRC of stage I refused local treatment and instead sought surgical treatment overseas.

Table 1. Characteristics of the Participants

Variables		N	%
City	Sur	286	41.60
	Jalaan Bani Bu Ali	168	24.40
	Jalaan Bani Bu Hassan	146	21.20
	Alkamil and Al Wafi	85	12.30
	Masirah	4	0.60
Gender	Male	325	47.20
	Female	363	52.80
Age	40-59	490	71.20
	< 60	198	28.80
Body mass index	Obesity	165	24
	Overweight	148	21.50
	Normal	75	10.90
	Underweight	9	1.30
	Non Determinant	391	56.80
Habits	Physical activities	272	39.50
	Good dietary practices	153	22.20
	Smoking	116	16.90
	Nonsteroidal anti-inflammatory drugs	96	13.90
	Alcohol	72	10.50
	Others	79	11.50
Medical history	No	60	8.70
	Yes	628	91.30
	Hypertension	191	27.80
	Diabetics	161	23.40
	Ischemic heart disease	83	12.10
	Chronic kidney disease	77	11.20
	Others	116	17
Gastro-intestinal diseases	No	456	66.30
	Yes	232	33.70
	Hemorrhoid	61	26.30
	Anal fissure	43	18.50
	Perianal fistula	45	19.40
	Crohn's disease	41	17.70
	Ulcerative colitis	42	18.10
Family history of CRC	Without family history	656	95.30
	Family history	32	4.70
	First degree relative	24	75
	Second degree relative	8	25

Discussion

CRC screening is often used on those with asymptomatic conditions. However, Rex et al. [17] did not find adequate evidence to support such screening

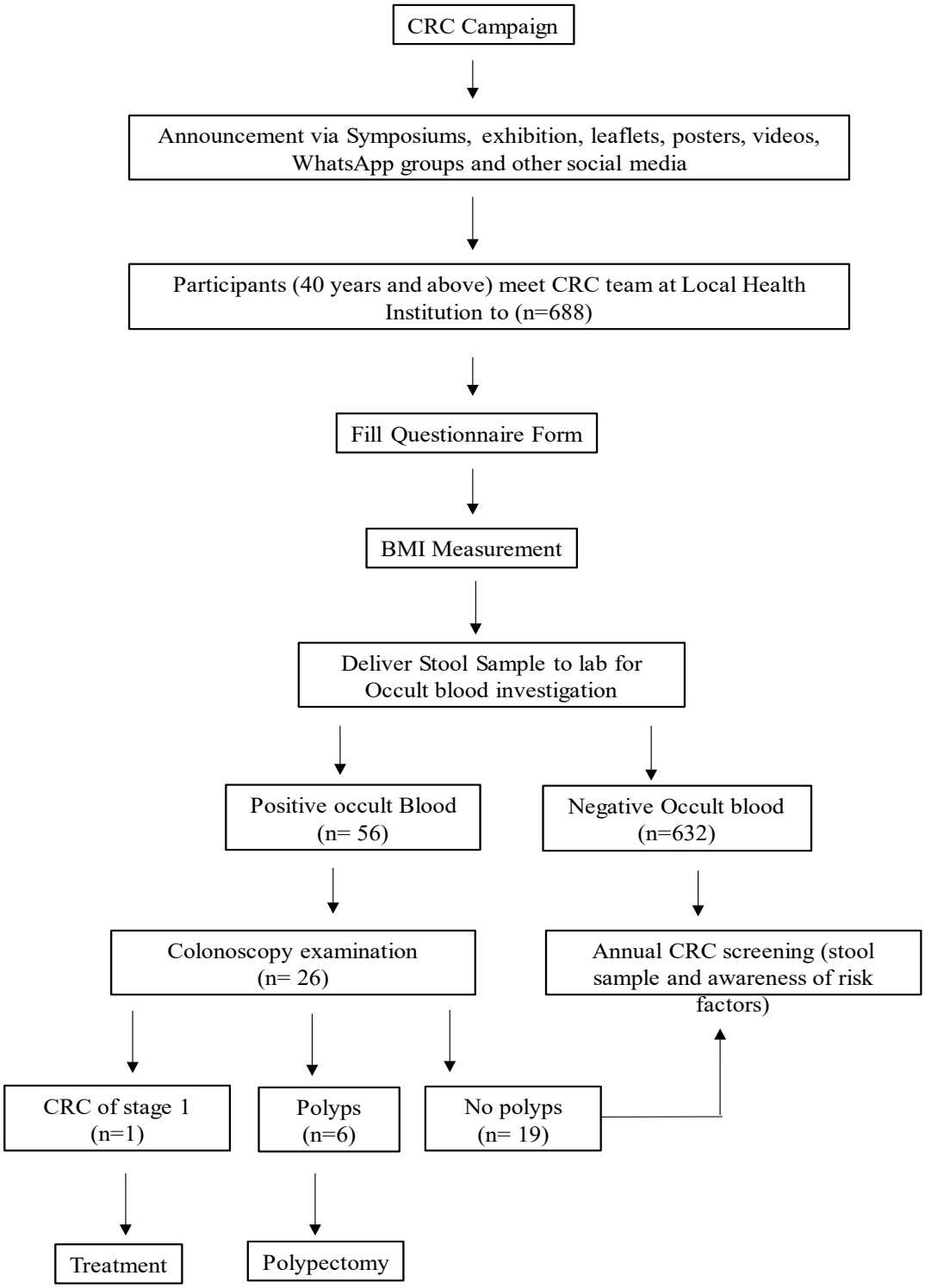

Figure 1. Study Design of the CRC Screening Campaign in the South Ash Sharqiya, Oman

for people under 50 years, specifically for those with no CRC risk factors such as a family history of CRC, Lynch syndrome, cigarette smoking, obesity and diabetes. Nonetheless, different CRC screening initiatives have been employed via FOBTs and colonoscopy screening globally, particularly in Europe and Australia. A suitable study with high external validity should have a power of 80% [18]. Hence, the present research raised the sample size from 452 to 1000 participants to improve the statistical power. During the study, 828 respondents participated, and after eliminating bias, the sample was reduced to 688, representing a response rate of 68.8%. The bias error in the sample may have been due to incomplete records in the institutions that did not meet the initial criteria for sample selection [19]. This response rate was sufficient and was close to that previously described by Pacheco-Pérez et al. [19] (70.3%). According to the Rex et al. [17] study, the USA has the highest CRC screening globally with the highest reduction in CRC incidence and mortality.

CRC screenings that have been successfully carried

Table 2. Characteristics of Participants According to the Occult Blood Test Results

Participant characteristics		Positive FOBTs (n=56)	Negative FOBTs (n=632)	P
City	Sur	(24) 42.8%	(262) 41.4%	0.116
	Jalaan Bani Bu Ali	(13) 23.2%	(155) 24.5%	
	Jalaan Bani Bu Hassan	(14) 25%	(132) 20.9%	
	Alkamil & Alwafi	(5) 8.9%	(80) 12.7%	
	Masirah	(1) 1.7%	(3) 0.5%	
Age	40-59 years	(48) 85.7%	(442) 70%	0.085
	< 60 years	(8) 14.3%	(190) 30%	
Gender	Male	(28) 50%	(297) 47%	0.855
	Female	(28) 50%	(335) 53%	
Body mass index	Obesity	(16) 28.6%	(149) 12.6%	0.077
	Overweight	(22) 39.3%	(126) 20%	
	Normal	(16) 28.6%	(59) 9.3%	
	Underweight	(2) 3.6%	(7) 1.1%	
Habits	Physical activities	(23) 41%	(249) 40.4%	0.64
	Good dietary practices	(13) 23.2%	(140) 22.1%	0.08
	Smoking	(6) 10.7%	(114) 17.4%	0.47
	NSAIDs	(5) 8.9%	(91) 14.4%	0.52
	Alcohol	(1) 1.8%	(71) 11.2%	0.08
	Others	(6) 10.7%	(73) 11.5%	0.102
Gastrointestinal diseases	No	54 (96.4%)	402 (63.6%)	0.43
	Yes	2 (3.6%)	230 (36.4%)	
	Hemorrhoid	(1) 1.8%	(60) 9.5%	0.32
	Anal fissure	0	(43) 6.8%	0.11
	Perianal fistula	0	(45) 7.1%%	0.09
	Crohn’s disease	0	(41) 6.5%	0.12
	Ulcerative colitis	(1) 1.8%	(41) 6.5%	0.37
Medical history	No	15 (26.8%)	45 (7.1%)	0.63
	Yes	41 (73.2%)	587 (92.9%)	
	Hypertension	(17) 41.5%	(174) 29.6%	0.56
	Diabetics	(14) 34.1%	(147) 25%	0.74
	Ischemic heart disease	(2) 4.9%	(81) 13.8%	0.23
	Chronic kidney disease	(2) 4.9%	(75) 12.8%	0.15
	Others	(6) 14.6%	(110) 18.7%	0.45
Family history of CRC	Without family history	(53) 95.4%	(603) 95.4%	0.38
	Family history	(3) 5.4%	(29) 4.6%	
	First degree relative	(2) 66.6%	(22) 75.9%	0.52
	Second degree relative	(1) 33.3%	(7) 24.1%	

FOBTs, Fecal occult blood tests; NSAIDs, Nonsteroidal anti-inflammatory drugs

out throughout the world, including those carried out in the United Kingdom since 2011 and in Korea since 2007 [20, 21], have mainly focused on creating awareness of the CRC risks and symptoms and preventing the spread of the condition at low cost. Unlike developed countries, developing nations such as Oman, Mexico and Tunisia have not shown a clear strategy for implementing the CRC screening initiatives [15, 19, 22]. CRC Screening is important because early diagnosis and identification of CRC lead to less cost than late diagnosis of CRC [17]. In the USA, the high rate of screening may be attributed to increased CRC awareness among the public and the high number of screening options available [17]. Hence, the implementation of CRC screening initiatives worldwide was intended to determine the awareness level of CRC risk factors and symptoms and encourage the public to undertake screening via colonoscopy. Through increased awareness, prevention could be encouraged, and diagnosis could be carried out earlier, leading to prompt identification of the condition and treatment with the effect of reducing the care cost, hospitalization and associated complications [19-21].

Early CRC screening results in the successful treatment of symptomatic cancer, with many patients

Table 3. Characteristics of Participants According to the Colonoscopy Results

Participant characteristics		Abnormal colonoscopy (n=7)	Normal colonoscopy (n=19)	P
Cities	Sur	(1) 14.3%	(11) 57.9%	0.22
	Jalaan Bani Bu Ali	(2) 28.6%	(2) 10.5%	
	Jalaan Bani Bu Hassan	(2) 28.6%	(2) 10.5%	
	Alkamil & Alwafi	(2) 28.6%	(4) 21%	
Age	40-59 years	(6) 85.7%	(16) 84.2%	1
	< 60 years	(1) 14.3%	(3) 15.8%	
Gender	Male	(4) 57.1%	(11) 57.9%	0.97
	Female	(3) 42.9%	(8) 42.1%	
Body mass index	Obesity	(1) 14.3%	(7) 36.8%	0.14
	Overweight	(2) 28.6%	(5) 26.3%	
	Normal	(2) 28.6%	(7) 36.8%	
	Underweight	(2) 28.6%	0	
Habits	Physical activities	(5) 71.4%	(8) 42.1%	0.35
	Good dietary practices	(2) 28.6%	(5) 26.3%	0.64
	Smoking	0	(4) 21%	0.21
	NSAIDs	0	(1) 5.2%	0.56
	Others	(1) 14.3%	(2) 10.5%	0.26
Gastro-intestinal diseases	Hemorrhoid	(1) 14.3%	(1) 5.3%	0.56
	Anal fissure	(0) 0%	(1) 5.3%	0.56
	Perianal fistula	(0) 0%	(1) 5.3%	0.56
	Crohn's disease	(0) 0%	(1) 5.3%	0.56
	Ulcerative colitis	(0) 0%	(1) 5.3%	0.56
Medical background	Hypertension	(2) 28.6%	(4) 21%	0.75
	Diabetics	(4) 57.1%	(4) 21%	0.2
	Ischemic heart disease	(1) 14.3%	(1) 5.3%	0.39
	Chronic kidney disease	0	(1) 5.3%	0.56
	Others	(3) 42.8%	(4) 21%	0.11
Family history	Family history	0	(1) 5.3%	0.56
	Without family history	(7) 100%	(18) 94.7%	

NSAIDs, Nonsteroidal anti-inflammatory drugs

surviving the condition at early stages. For example, there was more than 90% survival of CRC over five years due to early diagnosis of the disease and tumor elimination before extending beyond the bowel wall [23]. However, when a tumor spreads to lymph nodes, the survival rate is 60%, while the survival rate is only 10% when the cancer has metastasized [23]. Interestingly, the current study supported that early CRC screening has led to the increased patient survival rate, prevention of disease spread, as well as reduced care costs.

Various sampling approaches are used for CRC screening campaigns, including a pilot study, questionnaires, literature, metaverse platform, and a cross-sectional descriptive design [19, 21, 24, 25]. In our study, we employed a stratified random approach and we chose free CRC participants to represent the community. Our sample selection approach was supported by Green and Meenan [26]. This study's CRC screening campaign consisted of national education programs such as radio, television ads, newspapers, social media, posters and leaflets. The study took the distribution approach employed by Whyte and Harnan [25] and Alsuqri et al. [5], which involved the tools distribution to government institutions and public places. The study employed medical examination through FOBTs and colonoscopy tests, questionnaires and treatment where necessary. Like the May et al. study [27], our survey expanded the response time to increase the response rate and limit potential disparities in CRC screening. However, the research's response time was 16 weeks, more than twice the duration of the screening studies carried out in England and Mexico [19, 28].

Females are more willing to participate in medical screening campaigns than males [7, 19]. The high willingness of women to participate in medical campaigns could be attributed to increased awareness and care for their health. Interestingly, we found 52.8% of the participants were females. Most of the participants (71.2%) were aged 40-59 years, which represents the more susceptible age to CRC requiring screening program [8, 29, 30]. However, Lee et al. [21] have shown that CRC screening should include the younger generation because they can also

develop CRC.

In the current study, the BMI records showed that 45.5% of the participants were obese or overweighed, a condition that Pacheco-Pérez et al. [19] and Shaukat et al. [24] associated with the adoption of western lifestyles such as physical inactivity and poor dietary habits. Our data supported the WHO 2015 report, which indicated that more than 25% of Omani people were obese, with 27.2% male and 37.7% female being obese [31]. Previously, the colonoscopy examination results of Mafiana et al. [4] supported that high BMI was associated with an increased risk of CRC.

Additionally, our study showed that 51.2% of respondents had CRC risk factors such as diabetes and hypertension. It also showed that hemorrhoid was the highest among gastrointestinal disease followed by other patterns such as fissure, perennial fistula, ulcerative colitis, and Crohn's disease. Even though all participants understood the FOBTs well, most had low awareness of the gastroscopy test. Thus, most respondents were not bothered by questions about gastroscopy tests since they had a limited understanding of CRC risk factors.

In spite of the specificity and low false positive of fecal immunochemical test (FIT) screening compared to guaiac FOBT screening, the study adopted guaiac FOBTs as used previously [23]. In fact, Bretthauer [23] argued that guaiac FOBT was a suitable screening tool for CRC because it reduced mortality by 16% compared to the absence of the screening. Furthermore, the screening method was suitable since it was non-invasive, cheap and easy to conduct worldwide. Interestingly, Rex et al. [17] considered that guaiac FOBT was more effective and cheaper than other CRC screening tools, such as FIT-fecal DNA, carried out every three years.

The current study found that 8.1% of stool samples showed positive FOBTs, which may be indicative of occult bleeding. Borges et al. [32] argued that occult bleeding could be a symptom of adenomas or neoplasms in their advanced stages. Our study also showed that 85.7% of the occult bleeding samples were derived from participants with young age. Likewise, previous findings [8, 29, 30] found that young generation were more susceptible to CRC. According to Rex et al. [17], high CRC incidence among young people is a major public health concern. Preventing young people from developing CRC helps to reduce the social impact of the disease, such as death at early age [24].

During our study, most participants were unwilling to participate because of fear of harm from the stool-based exams, including false-positive results and harm associated with colonoscopy tests. Potential harm associated with colonoscopy examination included perforation and bleeding. The screening may specifically affect older people due to three main reasons. Firstly, older people have a low life expectancy, which hinders them from fully benefiting from the screening test. Polypectomy screening benefits start to be realized between 7 and 10 years and hence may not benefit individuals not expected to live more than 7 to 10 years. Secondly, the elderly may also not benefit from the screening because they have increasing competing causes of death. The elderly has a high risk of death and may not benefit from the screening. Thirdly, older people may also be vulnerable to screening risks compared to younger generations. The screening risks that may affect older people include false positive results, anxiety, preformation, dehydration, excessive bleeding, electrolyte disturbance, alteration of anticoagulation, and adverse effects on renal functioning. Early detection and prevention of CRC benefit older people, which may offset the screening procedure risk. Generally, older adults over 86 years should not be screened because of the competing causes of death [24]. Due to the competing causes of mortality, the USA CRC screening program recommended that screening should stop at 75 years [29, 30].

Our study showed that 53.6% of those who recorded positive FOBTs were unwilling to undertake colonoscopy screening. Their refusal to undertake the exam may be attributed to a lack of trust in healthcare professionals, cultural and religious beliefs, awareness, embarrassment, discomfort and distress associated with the procedures [20, 5, 19]. Other barriers to undertaking a colonoscopy included belief in herbal and traditional medicines, family commitment, emotional barriers, and work priorities [5]. Shaukat et al. [24] suggested that these barriers could be minimized through a spectrum of care and increased public awareness of the screening program. Such awareness alleviates people's fears about the procedure and motivates them to participate. Shaukat et al. [24] also indicated that overall acceptance and participation in the screening could be increased by adopting accurate, non-invasive, and cost-effective methods with limited patient complications.

Colonoscopy is considered as a gold standard approach for CRC screening because it visualizes the whole bowel and allows doctors to remove pre-cancerous lesions. The high-risk individuals who needed colonoscopies were older adults, those experiencing rectal bleeding, individuals with a family history of CRC, individuals with iron deficiency anemia, tobacco smokers, diabetic, and obese individuals [17, 20]. In the present study, colonoscopy testing allowed the detection of polyps in six participants and CRC of stage I in the seventh volunteers.

Even though colonoscopy is widely used for CRC screening, Shaukat et al. [24] suggested that a combination of colonoscopy and other methods, such as annual FIT conducted after ten years, was effective and less costly than alternative methods such as multi-target stool DNA screening done after three years. Similarly, Al-Azri et al. [8] indicated that combining annual FOBTs and colonoscopies done every five years could help reducing CRC incidence and CRC-related mortality.

Earlier studies described a positive correlation between obesity and CRC development [4, 8, 19, 20]. Pacheco-Pérez et al. [19] indicated that physical activity and maintaining appropriate weight could reduce the risk of CRC. Lifestyle changes and healthy habits could contribute to a reduced CRC risk. Nevertheless, herein, no significant association was described between the diagnosis of polyps and CRC and the habits of participants, such as physical activities, healthy dietary practice and smoking.

In line with the previous Omani studies [33, 34], the present study found adenomatous polyp to be the most common type of colon polyps. Participant diagnosed with CRC of stage I refused local treatment and instead sought surgical treatment overseas. In line with these findings, Al-Azri et al. [7] found also that some patients diagnosed with CRC preferred overseas treatment. The increased screening of CRC among the public could be enhanced through increased public awareness [25]. Early diagnosis and screening could also be promoted by using appropriate methods that improve the quality of CRC screening and reduce CRC incidence and mortality in Arab countries, particularly in Oman [5, 24, 33].

The current study have various limitations. Firstly, the evidence presented on the length of the impact of the awareness campaign. Secondly, screening rates are less precise due to the study's small sample size. In addition, the study's findings may have been influenced by selection bias since the awareness campaign only focused on one area and not the entire nation to have a more representative sampling that would increase the generalizability of the study findings. Furthermore, the questionnaire used in the present study was adapted from another study but was not adequately validated for local settings. Moreover, the time constraint means that a large sample size was not used, which hindered the study from explaining the effect of risk factors on medical outcomes. Additionally, the emotional barriers, such as embarrassment and stigma associated with the screening and diagnosis, prevented many people from participating in the study. The limited awareness due to access to health information may have also hindered many from participating in the CRC screening program. Likewise, limited data delayed the exploration of certain questions of interest, including risk factors for CRC and the lack of programmed CRC screening in Oman. Finally, the screening program and the study findings may also have been affected by other unknown confounders since it was an observational survey.

Nevertheless, the present study had various strengths despite the highlighted limitations. First, the study employed a diverse and extensive database to analyze the CRC screening rate over time. Moreover, the study is the first to successfully show a stratified random CRC screening rate and compare the rate over time. Furthermore, our study employed different screening methods, especially in areas with limited access to colonoscopy.

While data about physical activity and food habits may be questioned, there is evidence that overweight and obesity are more common in younger people. The high cases of being overweight contributed to a higher risk of CRC. Additionally, a lack of awareness contributed to limited knowledge of colonoscopy examination amongst Omani people. The result showed that the most prevalent colon polyp was adenomatous polyp. The high cases of adenomatous polyps were reported despite suspicion that the study participants were CRC-free. As the prevalence of CRC in Oman continues to rise, screening programs, including FOBTs and colonoscopy, are advised to promote public knowledge of the disease and its main prevention. Current screening recommendations, starting at age 40 years, include a colonoscopy every five to ten years and yearly FOBT or FIT testing. Physicians should be more involved in promoting cancer education to the public to ensure the success of future CRC screening initiatives in Oman.

Author Contribution Statement

Study concept and design were done by JAM, NAA, SAH, MAO and NM. Data curation were provided by JAM, AAF, BAH, SK, AAR, MAH, SAA, SAH, MAJ, FAS, MAS, SAJ, MAA, NAA, BAR, MAA, and FAW. Formal analysis was done by JAM and BAH. Methodology by. The data were analyzed and interpreted by JAM, KS, NAA and NM. Drafting of the manuscript was done by JAM. Critical revisions of the manuscript for important intellectual content was performed by NM. Administrative, technical, or material support was provided by SK, IO, SH, and NM. All authors read and approved the final manuscript.

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Approval

The study is part of an approval PhD student thesis (JAM). It was approved by the Medical and Scientific Research Committees of the Faculty of Medicine of Sousse, University of Sousse, Tunisia. In addition, this study was approved by the Medical Research and Ethics Committees of Ministry of Health of Oman/Center of Studies and Research/22/26041.

Ethical declarations

Institutional Review Board approval was obtained from the Ministry of Health, Directorate General of Health Services, Governorate of South Ash Sharqiya, and Department of Planning Ethics Committees (Oman). The authors declare that they have received a written informed consent from volunteers to participate to this campaign and to publish their data.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship or publication of this article.

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