

# THE ROLE OF DIETARY AND LIFESTYLE FACTORS IN THE DEVELOPMENT OF COLORECTAL CANCER: CASE CONTROL STUDY IN MINIA, EGYPT

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## SUMMARY

**Background:** Colorectal cancer (CRC) is the third most common cancer worldwide, after lung and breast cancer, and is associated with the population dietary and lifestyle factors.

**Aim:** To determine the relation between dietary and lifestyle factors and development of CRC in patients attending Minia oncology centre and compare them with their control.

**Methods:** Study included 150 CRC patients attending Minia oncology centre and 300 control subjects matched by age and sex. Subjects participating in the study filled in a questionnaire including questions about socio-demographic data, medical data concerning CRC and its treatment as well as dietary and lifestyle factors.

**Results:** The most significant dietary and lifestyle CRC risk factors were higher consumption of red meat (OR = 57.1), preserved food (OR = 39.4), artificial sweeteners (OR = 20.8), fast foods (OR = 12.8), soft drinks (OR = 4.6), spicy foods (OR = 4.2), processed meat (OR = 2.4), and smoking (OR = 8.8). The most significant protective factors were physical activity (OR = 0.001), calcium rich diet (OR = 0.08), higher consumption of fruits and vegetable (OR = 0.02), cruciferous vegetables (broccoli OR = 0.11, cauliflower OR = 0.30 and cabbage OR = 0.30), high fiber bread (OR = 0.15), fruit juice (OR = 0.18), and sea foods (tuna OR = 0.28 and fish OR = 0.38).

**Conclusion:** Sedentary lifestyle and unhealthy dietary choices were prevalent among CRC cases. This study provides strong evidence that lifestyle and dietary modification are important factors in the prevention of colorectal cancer.

**Key words:** colorectal cancer, life style, diet, case-control study, Minia

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## INTRODUCTION

Colorectal cancer (CRC) is the third most common cancer worldwide after lung and breast; it is the third most common cancer in men after lung and prostate cancer and the second in women after breast cancer. It was estimated that 1.23 million new cases of CRC were diagnosed in 2008 worldwide (1).

The global annual incidence of CRC is approximately one million cases and its annual mortality is more than five hundred thousand (WHO, 2011) (2). In Egypt, the relative frequency of CRC is about 9–12% with high male predominance 3:1 (Mokhtar, 2010) (3). According to the Egypt National Cancer Registry, age-specific incidence rates of CRC per 100,000 were 6.3 for males and 4.3 for females in 2009. According to Minia Cancer Registry in 2011, the crude incidence rate of CRC was about 3.4 per 100,000 population in Minia (4).

The concept of “lifestyle” is based on the idea that people generally exhibit a recognizable pattern of behaviour in their everyday lives, the WHO definition (5) of lifestyle providing a broader understanding of the determinants of a healthy lifestyle

stated that lifestyle is a way of living based on identifiable patterns of behaviour which are determined by the interplay between the individual personal characteristics, social interactions, and socio-economic and environmental living conditions (6).

Life style factors associated with risk of CRC include smoking, alcohol intake, high red meat and processed meat consumption, high fat and protein diet intake, physical inactivity, and overweight (7, 8). According to the National Institute for Clinical Excellence, about three quarters of CRC cases are associated with the population lifestyle (9).

Alterations and changes in the traditional Egyptian diet, introduction of new types of foods and eating habits such as consumption of processed or semi-processed, tinned or cooked meats, fried potatoes, hamburger, and pizza are taking place. Fast foods became popular as well as physical inactivity and smoking which might lead to increasing CRC among Egyptian population (10). Therefore, a study was conducted with the aim of determining the relation between lifestyle factor and development of CRC in patients attending Minia oncology centre.

## MATERIALS AND METHODS

### Study Design: Case Control Study

Administrative and ethical consideration: An approval was obtained from the Ministry of Health and a manager of Minia oncology centre to attain data about number of CRC patients attending the centre during the previous years and to facilitate data collection through a questionnaire. A written informed consent was obtained from each participant.

### Study Population

Selection of cases: Inclusion criteria – primary CRC cases of either sex without age restriction receiving treatment (i.e. surgery, chemotherapy, radiotherapy, or combination of these therapies) in Minia oncology centre from October 2010 to June 2011 were recruited. Exclusion criteria – cases with family history of CRC, patients with a primary cancer other than CRC and severely ill cases.

Selection of control: Inclusion criteria – 300 age and sex matched controls were selected randomly from community where the cases lived during the period from June 2011 to August 2011. Exclusion criteria – relatives or cases and individuals with family history of colorectal cancer.

Collection of data: Data were collected through a questionnaire. Questions dealt with issues such as socio-demographic

characteristics (age, gender, residence, educational level, occupation, and marital status); medical data concerning disease (its duration and CRC site and received therapy); and life style factors concerning dietary history – dietary pattern during 2 years prior to cancer diagnosis was assessed through the dietary questionnaire introduced by Melbourne University (11). This food frequency questionnaire includes eight food items: cereal foods, dairy products, meat and fish, fruits, vegetables, egg, drinks, and sweets. The analysis of each food item includes the frequency of intake daily, weekly or monthly; the number of servings for each food item and conversions of household measures and serving sizes of various foods into grams (12). Life style factors concerning smoking history included type of smoking, duration of smoking, number of cigarettes per day and smoking index, i.e. total number of cigarettes per day (other types as shish converted into cigarette unit) multiplied by the duration of smoking, passive smoking, quitting smoking and reasons for it. Other questions inquired about history of alcohol intake and history of physical activity (performing regular exercise, type and the frequency per week).

Anthropometric measurements included weight and height and calculated BMI.

### Statistical Analysis

Statistical analysis was performed using SPSS 13 and quantitative data (mean and standard deviation), qualitative data (frequency distribution) were measured. Chi square test and Fisher's

**Table 1.** CRC cases and controls according to their age and sex, Minia governorate, October 2010 to August 2011

Data		CRC cases		Control		p
		N	%	N	%	
Age groups	<20 year	4	2.7	6	2.0	0.3 <sup>a</sup>
	20–40 year	45	30.0	102	34.0	
	40–60 year	80	53.3	136	45.3	
	>60 year	21	14.0	56	18.7	
Sex	Male	72	48.0	144	48.0	1 <sup>b</sup>
	Female	78	52.0	156	52.0	
Residence	Urban	58	38.7	116	38.7	1 <sup>b</sup>
	Rural	92	61.3	184	61.3	
Marital status	Single	16	10.7	27	9.0	0.2 <sup>a</sup>
	Married	117	78.0	250	83.8	
	Widow	16	10.7	23	7.7	
	Divorced	1	0.7	0.0	0.0	
Education level	Illiterate	87	58.0	162	54.0	0.1 <sup>b</sup>
	Read and write	17	11.4	50	16.7	
	Secondary	38	25.3	82	27.3	
	University and higher	8	5.3	6	2.0	
Occupation	Unemployed	110	73.3	246	82.0	0.09 <sup>b</sup>
	Clerical	6	4.0	9	3.0	
	Manual	25	16.7	27	9.0	
	Professional	9	6.0	18	6.0	
Total		150	100.0	300	100.0	

<sup>a</sup>Fisher exact = 3.2 and 3.6, DF = 3 and, <sup>b</sup> $\chi^2$  = 0.000, 0.000, 5.9 and 6.3, DF = 1, 1, 3 and 3

exact test was used to compare proportions. Student t-test was used to compare two means. Odds ratio was calculated to predict the risky and protective factors in relation to CRC. Multiple regression analysis was used to determine the combined effect of different independent variables on the target (dependant variable). The probability of less than 0.05 was used as a cut off point for all significant tests.

## RESULTS

It was found that more than half (53.3%) of CRC patients were aged 40–60 years, 52% of colorectal cancer cases were females, 61.3% of CRC patients were living in rural areas, 78% were married, 58% were illiterate, and 73.3% were unemployed (Table 1). Colon cancer accounted for 52% of the total of CRC cases. Sigmoid region is the most CRC afflicted part of colon (42.4%), followed by caecum (24.4%), and the other sites. Majority (75%) of rectal cancer is located in lower rectum (Table 2).

Both active and passive smoking was found to be significantly more frequent in CRC patients than in their controls (34% vs. 18.7% and 24.7% vs. 5.3%, respectively). All patients were cat-

egorized as physically inactive compared to 78.3% of controls ( $p=0.001$ ) (Table 3a).

Red meat consumption was found to be higher among patients ( $801.7 \pm 710.8$  grams per week) than among controls ( $234.6 \pm 110.8$  grams per week) and this difference was statistically significant ( $p=0.001$ ). The same was noted for processed meat consumption by CRC patients ( $629.03 \pm 337.8$ ) than by controls ( $186.7 \pm 83.2$ ) (statistically significant difference  $p=0.006$ ). More than half (57.3%) of controls ate salmon and sardine once or more times a week compared to 22.7% of patients ( $p=0.008$ ). Intake of calcium rich diet was higher among controls (64.3%) than among patients (36.7%). 40.7% of controls ate more than five servings of fruits and vegetables per day compared to 2.7% of patients only and this difference was statistically significant ( $p=0.001$ ). Daily consumption of spicy foods was higher among patients (67.3%) compared to 5.7% of controls, this difference was statistically significant ( $p=0.004$ ). 27.7% of patients consumed preserved food daily compared to 10% of controls (0.001). 10% of patients consume fast foods daily compared to only 2% of controls ( $p=0.001$ ). About half (48.7%) of patients consumed soft drinks daily compared to 15% of controls, this difference was statistically significant ( $p=0.001$ ). Daily consumption of fruit juice was

**Table 2.** CRC cases according to classification and distribution of cancer, Minia Oncology Centre, October 2010 to June 2011

Classification and distribution of CRC		N	%
Colon	Ascending colon	15	19.2
	Transverse colon	4	5.1
	Ascending colon and transverse colon	1	1.3
	Caecum	19	24.4
	Descending	6	7.7
	Sigmoid	33	42.4
	Total	78	52.0
Rectum	Upper rectum	11	25.0
	Lower rectum	33	75.0
	Total	44	29.3
Colorectal	Recto sigmoid	28	18.7
Total		150	100.0

**Table 3a.** Relation between lifestyle factors and CRC among cases and controls, Minia governorate, October 2010 to August 2011

Data		CRC cases		Control		p
		N	%	N	%	
Smoking history	Non smoker	62	41.3	228	76.0	0.005 <sup>b</sup>
	Smoker	51	34.0	056	18.7	
	Passive smoker	37	24.7	016	5.3	
Physical activity	Inactive	150	100	235	78.3	0.001 <sup>a</sup>
	Moderately active	0	0.0	12	4.0	
	Severely active	0	0.0	53	17.7	
Alcohol intake	Never	147	98.0	291	97.0	0.700 <sup>b</sup>
	Rarely	3	2	9	3	
Total		150	100.0	300	100.0	

<sup>a</sup>Fisher exact (DF) = 37.9(2), 125.1(1), 71.6(1), 151.3(4), 206.3(5), 15.6(3), <sup>b</sup> $\chi^2$  (DF) = 52.05(2), 19.3(1), 47.03(1), 70.9(2), 0.38(1), 58(1) and 28.5(1)

**Table 3b.** Relation between dietary factors and CRC among cases and controls, Minia governorate, October 2010 to August 2011

Data		CRC cases		Control		p
		N	%	N	%	
Red meat (grams/week)	≤500 g	89	59.3	297	99	0.001 <sup>a</sup>
	>500 g	61	40.7	003	1	
	Range	120–5,510		0–700		0.001 <sup>c</sup>
	Mean (SD)	801.7±710.8		234.6±110.8		
	≤25 g	50	33.3	249	83	0.001 <sup>b</sup>
	>25 g	100	66.7	51	17	
	Range	0–3,570		0–1,108		0.006 <sup>c</sup>
	Mean (SD)	629.03±337.8		186.7±83.2		
Fresh fish	Less than once per week	106	70.7	145	48.3	0.001 <sup>b</sup>
	Once or more per week	044	29.3	155	51.7	
Canned fish	Less than once per week	116	77.3	128	42.7	0.008 <sup>b</sup>
	Once or more per week	34	22.7	172	57.3	
Calcium rich diet	Low intake	88	58.6	59	19.7	0.001 <sup>b</sup>
	Moderate intake	7	4.7	48	16	
	High intake	53	36.7	193	64.3	
Fruits and vegetables	≤5 servings per day	146	97.3	178	59.3	0.001 <sup>a</sup>
	>5 servings per day	004	2.7	122	40.7	
Spicy food (e.g. chili)	No	039	26	208	69.3	0.004 <sup>a</sup>
	Rarely	0.0	0.0	018	6.0	
	1–2 per week	003	2.0	041	13.7	
	3–6 per week	007	4.7	016	5.3	
	Daily	101	67.3	017	5.7	
Preserved foods	No	20	18.5	219	73	0.001 <sup>a</sup>
	Rarely	02	1.9	021	7.0	
	1–2 per week	45	41.7	020	6.7	
	3–6 per week	11	10.2	010	3.3	
	Daily	50	27.7	030	10	
Fast foods	No	119	79.3	260	86.7	0.001 <sup>a</sup>
	1–2 per week	012	8.0	020	6.7	
	3–6 per week	004	2.7	014	4.7	
	Daily	015	10	006	2.0	
Soft drinks	Yes	73	48.7	45	15	0.001 <sup>b</sup>
	No	77	51.3	255	85	
Fruit juice	Yes	011	7.3	089	29.7	0.001 <sup>b</sup>
	No	139	92.7	211	70.3	
Total		150	100.0	300	100.0	

<sup>a</sup>Fisher exact (DF) = 125.1(1), 71.6(1), 206.3(5), 151.3(4) and 15.6(3), <sup>b</sup>X<sup>2</sup> (DF) = 19.3(1), 47.03(1) and 70.9(2), 58.5(1) and 28.5(1), <sup>c</sup>t (DF) = 13.5(448) and 21.4(448)

higher among controls (29.7%) than among CRC patients (7.3%) and this difference was statistically significant ( $p = 0.001$ ) (Table 3b). Table 4 shows that the frequency of obesity was higher among patients (20.7%) than controls (16.7%) ( $p = 0.007$ ).

Data in Table 5 show that higher consumption of red meat, preserved food, artificial sweeteners, fast foods, soft drinks, spicy foods, processed meat, and smoking were significantly related to onset of CRC. The odds of higher consumption of red meat (more than 500 g/week) among CRC patients was 57.1 compared

to controls, the odds of frequent consumption of preserved foods among patients was 39.4 compared to controls, the odds of use of artificial sweeteners among patients was 20.8, the odds of frequent consumption of fast foods among patients was 12.8 than among controls, the odds of smoking was 8.8 times among patients than among controls. It was found that the most protective factor was physical activity (odds ratio=0.001,  $p=0.001$ ) followed by high consumption of fruits and vegetables (odds ratio=0.04,  $p=0.001$ ) (Table 6).

**Table 4.** Relation between anthropometric measures and CRC among cases and controls, Minia governorate, October 2010 to August 2011

BMI	CRC patients (N=150)	Control (N=300)	p
	n (%)	n (%)	
Under weight	11 (7.3)	7 (2.4)	0.007
Normal weight	77 (51.3)	146 (48.7)	
Over weight	31 (20.7)	97 (32.3)	
Obese	31 (20.7)	50 (16.7)	

**Table 5.** Multiple regression analysis of life style factors increasing the occurrence of CRC among cases attending Minia oncology centre, October 2010 to June 2011

Variables	Beta	Odds ratio (OR)	95% CI	p
Red meat >500 g/week	4.04	57.1	12.1–270.3	0.001
Preserved food	3.6	39.4	15.5–100.1	0.001
Artificial sweeteners	3.03	20.8	2.7–159.7	0.003
Fast foods	2.5	12.8	3.8–39.1	0.002
Smoking	2.1	8.8	3.9–19.3	0.001
Soft drink	1.5	4.6	1.9–11.01	0.001
Spicy foods	1.4	4.2	1.7–9.9	0.001
Processed meat	0.89	2.4	1.5–3.8	0.001
Pickles	0.43	1.5	0.5–4.3	0.400
Tea	0.44	1.3	0.8–2.1	0.300
Obesity	0.26	1.3	0.7–2.1	0.200
Alcohol	0.99	1.1	0.8–1.2	0.500

N.B. the dependant variable is CRC,  $R^2 = 0.76$

**Table 6.** Multiple regression analysis of life style factors protecting from the occurrence of CRC among patients attending Minia oncology centre, October 2010 to June 2011

Variables	Beta	Odds ratio (OR)	95% CI	p
Physical activity	8.7	0.001	0.001–0.0002	0.001
More than five fruits and raw vegetable servings per day	3.6	0.02	0.008–0.09	0.001
High calcium diet	2.7	0.08	0.04–0.17	0.001
Broccoli (once or more per week)	2.1	0.11	0.01–0.48	0.030
High fiber bread	1.8	0.15	0.04–0.52	0.003
Fruit juice	1.6	0.18	0.09–0.36	0.001
Canned fish (once or more per week)	1.2	0.28	0.14–0.55	0.001
Cauliflower (once or more per week)	1.2	0.30	0.20–0.46	0.001
Cabbage (once or more per week)	1.07	0.34	0.22–0.52	0.001
Fresh fish (once or more per week)	0.94	0.38	0.25–0.59	0.001

N.B. the dependant variable is CRC,  $R^2 = 0.64$ .

## DISCUSSION

CRC is cancer of the colon and rectum arising from their mucosal lining. It is the third most commonly diagnosed cancer after lung and breast worldwide (1) and smoking is believed to play a great role in CRC incidence (13).

To determine the relation between dietary and lifestyle factors (dietary pattern, smoking, physical activity, and alcohol intake) and development of CRC, a control case study was carried out among CRC patients attending Minia oncology centre from Oc-

tober 2010 to June 2011. Cancer patients often pursue lifestyle and dietary changes with the aim to improve treatment outcomes, so the questionnaire assessed dietary history and pattern of their habits and lifestyle during 2 years prior to cancer diagnosis.

The age and sex were matched between cases and controls, their age ranged between 16–80 years with mean  $46.1 \pm 13.9$  and  $46.7 \pm 17.5$ , respectively, the majority of them falling into the age group of 40–60 years (53.3% cases and 45.3% controls), which was in agreement with Almurshed (14) who studied socio-demographic, life style and anthropometric parameters and CRC

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in a case control study in Riyadh and found that 54% of cases were 40–60 years old and 46% of controls were falling into the same age group. About half of the cases and controls were females (52%) and 48% were males. Regarding other socio-demographic data, 61.3% of cases came from rural areas, 78% were married, 58% were illiterate, and 73.3% were unemployed which was similar to results reported by Almurshed, who found that 86% of cases were married, 44% were illiterate and 54% were unemployed (14).

We observed that the most common site of CRC was distal part of colon (74%), followed by proximal one (26%), these findings correspond with results reported by Duijnhoven et al. (15) who found that 27.1% of CRC cases were proximal and 72.9% were distal cancer. About 60% of CRC cases arise in the distal part of colon in countries where colonic cancer incidence is high (7). In this study Hansen revealed that 42.4% of colon cancer occurred in the sigmoid region, 75% of rectal cancer was in the lower rectum and 18.7% was recto sigmoid.

In our study, we observed that there was a significant difference between CRC cases and controls regarding history of smoking, as 34% of cases versus 18.7% of controls were smokers and 24.7% of cases were passive smokers compared to only 5.3% of controls. This was in agreement with Limsui et al. (16), who conducted a prospective study on the relation between cigarette smoking and CRC risk and found that 34% of those who develop CRC were smokers. Similar findings were reported by Abdulbari et al. (17), who carried out a case control study on lifestyle habits and CRC risk in Qatar and found that 26.7% of cases and 17% of controls were smokers.

All cases (100%) examined in this study were physically inactive, while 78.3%, 4% and 17.7% of controls were inactive, moderately and severely active, respectively, and these differences were statistically significant. These findings are in agreement with Arafa et al. (18), who found that 75.7%, 7.7% and 16.8% of controls were inactive, moderately and severely active, respectively, and approximately the same what reported by Almurshed (14), who found that 100% of cases were physically inactive and 54%, 33% and 13% of controls were inactive, moderately and severely active, respectively.

This study showed that red meat consumption was significantly higher ( $801.7 \pm 710.8$  grams per week) among cases than among controls ( $234.6 \pm 110.8$  grams per week), more than one third of patients (40.7%) ate more than 500 g of red meat per week compared to 1% of controls. This was in agreement with Alexander and Cushing (19), who conducted critical summary of prospective epidemiologic studies of red meat consumption and found positive association between red meat consumption and CRC. The World Cancer Research Fund (WCRF) recommends that red meat consumption should be less than 500 grams per week.

We observed that there was a significant relation between processed meat consumption and CRC as its consumption was higher among cases ( $629.03 \pm 337.8$  grams per week) than among controls ( $186.7 \pm 83.2$  grams per week), consumption of more than 250 grams per day of processed meat was higher (66.7%) among cases than among controls (17%). This was in agreement with Santarelli et al. (21), who conducted systematic review on multiple observational and experimental studies which assessed the relation between processed meat consumption and CRC and reported that processed meat intake increases CRC risk. Abdulbari et al. (17) also found that daily consumption of processed meat was higher

(20.9%) among cases than in controls (17.1%). WCRF reported that consumption of more than 250 grams per day of processed meat increase the risk of CRC (20).

We also found that sea food consumption was significantly higher among controls than among cases, eating fish once or more per week was higher among controls (51.7%) compared to 29.3% of cases and more than half (57.3%) of controls ate canned fish once or more per week compared to 22.7% of cases. This was in agreement with Hall et al. (22), who studied fish, n-3 fatty acid intake and CRC in men in 22 years prospective study and found that fish intake was inversely associated with the risk of CRC, similarly to what was determined by Sanjoaquin et al. (23), who carried out a prospective study on lifestyle and CRC incidence and found that only 33.6% of CRC cases ate fish once or more a week.

This study showed that consumption of calcium rich diet was higher among controls (64.3%) compared to 36.7% of cases, and consumption of lower amount of calcium was higher among cases (58.6%) than in controls (19.7%). This was in agreement with Mizoue et al. (24), who found that mean calcium rich foods intake was higher among controls (200 grams per day) compared to cases (167 grams per day) and that only 34.8% of CRC cases consumed calcium rich food compared to 40.9% of controls.

Eating more than five servings per day was higher among controls (40.7%) than among cases (2.7%). This was in agreement with Arafa et al. (18), who found that eating more than five servings per day was higher among controls (45.9%) than cases (33.6%).

We found that consumption of spicy foods and preserved foods was significantly higher among cases than among controls, daily consumption of spicy foods was higher among cases (67.3%) compared to 5.7% among controls, which was in agreement with Nayak et al. (25), who conducted a case control study on the role of diet in CRC in India and found strong positive association between spices and CRC. Regarding preserved foods, its daily consumption was higher among cases (27%) than among controls (10%). These findings were in agreement with Chiu et al. (26), who studied dietary factors and CRC in China and found that the risk of colon cancer increased significantly with increasing consumption of preserved foods.

This study showed that there was no significant difference regarding alcohol consumption between cases and controls, similarly to findings by Sriamporn et al. (27), who studied risk factors for CRC in Northeast Thailand and found that the risk associated with alcohol consumption did not achieve statistical significance. Squires et al. (28) did not find any significant differences between cases and controls for males and females regarding mean alcohol consumption per day.

Daily consumption of soft drinks was significantly higher among cases (48.7%) than in controls (15%), similarly to results reported by Abdulbari et al. (17), who found that daily soft drink intake was significantly higher among cases (28.7%) in comparison to controls (18.8%). Fruit juice consumption was significantly higher among controls (29.7%) compared to 7.3% of cases.

We also observed that frequency of obesity was higher in cases (20.7%) than in controls (16.7%). This approximates to what was reported by Slattery et al. (29), who studied physical activity and CRC and found that obesity was higher in cases (21.3%) than in controls (18%), as well as by Hu et al. (30), who found that 21.2% of cases were obese compared to 14.4% of controls. Sun et al. (31) studied the association of total energy intake and macronutrient

consumption with CRC risk and found that obesity was higher among cases (22.4%) in comparison to controls (18.5%). Williams et al. (32) studied dietary patterns and rectal cancer risk in white Americans and African-Americans and found that obesity was higher in cases (39%) than in controls (29%).

It was observed in the study that higher consumption of red meat (OR=57.1), preserved food (OR=39.4), artificial sweeteners (OR=20.8), fast foods (OR=12.8), soft drinks (OR=4.6), spicy foods (OR=4.2), processed meat (OR=2.4), and smoking (OR=8.8) constitute significant risk for CRC. Almurshed (14) found that higher red meat consumption (OR=44) is associated with increased CRC risk. Chiu et al. (26) found that preserved food increase the risk of CRC (OR=2 among males and 2.7 among females). Giles (11) found that OR of artificial sweeteners for colon and rectal cancer was 1.07 and 1.1, respectively, among men, and 1.02 and 1.04 for colon and rectal cancer, respectively, among those with BMI less than 25 kg/m<sup>2</sup>. Abdulbari et al. (17) found that smoking (OR=2.12) and soft drinks (OR=1.62) increase the risk of CRC. Similarly, Nayak et al. (25) found that OR of spices was 9.62. Chiu and Gapstur (33) investigated the effect of dietary changes during adult life and found that OR of high processed meat intake was 3.7. Ramadas and Kandiah (34) found that fast foods are associated with CRC risk (OR=1.96).

This study showed that physical activity (OR=0.001), higher consumption of fruits and vegetable (OR=0.02), calcium rich diet (OR=0.08), cruciferous vegetables (broccoli OR=0.11, cauliflower OR=0.30 and cabbage OR=0.30), high fiber bread (OR=0.15), fruit juice (OR=0.18), and sea foods (tuna OR=0.28 and fish OR=0.38) lower the risk of CRC. This was in agreement with Almurshed (14), who found that physical activity (OR=0.14) had protective effect. Nayak et al. (25) found that OR for high fruits and vegetable consumption was 0.15 and Duijnhoven et al. (15) found that the risk of CRC related to high fruits and vegetable consumption was 0.86. Nashar and Almurshed (35) found that calcium rich diet (OR=0.75), cruciferous vegetables (broccoli OR=0.12, and cabbage OR=0.21), high fiber food (OR=0.11), and fruit juice (0.14) had protective effect. Mizoue et al. (24) found that high intake of calcium rich foods as milk had protective effect with regard to CRC (OR=0.60). Hall et al. (22) found that the relative risk of sea food consumption was 0.76 for fish and 0.95 for tuna fish.

## CONCLUSIONS

These results indicated that the CRC cases enrolled in this study were adopting a sedentary lifestyle and their dietary pattern was characterized by unhealthy diet. Thus the study hypothesis that CRC is strongly related to the life style of population may be accepted. Personalized, evidence based, and guidance on healthy lifestyle choices appear to be a much needed part of preventive community interventions and care planning to survivors. Nutrition education programmes about role of diet in development or protection from CRC as well as preventing obesity through the promotion of healthy eating and fostering daily physical activity are greatly needed.

## Conflict of Interests

None declared

## Authors' Contributions

All authors contributed substantially to the study conception and design, data collection and analysis, and drafting and revision of the article. All approved the final version to be published.

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