RESEARCH ARTICLE

Editorial Process: Submission:11/04/2017 Acceptance:01/03/2018

Fast Foods, Sweets and Beverage Consumption and Risk of Colorectal Cancer: A Case-Control Study in Jordan

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Abstract

Background: The effects of consuming fast foods, sweets and beverages on the development of colorectal cancer (CRC) are unclear. The aim of this case-control study was to assess possible associations between the consumption of different fast foods, sweets and beverages and CRC risk in a Jordanian population. **Methods:** Two hundred and twenty diagnosed CRC cases and 281 controls were enrolled. Diet history was obtained using a validated quantitative questionnaire. **Results:** Consumption of some types of fast food, and particularly falafel, was associated with an increased risk of developing CRC. Elevated risk was found for potato and corn chips with an AOR of 4.36 (95%CI: 1.24-15.28) for daily consumption and 3.33 (95%CI: 1.00-11.11) for ≥5 servings/week. Consuming 1-2 or >5 servings per week of fried potatoes or 2-3 servings per week of chicken in sandwiches also increased the risk while exposure to fresh tomato juice and hot pepper sauce on a monthly basis appeared to exert a protective effect. **Conclusions:** Consumption of fried fast food items was significantly linked with an increased risk of developing CRC in Jordan.

Keywords: Colorectal cancer- fast foods- sweets- beverages

Asian Pac J Cancer Prev, **19 (1)**, 261-269

Introduction

In 2012, Colorectal Cancer (CRC) was estimated to be the third most commonly diagnosed cancer in males and the second most diagnosed cancer in females (Jemal et al., 2011). The highest incidence of CRC was found in Australia, New Zealand, Europe, North America and Eastern Asia (Jemal et al., 2011). The lowest incidence was found in Africa and South-Central Asia (Jemal et al., 2011). In 2010, The Jordan Cancer Registry reported that CRC was the most frequently diagnosed form of cancer in men and the second most frequently diagnosed form of cancer in women (Abdel-Razeq et al., 2015). CRC disease in Jordan, accounted for 10.3% and 8.9% of the diagnosed cancers in men and women, respectively (Abdel-Razeq et al., 2015). More importantly, the high incidence, approximately one-third of all cancers diagnosed in high-income earning countries, has been attributed to factors related to food, nutrition, and physical inactivity (Wiseman, 2008; Tayyem et al., 2013).

More recently, it has been suggested that the increased incidence of CRC in newly developed or economically transitioning countries is most likely due to the increased prevalence of obesity, in addition to the adoption of western lifestyle and diets, including the consumption of high calorie-dense foods and the lack of physical exercise (Center et al., 2009). A good example of this phenomena has been reported in Japan, a developed country with a very strong economy and a high incidence of CRC (mainly among males), has been blamed on the adoption of the Western diet (WD) and foods (Center et al., 2009). The result of a case-control study in Argentina has suggested that the Southern Cone Diet (red meat, starchy vegetables, wine) and high-sugar drink dietary patterns are responsible for promoting the development of CRC, while a prudent dietary pattern, including dairy foods, fruit and non-starchy vegetables, has the opposite effect (Pou et al., 2012). In addition, a study in Uruguay has indicated that colon cancer was directly associated with the Western dietary pattern (Stefani et al., 2001). In a case–control study conducted in the Iranian city of Tehran, two major dietary patterns were derived using principal component analysis (Safari et al., 2013). The "Healthy Pattern" showed a decrease in the risk of developing CRC, while an increased risk of developing CRC was observed with the "Western Pattern" (Safari et al., 2013).

Beginning in the 1980's, observers in urban areas of Jordan have noted an increase in the amount of fast foods being consumed, and a trend toward more westernized lifestyle and dietary choices (Food and nutrition profile, 2011). The noted changes were attributed to the increase number of women entering the workforce and that many

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families preferred the convenience of fast foods for their meals (Food and nutrition profile, 2011).

This study, the first in the Middle East, and more specifically in Jordan, was conducted with the aim of investigating the possible association between the consumption of some fast foods, sweets and beverages and the risk of developing CRC in this population. This study is important and novel in the light of the reported major change in the dietary pattern (Food and nutrition profile, 2011), and the Jordanian Cancer Registry report of significant increase in the frequency of CRC diagnosed in Jordan.

Materials and Methods

The study population consisted of 501 participants; with 220 diagnosed CRC cases and 281 controls (248 males and 253 females). Participants were enrolled in the study from January 2010 to December 2012. Those participating subjects, who were diagnosed with CRC, were recruited from five Jordanian hospitals specialized in oncology diagnosis and treatment. For uniformity, cases and controls were paired matched as closely as possible for age, sex and occupation. The ratio of CRC cases to controls was approximately 1:1. The control group was recruited from hospital personnel, outpatients and visitors. Recruited participants in both control and case group were excluded if any first- or second-degree relatives were diagnosed with CRC. To be included in the study, cases had to be diagnosed with CRC disease and the confirmatory diagnosis must have occurred at least one year before the first interview. And they must be free of other types of cancer, diabetes mellitus, liver and renal diseases, and rheumatoid arthritis. Participants must be aged ≥18 years, be of Jordanian nationality, and be able to communicate verbally. The exclusion criteria was designed to avoid those participants who had diabetes mellitus, liver and renal diseases, and rheumatoid arthritis because these disease conditions may require adherence to "special dietary" guidelines that may interfere or influence the real effects of the dietary pattern under investigation. Participants were also excluded if they had a critical illness or were currently hospitalized. The study protocol was approved by the Ethics Committee (local Institutional Review Board, IRB) from the various hospitals. Written informed consent was obtained from all subjects before their interviews.

Socio-demographic data, health and dietary histories, anthropometric (weight and height) measurements, and physical activity levels were collected by trained research assistants using prepared questionnaires. The measurement of body weight, height and the calculation of body mass index (BMI) were carried out as indicated by Lee and Nieman (2012).

A validated Arabic quantitative FFQ adapted from the Diet History Questionnaire I (DHQ I) of the National Cancer Institute of the United State of America and validated to be suitable for use in Jordan, was used for dietary assessment. (Tayyem et al., 2014). This FFQ was used as an assessment tool to estimate the frequency of fast foods consumption in our study population. The FFQ questions sought to obtain information on the dietary history of participants before CRC diagnosis, and to confirm the dietary habits of our disease free participants, during the 12 months prior to the commencement of the study. We estimated that dietary choices during the last 12 months would be indicative of a fixed habitual pattern reflecting prior years. Information on the following food items were obtained: fried potato, Falafel (a deep-fried patty made from ground chickpeas, fava beans, or both), beef burger, chicken sandwich, tomato sauce, ketchup, hot pepper sauce, orange juice, soft drinks, coffee, tea, sugar, coffee mate, biscuit, potato and corn chips, popcorn, cake, Ma'mool (small shortbread pastries filled with dates), desserts, chocolate, and candy. These food items were listed in the FFQ as fast foods. Food models and standard measuring tools were used to facilitate estimating the consumed portion size. Participants were asked if they consumed each food type separately, for example, beef burger, Falafel, orange juice, coffee, cake…etc.). If the answer was in the affirmative, additional questions were asked related to frequency and amount of the food item consumed. If the participant did not eat a particular food, related questions were skipped and the research assistant moved to another question. Participants were asked how frequently, on average, during the past year they had consumed one standard serving of a specific food item in nine categories (<1/month, 2-3/month, 1-2/week, 3-4/week, 5-6/week, 1/day, 2-3/day, 4-5/day, or 6/day). The responses on the frequency of consumption of a specified serving size for each food item were converted into average daily intake.

7-Day Physical Activity Recall PAR is an organized questionnaire that focuses on a participant's recall of time spent doing physical activity over a seven day period (Sallis et al., 1985). The validated PAR questionnaire was used to measure physical activity level. Our study participants were asked to respond to the PAR questions with emphasis on their personal exercise pattern and behavior during the noted time period (i.e before diagnosis). Physical activity level was calculated according to the Sallis et al., (1985) protocol.

All statistical analyses were conducted using SPSS version 19.0 (IBM SPSS Statistics for Windows, IBM Corporation). Descriptive analyses were used to examine the frequency of different variables. The consumption of some fast foods, sweets and beverages was computed separately in two ways, either grouped into 4 categories based on the number of times the particular food item was consumed, rarely (referent category), daily, weekly, monthly (Tables 2 and 3), or grouped based on number of servings of the food item consumed either daily or weekly, < 1.0 serving per week (referent category), 1-2 servings per week, 3-4 servings per week, ≥ 5 servings per week (Table 4 and 5). The referent category was the group with the lowest intake. Multiple logistic regression was used to calculate adjusted odds ratio (AOR) and confidence intervals (95% CIs), and linear regression was used to calculate p-values for trend. The following items were evaluated as potential confounders: age (continuous), gender, BMI (continuous), physical activity level (continuous), total energy intake (continuous), occupation,

education level, marital status and family history of CRC. Chi-square was used to estimate the differences among categorical variables. The significance level was set at $p<0.05$.

Results

The Socio-demographic characteristics of study participants are shown in Table 1. Table 1 shows the differences between diagnosed CRC case and control subjects with respect to marital status, education attainment, smoking, household income and family history of CRC.

Table 1. Selected Characteristics[a] of the Participants' study

	Control (n=281)	Case (n=220)
Age (mean ± SD)	51.3± 11.1	52. 9± 11. 7
Sex n (%)		
Male	132 (47)	116 (52.7)
Female	149 (53)	104 (47.3)
BMI (mean ± SD)	29.1± 5.6	27.7± 6.2
BMI Category		
Under Weight (<18.5)	2 (0.7)	5 (2.5)
Normal (18.5-24.9)	52 (18.8)	57 (27.9)
Overweight (25-29.9)	122 (44.2)	83 (40.7)
Obese (≥30)	100 (36.2)	59 (28.9)
Marital status n (%)		
Married	248 (88.3)	199 (90.5)
Single	17 (6)	5 (2.3)
Divorced	1 (0.4)	3 (1.4)
Widowed	15 (5.3)	13 (5.9)
Occupation n (%)		
Yes	100 (35.6)	69 (31.4)
No	181 (64.4)	151 (68.6)
Smoking n (%)		
Smoker	53 (18.9)	37 (16.8)
Non-smoker	227 (81.1)	173 (78.6)
Family history of CRC n (%)		
Yes	101 (36.5)	84 (38.5)
No	176 (63.5)	134 (61.5)
Other health problem n (%)		
Yes	119 (42.7)	83 (37.7)
No	160 (57.3)	136 (61.8)
Education n (%)		
Illiterate	11 (3.9)	17 (7.7)
primary and secondary	137 (49.1)	107 (56.4)
Diploma and BSc	113 (40.5)	86 (39.1)
MSc and PhD	18 (6.5)	10 (4.5)
MET n (%)		
Inactivea	131 (52.2)	121 (56.3)
Minimally Activeb	53 (21.1)	37 (17.2)
HEPA activec	67 (26.7)	57 (26.5)

BMI, Body Mass Index; [a]Inactive, not fitting in "Minimally Active" or "HEPA active"; [b] Minimally Active, at least 600 MET per week; [c] Health Enhancing Physical Activity, HEPA active: more than 3,000 MET per week

Table 2 shows the AOR and 95%CI for salty and fast foods consumption and the risk of CRC. After adjusting for potential confounders, the results indicate that high intake of fast foods may increase the risk of developing CRC. The consumption of Falafel had a significant association with CRC risk, AOR was 3.55 (95% CI: 1.37-9.21) for daily consumption, and for weekly consumption the AOR was 2.20 (95%CI: 1.26-3.82). The results for the total servings of Falafel consumed on a daily and weekly frequency, AORs and CI, were found to be 2.19 (1.29-3.72), 2.68 (1.19-6.01), and 3.63 (1.44-9.10) for 1-2 serving/week, 3-4 servings/week, and ≥5 servings/week, respectively with P-trend=0.013 (as shown in Table 3). The consumption of chicken in the form of a sandwich, was found to increase CRC risk with AOR of 3.12 (95%CI: 1.69-5.75) and 4.78 (95%CI: 2.63-8.70) when consumed on weekly and monthly basis, respectively with P-trend=0.001 (table 2). The results showed a significant increase in the risk of developing CRC in those consuming 1-2 servings/ week of chicken sandwiches, AOR was 1.90 (95% CI: 1.04-3.46) (table 3). There was a significant trend seen in those subjects who consume ≥3 servings/week of chicken sandwiches, AOR was 1.52 (95%CI: 0.55-4.20). Table 3 shows that Fried potato may increase CRC risk with AOR 1.91 (95%CI: 1.13-3.24) and 3.88 (95%CI: 1.36-11.03) when consumed at a frequency of 1-2 servings/week and ≥5 servings/week, respectively. Potato and corn chips was found to increase CRC risk with AOR 4.36 (95%CI: 1.24-15.28) when consumed daily and 3.33 (95%CI: 1.00-11.11) when consumed ≥5 servings/week (Tables 2 and 4).

While as illustrated in Table 3, the daily consumption of cake showed 3.91 higher odds (95%CI: 1.28-11.87), consuming 1-2 servings/week and ≥5 servings/ week significantly increase CRC risk with OR=1.75 (95%CI: 1.01-3.03) and OR=4.10 (95%CI: 1.43-11.78), respectively with P-trend=0.008 (Table 3 and 5). From table 3, monthly intake of fresh tomato juice and hot pepper sauce exerted a protective effect against CRC with OR=0.44 (95%CI: 0.22-0.89) and OR=0.39 (95%CI: 0.18-0.88). The weekly consumption of soft drinks reduced the risk for developing CRC (OR=0.52; 95% CI: 0.28-0.95), and the reduction was higher (OR=0.31; 95%CI 0.11-0.89) when 3-4 servings/week were consumed (Table 3 and 5).

Discussion

In this study, we examined the relationship between the consumption of some fast foods, sweets and beverages traditionally consumed in Jordan with the risk of developing CRC. In our study group, fast food items are usually consumed separately (according to cultural traditions) as main dishes and not as a full meal. For example, fried potato may be eaten without burger or soft drink and vice versa. Additionally, soft drinks and fruit juices are frequently offered as a welcoming beverage for visiting guests, and very often served with regular meals.

Several studies have reported on the effect of diet on the development of CRC (Stefani et al., 2001; Center et al., 2009; Pou et al., 2012; Safari et al., 2013). These

Table 2. Adjusted* OR for the Consumption of Some Fast and Salty Foods

Item	Category of Consumption				P- trend
	Rarely **	Monthly	Weekly	Daily	
Falafel					
AOR (95%CI)	1	0.92 (0.44-1.94)	2.20 (1.26-3.82)	3.55 (1.37-9.21)	0.013
No. Cases	74	30	93	23	
No. Controls	113	53	97	16	
Chicken Sandwich					
AOR (95%CI)	1	4.78 (2.63-8.70)	3.12 (1.69-5.75)	-	0.001
No. Cases	99	68	51	2	
No. Controls	201	42	38	-	
Fried Potato					
AOR (95%CI)	1	0.41 (0.17-1.00)	0.97 (0.44-2.16)	1.85 (0.54-6.35)	0.114
No. Cases	20	44	135	21	
No. Controls	33	89	147	11	
Beef Burger					
AOR (95%CI)	1	0.92 (0.55-1.53)	1.28 (0.43-3.78)	-	0.467
No. Cases	133	67	18	2	
No. Controls	168	101	12	-	
Pizza					
AOR (95%CI)	1	0.72 (0.44-1.18)	2.97 (0.74-11.82)	-	0.106
No. Cases	119	90	11	-	
No. Controls	130	139	12	-	
Tomato Sauce					
AOR (95%CI)	1	0.65 (0.32-1.36)	0.85 (0.46-1.54)	0.44 (0.13-1.57)	0.633
No. Cases	49	42	123	6	
No. Controls	53	60	154	14	
Chips					
AOR (95%CI)	1	1.42 (0.71-2.84)	0.94 (0.53-1.67)	4.36 (1.24-15.28)	0.314
No. Cases	119	34	42	25	
No. Controls	156	39	71	15	
Popcorn					
AOR (95%CI)	1	0.96 (0.57-1.61)	0.68 (0.34-1.34)	-	0.313
No. Cases	106	76	34	4	
No. Controls	135	100	46	-	
Ketchup					
AOR (95%CI)	1	0.62 (0.34-1.12)	0.93 (0.50-1.76)	0.74 (0.11-4.82)	0.891
No. Cases	132	37	47	4	
No. Controls	158	71	47	5	
Hot Pepper Sauce					
AOR (95%CI)	1	0.39 (0.18-0.88)	0.89 (0.44-1.80)	0.87 (0.41-1.87)	0.786
No. Cases	149	20	25	26	
No. Controls	180	42	36	23	
Mayonnaise					
AOR (95%CI)	1	0.38 (0.13-1.13)	0.37 (0.04-3.46)	-	0.109
No. Cases	210	8	1	1	
No. Controls	255	22	4	-	

* Adjusted for total energy, fruit and vegetable intake, physical activity, smoking, education level, marital status, work status, income, other health problems and CRC history; **, Reference group

studies concluded that Jordanians are adopting WD, this type of diet is principally defined by fast foods, high-fat, high-sodium, low-calcium and vitamin D content, is associated with the risk of developing CRC (Stefani et

Table 3. Adjusted* OR for the Consumption of Some Sweets and Beverages

Item	Category of Consumption				P- trend
	Rarely **	Monthly	Weekly	Daily	
Sugar					
AOR (95%CI)	1	1.54 (0.07-32.44)	0.87 (0.30-2.55)	0.79 (0.39-1.58)	0.915
No. Cases	31	4	15	125	
No. Controls	45	4	20	159	
Coffee mate					
AOR (95%CI)	1	1.08 (0.38-3.07)	0.99 (0.45-2.18)	2.29 (0.82-6.39)	0.93
No. Cases	178	10	19	13	
No. Controls	227	15	23	16	
Biscuits					
AOR (95%CI)	1	0.90 (0.47-1.72)	1.03 (0.58-1.84)	1.18 (0.54-2.59)	0.659
No. Cases	61	47	81	30	
No. Controls	85	62	91	42	
Cake					
AOR (95%CI)	1	0.92 (0.51-1.65)	1.67 (0.89-3.10)	3.91 (1.28-11.87)	0.008
No. Cases	53	86	67	14	
No. Controls	80	129	63	9	
Ma'mool					
AOR (95%CI)	1	0.76 (0.38-1.50)	0.83 (0.41-1.68)	2.06 (0.59-7.20)	0.087
No. Cases	157	27	22	14	
No. Controls	197	47	32	5	
Desserts					
AOR (95%CI)	1	0.97 (0.55-1.70)	1.09 (0.51-2.32)	1.30 (0.36-4.68)	0.061
No. Cases	56	109	47	8	
No. Controls	80	151	43	7	
Chocolate					
AOR (95%CI)	1	0.83 (0.42-1.66)	1.34 (0.74-2.43)	1.86 (0.92-3.77)	0.127
No. Cases	61	37	75	47	
No. Controls	85	60	87	48	
Candy					
AOR (95%CI)	1	0.91 (0.47-1.76)	1.02 (0.56-1.87)	1.69 (0.80-3.58)	0.435
No. Cases	117	28	44	31	
No. Controls	151	45	55	29	
Fresh Tomato Juice					
AOR (95%CI)	1	0.44 (0.22-0.89)	0.52 (0.15-1.74)	-	0.108
No. Cases	177	24	11	6	
No. Controls	222	46	13	-	
Orange Juice					
AOR (95%CI)	1	0.56 (0.31-1.02)	0.67 (0.37-1.21)	1.07 (0.45-2.55)	0.118
No. Cases	62	50	70	35	
No. Controls	64	101	89	26	
Soft Drinks					
AOR (95%CI)	1	0.77 (0.40-1.50)	0.52 (0.28-0.95)	1.39 (0.73-2.63)	0.179
No. Cases	80	31	46	61	
No. Controls	93	53	87	48	
Coffee					
AOR (95%CI)	1	0.50 (0.13-1.96)	0.70 (0.29-1.65)	0.94 (0.50-1.79)	0.983
No. Cases	45	12	24	116	
No. Controls	50	14	40	153	
Tea					
AOR (95%CI)	1	2.31 (0.11-47.50)	0.59 (0.18-1.95)	1.19 (0.47-3.05)	0.144
No. Cases	14	2	20	161	
No. Controls	29	2	35	190	

* Adjusted for total energy, fruit and vegetable intake, physical activity, smoking, education level, marital status, work status, income, other health problems and CRC history; ** Reference group

Table 4. Adjusted* OR for Serving Frequencies of the Consumption of Some Fast and Salty Foods

Item	Category of Consumption				
	<1serving/week	1-2 serving/week	3-4 serving/week	≥5 serving/week	P- trend
Falafel					
OR (95% CI)	1 (referent)	2.19 (1.29-3.72)	2.68 (1.19-6.00)	3.63 (1.44-9.10)	
Total No. of cases	104	68	25	23	0.013
Total No. of controls	166	80	17	16	
Chicken Sandwich					
OR (95% CI)	1 (referent)	1.90 (1.04-3.46)	1.52 (0.55-4.20)	-	
Total No. of cases	167	41	10	2	0.001
Total No. of controls	243	30	8	0	
Fried Potato					
OR (95% CI)	1 (referent)	1.91 (1.13-3.24)	1.56 (0.77-3.15)	3.88 (1.36-11.03)	
Total No. of cases	64	102	33	21	0.114
Total No. of controls	122	111	36	11	
Beef Burger					
OR (95% CI)	1 (referent)	1.66 (0.55-5.06)	0 (0-0)	-	
Total No. of cases	200	17	1	2	0.467
Total No. of controls	269	11	1	0	
Tomato Sauce					
OR (95% CI)	1 (referent)	0.92 (0.56-1.50)	1.41 (0.68-2.91)	0.57 (0.18-1.84)	
Total No. of cases	91	83	40	6	0.633
Total No. of controls	113	129	25	14	
Ketchup					
OR (95% CI)	1 (referent)	1.21 (0.63-2.36)	1.22 (0.38-3.88)	0.98 (0.15-6.31)	
Total No. of cases	169	37	10	4	0.891
Total No. of controls	229	39	8	5	
Hot Pepper Sauce					
OR (95% CI)	1 (referent)	1.04 (0.46-2.35)	0.87 (0.29-2.59)	1.00 (0.46-2.11)	
Total No. of cases	169	16	9	26	0.786
Total No. of controls	222	25	11	23	
Chips					
OR (95% CI)	1 (referent)	0.91 (0.49-1.69)	1.00 (0.38-2.65)	3.33 (1.02-11.11)	
Total No. of cases	153	31	11	25	0.314
Total No. of controls	195	53	18	15	
Popcorn					
OR (95% CI)	1 (referent)	0.67 (0.34-1.32)	0.67 (0.17-2.66)	-	
Total No. of cases	182	26	8	4	0.313
Total No. of controls	235	40	6	0	

al., 2001; Center et al., 2009; Pou et al., 2012; Safari et al., 2013; Newmark et al., 2001). Among the main characteristics of the WD, the main focus of attention relied on high consumption of meat, which has been considered a risk factor for colorectal cancer (Bouvard et al., 2015). However, complete absence of meat from the diet did not provide significant benefits toward cancer risk in cohort studies and other factors may contribute to the potential harmful effects of a WD (Godos et al., 2017). For instance, another characteristic of the WD is the method of food preparation, involving deep frying in solid fats. One study has reported that WD interferes with biological response pathways of lipid metabolism, oxidative stress, and the immune response in colon cells (Erdelyi et al., 2009). The WD has become more common in developing and recently developed countries of the world (Popkin, 2006; Rosencheck, 2008), and the results of this study suggests that four of our investigated fast food items (Falafel, chicken sandwich, fried potato, and potato and corn chips) are associated with a significant increase in the risk of CRC development. Falafel, a traditional food item in countries of the Middle East, was originally prepared by Egyptians. This food item is a familiar fast food, with other food items are sold locally. In 1984, Laher et al. explained that fried foods contributed to CRC development because of the accumulation of polycyclic aromatic hydrocarbons

Table 5. Adjusted* OR for Serving Frequencies of the Consumption of Some Sweets and Beverages

Item	Category of Consumption				
	<1serving/week	1-2 serving/week	3-4 serving/week	≥5 serving/week	P- trend
Coffee					
OR (95% CI)	1 (referent)	1.70 (0.58-4.94)	0.49 (0.16-1.53)	1.05 (0.58-1.88)	
Total No. of cases	57	13	10	117	0.983
Total No. of controls	64	14	21	158	
Tea					
OR (95% CI)	1 (referent)	0.45 (0.07-2.85)	0.63 (0.17-2.26)	1.15 (0.47-2.79)	
Total No. of cases	16	3	16	162	0.144
Total No. of controls	31	7	22	196	
Soft Drinks					
OR (95% CI)	1 (referent)	0.76 (0.41-1.42)	0.31 (0.11-0.89)	1.27 (0.71-2.28)	
Total No. of cases	111	35	10	62	0.179
Total No. of controls	146	54	26	55	
Sugar					
OR (95% CI)	1 (referent)	1.50 (0.70-3.23)	0.72 (0.37-1.37)	0.70 (0.36-1.36)	
Total No. of cases	48	44	58	70	0.915
Total No. of controls	62	36	90	93	
Coffee Mate					
OR (95% CI)	1 (referent)	1.27 (0.54-2.98)	0.28 (0.03-2.64)	2.15 (0.80-5.77)	
Total No. of cases	188	17	1	14	0.93
Total No. of controls	242	18	5	16	
Biscuit					
OR (95% CI)	1 (referent)	1.13 (0.65-1.96)	1.33 (0.60-2.97)	1.22 (0.58-2.56)	
Total No. of cases	108	59	22	30	0.659
Total No. of controls	147	70	21	42	
Cake					
OR (95% CI)	1 (referent)	1.75 (1.01-3.03)	2.54 (0.90-7.18)	4.10 (1.43-11.78)	
Total No. of cases	139	56	11	14	0.008
Total No. of controls	209	52	11	9	
Ma'mool					
OR (95% CI)	1 (referent)	0.80 (0.38-1.71)	1.54 (0.38-6.22)	2.39 (0.69-8.30)	
Total No. of cases	184	17	5	14	0.087
Total No. of controls	244	27	5	5	
Desserts					
OR (95% CI)	1 (referent)	1.09 (0.57-2.09)	0.78 (0.13-4.73)	1.43 (0.43-4.75)	
Total No. of cases	165	42	5	8	0.061
Total No. of controls	231	39	4	7	
Chocolate					
OR (95% CI)	1 (referent)	1.54 (0.87-2.72)	1.24 (0.540-2.84)	1.93 (1.00-3.71)	
Total No. of cases	98	54	21	47	0.127
Total No. of controls	145	63	24	48	
Candy					
OR (95% CI)	1 (referent)	1.28 (0.68-2.46)	0.84 (0.31-2.31)	1.82 (0.87-3.78)	
Total No. of cases	145	34	10	31	0.435
Total No. of controls	196	39	16	29	-

* Adjusted for total energy, fruit and vegetable intake, physical activity, smoking, education level, marital status, work status, income, other health problems and CRC history.

(PAHs), primarily due to the method of food preparation. Laher's conclusion was further corroborated in the European Food Safety Authority (EFSA) report (2008). The Contaminants in the Food Chain (CONTAM) Panel (2008) showed that PAHs contain a large class of organic compounds that are composed of two or more fused

aromatic rings, and these aromatic rings generally occur in complex mixtures consisting of many compounds. These compounds are primarily formed by incomplete combustion or pyrolysis of organic matter occurring during industrial processing. The major route of exposure of PAHs to the non-smokers is by way of food, whereas for smokers the involvement comes directly from the inhaling of the cigarette smoke and from food. PAHs have attracted significant attention during the last decades due to their carcinogenic and mutagenic effect resulting in several types of cancer (lungs, skin and prostate) (Rybicki et al., 2006; Hecht et al., 2010). Laher et al., (1984) concluded that the intestine is the major organ affected by dietary PAHs. The authors suggested that a high-fat diet may well be a high carcinogenic diet, since PAHs are sequestered in dietary fats. It has been reported that some vegetable oils (including seed oils) may become contaminated with PAHs during the processing of the oils (Speer et al., 1990; Standing Committee on Foodstuffs, 2001). Kamel and El Sheikh (2012) examined the quality of 50 fried fast food samples, collected randomly from different restaurants in Egypt. The tested foods included breaded chicken and Falafel which had been fried in palm oil and other mixed oils, respectively.

The fat content was between 8.25- 19.66% for Falafel and 8.47- 17.90% for breaded chicken (Kamel and El Sheikh, 2012). Additionally, it was found that Falafel samples have significantly higher ($p<0.05$) peroxide value than other foods, the mean value was 11.18 meq/kg (Kamel and El Sheikh, 2012). The Dietary Trans-Fatty Acids (TFAs) have been associated with the risk of developing colon and other types of cancer (Hu, 2011). Mashal et al., (2012) analyzed TFA levels of selected Arabic foods in Jordan. They found that the TFAs content in Falafel ranged from 1.54 to 7.23 % per 100 g of fat. Consequently, an average meal with 4-5 medium pieces of Falafel contains an approximately 4% TFA.

The monthly intake of fresh tomato juice appeared to have a protective effect against the development of CRC. The protective effect of these foods may be due to their anti-oxidant and anti-inflammatory properties. In fact, ingredients in tomato, kaempferol, chlorogenic acid, glycoalkaloids and lycopene are known to be anti-mutagenic or anti-carcinogenic (Friedman et al., 2009). Additionally, in a colon cancer research study (Walfisch et al., 2007) lycopene extract from tomato was found to decrease plasma levels of insulin-like growth factor-1, by about 25% when compared to the placebo group ($P<0.05$).

Monthly intake of hot pepper sauce showed a protective effect against the development of CRC. Capsaicin is a homovanillic acid derivative of hot peppers (trans-8-methyl-Nvanillyl-6-nonenamide) and the spicy component of hot chili peppers has been reported to have anticancer properties (Surh, 2002). The suggested anticancer mechanisms of action of capsaicin involve cell-cycle arrest, increasing the generation of reactive oxygen species and inducing apoptosis in colonic cells through dissipation of the mitochondrial inner transmembrane potential and activation of caspase 3, a major apoptosis-executing enzyme (Yang et al, 2009).

An unexpected result of this study is the finding of an apparent protective effect of soft drinks with AOR of 0.52. This result may be due to the anti-constipation characteristic of carbonated drinks. In fact, research studies by Mun and Jun (2011) have suggested that the consumption of carbonated water is an effective way to prevent constipation. However, in a conflicting report, Bener et al., (2010), found that soft drinks were positively associated with the development of CRC. Additional investigation is required to confirm the role, if any, of soft drinks on CRC development.

Cakes and chocolates may contribute to CRC development. Chocolate is reported to contain a high level of flavonoids. The amount of flavonoids varies by the proportion of cocoa liquor present in each chocolate type (white, milk, and dark). The presence of flavonoids in the diet is believed to exert a positive effect. However, the absorption of flavonoids is reduced in milk chocolates due to milk proteins binding of the flavonoids. Cakes and milk chocolates contain a high level of carbohydrates, sugars and fats (Vinson et al., 1999). Consumption of foods with high fat content and elevated glycaemic index was shown to significantly increase the risks of developing colorectal cancer (Vinson et al., 1999).

Strong points of this study are the use of a validated Arabic FFQ that was modified to reflect the food consumption pattern in Arab countries, especially Jordan. The use of food models and measuring tools to estimate portion sizes. And the diverse mix of study participants recruited from 5 different hospitals, with recruitment occurring in the first year of diagnosis, for participants with confirmed CRC disease.

There are limitations in this study, for example, the one year dietary recall period may not be an accurate amount of time in which to conclude that an association exists between dietary intake and CRC development. However, we believe that because food selection and taste is mostly based on availability and habits that influence deliberate choices, including endemic cultural biases, we accept that the recall period of one year is very likely reflective of the previous years. Thus, the association between dietary intake and CRC may have been developing for several years. In addition, our sample size is small, and this may have been reflected in the statistical calculations. However, we recruited CRC patients from five large hospitals during an approximate 2 year period. Jordan is a small country with the estimated population in 2009 of approximately 6 million people, and a cancer diagnostic rate for CRC of 17.3 per 100,000. We had difficulties in recruiting more participants to increase our sample size.

In conclusion, the results of this study suggest that consumption of some fast food items may contribute to an increased risk of developing CRC. Therefore, enhancing the awareness towards adopting healthy dietary choices and avoiding dietary pattern rich in fast foods is of great importance to decrease the risk of developing CRC disease.

Competing interests

The authors have declared that no competing interest exists.

Acknowledgments

The authors would like to thank the Higher Council of Science and Technology for sponsoring the research projects.

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