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

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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 noted time period (i.e before diagnosis). Physical activity 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.

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 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.

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,
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 level, smoking, and family history of CRC.

Table 1. Selected Characteristics* of the Participants' study

| Characteristic                  | Case (n=220) | Control (n=281) |
|--------------------------------|--------------|-----------------|
| **Age (mean ± SD)**            | 52.9 ± 11.7  | 51.3 ± 11.1     |
| **Sex n (%)**                  |              |                 |
| Male                           | 116 (52.7)   | 132 (47)        |
| Female                         | 104 (47.3)   | 149 (53)        |
| **BMI (mean ± SD)**            | 27.7 ± 6.2   | 29.1 ± 5.6      |
| **BMI Category**               |              |                 |
| Under Weight (<18.5)           | 5 (2.5)      | 2 (0.7)         |
| Normal (18.5-24.9)             | 57 (27.9)    | 52 (18.8)       |
| Overweight (25-29.9)           | 83 (40.7)    | 122 (44.2)      |
| Obese (≥30)                    | 59 (28.9)    | 100 (36.2)      |
| **Marital status n (%)**       |              |                 |
| Married                        | 199 (90.5)   | 248 (88.3)      |
| Single                         | 5 (2.3)      | 17 (6)          |
| Divorced                       | 3 (1.4)      | 1 (0.4)         |
| Widowed                        | 13 (5.9)     | 15 (5.3)        |
| **Occupation n (%)**           |              |                 |
| Yes                            | 69 (31.4)    | 100 (35.6)      |
| No                             | 151 (68.6)   | 181 (64.4)      |
| **Smoking n (%)**              |              |                 |
| Smoker                         | 37 (16.8)    | 53 (18.9)       |
| Non-smoker                     | 173 (78.6)   | 227 (81.1)      |
| **Family history of CRC n (%)**|              |                 |
| Yes                            | 84 (38.5)    | 101 (36.5)      |
| No                             | 134 (61.5)   | 176 (63.5)      |
| **Other health problem n (%)** |              |                 |
| Yes                            | 83 (37.7)    | 119 (42.7)      |
| No                             | 136 (61.8)   | 160 (57.3)      |
| **Education n (%)**            |              |                 |
| Illiterate                     | 17 (7.7)     | 11 (3.9)        |
| primary and secondary          | 107 (56.4)   | 137 (49.1)      |
| Diploma and BSc                | 86 (39.1)    | 113 (40.5)      |
| MSc and PhD                    | 10 (4.5)     | 18 (6.5)        |
| **MET n (%)**                  |              |                 |
| Inactive                       | 121 (56.3)   | 121 (56.3)      |
| Minimally Activeb              | 37 (17.2)    | 53 (21.1)       |
| HEPA active                    | 57 (26.5)    | 67 (26.7)       |

BMI, Body Mass Index; aInactive, not fitting in “Minimally Active” or “HEPA active”; bMinimally Active, at least 600 MET per week; cHealth Enhancing Physical Activity, HEPA active: more than 3,000 MET per week

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 (Tables 2 and 4).

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

| Item                | Rarely ** | Category of Consumption | P- trend |
|---------------------|-----------|-------------------------|----------|
|                     |           | Monthly | Weekly | Daily |                  |
| Falafel             | AOR (95%CI) | 1.02 (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) | 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) | 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) | 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) | 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) | 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) | 1.42 (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) | 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) | 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) | 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) | 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
| Item       | Category of Consumption | P- trend |
|------------|-------------------------|----------|
| **Sugar**  | Rarely **                | Monthly  | Weekly       | Daily       | 0.915     |
|            | 1                       | 1.54 (0.07-32.44) | 0.87 (0.30-2.55) | 0.79 (0.39-1.58) |          |
|            | 31                      | 4        | 15           | 125         |          |
|            | 45                      | 4        | 20           | 159         |          |
| **Coffee mate** | AOR (95%CI)  |          |              |             | 0.93      |
|            | 1                       | 1.08 (0.38-3.07) | 0.99 (0.45-2.18) | 2.29 (0.82-6.39) |          |
|            | 178                     | 10       | 19           | 13          |          |
|            | 227                     | 15       | 23           | 16          |          |
| **Biscuits** | AOR (95%CI)  |          |              |             | 0.659     |
|            | 1                       | 0.90 (0.47-1.72) | 1.03 (0.58-1.84) | 1.18 (0.54-2.59) |          |
|            | 61                      | 47       | 81           | 30          |          |
|            | 85                      | 62       | 91           | 42          |          |
| **Cake**   | AOR (95%CI)  |          |              |             | 0.008     |
|            | 1                       | 0.92 (0.51-1.65) | 1.67 (0.89-3.10) | 3.91 (1.28-11.87) |          |
|            | 53                      | 86       | 67           | 14          |          |
|            | 80                      | 129      | 63           | 9           |          |
| **Ma’mool** | AOR (95%CI)  |          |              |             | 0.087     |
|            | 1                       | 0.76 (0.38-1.50) | 0.83 (0.41-1.68) | 2.06 (0.59-7.20) |          |
|            | 157                     | 27       | 22           | 14          |          |
|            | 197                     | 47       | 32           | 5           |          |
| **Desserts** | AOR (95%CI)  |          |              |             | 0.061     |
|            | 1                       | 0.97 (0.55-1.70) | 1.09 (0.51-2.32) | 1.30 (0.36-4.68) |          |
|            | 56                      | 109      | 47           | 8           |          |
|            | 80                      | 151      | 43           | 7           |          |
| **Chocolate** | AOR (95%CI)  |          |              |             | 0.127     |
|            | 1                       | 0.83 (0.42-1.66) | 1.34 (0.74-2.43) | 1.86 (0.92-3.77) |          |
|            | 61                      | 37       | 75           | 47          |          |
|            | 85                      | 60       | 87           | 48          |          |
| **Candy**  | AOR (95%CI)  |          |              |             | 0.435     |
|            | 1                       | 0.91 (0.47-1.76) | 1.02 (0.56-1.87) | 1.69 (0.80-3.58) |          |
|            | 117                     | 28       | 44           | 31          |          |
|            | 151                     | 45       | 55           | 29          |          |
| **Fresh Tomato Juice** | AOR (95%CI)  |          |              |             | 0.108     |
|            | 1                       | 0.44 (0.22-0.89) | 0.52 (0.15-1.74) | -            |          |
|            | 177                     | 24       | 11           | 6           |          |
|            | 222                     | 46       | 13           | -           |          |
| **Orange Juice** | AOR (95%CI)  |          |              |             | 0.118     |
|            | 1                       | 0.56 (0.31-1.02) | 0.67 (0.37-1.21) | 1.07 (0.45-2.55) |          |
|            | 62                      | 50       | 70           | 35          |          |
|            | 64                      | 101      | 89           | 26          |          |
| **Soft Drinks** | AOR (95%CI)  |          |              |             | 0.179     |
|            | 1                       | 0.77 (0.40-1.50) | 0.52 (0.28-0.95) | 1.39 (0.73-2.63) |          |
|            | 80                      | 31       | 46           | 61          |          |
|            | 93                      | 53       | 87           | 48          |          |
| **Coffee** | AOR (95%CI)  |          |              |             | 0.983     |
|            | 1                       | 0.50 (0.13-1.96) | 0.70 (0.29-1.65) | 0.94 (0.50-1.79) |          |
|            | 45                      | 12       | 24           | 116         |          |
|            | 50                      | 14       | 40           | 153         |          |
| **Tea**    | AOR (95%CI)  |          |              |             | 0.144     |
|            | 1                       | 2.31 (0.11-47.50) | 0.59 (0.18-1.95) | 1.19 (0.47-3.05) |          |
|            | 14                      | 2        | 20           | 161         |          |
|            | 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
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 also sold locally.

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

| Item               | Category of Consumption | <1 serving/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)|                 | 0.013   |
| Total No. of cases | 104                    | 68              | 25              | 23              |               |         |
| 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 (0-0)       |                 |                 |         |
| 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               |                |         |
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(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

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

| Item        | Category of Consumption | <1 serving/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 (0.54-2.84) | 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.
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) (Rybacki 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-N-vanillyl-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.
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