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Original article

Dietary patterns and colorectal cancer

Reema F. Tayyem [a,*], Hiba A. Bawadi [b], Ihab Shehadah [c], Lana M. Agraib [d], Suhad S. AbuMweis [d], Tareq Al-Jaberi [e], Majed Al-Nusairr [f], Kamal E. Bani-Hani [g], Dennis D. Heath [h]

[a] Department of Nutrition and Food Technology, Faculty of Agriculture, The University of Jordan, Amman 11942 Jordan
[b] Human Nutrition Department, College of Health Sciences, Qatar University, P.O. Box: 2713, Doha, Qatar
[c] Chief Gastroenterology Division, King Hussein Cancer Center, Jordan
[d] Department of Clinical Nutrition & Dietetic, The Hashemite University, P.O. Box 150459, Zarqa 13115, Jordan
[e] Jordan University of Science and Technology, Jordan
[f] Chief Gastroenterology Division, Prince Hamza Hospital, Jordan
[g] Faculty of Medicine, Hashemite University, Jordan
[h] Cancer Prevention and Control Program, Moores Cancer Center, University of California, San Diego, La Jolla, CA 92093, USA

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S U M M A R Y

Background & aims: Dietary pattern and lifestyle have been reported to be important risk factors in the development of colorectal cancer (CRC). However, the mechanism of action of dietary factors in CRC disease is unclear. The aim of this study is the examination of several dietary choices and their potential association with the risk of developing CRC.
Methods: Dietary data was collected from 220 subjects who were previously diagnosed with CRC, and 281 control subjects (matched by age, gender, occupation and marital status). The data was collected between January 2010 and December 2012, using interview-based questionnaires. Multivariate logistic regression was used to estimate the relationship between dietary choices and risk of developing colorectal cancer.
Results: Factor analysis revealed three major dietary patterns. The first pattern we identified as the "Healthy Pattern", the second was identified as "High Sugar/High Tea Pattern" and the third as "Western Pattern". In the Healthy Pattern group we found a 10.54% variation in food intake, while the intake variation was 11.64% in the Western Pattern. After adjusting for confounding factors, the Western Pattern food choice was found to be significantly associated with an increased risk of developing CRC (OR = 1.88; 95% CI = 1.12–3.16). The results for the Healthy and High-Sugar/High Tea Patterns showed a decrease, but the statistic was not significant for the risk of CRC development.
Conclusion: The Western Pattern of dietary choice was directly associated with CRC. The association between the dietary food choice in the Healthy and High-Sugar/High Tea Patterns and colorectal cancer needs further study in our Jordanian population.

1. Introduction

In colorectal cancer (CRC) disease, several well-known dietary and non-dietary risk factors have been implicated. Some of those factors are high consumption of red meat and processed meat; low fiber intake; alcohol drinking; obesity; and a sedentary life style [1]. Additionally, genetic susceptibility [2], tobacco smoking [3], and exposure to environmental carcinogens, were found to promote proliferation and malignant transformation of CRC cells [4].

Previous studies have focused on the effects of a single food item or a nutrient on lowering risk of CRC incidence [5]. However, the association of a single food item or food group with the risk of developing CRC may not be valid because of the presumption that each single food item or nutrient has an isolated effect [6]. A dietary pattern in food choice is defined as a combination of the dietary components (food items, food groups, nutrients, or both) used to summarize elements of the total diet or the major features of the

* Corresponding author.
E-mail addresses: r.tayyem@ju.edu.jo (R.F. Tayyem), hbawadi@qu.ed.qa (H.A. Bawadi), ishehadeh@khcc.jo (I. Shehadah), elonafrsh2003@yahoo.com (L.M. Agraib), suhad.abumweis@hu.edu.jo (S.S. AbuMweis), tmrjaberi@hotmail.com (T. Al-Jaberi), k_banihani@hu.edu.jo (K.E. Bani-Hani), dheath@ucsd.edu (D.D. Heath).

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food choices for the population under study [7]. The descriptive summary of the dietary pattern has been used in nutritional epidemiology to explain and assess the overall dietary experience, by suggesting that the synergistic effects of the variety of dietary and non-dietary factors can be used to explain the relationship between diet and health [8].

In general there are two dietary patterns; “Healthy” and “Western”. The healthy dietary pattern is largely characterized by a greater intake of fruits, vegetables, grains, and a lower intake of sweets, red meat, and processed meat, this dietary pattern is considered to be associated with lowering the risk of developing CRC. Alternatively, the Western dietary pattern, reported to contain more meat, highly processed food, potatoes, refined carbohydrates, and much lower in vegetables and dietary fiber, has been reported to increase the risk of developing CRC [7,9]. The numbers of studies that have examined the possible effect of dietary patterns and CRC disease in the developing countries are few. However, we previously reported on the association between macro- and micronutrients consumption and the risk for colorectal cancer among Jordanians [10]. In this study we aimed to examine the major dietary patterns and their possible association in the development of CRC in a Jordanian population, using factor analysis or Principal Component Analysis.

2. Materials and methods

2.1. Study population and methods

A detailed description of the method has been reported elsewhere [11]. Briefly, a case-control study of 501 participants was conducted from January 2010 to December 2012; with 220 diagnosed with CRC disease, and 281 controls (a total of 248 males and 253 females). Patients diagnosed with CRC disease (cases) were recruited from five Jordanian hospitals specializing in oncology diagnosis and treatment. The Control group was recruited from outpatients, hospital personnel, and visitors. Controls were matched with cases for age, gender, occupation and marital status. The study protocol was approved by Institutional Review Board Committees from all hospital groups. Control subjects were excluded if any first- or second degree relatives were diagnosed with CRC. The following inclusion criteria for controls were used: Jordanian nationals aged 18 years or older, ability to communicate clearly and verbally, free of any type of diagnosed cancer, diabetes mellitus, liver disease and rheumatoid arthritis. For inclusion in the diagnosed CRC cancer group, subjects must have received their diagnosis less than 1 year prior to the time of the first interview. The exclusion criteria for this group included those who were considered “critically ill”, such as an in-patient at any facility and those who were unable to communicate verbally and clearly. Written informed consent was obtained from all subjects before their interview.

2.2. Data collection

Socio-demographic information (age, marital status, household income, education, occupation and tobacco usage); medical history as well as dietary data were collected by trained research assistants using interview-based questionnaires. The comprehensive medical data included the participant's full medical history to confirm the status of CRC diagnosed subjects and disease-free subjects.

A validated Arabic quantitative Food Frequency Questionnaire (FFQ), adapted from the Diet History Questionnaire (DHQ I) of the National Cancer Institute of the United States of America [12] was used for dietary assessment. The FFQ questions tracked the information on the dietary history of study participants prior to CRC diagnosis, and to confirm the dietary habits of control participants. A period of one year prior to the diagnosis date was selected, to reflect seasonal variation in some food types. A constant dietary pattern for the period was noted in our participants, with most of the participants suggesting this pattern existed for at least five years. A qualified dietitian asked participants, during face-to-face interviews, how frequently, on average, during the past year they had consumed one standard serving of specific food items 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). An answer in the affirmative resulted in additional questions related to frequency and amount of food consumed. If the participants' dietary pattern did not include a food type, then related questions were skipped. Food lists in the modified FFQ questions were classified based on types of foods: 21 items of fruits and juices; 21 items of vegetables; eight items of cereals; nine items of milk and dairy products; four items of beans; 16 items of meat such as red meat (lamb and beef), chicken, fish, cold meat, and others; four items of soups and sauces; five items of drinks; nine items of snacks and sweets; and 14 items of herbs and spices [12]. For better portion size estimation food models and standard measuring tools were used. Dietary intakes were analyzed using dietary analysis software (ESHA Food Processor SQL version 10.1.1; ESHA, Salem, OR, USA) with additional data on foods consumed in Jordan.

The 7-day Physical Activity Recall (PAR), developed by Sallis et al. (1985) was used to measure physical activity level. 7-Day PAR is a structured interview that depends on participant's recall of time spent engaging in physical activity over a seven day period [13]. Participants were asked to respond to a PAR question based on the way they used to behave prior to being diagnosed with CRC. The number of hours spent in different activity levels were obtained and converted into metabolic equivalents (METs). The total physical activity MET minutes per week was obtained by summing the METs and then performing categorical analysis (inactive, minimally active, or health enhancing physical activity active) [13]. Body weight (measured to the nearest 0.1 kg); height (measured to the nearest 0.5 cm); and body mass index (BMI) were taken and calculated as prescribed by Lee and Nieman [14].

2.3. Statistical analyses

Statistical analysis was performed with SPSS IBM-20 software. The significance level was set at $p \leq 0.05$. For descriptive statistics, mean $\pm$ standard deviation (SD) and percentages were used. T-tests evaluated the differences between cases and controls in continuous variables, and Chi-square was used to detect differences among categorical variables. Dietary patterns were derived using Principal Component Analysis (PCA), form factor analysis. The food items in the FFQ were separated into 22 food groups, based on their similarity of nutrient content and culinary usage or their reported relationship with cancer [15] (Table 1). Kaiser-Meyer-Olkin (KMO-test) and Bartlett's test of sphericity were used to assess suitability for using factor analysis for this exercise. As suggested by Safari et al. (2013) [16] sampling adequacy and inter-correlation of factors were supported by KMO value > 0.632 and Bartlett's test of sphericity < 0.001, respectively. Communality index was assessed to indicate the variance in each food group being tested by the analysis [16]. Factors were retained based on an eigenvalue of >1 for screen plot. Then Varimax rotation was applied to review the correlations between variables and factors [16]. Food groups with absolute factor loadings >0.20 were considered to have contributed significantly to the pattern. Cases and controls received an individual factor score for each identified pattern [17]. Potential confounders (with age, sex, BMI, physical activity level (MET-min/week), total energy intake, occupation, education level, smoking,