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Dietary patterns associated with the risk of pancreatic cancer
Case-control study findings

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Abstract

Diet is an important modifiable lifestyle factor, but epidemiological studies evaluating the association between dietary patterns and pancreatic cancer (PC) have reported inconsistent findings. This study aimed to evaluate the impact of several dietary choices on the risk of PC among newly diagnosed Jordanian patients. A case-control study was conducted at major teaching and general hospitals, including a Jordanian oncology center. The study included 101 patients with incident pancreatic cancer and 314 controls. Data was collected using interview-based questionnaires. Dietary intake was estimated using a validated Arabic and reproducible food-frequency questionnaire. Dietary patterns were derived using Principal Component Analysis. Multinomial logistic regression was used to estimate the association between dietary patterns and PC. Four dietary patterns were identified. The "Traditional" dietary pattern, which presented a diet rich in fresh fruits, vegetables, milk, yogurt, and lentils, was associated with a significant decrease in the odds of PC (OR = 0.42, 95% CI = 0.21–0.84) for the third quartile compared to first one. The "High-fruit" dietary pattern, which was loaded with strawberry, melon, watermelon, and other fruits, significantly reduced the odds of PC (OR = 0.38, 95% CI = 0.19–0.75) for the second quartile compared to the first one. The "Soup" dietary pattern was mainly composed of vermicelli soup, vegetable soup, lentil soup, and mushroom soup, which decreased the odds of PC (OR = 0.18, 95% CI = 0.07–0.38). There was no relation between PC and the "Western" dietary pattern, loaded with beer, wine, roasted lamb, meat, chicken sandwich, beefsteak, and fried fish. The "Traditional," "High-fruit," and "Soup" dietary patterns were associated with reduced risk of PC among Jordanians.

Abbreviations: BMI = body mass index, CI = confidence interval, FFQ = food frequency questionnaire, KHCC = King Hussein Cancer Center's, KMO = Kaiser–Meyer–Olkin, MET = metabolic equivalents, OR = odds ratios, PAR = seven-day physical activity recall, PC = pancreatic cancer, PCA = Principal Component Analysis.

Keywords: Dietary patterns, pancreatic cancer, retrospective

1. Introduction

Although the incidence rate of pancreatic cancer (PC) is considerably low, its mortality rate is the highest among all major cancers.[1,2] This could be attributed to the inferior prognosis of PC, which is usually diagnosed at developed stages, and the ineffectiveness of treatment; thus poor survival rate,[3–5] which necessitates assessing and controlling its risk factors and enhancing the prevention measures. Even though genetics affect the risk of PC, the exact etiology of PC is poorly understood.[1,4] However, modifiable factors, including obesity, cigarette smoking, alcohol consumption, and dietary factors, among others, play a detrimental role in shaping its risk.[1] Dietary factors may contribute to up to 50% of PC.[3]

The available evidence concerning the association between a single dietary component and risk of PC shows inconsistent results,[3,4] which hinders our ability to control the influence of diet, one of the most important risk factors on the occurrence of PC. For instance,

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of King Hussein Cancer Center (IRB No. 15 KHCC 03, Amman, Jordan), King Abdullah University Hospital, Jordan University Hospital, and Al-Bashir Hospital.

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high carbohydrate consumption was found to have a protective effect against the risk of PC in a cohort study in Finland,[3] nevertheless, the elevated consumption of fructose and sucrose (except soda drinks) was significantly and positively associated with the risk.[6] Data derived from 2 population-based prospective cohorts on added sugar from all dietary sources, including soft drinks, showed a significant deleterious impact on the risk of PC.[7]

Conversely, studying dietary patterns is believed to provide a clearer idea.[8] Dietary pattern analysis is a method of dietary analysis that reflects the cumulative and interactive effects among dietary components to show the complexity of the human diet. It is a comprehensive and conclusive approach that can assess the combined effect of food and nutrient interaction to explore the association of dietary patterns and disease.[8]

A systematic review of the relationship between dietary patterns and risk of PC in 2017 revealed a significant inverse association, with a stronger association in men than in women.[1] Generally, diets rich in fresh fruits, vegetables, nuts, and whole grains might help to reduce the risk of PC; on the other hand, an increased intake of saturated fat, fried foods, and animal products may induce its occurrence.[3,5] PC risk was found to be lower among individuals who highly adhered to the Mediterranean diet, while the opposite association was detected for the Western diet.[9]

Given the complexity and the interaction of different dietary components and the narrow picture provided by studying a single dietary component, studying the overall dietary pattern offers an inclusive view of the relationship between a diet and disease risk. The current evidence in this regard is limited; therefore, this study was conducted to assess the influence of dietary patterns on the risk of PC risk among newly diagnosed Jordanian patients in a case-control design.

2. Methods

2.1. Study design and participants

This case-control study was conducted in Jordan between March 2015 and August 2018. One hundred and fourteen PC patients with a medical report confirming the diagnosis of PC were invited to participate in this study. However, 101 PC patients accepted to participate in this study. The control group consisted of 314 individuals who were not diagnosed with any cancer and were conveniently selected from the community. The population-based controls were frequency-matched to the cases based on age, occupation, and marital status. The ratio of cases to controls in this study was 1:3.

The inclusion criteria included Jordanian nationality, being aged 18 years or older at enrollment, being able to communicate verbally and being free of any chronic diseases that require dietary modifications such as kidney disease, liver disease, and celiac disease. Patients diagnosed with gastric or pancreatic cancer within the last 6 months were enrolled. The exclusion criteria included individuals who were critically ill, hospitalized, and unable to communicate verbally. Informed consent was obtained from all participants before their enrollment in the study.

Cases were enrolled from 4 hospitals that include an oncology center. These hospitals were King Hussein Cancer Center, King Abdullah University Hospital, Jordan University Hospital, and Al-Bashir Hospital. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki. It was approved by the King Hussein Cancer Center's Institutional Review Board Ethics Committee (IRB No. 15 KHCC 03, Amman, Jordan), King Abdullah University Hospital, Jordan University Hospital, and Al-Bashir Hospital.

2.2. Data collection

The data were obtained by completing personal and physical activity questionnaires and a food frequency questionnaire (FFQ). The questionnaires were completed using a face-to-face interview technique, and trained nutritionists filled out the questionnaires.

The personal questionnaire included questions related to age, gender, marital status, educational level, employment status, family income/month, smoking status, previous and current health problems, family history of cancer, and presence and absence of stomach aches and stomach ulcers.

2.3. Dietary assessment

Data on diet were collected using a validated Arabic FFQ for dietary assessment, which had been previously validated.[10] The modified FFQ has a reasonable relative validity and reliability for energy, carbohydrate, fiber, fat, saturated fat, calcium, and iron intakes in Jordanian adults over 1 year. Standardized food models (NASCO, Saugerties, NY) and standard measuring tools were used (NASCO) to estimate the portion size. Data were collected through face-to-face interviews. Food lists in the FFQ were categorized based on the type of food: 21 items of fresh and dried fruits and juices; 21 items of fresh and cooked vegetables; 8 items of the most common consumed cereals; 9 items of milk and dairy products; 4 items of legumes; 16 items of all types of meat; 4 items of soups and sauces; 5 items of drinks; 4 items of snacks and sweets; and 14 items of herbs and spices. Total energy intakes were analyzed using dietary analysis software (Food Processor SQL version 10.1.129; ESHA, Salem, OR) with additional data on foods consumed in Jordan[11] to estimate daily intake of energy.

2.4. Anthropometric measurements

Participants' body weights and heights were measured using standardized techniques and calibrated tools by trained research assistants using a calibrated scale (Omron, Japan). Height was measured to the nearest cm when participants were in the full standing position without shoes using a calibrated measuring rod.[12] Body mass index (BMI) was calculated by dividing weight (kilograms) by height squared (meters) and was categorized as normal body weight, 18.5 to 24.9; overweight, 25.0 to 29.9; and obese, >30.0.[12] A trained dietitian performed all the anthropometric measurements.

2.5. Seven-day physical activity recall (PAR)

The validated PAR questionnaire was used to measure physical activity levels.[13] Seven-Day PAR is a questionnaire that focuses on a participant's recall of the usual time spent doing a physical activity over 7 days.[13] The number of hours expended in sleeping and different physical activity levels was taken and converted into metabolic equivalents (MET). According to the scoring instructions, sleeping was allocated a value of 1.0 MET, light activity a value of 1.5 METs, moderate activity a value of 4.0 METs, and very hard activity a value of 7.0 METs or greater.[14]

2.6. Statistical analysis

SPSS version 22.0 (IBM SPSS Statistics for Windows, Version 22.0, IBM Corp., Armonk, NY) was used to perform statistical analyses. For descriptive statistics, mean ± standard deviation (SD) and percentages were used. *t* test was used to evaluate the differences between cases and controls in continuous variables, and Chi-square was used to detect differences among categorical variables. The significance level was set at $P \leq .05$.

Dietary patterns were derived using Principal Component Analysis (PCA) and Factor Analysis (FA). Principal components are linear combinations of the input variables and explain as much of the variation in the data as possible. PCA allows the investigation of diet as a whole, by combining the foods or food groups that are commonly eaten together as part of an underlying dimension of food consumption.[15] With the use of this approach, a number of associations could be detected between dietary patterns and the risk of several chronic diseases.[16] PCA might deal with the complexity of diet and tackle confounding issues better than single food or nutrient analysis. Each component describes a dietary pattern and the linear combination allows the calculation of a component score for each participant; the higher the score, the more likely this pattern is present in an individual's diet. The patterns described by each component may be interpreted by its factor loadings, which are the correlations between the component and each input variable. Consumption frequency was used to identify dietary patterns. The foods in the FFQ were separated into 51 food items based on their similarity of nutrient content and culinary usage or their reported relationship with PCA (Table 1). These factors explained 30.34 of the total variance in the original data set. Only the magnitude of each loading was used to name the factors. A Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity were used to assess suitability for using factor analysis for this exercise. Sampling adequacy and inter-correlation of factors were supported by KMO value > 0.667 and Bartlett's test of sphericity < 0.001, respectively. Factors were retained based on an eigenvalue of > 1.25 for the screen plot. Further, Varimax rotation was applied to review the correlations between variables and factors. Food items with absolute factor loadings > 0.25 were considered to have contributed significantly to the pattern. Cases and controls received an individual factor score for each identified pattern. Potential confounders (adjusted for age, gender, BMI, smoking, marital status, total energy intake, education level, and physical activity) were chosen based on reported risk factors for PC.[17,18] Odds ratios (OR) and 95% confidence interval (CI) were calculated using a multinomial logistic regression model.

3. Results

Table 1 shows that the first factor, the "Western" dietary pattern, has the greatest loading in beer, wine, roasted lamb, meat, chicken sandwich, beefsteak, and fried fish. The second factor is the "Traditional" dietary pattern, loaded with fresh fruits, vegetables, milk, yogurt, lentils. While the third factor represents a "High-Fruit" dietary pattern (strawberry, melon, watermelon, other fruit), the fourth is loaded with vermicelli soup, vegetable soup, lentils soup, and mushroom soup.

Table 2 shows the characteristics of participants with GC (n = 172) and PC (n = 101) and controls (n = 314) as have been described by Al-Awwad et al[18] study. Participants with PC had similar age, height, and in-come as controls. The pre-diagnosis BMI for participants with PC were higher than controls. However, current body weight and BMI for patients with PC were lower than for controls. The number of cigarettes smoked per day was 10.8 ± 1.6 for participants with PC and 9.0 ± 0.9 for controls. The duration of smoking was 13.1 ± 26.7 years for PC cases and it was higher than for controls (8.8 ± 14.7years). Total physical activity METs (MET-min/wk) were 952.9 ± 47.2 and 1314.7 ± 45.6 for PC cases and controls, respectively. However, all participants were considered minimally active. Most PC cases (52.6%) showed normal BMI. However, most were previously considered overweight (PC, 41.1%) or obese (PC, 41.1%). The Majority of PC (73.9%) cases were considered stage 4. Participants with PC reported family histories of the lung (5.9%), breast (6.9%), prostate (5.9%), and other (13.9%) cancers.

The detected 4 dietary patterns and their corresponding ORs of PC cases and controls, represented by quartiles of factor scores and continuous factor scores, are shown in Table 3. There was a significant reduction in the risk of PC with following the "Traditional" dietary pattern at the third and fourth quartiles after adjusting for age, gender, BMI, smoking, marital status, total energy intake, education level, and physical activity (OR, 95% CI: 0.417 (0.206–0.843); 0.215 (0.095–0.486), respectively). Additionally, the third dietary pattern, "High-Fruit" showed a significant protective association for PC on the first, second, and third quartiles (OR, 95% CI: 0.381 (0.194–0.749); 0.246 (0.120–0.504); 0.181 (0.083–0.394), respectively) the "Soup" dietary pattern showed this protective effect on the third quartile only (OR, 95% CI: 0.159 (0.066–0.379) (Table 3). Although the "Western" dietary pattern showed a risk of developing PC, this risk was not significant at any level.

4. Discussion

This study assessed the cumulative effects of overall dietary components, which account for the interaction of various foods and nutrients and their bioavailability, on the risk of PC. Here, we demonstrated that higher intakes of "Traditional," "High-Fruit," and "Soup" dietary patterns were associated with lower risks of PC in a case-control study of Jordanian adults.

A higher commitment to the "Traditional diet," identified in this study, included fresh fruits, vegetables, milk, yogurt, and lentils, which had significant 58 to 79 protective effects against having PC. The "Traditional" Jordanian diet shared some hallmarks with the Mediterranean dietary pattern, such as high content of vegetables, olive oil, and legumes which might help reduce cancer risk by the synergistic effect of its anti-carcinogenic components. The current evidence lacks consistent support regarding the relationship between the Mediterranean diet and PC risk despite being characterized as a healthy diet.[19,20] Data from 2 large prospective populations found that adherence to the Mediterranean diet components, except alcohol, was associated with a lower risk of developing PC.[21,22] The largest factor was loading on the "Traditional" pattern identified in this study delivered by the consumption of fruits and vegetables (i.e., >0.3 KMO for each item), which may indicate an overall healthy and anti-carcinogenic eating pattern.

Overall, this study detected a significant inverse association between the consumption of patterns that were rich in fruits and vegetables ("Traditional" and "High-Fruit") and PC risk. In support of our findings, a protective effect of the habitual consumption of fresh fruits and vegetables on PC risk was detected in a Japanese case-control study.[23] Case-control studies detected an inverse association between PC risk and dietary patterns containing ample amounts of fruits and vegetables.[4,24] The risk reduction associated with the consumption of raw fruits and vegetables could be attributed to their considerable content of vitamin C, carotenoids, and phytochemicals. Several potential mechanisms have been suggested to elucidate the potential power to prevent cancer in foods containing those nutrients/chemicals, mainly fresh fruits and cruciferous vegetables.[25,26]

On the other hand, previous studies documented that meat and saturated fat intakes were associated with an increased risk of PC.[3,5,17,24] Here, we detected a nonsignificant positive association. Evidence concerning the positive association between PC and high intake of meat, dairy products, fat, and cholesterol is not confirmative.[25,27] This could be explained by questionnaire-based variation; positive associations mainly were detected for specific types of meat such as grilled, fried, and smoked meat, while no association was observed for the meat group as a whole.[27] Some cooking, preparation, and processing techniques may produce harmful substances that impact cancer risk if consumed habitually; however, their effects may be diluted as only a minor part of a whole pattern. Additionally, the Western dietary pattern identified in this study also contained fruits and cruciferous vegetables, which could attenuate the possible carcinogenic stimuli of fried food, meat cooked at high temperatures, and fat in the meat.

Table 1

Factor loading matrix for the two major dietary patterns identified in a representative sample.

	Dietary patterns in PC patients			
Food groups	**Western**	**Traditional**	**High-fruit**	**Soups**
Beer	0.864			
Wine	0.861			
Roasted lamb meat	0.673			
Cauliflower	0.59			
Broccoli	0.587		0.269	
Grape fruit	0.483			
Carrot	0.454	0.267		
Chicken sandwich	0.441		0.343	
Boiled potato	0.395	0.295		
Mixed vegetables	0.373			
Vegetable salad		0.589		
Butter milk		0.516		
Tomato		0.483		
Grape		0.482		
Cooked vegetables		0.475		
Mansaf (cooked yogurt)		0.472		
Apple		0.468		
Yogurt		0.456		
Banana		0.44		
Cabbage leaves		0.423		
Pepper		0.418		
Stuffed vegetables		0.412		
Pickles		0.409		
Fresh vegetables		0.406		
Olives pickles		0.384		
Lettuce		0.342	0.325	
Green beans		0.328		
Fried potato		0.264		
Corn flakes			0.675	
Beef steak	0.374		0.544	
Peas			0.538	
Strawberry			0.523	
Melon			0.504	
Chips			0.488	0.258
Watermelon			0.442	
Other fruit	0.318		0.434	
Corn			0.374	
Fried fish	0.266		0.368	
Marconi with cheese			0.331	
Yellow cheese			0.328	
Chocolate			0.326	
Vermicelli soup				0.788
Vegetable soup				0.714
Lentil soup		0.28		0.603
Mushroom soup				0.598
Free fat white cheese				0.576
Mayonnaise			0.259	0.493
Falafel				0.389
Hummus				0.387
Ketchup			0.332	0.372
Candies			0.298	0.304
Variance of intake explained (%)	**11.51**	**7.29**	**6.14**	**5.40**

PC = pancreatic cancer.

The identified "High-Fruit" pattern demonstrated up to 81 significant protective effects against PC. It consisted of mixed components, including beefsteak, chicken, mayonnaise, candies, yellow cheeses, broccoli, fresh vegetables, and fruits, which share some features of Western and healthy patterns. This could reflect the complexity of the diet and the importance of incorporating nutritious foods to ameliorate disease risks. For instance, the carcinogenic influence of N-nitroso compounds and heterocyclic amines could be attenuated by the presence of adequate amounts of nutrients and phytochemicals.[25,28] The latter might also debilitate the oxidative damage of DNA and inflammatory processes and improve DNA methylation and insulin metabolism initiated by potential dietary triggers.[28]

The highest consumption of the "Soup" dietary pattern was found to have about 84 protective effects against developing PC. This pattern contained Falafel (a low-cost traditional Jordanian fried food) as well as Ketchup Mayonnaise (frequently used condiments with junk foods); however, the largest factor loadings (≥ 0.6) were for soups which may indicate a home-prepared eating pattern and possibly low economic status. It has been distinguished that the risk factors of PC are highly associated with a higher economic and development index.[29] Therefore, the detected protective effect of the "Soup" pattern might be linked to low economic status and possibly limited choices of processed and unhealthy food choices.

Table 2

Characteristics of the study participants (n = 415).[18]

Variables	PC cases (n = 101)	Controls (n = 314)
Mean ± SEM		
Age (yr)	56.97 ± 1.2	54.0 ± 0.7
Height (cm)	166.2 ± 0.9	168.0 ± 0.5
Pre-diagnosis body weight (kg)	83.4 ± 2.0	79.4 ± 1.2
Current weight (kg)	69.4 ± 1.4	80.9 ± 0.9
Pre-diagnosis BMI (kg/m^2)	30.2 ± 0.7	28.3 ± 0.4
Current BMI (kg/m^2)	25.1 ± 0.5	28.7 ± 0.3
Income (JD)	700.1 ± 74.7	575.9 ± 36
Number of cigarettes/day	10.8 ± 1.6	9.0 ± 0.9
Duration of smoking (yr)	13.1 ± 26.7	8.8 ± 14.7
Total physical activity (MET-min/wk)†	952.9 ± 47.2	1314.7 ± 45.6
n (%)		
Gender		
Male	59 (58.4)	191 (60.8)
Female	42 (41.6)	123 (39.2)
Pre-diagnosis BMI categories		
<18.5	1 (1.1)	6 (2.1)
18.5–24.9	16 (16.8)	73 (25.9)
25–29.9	39 (41.1)	97 (34.4)
>30	39 (41.1)	106 (37.6)
Current BMI categories		
<18.5	6 (6.2)	0 (0.0)
18.5–24.9	51 (52.6)	85 (27.8)
25–29.9	21 (21.6)	108 (35.3)
>30	19 (19.6)	113 (36.9)
Cancer stages		
No cancer	0 (0.0)	314 (100.0)
First stage	1 (1.1)	0 (0.0)
Second stage	1 (1.1)	0 (0.0)
Third stage	21 (23.9)	0 (0.0)
Fourth stage	65 (73.9)	0 (0.0)
Marital status		
Married	87 (86.1)	273 (86.9)
Single	5 (5.0)	20 (6.4)
Divorced	3 (3.0)	7 (2.2)
Widow	6 (5.9)	14 (4.5)
Education level		
Illiterate	7 (6.9)	18 (5.8)
Less than high school	24 (23.8)	80 (25.6)
High school	14 (13.9)	72 (23.0)
Diploma	18 (17.8)	56 (17.9)
Bachelor	30 (29.7)	71 (22.7)
Master's degree	5 (5.0)	13 (4.2)
Doctorate degree	3 (3.0)	3 (1.0)
Employment status		
Yes	45 (45.0)	153 (49.0)
No	55 (55.0)	159 (51.0)
Smoking status		
Total number of the smokers	47 (46.5)	124 (39.5)
Current smoker	38 (37.6)	99 (31.5)
Previous smoker	3 (3.0)	13 (4.1)
Passive smoker	6 (5.9)	12 (3.8)
Nonsmoker	54 (53.5)	190 (60.5)
Health problem		
No	45 (44.6)	151 (48.1)
Yes	56 (55.4)	163 (51.9)
Type of health problem		
No	45 (44.6)	151 (48.1)
Diabetes mellitus	36 (35.6)	81 (25.8)
Heart	10 (9.9)	19 (6.1)
Hypertension	9 (8.9)	40 (12.7)
Other	1 (1.0)	23 (7.3)
Family history of cancer		
Yes	49 (48.5)	100 (31.8)
No	52 (51.5)	214 (68.2)
Cancer type for patient's family		
No	52 (51.5)	214 (68.2)
Gastric	4 (4.0)	10 (3.2)
Colon and/or rectal	1 (1.0)	13 (4.1)
Pancreatic	3 (3.0)	1 (0.3)
Bone cancer	3 (3.0)	6 (1.9)
Lung	6 (5.9)	11 (3.5)
Leukaemia	1 (1.0)	10 (3.2)
Breast	7 (6.9)	13 (4.1)
Liver	4 (4.0)	5 (1.6)
Prostate	6 (5.9)	4 (1.3)
Other	14 (13.9)	27 (8.6)
Physical activity levels		
Inactive*	26 (26.0)	46 (14.6)
Minimally active†	73 (73.0)	251 (79.9)
HEPA active‡	1 (1.0)	17 (5.4)

(Continued)

Table 2 *(Continued)*

BMI = body mass index, HEPA = health-enhancing physical activity, MET = metabolic equivalents, PC = pancreatic cancer.

*Inactive: not fitting in "Minimally Active" or "HEPA Active".

†Minimally active: at least 600 MET-min/wk.

‡HEPA active: more than 3000 MET-min/wk.

Table 3

Risk of PC across quartiles of the dietary patterns among study participants.

Dietary pattern	Q1	Q2 OR (95% CI)	Q3 OR (95% CI)	Q4 OR (95% CI)
Western	1	0.954 (0.462–1.969)	1.259 (0.608–2.605)	1.309 (0.644–2.664)
Cases/controls	27/72	22/75	25/72	25/73
Traditional	1	0.711 (0.373–1.356)	0.417 (0.206–0.843)	0.215 (0.095–0.486)
Cases/controls	38/59	29/70	19/78	12/85
High-fruit	1	0.381 (0.194–0.749)	0.246 (0.120–0.504)	0.181 (0.083–0.394)
Cases/controls	45/53	24/74	17/81	14/85
Soups	1	1.351 (0.697–2.620)	0.569 (0.277–1.170)	0.159 (0.066–0.379)
Cases/controls	33/65	34/64	22/75	11/88

The control group was considered the reference group for dietary pattern analysis.

OR and CI represent odd ratio and confidence interval. OR was adjusted for age, marital status, BMI, education, smoking, breastfeeding, physical activity, and energy (Kcal).

BMI = body mass index, PC = pancreatic cancer.

A large cohort study revealed that having a higher healthy lifestyle score characterized by nonsmoking, adherence to the Mediterranean dietary pattern, regular physical activity, normal BMI, and limited alcohol consumption was associated with a better prevention rate of PC.[21] Such evidence supports the importance of assessing the overall influence of modifiable factors to establish comprehensive measures to prevent or reduce PC risk. The findings of this study were adjusted for several confounders suggested to affecting the risk of PC.

Despite its strength, it is worth mentioning the limitations of this research. Possible recall bias and estimation errors are questionnaire-inherited limitations that cannot be excluded; nevertheless, they were limited by using validated FFQ and food model measuring tools. On the other hand, a major strength of the current study was examining the cumulative influence of dietary patterns, rather than the effect of specific nutrients and foods. Compliance with the questionnaire was high, with an eminent response rate of > 95%. The statistical adjustment for several substantial lifestyle determinants of PC risk, including smoking, obesity, and physical activity, would have strengthened the detected associations.

6. Conclusion

Our findings support the notion that consuming dietary patterns rich in plant sources, including fruits, vegetables, and legumes, is a wise choice that would contribute to a lower risk of PC associated with higher nutrient density and better diet quality.

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