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ORIGINAL ARTICLE

Dietary intake and risk of depression among male and female with HIV/AIDS

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Abstract

Purpose Depression is the most common mental disorder among subjects with HIV. The present study was conducted to determine the relationship between dietary intake and depression among male and female with HIV/AIDS.

Methods 335 HIV/AIDS subjects were evaluated who referred to Behavioral Disorders Counseling Center in Kermanshah, province in Iran. Depression was assessed using Beck questionnaire. Food frequency questionnaire was used to assess dietary intake.

Results Our findings indicated that 76.1% of the studied subjects had varying degrees of depression. The rate of depression in the men was significantly higher than in the women ($P=0.007$). The mean of weight in the men with depression was significantly lower than of the men without depression ($P=0.01$). Higher adhere to legume and vegetables in the men (OR 0.049, CI 95% 0.003–0.713 and OR 0.534, CI 95% 0.334–0.855, respectively) and dairy products in the women (OR 0.493, CI 95% 0.265–0.917) were associated with decrease risk of depression.

Conclusion The results of this study were shown that the high prevalence of depression among these subjects. Higher intake of legume and vegetables and dairy products had a protective effect on the risk of depression.

Level of evidence Level V, descriptive cross-sectional study.

Keywords Dietary intake · Depression · Mental disorder · HIV/AIDS

Introduction

Depression is the most common mental disorder in the world wide that World Health Organization (WHO) stated more than 350 million people suffer from it [1]. This disorder occurs in women twice as likely as men that can increase years lived with disability and consequence mortality rate [2–4]. The etiology of this disease is not yet completely understood, but inflammation and oxidative damage are known to be effective factors in the pathogenesis of depression [5].

AIDS/Human immunodeficiency virus (HIV) infection is one of the public health concerns in the worldwide [6]. Depression is the most common mental disorder in these patients which is estimated more than 30% of people with HIV/AIDS are depressed [7]. It is necessary identification of psychological and environmental factors affecting depression for prevention of it.

Epidemiological studies have shown that among environmental factors, dietary modification is an appropriate approach for decrease of depression [8–10]. Risk of

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depression can decrease adhered to healthy dietary pattern that was characterized with high intake of sea food, low-fat diary, fruits, vegetables, whole grain, olive oil and low consumption of red and processed meat, sugar-sweetened beverage, refined grain and saturated fatty acids [11]. Fruits and vegetables contain high levels of antioxidants and essential micronutrients which are playing important role in the reduction of inflammatory components and reactive oxygen oxidative (ROS) [5]. In addition, sea food and olive oil are rich in unsaturated fatty acids including linolenic acid and oleic acid that are associated inversely with the risk of depression [11, 12]. On the other hand, adherence to western diet that contains high level of saturated fatty acids and simple carbohydrate can promote inflammation and oxidative process and consequence risk of depression [13]. Therefore, understanding dietary factors associated with depression are an important strategy to reduce it. To our knowledge, there is no study that assesses relationship between dietary intake and risk of depression among male and female with HIV.

Materials and methods

Study design and participants

This cross-sectional study was performed on HIV/AIDS subjects who referred to Behavioral Disorders Counseling Center in Kermanshah, province in Iran. Sample size was calculated based on the prevalence of malnutrition in the previous studies [14, 15] with accuracy of 5%, $P=0.33$ and 95% confidence as follows:

$$n = \frac{z^2 p(1-p)}{d^2} = 340.$$

These samples were selected among subjects referred to Behavioral Disorders Counseling Center in Kermanshah randomly. Inclusion criteria were the definitive diagnosis of HIV infection, complete consent to participate in the study and living in Kermanshah Province. Subjects who were not diagnosed with HIV/ AIDS definitively and did not provide us complete information were excluded from the study. Overall data from 335 subjects were considered for this study (see flowchart of the study) (Fig. 1).

Demographic data and anthropometry

Before data collection, informed consent was obtained from all subjects. Demographic information including age, gender, education level and marital status were collected. Weight was measured using calibrated mechanical Seca scale (with accuracy 100 g) with minimal clothing and height was measured using a fixed tape without shoes in standing position while the heels and hips were in contact with the wall (with accuracy 0.1 cm). Body mass index (BMI) was calculated weight (kg) divided to (height)^2 (meter) [16]. Physical activity level (PAL) was assessed by international physical activity questionnaire short form (IPAQ-SF) that the validity and reliability of it have been confirmed in previous study in Iran [17]. According to data from this questionnaire, total metabolic equivalent of task (met) was calculated and was categorized into light, moderate and intense physical activity.

Outcome measurement

The valid long form of the Beck Depression Inventory (BDI) was applied to screen of depression [18]. This self- reported questionnaire contains 21 symptoms of depression and each of them has 4 statements. These statements are scored from 0 (no distress) to 3 (severe distress) and the total score of 21 items is between 0 and 63 that was categorized to 6 groups as follows: total score between 0 and 9 was considered normal, 10–16 mild depression, 17–29 moderate depression, and 30–63 severe depression.

Dietary assessment

Dietary intake was assessed using 161-item food frequency questionnaire (FFQ) whose validity and reliability have been confirmed in Iran [19]. Subjects were asked to report the frequency of 161 food consumptions based on 9 options from never to more than 6 times per day. The food items were asked based on the portion size which was familiar for the people for example "cup" for cooked rice and milk. We turned this native portion size to "Serving size" that is a standardized amount of the food for example one serving size of cooked rice and milk are 1/2 cup and 1 cup, respectively. We combined all the food items to ten food groups including: egg, red meat, poultry and fish, diary, legume, grain, fruits, vegetables, beverage and added sugar. This questionnaire was analyzed to determine energy and nutrient intake using Nutritionist four software based on the United States Department of Agriculture food composition that was adjusted for Iranian foods [20].

Statistical analysis

We applied SPSS software (version 19; SPSS Inc., Chicago, IL) for statistical analysis. Using data from BDI questionnaire, subjects were classified into four groups: normal, mild, moderate and severe depression. Frequency (%) and mean ± standard division (SD) were used to report the subject characteristics. Significant difference of quantitative and qualitative variables between the subjects with and without depression in both sexes was reported using Chi square, *U* Mann–Whitney, ANOVA and Kruskal–Wallis tests, respectively. 161 food items were

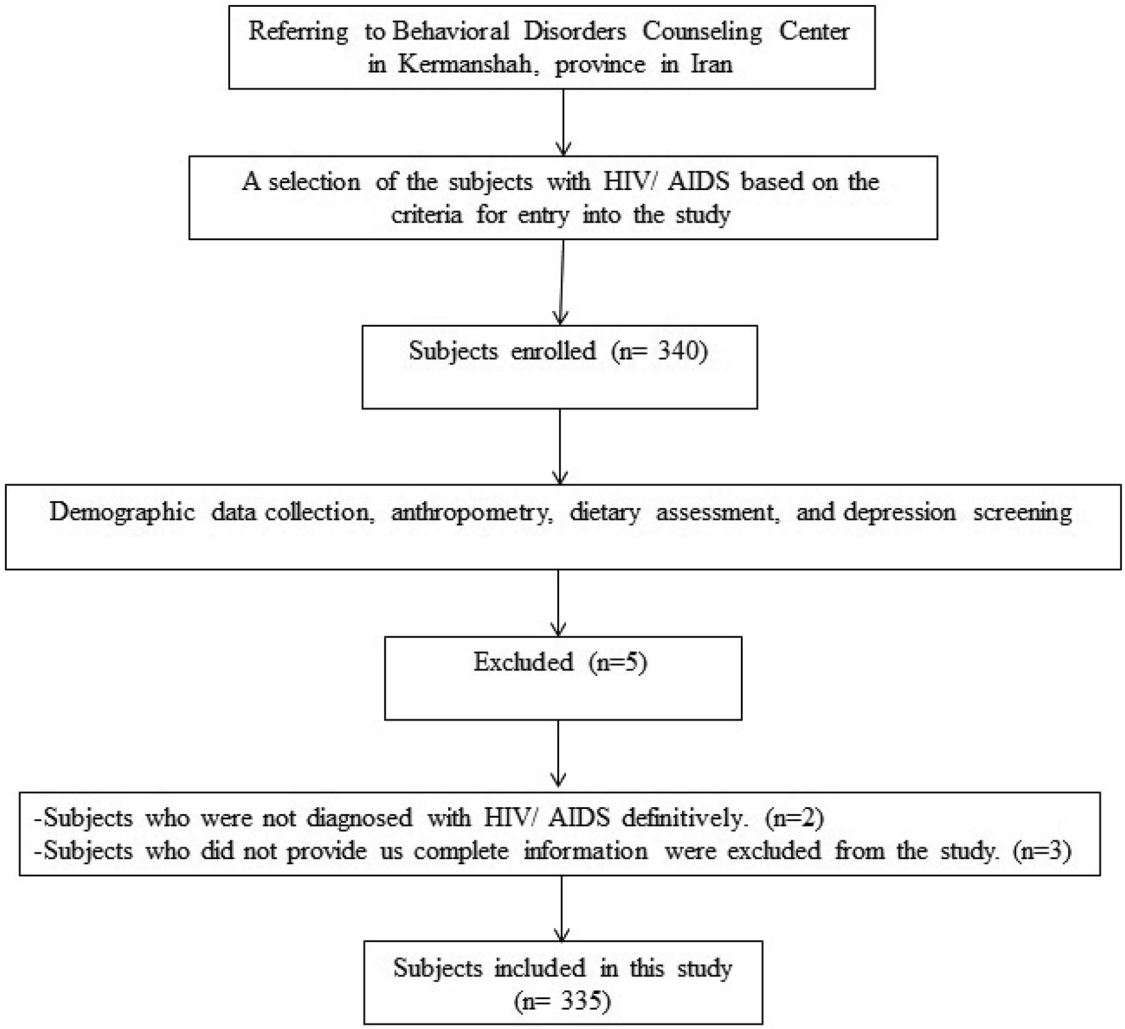

Fig. 1 Flowchart of the sample selection in this study

categorized to 10 food groups: egg, red meat, poultry and fish, diary, legume, grain, fruits, vegetables, beverage and added sugar. To determine significant difference of all dietary intakes including energy, micro- and macro-nutrients and mentioned food group intake between the subjects with and without depression, ANOVA and Kruskal–Wallis tests were used. Association between dietary intakes with risk of depression was analyzed by ordinal logistic regression in adjusted model. We controlled age (continuous), educational level (categorical), BMI (continuous), total met (continuous) and dietary intake in adjusted model. In all the analyses, we considered P value < 0.05 as significant level.

Results

In this study, 212 (63.3%) of the studied subjects were men and rest of them were women. 41.5% and 25% of the men had moderate and severe depression that were significantly higher than the women ($P = 0.007$) (Fig. 2). The mean of weight in men with depression was significantly lower than the men without depression ($P = 0.01$). Characteristics of studied subjects are presented in Table 1.

The mean of protein intake in the studied subjects decreased with increasing severity of depression in both

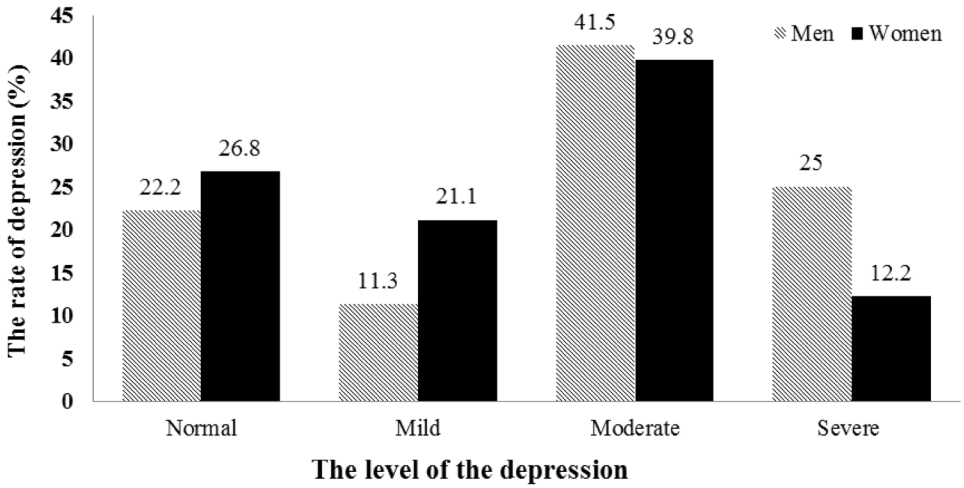

Fig. 2 The rate of depression categories among HIV/AIDS patients in both sexes

sexes (93.20 ± 31.87 g/day in the normal subjects and 69.46 ± 28.29 g/day in the subjects with severe depression, $P = 0.001$ in men, 85.28 ± 22.23 g/day in the normal subjects and 67.08 ± 38.96 in the subjects with severe depression, $P = 0.08$ in women). The mean of energy and other nutrient intake including protein, carbohydrates, fat, fiber, vitamin A, E, folate and calcium among subjects with and without depression are presented in Table 2. In addition, the mean of food group intake including egg, red meat, poultry and fish, diary, legume, grain, fruits, vegetables, beverage and added sugar among men and women with and without depression are presented in Table 2.

Our findings did not show any association between energy and nutrient intake and risk of depression in the adjusted model. Multiple-adjusted odds ratios and 95% confidence intervals for various categories of depression across energy and nutrient intake are presented in Table 3.

In terms of food group intake, higher adherence to legume and vegetables was associated with decreased risk of depression in men (OR 0.049, CI 95% 0.003–0.713 and OR 0.534, CI 95% 0.334–0.855, respectively). In addition, higher intake of diary in women was associated with lower risk of depression (OR 0.493, CI 95% 0.265–0.917) (Table 3).

We did not observe any association between intake of egg, red meat, poultry and fish, grain, fruits, beverage and added sugar and risk of depression in both sexes. Although we controlled age, educational status, BMI, PAL and other dietary intake, we did not observe any association between intake of these mentioned food groups and risk of depression in both sexes (Table 3). In addition, there was no a significant association between intake of diary and risk of depression in men (OR 0.793, CI 95% 0.507–1.239). We did not observe any association between intake of legume and vegetables and risk of depression in women (OR 0.317, CI 95% 0.003–36.531 and OR 0.864, CI 95% 0.590–1.266, respectively).

Discussion

This cross-sectional study was performed on HIV/AIDS subjects who were referred to Behavioral Disorders Counseling Center. We observed the higher intake of legume, vegetables and dairy products was associated with reduced risk of depression. To the best our knowledge, this is the first study which assesses the relationship between dietary intake and risk of depression among adults with HIV. After controlling for possible confounders, we also did not observe any association between intake of egg, red meat, poultry and fish, grain, fruits, beverage and added sugar and risk of depression.

This study showed that in the depressed men, weight and BMI were lower than the non-depressed men. In the women with depression, mean of weight was higher than the women without depression. In a study which was conducted on HIV-positive individuals with obesity, weight gain was one of the factors related to depression symptoms [21, 22]. Blashil et al. indicated that underweight subjects had higher levels of depression than their normal, overweight, and obese counterparts [23]. Previous findings proposed that weight and depression might have bidirectional relationship [22, 24, 25]. Therefore, it is theoretically possible that changes in weight are significantly related to the prevalence of depression in subjects with HIV. On the other hand, overweight may explain the association between the dietary intake of some food groups and inflammation which might be the reason for depression [26]. Therefore, it is likely that overweight is one possible pathway by which the dietary pattern is related with inflammation and risk of depression.

Another issue of possible concern in previous studies was the positive correlation between calorie intake and risk of depression among HIV subjects [27, 28]. Apart from that, increased energy expenditure is more prevalent in HIV subjects than healthy individuals [29], and in turn it is

Table 1 Characteristics of studied HIV/AIDS patients

Variables	Male				*P*	Female				*P*
	Normal	Mild	Moderate	Severe		Normal	Mild	Moderate	Severe	
Age (year), mean ± SD	38.60 ± 9.37	40.21 ± 8.52	39.27 ± 6.87	39.60 ± 7.03	0.999	35.24 ± 14.95	37.58 ± 7.53	38.20 ± 8.58	38.20 ± 7.65	0.582
Marital status, *n* (%)										
Married	25 (53.2)	13 (54.2)	38 (43.2)	15 (28.3)	0.048	14 (42.4)	14 (53.8)	28 (58.3)	8 (53.3)	0.568
Single	22 (46.8)	11 (45.8)	50 (56.8)	38 (71.7)		19 (57.6)	12 (46.2)	20 (41.7)	7 (46.7)	
Education, *n* (%)										
Illiterate	1 (2.1)	3 (12.5)	1 (1.1)	3 (5.7)	0.423	5 (15.2)	1 (3.8)	12 (24.5)	2 (13.3)	0.01
Under diploma	31 (66)	16 (66.7)	65 (73.9)	39 (73.6)		19 (57.6)	19 (73.2)	33 (67.3)	8 (53.3)	
Diploma and higher	15 (31.9)	5 (20.9)	22 (25)	11 (20.8)		9 (27.2)	6 (23)	4 (8.2)	5 (33.4)	
Weight (kg), mean ± SD	70.30 ± 17.10	65.06 ± 9.94	67.27 ± 10.72	65.49 ± 11.91	0.01	62.30 ± 16.68	68.90 ± 15.42	64.66 ± 13.24	63.50 ± 10.30	0.492
BMI* (kg/m^2), mean ± SD	23.63 ± 4.75	21.30 ± 2.92	22.07 ± 3.28	21.02 ± 3.74	0.089	24.40 ± 4.86	27.04 ± 5.59	25.01 ± 4.87	24.46 ± 3.54	0.703
PAL, *n* (%)										
Light	22 (46.8)	14 (58.4)	55 (62.5)	33 (62.5)	0.119	21 (63.6)	17 (65.4)	37 (75.5)	8 (53.3)	0.259
Moderate	17 (36.2)	5 (20.8)	26 (29.5)	18 (34)		12 (36.4)	7 (26.9)	10 (20.4)	7 (46.7)	
Intense	8 (17)	5 (20.8)	7 (8)	2 (3.8)		0 (14)	2 (7.7)	2 (4.1)	0 (14)	

P value was obtained from Chi square and Kruskal–Wallis tests

**BMI* body mass index, *PAL* physical activity level

Table 2 Difference of dietary intake between HIV/AIDS patients with various categories of depression in both sexes

Dietary intake	Male Normal	Mild	Moderate	Severe	*P*	Female Normal	Mild	Moderate	Severe	*P*
Energy intake (Kcal/day)	2431.43 ± 665.48	2500.67 ± 664.42	2240.80 ± 814.50	1910.24 ± 774.98	0.002	2417.76 ± 745.12	2195.42 ± 470.72	2134.66 ± 799.77	1796.23 ± 1029.48	0.073
Protein (% kcal)	15.22 ± 2.17	14.82 ± 1.79	14.87 ± 2.28	14.74 ± 2.77	0.768	14.38 ± 2.03	14.45 ± 1.48	13.91 ± 1.85	15.23 ± 2.24	0.125
Carbohydrates (% kcal)	48.13 ± 3.87	48.46 ± 3.31	48.28 ± 5.24	48.83 ± 5.73	0.898	48.05 ± 4.48	46.53 ± 4.73	47.98 ± 4.23	46.75 ± 5.85	0.47
Fat (% kcal)	36.06 ± 3.02	36.31 ± 2.49	36.22 ± 4.19	35.97 ± 5.63	0.983	36.91 ± 3.41	38.04 ± 4.33	37.04 ± 3.83	37.42 ± 4.81	0.702
Protein (g/day)	93.20 ± 31.87	91.92 ± 23.62	83.09 ± 32.05	69.46 ± 28.29	0.001	85.28 ± 22.23	79.34 ± 19.51	73.03 ± 25.65	67.08 ± 38.96	0.08
Carbohydrates (g/day)	289.90 ± 72.77	304.43 ± 89.34	269.01 ± 99.50	233.76 ± 97.26	0.004	292.83 ± 101.39	254.45 ± 55.81	254.10 ± 93.12	207.21 ± 120.29	0.032
Fat (g/day)	98.52 ± 32.52	100.73 ± 27.00	91.11 ± 36.68	76.41 ± 34.07	0.004	99.25 ± 33.28	93.28 ± 24.01	89.43 ± 39.44	76.81 ± 47.97	0.253
Fiber (g/day)	15.97 ± 4.31	17.17 ± 4.68	15.88 ± 5.60	13.39 ± 5.59	0.009	16.89 ± 4.89	16.68 ± 4.93	16.19 ± 5.31	13.96 ± 8.42	0.383
Vitamin A (μg/day)	791.46 ± 282.14	873.67 ± 293.55	790.41 ± 295.01	657.97 ± 288.40	0.005	825.25 ± 265.68	789.01 ± 201.83	749.50 ± 322.81	764.59 ± 660.24	0.301
Vitamin E (mg/day)	12.79 ± 8.49	18.91 ± 22.88	13.57 ± 16.78	10.76 ± 10.89	0.02	16.04 ± 15.54	12.52 ± 8.03	9.45 ± 6.62	9.65 ± 9.42	0.071
Folate (μg/day)	450.03 ± 315.17	429.35 ± 218.76	385.13 ± 202.63	328.18 ± 167.78	0.06	394.74 ± 192.89	385.06 ± 110.97	384.22 ± 312.60	287.84 ± 175.72	0.113
Calcium (mg/day)	3172.72 ± 941.06	3364.74 ± 979.68	3009.93 ± 1138.96	2488.13 ± 1011.91	0.001	3192.63 ± 936.06	3040.46 ± 802.49	2947.48 ± 1168.45	2470.89 ± 1557.23	0.127
Egg (serving/day)	0.66 ± 0.42	0.70 ± 0.43	0.77 ± 0.43	0.81 ± 0.48	0.374	0.72 ± 0.38	0.64 ± 0.43	0.70 ± 0.42	0.75 ± 0.55	0.729
Red meat (serving/day)	0.70 ± 0.84	0.61 ± 0.22	0.53 ± 0.42	0.44 ± 0.41	0.007	0.44 ± 0.20	0.54 ± 0.21	0.45 ± 0.26	0.35 ± 0.28	0.11
Poultry and fish (serving/day)	0.62 ± 0.35	0.55 ± 0.33	0.44 ± 0.36	0.54 ± 1.54	<0.001	0.51 ± 0.24	0.53 ± 0.52	0.36 ± 0.26	0.36 ± 0.42	0.027
Diary (serving/day)	2.24 ± 0.96	2.81 ± 1.01	2.19 ± 1.14	1.71 ± 1.24	0.001	2.62 ± 1.22	2.03 ± 1.01	1.74 ± 1.03	1.96 ± 2.48	0.001
Legume (serving/day)	0.22 ± 0.12	0.20 ± 0.12	0.16 ± 0.09	0.18 ± 0.12	0.058	0.21 ± 0.07	0.17 ± 0.1	0.17 ± 0.08	0.16 ± 0.11	0.046

Table 2 (continued)

Dietary intake	Male Normal	Mild	Moderate	Severe	*P*	Female Normal	Mild	Moderate	Severe	*P*
Grain (serving/day)	4.13 ± 0.89	3.89 ± .92	3.84 ± 1.18	3.51 ± 1.23	0.032	4.03 ± 1.14	3.74 ± 0.91	3.66 ± 1.08	3.05 ± 1.12	0.037
Fruits (serving/day)	0.99 ± 0.63	1.12 ± 0.51	0.82 ± 0.57	0.80 ± 0.67	0.019	1.07 ± 0.62	0.84 ± 0.55	0.83 ± 0.74	0.61 ± 0.68	0.024
Vegetables (serving/day)	2.22 ± 0.97	2.38 ± 0.94	2.25 ± 1.12	1.58 ± 0.87	<0.001	2.86 ± 1.88	2.67 ± 1.17	2.66 ± 1.13	2.24 ± 1.39	0.531
Beverage (serving/day)	3.73 ± 1.82	4.67 ± 2.00	4.00 ± 1.80	3.83 ± 2.01	0.198	2.93 ± 1.67	3.28 ± 1.92	3.28 ± 1.59	3.15 ± 1.69	0.922
Added sugar (serving/day)	4.74 ± 2.03	5.61 ± 2.67	4.84 ± 2.19	4.53 ± 2.33	0.272	4.10 ± 1.93	3.78 ± 2.14	3.80 ± 1.82	3.07 ± 1.33	0.405

All variables were presented as mean ± SD

**P* value was obtained from ANOVA and Kruskal–Wallis tests

associated with depression and fatigue [30]. Although our results were not showing any association between depression and calorie intake, it was observed that subjects with severe depression had lower daily energy intake compared to normal subjects and other degrees of depression.

Previous studies also explored the relationship between dietary intake and depression in many clinical settings [31, 32]. Diet could stimulate or inhibit chronic inflammation and some foods have played a key role in the progress of inflammation and depression [33]. For instance, red meat leads to inflammation, however, fish or long-chain omega-3 intake decreases inflammation and depression [34, 35]. Although it is not clear whether there is cause or effect relationship between inflammation and depression, it is totally accepted that inflammation plays a key role in the progress of depression. On the other hand, the anti-inflammatory and antioxidant capacity of dietary ingredients could improve this situation and may decrease the depressive symptoms among HIV subjects. Our findings suggest that higher intake of legume, vegetables and dairy products might have a beneficial effect on reducing the depression. On the other hand, those food groups contain some bioactive compounds with important anti-inflammatory and antioxidant properties [36]. The etiology of depression is manifold and includes several factors and many mechanisms. In fact, two main factors including oxidative stress and low-grade inflammation play main roles in the pathology of depression [37]. It seems that the relationship between dietary intakes and depression is mediated through the increase or decrease of inflammation and oxidative stress.

Previous cohort studies revealed that the risk of depression was inversely associated with fruit and vegetable consumption [5]. In our study, fruit and vegetable intakes which are the primary factors in antioxidant intake were lower in individuals with depression. In addition, we observed an inverse relationship between fruit consumption and lower risk of depression in men. Although our results did not show any association between depression and nutrient intakes, some previous studies revealed a positive relationship between nutrient intake and mental health [5, 38]. In this context, some nutrients such as vitamin C, B-vitamins and *n*-3 fatty acids have been revealed to be associated with the decreasing risk of depression. Therefore, the appropriate sources of antioxidants also include vegetable and fruit that may play a role in decreasing the risk of depression.

In addition to the nutrients mentioned above, some studies showed that folate and cobalamin intakes have link with the risk of depression [39, 40]. They are the main cause of single-carbon transfer methylation reactions that are connected with the syntheses of serotonin and other neurotransmitters. Folate and cobalamin deficiency additionally results in the accumulation of homocysteine which have also been suggested to aggravate depression [41]. In our study, there

Table 3 Multiple-adjusted odds ratios and 95% confidence intervals for depression across dietary intake in HIV patients in both sexes

Dietary intake	Men OR (CI 95%)*	*P* trend	Women OR (CI 95%)	*P* trend
Energy intake (Kcal/day)	0.993 (0.977–1.009)	0.395	0.988 (0.963–1.014)	0.364
Protein (g/day)	0.981 (0.919–1.048)	0.579	1.036 (0.900–1.192)	0.624
Carbohydrates (g/day)	1.024 (0.959–1.093)	0.486	1.041 (0.942–1.150)	0.431
Fat (g/day)	1.067 (0.917–1.241)	0.4	1.125 (0.898–1.411)	0.306
Fiber (g/day)	1.101 (0.943–1.286)	0.224	0.922 (0.760–1.118)	0.409
Vitamin A (µg/day)	1 (0.998–1.002)	0.953	1.001 (0.999–1.004)	0.321
Vitamin E (mg/day)	1.007 (0.983–1.031)	0.578	0.968 (0.918–1.021)	0.226
Folate (µg/day)	0.998 (0.996–1.001)	0.204	1 (0.997–1.003)	0.928
Calcium (mg/day)	1.002 (1.000–1.003)	0.03	1.001 (1.000–1.003)	0.152
Egg (serving/day)	1.697 (0.823–3.501)	0.152	0.474 (0.164–1.368)	0.167
Red meat (serving/day)	0.967 (0.456–2.050)	0.93	0.278 (0.020–3.836)	0.339
Poultry and fish (serving/day)	1.345 (0.862–2.099)	0.192	0.495 (0.084–2.915)	0.437
Diary (serving/day)	0.793 (0.507–1.239)	0.308	0.493 (0.265–0.917)	0.025
Legume (serving/day)	0.049 (0.003–0.713)	0.027	0.317 (0.003–36.531)	0.635
Grain (serving/day)	1.236 (0.827–1.848)	0.302	0.695 (0.388–1.247)	0.223
Fruits (serving/day)	0.832 (0.412–1.678)	0.607	1.233 (0.542–2.808)	0.618
Vegetables (serving/day)	0.534 (0.334–0.855)	0.009	0.864 (0.590–1.266)	0.455
Beverage (serving/day)	0.992 (0.750–1.311)	0.953	1.326 (0.974–1.806)	0.073
Added sugar (serving/day)	0.929 (0.730–1.183)	0.55	0.837 (0.624–1.122)	0.233

*Adjusted for age, educational status, body mass index (BMI), total metabolic equivalent of task (total met) and other dietary intake

was no relationship between the intake of the folate and depression in both genders. It is also possible that folate intake of the population in our study was too inadequate to reveal considerable beneficial effects.

Previous studies indicated that depression risk increased with higher intakes of beverage and added sugar [42]. In the current analysis, contrary to our expectation, we did not observe any relationship between high sugar intake (including sugar-sweetened beverages and added sugars) with depression. This might be explained by the fact that in our study, the energy intake of the subjects was balanced. Nevertheless, studies on the relationship between sugar consumption and depression risk have yielded inconsistent results [42–44]. On the other hands, some researchers believe that carbohydrate intakes might improve the mood of individuals or even relieve depression [43]. The intake of a high carbohydrate diet or glycemic index (GI) in the short term with rapid changes in serotonin levels might lead to a relief of some psychological symptoms. However, eating too much sugar may increase the risk of depression [44]. Sugar-sweetened beverages, added sugars and soft drinks have been associated with obesity and chronic inflammation, and can increase vulnerability to the development of depression.

There are several limitations to our study which should to be addressed. First, as it was a cross-sectional study, it is not clear whether the association of dietary intake and depression is cause or effect. Second, although we used self-reported BDI score to assess depression, the use of different tools and clinical examination to identify subjects with depression is preferred. Third, the study subjects were mainly the individuals with behavioral disorders who referred to the counseling center that was not fully representative of the Iranian population with HIV. Fourth, the FFQ was used for assessing the dietary intake over the past year in which recall bias may occur.

Several strengths of current study also deserve to be declared, such as its relative large sample size, the multiple adjustments of our estimates for potential confounders such as physical activity, educational status and BMI, and the highly interested subjects who were able to provide accurate information.

Conclusion

Regardless of these limitations, our study is unique in expanding the focus of association between dietary intake and the risk of depression in a large cross-sectional study of Iranian subjects. The results suggest that consumption of legume, vegetables and diary may protect against the onset of depressive symptoms, whereas a diet rich in egg, red meat, poultry and fish, grain, fruits, beverage and added sugar was not associated with risk of the depression. In

addition, we found that the men who developed depression reported reduced total calorie intake and reductions in intake of some nutrients. As we know, these changes in dietary intake have been associated with depression symptoms in HIV subjects. Further evidence from well-designed studies is necessary to approve or rebut the association between dietary intakes and depressive symptoms in subjects with HIV.

Our findings also propose two main implications for clinician. First, patients with depression may tend to take less calorie intake. Second, physicians should carefully monitor depressed subjects' nutrient intakes, weight, and provide supplementation when weight loss is detected. Hence, efforts to increase dietary diversity should be considered as a potential target for the prevention of depressive symptoms in subjects with HIV.

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Compliance with ethical standards

Data availability Data will be available upon request from the corresponding author.

Conflict of interest statement The authors have no conflict of interest to disclose.

Ethical approval This study was approved by Research Council of Kermanshah University of Medical Sciences (No: KUMS.REC.1393.117). All the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Written informed consent was obtained from each studied subjects after explaining the purpose of the study. We read the informed consent for illiterate subjects and obtained their fingerprints. The right of subjects to withdraw from the study at any time and subject information is reserved and will not be published.

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