



Review Article

The study of the relationship between diet and depression in adults

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Abstract

Introduction: Depression is a kind of common mental disorder and nutrition has a role in its prevention and treatment. In previous studies, a relationship was found between depression and intake of some nutrients and food but the results were contradictory and the reason of these contradictions was ignoring the diet. The purpose of this review study is to determine the relationship between the diet and depression.

Materials and Methods: By using the keywords (depression OR anxiety) AND (diet OR nutrition OR food) AND (pattern OR habit OR behavior in databases of (SID, Science Direct, PubMed, Scopus Elsevier). the number of 352 articles were obtained. After removing the repeated and unrelated articles, 19 articles that were published in the time period of 2009-2015 entered the study.

Results: From the all found studies, 4 studies were cross-sectional, 11 studies were cohort and 3 studies were case-control. In all these studies, diet was tested by food frequency questionnaire, 24 hour recall and food record. Also, depression was tested by CES-D (Centre For Epidemiologic Depression Scale) or diagnosis of doctors. In general, 2 types of diet were identified: healthy diet and unhealthy diet. Healthy diet is significantly associated with the reduction of depression while there was no relationship between unhealthy diet and depression.

Conclusion: The findings suggest that the receiving lots of fruit, vegetable, fish and cereal maybe associated with the reduction of depression. Although it seems that more accurate control and cohort studies are needed to confirm these findings.

Keywords: Depression, Diets, Food groups

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Introduction

Depression is one of the most common psychiatric recognitions. Thus according to the world health organization, depression will have the 4th place among the diseases in 2020 according to the load that it will impose to the society. In our country, it is considered among 7 reasons of diseases and inability at different ages (1-3). According to the national study of disease and damages in Iran, depression is the third health problem in the country (4,5).

The reasons of this disease are: inheritance, chemical changes of brain, losing parents at the childhood, adverse events of life, psychodynamic factors, different physical diseases, using some medicines and malnutrition. Also diet can be effective in the incidence of depression (6,7). Drug treatment for depression is successful at 60-80%. In general less than 25% of depressed patients receive

medicine. Due to the weak treatment in patients and probability of recurrence after recovery, paying attention to other factors like nutrition seems necessary to prevent and treat depression (8).

Nutritional factors have an important role in the incidence of depression. On the other hand, the people with depression often have inappropriate nutrition and thus are the exposure of risk. Inappropriate nutrition can be significantly effective in the prevalence, intensity, and duration of depression (9). Most studies have shown the relationship between a nutrient and depression. For example, the intake of vitamin D, Zink, and vitamin B9 is effective in the treatment of depression in adults (2-7, 10-14).

There are some disadvantage in previous studies that examined the relationship of only one nutrient or a kind of food and depression. First, a nutrient is not used alone by the person, but is used in the form of a food composition. Second: the effect of a nutrient alone is very low and the measurement of its effect is a complex work. While the measurement of the

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effects of a set of nutrients that are diet of the person is easier. Third, the intake of a nutrient is certainly related to the diet of the person. Fourth, the study of the relationship between a specific nutrient and depression is problematic because there is the probability of synergic effect or interventions in the diet.

Thus, according to the importance of depression and its high prevalence in the society and according to the few studies on the relationship between diet and depression, the present study was aimed at the conclusion of the studies, results, finding answers to the current questions and achieving the general results to predict depression.

Materials and Methods

As figure 1 shows, 352 articles were obtained in English databases of science Direct, PubMed, Scopus Elsevier and Persian databases of SID, Medlib and Magi ran in order to find the related source for this review study. To search in English websites, the following keywords and operators were used: (Depression OR anxiety) AND (diet OR nutrition OR food) AND (pattern OR habit OR behavior)

Persian databases were also searched by the keywords: depression, diet, food groups, fruit, vegetable, dairy products, fat, meat and cereal.

The input criteria to this review study include: 1. Human studies that were done as cross sectional, case control and cohort. 2. The studies that considered the total diet of participants. 3. The studies that used the methods like 24 hour recall, food record, and food frequency questionnaire to assess the diet. 4. The studies that were done on people aged above 18 and the patients were not hospitalized. The output criteria of the review study include: the studies on people with mental diseases. 2. The studies that measured the effect of one nutrient with depression and did not consider the total diet. 3. The studies on a specific population with different nutritional needs that were not the agent of the total population. (like pregnant women, lactating women, and adults). 4. The studies on a population with underlying disease that the disease could be a confounder to cause depression (like fatness, blood pressure and hypercholesterolemia). Also, the clinical trial articles, studies in languages other than English and Persian, animal, cellular, molecular and review studies were excluded.

Results

By searching the databases and other references, 352 articles were indentified. By removing 119

repeated articles and some animal and unrelated studies, 70 studies were selected. Finally, 19 studies with full text that were published in 2009-2015 were included in the study (Fig 1).

In 3 studies, the participants were only women (15-17) and in 7 studies the participants were men and women (18-24) in 8 studies, the gender of participants were not considered (1,25-32). The food groups evaluated in these studies are almost similar and include bread and cereal, fruit and vegetable, meat, dairy products and fat. In the found studies, FFQ was used in 15 studies to evaluate diet and the number of food items was 18 to 168. Three studies used food record to evaluate FFQ (18,24,25) and 3 studies used Brief Self-administered Diet Questionnaire (BDHQ) (19,24,33) In a study, FFQ was used with a 24 hour recall at the beginning of the study and a 24 hour recall was used 3 to 7 days after the beginning of the study (27) in some studies, doctors and CES-D questionnaire were used.

The relationship using food groups and the risk of depression

The study of Nanri et al. in Japan showed that Japanese diet that included the high use of fruit and vegetable, mushroom and soy products was associated with the reduction of depression symptoms (18). Noghuchi et al. in 2012 observed that the mental symptoms of depression in men are associated with the insufficient intake of vegetable and fish while the physical symptoms of depression are associated with the insufficient intake of meat (19).

Dipnall et al. in 2014 found a direct relationship between sweet diet and depression. In other words, the diet full of carbohydrate increases the probability of diabetes and depression (24). In 2013, Rashidkhani et al. suggested a study that the diet full of fish, poultry, low fat and full fat dairy products, coffee, fruit, nuts, juice, vegetables, beans, olive and drinks had a significant relationship with less chance of suffering from depression in women (15). In 2015, a study by Corinna et al. showed that the healthy people in the control group used more fruit and chocolate, cake, pasta and also had a lower use of meat and poultry (25). Rienks et al. in 2010 showed that the high intake of foods including Omega 3 like fish, olive and vegetable in Mediterranean diet with the decrease of suffering from depression (17), Sanchez et al. showed that high intake of fish and olive with nuts reduces depression to 20-30% (14). Akiko et al. in a study showed that the use of fruit, vegetable, fish and olive is associated with depression and probability of suicide (22). LePort et al. in a cohort study

showed that low fat diets including fruit, vegetable and fish is associated with the reduction of depression in men and women (23).

Discussion

Most studied diets in the collected studies included fruit, vegetable and cereal and we considered them as healthy diet due to the similarity of these diets. In general, in this review study, 2 types of diet were identified: 1. Healthy diet. 2. Unhealthy diet. According to the studies there is a relationship between healthy diet and the chance of depression while there was no relationship between unhealthy diet and depression. The lack of a relationship between depression and unhealthy diet may be attributed to the number of studies in the field of the relationship between unhealthy diet and depression. Healthy diet is based on food guidelines and is full of fruit, vegetable, cereal, poultry, fish and low fat dairy products. Most review studies believe that this diet has reduced the death due to many diseases.

Several basic mechanisms are proposed in this regard. The emphasis on table 2 shows that the Mediterranean diet has a reverse effect on the occurrence of depression symptoms. Also in the study of Ibarra et al. the study sample was small (77 subjects) and also the duration of the study sample was 6 months that was short in comparison to other studies. In the study of Norio et al, all participants were volunteers and because they were interested in participation in the program, they had good conditions in terms of health. Thus, there is sampling error in this study. 4 main mechanisms of reducing the probability of depression by healthy diet: 1. Healthy diet includes tryptophan (precursor of serotonin). 2. Diet full of Omega 3 and Omega 6 compounds that both have a role in anti-inflammatory pathways. 3. Healthy diet includes Folic acid (depression is related to the low level of Folic acid). 4. The increase of Homocysteine in the body that is associated with the increase of Methionine. So that Adenosyl methionine – s has a fundamental role in Neurotransmitters.

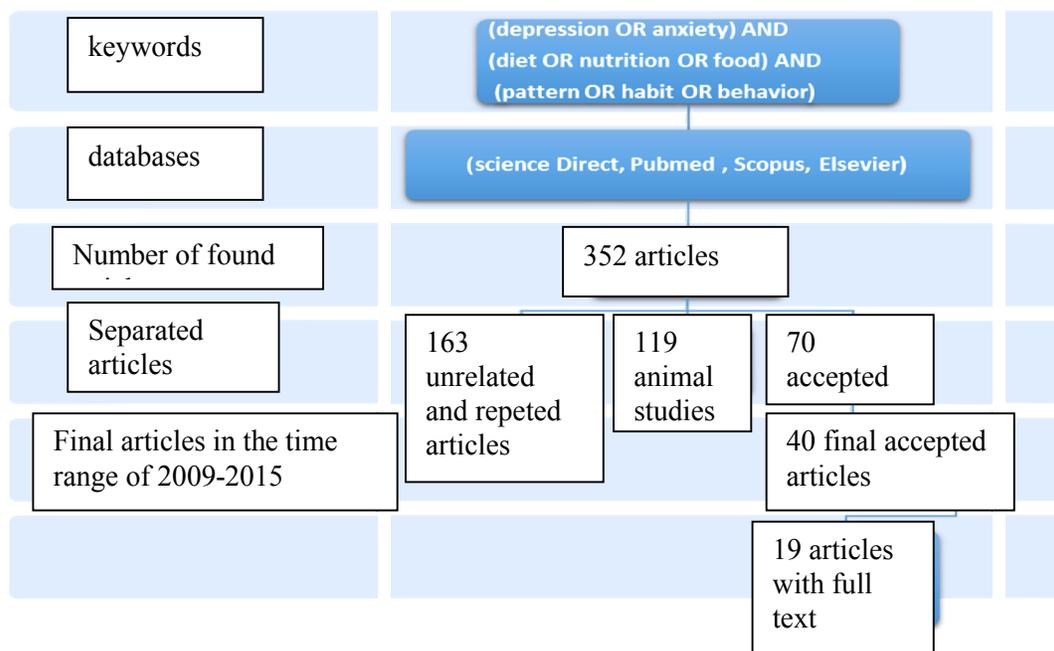


Figure 1. The flowchart of the search and study of review articles

Table 1. Studies of depression and diet

Findings	The type of diet recognized in the study	Study design	Sample size	Study title	Author (Year) (type of study) (Country)
In this study no significant relationship was found to increase the risk or reduce the risk of depression and its	- Healthy - western - Bread and pastries - diet with alcohol	BDHQ) 52 food groups +food record 16 for 16 days 92 women , 92 men	N=971 303 men 488 women Age 22-86	"No association between dietary patterns and depressive symptoms among a community-dwelling population in Japan"	Sugawara N, et al. 2012 Cross sectional Japan

<p>symptoms by removing or not removing the Confounders</p> <p>Healthy diet: vegetables, seaweed, tofu, fruit, fish</p> <p>Western diet: high intake of beef and pork, procedures, mayonnaise, desserts, ice cream, bread, spaghetti and macaroni</p> <p>Bread and pastry diet: high intake of bread and pastries and low intake of vegetables</p> <p>Diet with lcohol: noodles, and octopus, shrimp, snails, as well as alcoholic beverages</p>					
<p>Healthy Diet</p> <p>Has a significant relationship with the decrease of depression. (OR=0.16 CI=0.06-0.44,p=0.00)</p>	<p>- Healthy - Unhealthy</p>	<p>Semiquantitative (FFQ)</p> <p>Includes 125 food and drink</p>	<p>N=135 45 Women with major depression 90 women without mental health problems Age: 45-25</p>	<p>"Dietary patterns and anthropometric indices among Iranian women with major depressive disorder"</p>	<p>Rashidkhani B, et.al. 2013</p> <p>Case control</p> <p>Iran</p>
<p>No significant difference was found between nutritional quality of the depressed and control subjects.</p>	<p>This study focuses on diet quality and has not detected a pattern.</p>	<p>With 18 food items (FFQ) + food record on 7 days</p>	<p>N = 1660 840 depressed 820 healthy people</p>	<p>"Associations between depression subtypes, depression severity and diet quality: cross-sectional findings from the BiDirect Study"</p>	<p>Rahe C, et.al. 2015</p> <p>Case control Cohort</p> <p>Germany</p>
<p>Low-fat diet (P <0.01), Western (P <0.001), and snacks (P <0.001), with fat and high sweet (P <0.001) in men and low-fat diet (P <0.01),(snack diet (P <0.001) in women are more associated with depression symptoms.</p>	<p>Low-fat diet Western diet Snack diet Fat diet with sweets traditional diet Healthy diet</p>	<p>With 35 food items (FFQ)</p>	<p>N=12404 Men=9272 Women=3132</p> <p>Age 60-45 years</p>	<p>"Association between Dietary Patterns and Depressive Symptoms Over Time: A 10-Year Follow-Up</p>	<p>Agne's Le Portl*, et.al. 2012</p> <p>Cohort</p> <p>France</p>
<p>Vegetarian diet and fish products have a reverse relationship with physical symptoms (P <0.05) and mental depression (P <0.01) in men. In Western and fish diets no significant association of dietary patterns and depression was found.</p>	<p>Vegetarian diet + fish products Fish diet Western diet and meat</p>	<p>BDHD) With 59 items of food and drink</p>	<p>N=166 Men=104 Women=62</p>	<p>"Relationship between dietary patterns and depressive symptoms: Difference by gender, and unipolar and bipolar depression"</p>	<p>Noguchi, R. et.al. 2013</p> <p>Cross sectional</p> <p>Japan</p>
<p>Healthy diet is significantly related to reducing the risk of depression (OR: 0.84; 95% CI: 0.76, 0.92; P <0.001). There was no Significant correlation between the Western diet and depression. (OR: 1.17; 95% CI: 0.97, 1.68; P = 0.094)</p> <p>Increased intake of vegetables, fish, whole grains, and fruits may be associated with reduced risk of depression.</p>	<p>-Healthy diet Western diet</p>	<p>(FFQ)</p>	<p>From 6 Social Networks, 21 Articles by 2013 were extracted and the results were extracted from 13 articles</p>	<p>"A systematic review and meta-analysis of dietary patterns and depression in community-dwelling adults"</p>	<p>Lai, J. S. et.al. 2015</p> <p>Reviews study</p>
<p>Healthy Japanese diet of vegetables, fruits, mushrooms and soy is associated with reduced depressive symptoms). P trend = 0.006)</p>	<p>Japanese healthy diet Animal diet Western breakfast diet</p>	<p>(BDHD) With 52 food and drink + 16- day food record for 92 women and 92 men</p>	<p>N=521 men=309 women =212</p>	<p>"Dietary patterns and depressive symptoms among Japanese men and women"</p>	<p>Nanri, A. et.al. 2010</p> <p>Japan</p> <p>Cross sectional</p>

-Animal diet: Get fish, shellfish, meat, processed meat, mayonnaise and eggs

Western diet: bread, pastries, milk or yogurt, mayonnaise and eggs, and get a little bit of rice, fish, alcohol

Japanese healthy diet: intake of vegetables, fruit, soybeans, mushrooms

<p>A Case-control study alone cannot determine definite relationship between diet and depression. It can only describe the difference in diet of depressed and healthy people.</p>		(FFQ) 168 items	N=330 Case group =110 Control group =220	"Comparing dietary patterns of depressed patients versus healthy people"	Khosravi M. et.al. 2014 Case control Iran
<p>Healthy diet is related to the reduction of depression in healthy people OR0.68,95% CI [0.52,0.88], p = 0.006) And in patients with type 2 diabetes.) OR0.79,95% CI [0.64,0.97], p = 0.029)</p>	<p>Healthy diet Unhealthy diet Sweet diet Mexican diet Breakfast diet</p>	<p>FFQ 25 items Initially a food recall was taken by dietitian and 3 to 10 days later another phone call was made.</p>	<p>N=4588 All participants are depressed and some have diabetes.</p>	<p>"The association between dietary patterns, diabetes and depression"</p>	<p>Joanna F. Dipnall. et.al. 2015 Cross sectional Australia</p>
<p>Healthy diet: leaves and lettuce, fruit, cooked cereal, breads made with whole grains Unhealthy diet: eating fried potatoes, cheese, meat, procedures, pizza, soft drinks Sweet diet: eating cookies, cakes, chocolate, candy, ice cream, sugary foods Mexican diet include beans, tomatoes, tomato sauce Breakfast diet: cold or hot breakfast and milk</p>					
<p>Inflammatory dietary pattern is associated with a higher risk of depression, this suggest that chronic inflammation may be the link between diet and depression. RR Inflammatory regime in depression explicit definition 1.41 (95% confidence interval [CI], 1.22, 1.63; P-trend <.001) And RR Inflammatory regime in depression broad definition 1.29 (95% CI, 1.18, 1.41; P-trend <.001) were reported.</p>		Inflammatory Diet	FFQ Questionnaire were filled out by people for 6 times during 18 years. In this study three inflammatory factors were assessed for 4692 participants.	N=43685 All the participants were women, and did not have a history of depression in the beginning of the study.	"Inflammatory dietary pattern and risk of depression among women" Walter C. Willett et.al. 2013 18-year- cohort Canada and Germany
<p>People with a history of depression were reluctant to eat healthy food Western diet was associated with non-current depression. In general, the study of the relationship between short-term and long-term depression and does not indicate the diet.</p>		Western diet Healthy diet	(FFQ)	J = 3668 343 = depressed now 1571 = depression 273 = with a high probability of depression	"Does reverse causality explain the relationship between diet and depression?" Jacka F, et.al 2015 Cohort Australia
<p>- Communication between the Western diet and depression compared to 15 per cent. But by taking confounding physical activity is not significant. (Between dietary patterns and depression are markers of inflammatory group of women with Western diet was associated with depression, end of life) (P = 0.06)</p>		Rich diet Western diet	(FFQ) 61 items Every 4 years, 161 items (FFQ)	N=2052	"Prospective study on long-term dietary patterns and incident depression in middle-aged and older Chocano PO, et.al 2013 Cohort 12 years USA

				women"	
Selenium levels were associated with depression before study (R = -0.233 and p = 0.041) Depressed people tend to deteriorate the quality of their life is seen in the group with lower activity on depression was not confirmed.	Groups: a healthy diet, physical activity and regular sleep. Control: no matter what, enjoy live	(FFQ) 21 items	N=77 over 18 years	"The Mediterranean Diet and micronutrient levels in depressive patients"	Ibarra O, et.al 2014 Case control Spain
Diet 3 with depression was statistically significant inverse relationship. (Odds ratio = 0.66 [0.51-0.86], trend P = 0.002) But the relationship between diet 1 and 2 with depress	Fish diet Western diet Japanese diet	(FFQ) 56 items	N = 241 women N = 2025 men	"Japanese dietary pattern consistently relates to low depressive symptoms"	Suzuki T, et.al 2013 Cohort Japan
Depression is a prudent diet that reduces suicide preconditions: hazard ratio 0.46 (95% CI 0.28-0.75,, P trend = 0.005) Western diet and Japanese diet not associated with suicide risk of suicide.	Prudential diet Western diet Japanese diet	(FFQ) 137 food items and 27 items Beverages	N=101630 men=47408 women=54222	"Dietary patterns and suicide in Japanese adults: the Japan Public Health Center-based Prospective Study"	Nanri A, et.al. 2013 Cohort Japan
Diet 1: 20-30% reduction in depression than the low-fat diet Despite this evidence that the Mediterranean diet reduces depression and when diabetics were analyzed but not significant statistically significant (P = 0.04.)Note: There walnuts in the diet and other physiological factors such as serotonin 1 as a source of inflammatory factors may be involved in this conclusion olive anti-inflammatory(- Mediterranean diet + olive oil - Low-fat diet (control)	(FFQ) 47 items	N=9324	"Mediterranean dietary pattern and depression: the PREDIMED randomized trial"	Almudena. et.al. 2013 Cohort 3 years Spain
Diet 1 prevents the beginning of depression until the next 5 years, Diet 1: contains antioxidants and folic acid, and Adenosyl . (OR = 0.74, 95% CI 0.56-0.99, P trend = 0.04) Diet 2 is harmful for depression: the need to study in the future:()OR = 1.58, 95% CI 1.11-2.23, P trend = 0.01)	Fruit, vegetable, fish diet Chocolate, candy, meat and high-fat diet	(FFQ) 27 items	N=3486 906women 2579 men	"Dietary pattern and depressive symptoms in middle age"	Tasnim N. et.al. 2009 Cohort Britain
Mediterranean diet had the lowest prevalence of depression) Odds ratio 0.82 (95% ci 0.77-0.88, P value <0.0001 There is a direct relationship between meat consumption and depression Mediterranean mechanism: 1. serotonin 2. Omega-3 3. Omega 6 4. Homocysteine Folic acid 5	Regime: -Vegetable -Fruit Mediterranean -Meat -dairy -Fat and sugar	(FFQ) 101 items	N = 4000 In 3 age groups 18-23 45-54 70-75	"Mediterranean dietary pattern and prevalence and incidence of depressive symptoms in mid-aged women"	Rienks et.al. 2013 Cohort 4 years Australia
The relationship between fast food consumption and depression were observed (P trend = 0.003. This effect was attributed to the consumption of trans fatty acids	Consumption of Sausages , burgers and donuts and pizza	Semi-quantitative (FFQ) (136 items	N=8964	"Fast-food and commercial baked goods consumption and the risk of depression"	Center for health sciences(Spain) 2011 cohort

Table 2. The relationship between healthy diet and depression

The inverse relationship between healthy diet and depression	Study type	Author name
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-	Cross sectional	Sugawara N
+	Case control	Rashidkhani B, et.al
+	Cohort	Rienks J, et.al
+	Cohort	LePort A, et.al.
+	Cohort	Tasnim N, et.al.
+	Review study	Lai JS, et.al.
+	Cross sectional	Nanri A, et.al.
-	Cohort	Almudena, et.al
+	Cross sectional	Dipnall JF, et.al
-	Case control	Ibarra O,et.al
+	Cohort	Suzuki T,et.al

Table 3. The relationship between unhealthy diet and depression

The relationship between unhealthy diet and depression	Study type	Author name
-	Cross sectional	Sugawara N
+	Cohort	Center for health sciences
-	Cohort	Rienks J, et.al
-	Cohort	LePort A, et.al.
-	Cohort	Tasnim N, et.al.
-	Review study	Lai JS, et.al.
-	Cohort	Nanri A, et.al.
-	Cohort	Suzuki T, et al.
-	Cohort	Jacka F, et al.
+	Cohort	Willett WC, et al.

+: there is a relationship

- : there is not a relationship

According to table 3 and different results of studies on the relationship between unhealthy diet and depression, finding a definitive response is a difficult task. However, here is the study of some proposed mechanisms to show the relationship between unhealthy diet and depression.

Inflammation is associated with the increase of a variety of Cytokines and this increase leads to some consequences like: transformation of Neurotransmitters, change of performance in Neuroendocrines and the change in the form of Synapses and they lead to some symptoms like: stress, nervous symptoms, lack of feelings.

In this regard, the most important mechanism is the performance of inflammatory mediators released from Macrophages. Microglia at the time of disease or injury begin the production of Cytokines like IL1, IL2, TNF and etc. These factors stimulate the tryptophan pathway to Kynurenic acid (Antagonist of N-methyl D-aspartic acid) and kyolinic acid (Agonists N-methyl D-aspartic acid) by IDO. Finally, the level of tryptophan decreases and according to the mentioned mechanism, the level of Serotonin also decreases. In addition, the increase of the level of Linoleic acid and its accumulation in the cell causes the death of cell.

Limitations

It should be noted that most articles in this review study did not evaluate the reason. In these studies, it is not certain whether the weak diet causes and develops depression or depression causes the intake of weak diet. However, most studies showed that depressed people go on full fat diets and carbohydrates to cure depression and reduce their symptoms. It should be noted that there is a wide range of their symptoms. It should be noted that there is a wide range of evaluation in relation to diet and depression. (Evaluation tool like FFQ, diet history questionnaire and 24 hour recall). For the epidemiological studies of nutrition, the probability of measuring errors in diet is always considered. There effects may have an effect on the identification of diets. FFQ measures the intake of foods in the long term but its error is large due to the dependence on memory and different understandings of people. Similarly, different methods are used in studies to evaluate depression (like structured clinical interview, information of the person in recognition of the previous depression or consumption of antidepressants, depression assessment questionnaire) that can create error in conclusion. in the present study, according to the observation studies that always indicate the probability of the presence of interferer, two aspects are considered. At the first step, the relationship between diet and depression can be due to the effect of diet on the development of progress. On the other hand, depression may lead to the decrease of quality in diet. Accordingly, cause and effect cannot be clearly separated. This is a limitation for cross sectional studies and must be considered at the time of interpretation. At the second step, the problem of Confounders has remained. Most studies are done by removing the Confounders but their effect has not been removed completely. (or were not measured or were measured inappropriately or the interferers were not identified completely. The previous studies that were done on the relation between diet and depression did not distinguish a variety of depression. (For example Atypical depression or Melancholic depression). Future studies must distinguish between the evaluation and analysis of a variety of depression. In short, the available references show the relationship between diets and depression, it seems that healthy and Mediterranean diets are associated with the reduction of depression while unhealthy diets may be related to a higher level of depression. But according to the main differences in the study features, there is not certain conclusion of high level of heterogeneity and some limitations of

methodology in studies.

To clarify the relationship between diet and depression, more studies are needed especially through the futuristic studies.

Conclusion

Healthy diet prevents the incidence of depression symptoms to a higher extent. But the effect of unhealthy diet on depression is not certain yet.

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