

Association of Indo-Mediterranean neuroprotective diet (MIND) pattern score, with depression, in an urban population of North India. The Indian MIND study

Abstract

Background: Psychological disorders such as anxiety and depression have become a public health problem due to urbanization and industrialization and associated changes in behavioural risk factors; western type diet, sleep disorders, stressful lifestyle, alcoholism, tobacco, and sedentary behaviour. Western diet appears to be a risk factor of depression because it is associated with chronic neuro-inflammation, whereas Indo-Mediterranean dietary patterns may be neuroprotective. This study aims to determine the association of Indo-Mediterranean Neuroprotective dietary (MIND) pattern with risk of depression.

Study design and setting: Cross-sectional survey in a hospital.

Subjects and methods: After written informed consent and approval from hospital ethic committee, all subjects (n=2002) above 25 years of age (1016 males and 986 females) were randomly selected and recruited from urban population of Moradabad, North India. Clinical data and risk factors were recorded with the help of case record form and validated questionnaires. Assessment of depression was made by the modified depression rating scale. Subjects were classified in to possible depression and depression by assessment of depressive symptoms. The association of depression with dietary factors was calculated by multivariate logistic regression analysis after adjustment of age, sex and body mass index.

Results: The overall prevalence of depression was 6.84% (n=137). The prevalence was significantly lower among men, compared to women (6.10% vs 7.61%, n=62 vs 75, P<0.02), respectively, and the risk increased with increase in age in both genders. Multivariate logistic regression analysis, after adjustment of age and body mass index, showed that fruit, vegetable and nuts intake were significantly and strongly but inversely associated with depression among both men, Odds ratio and 95 % confidence interval of difference; (0.76, (95% CI 0.70-0.86, P<0.001) as well as in women, Odds ratio and 95% confidence interval; (0.78, 95% CI 0.72-0.86, P<0.001), MIND diet score >24 was also inversely associated with depression among both men (0.89, 95% CI, 0.81-0.99, P,0.01) and women (0.87, 95% CI 0.80-0.97, P<0.01). Total western type food intake revealed positive association among both men (0.78, (95% CI 0.69-0.87, P, 0.001) and women (0.79, 95% CI 0.74-0.88, P<0.001). The intake of meat and eggs also showed modest positive association with depression, in men (0.89, (95% CI 0.76-1.01, P<0.05) but not among women. Sedentary behavior was significantly associated with depression among both men (0.88, 95% CI 0.77-1.00, P<0.05) and women (0.93, 95%CI 0.71-1.03, P<0.05). Tobacco intake showed significant modest association with depression among men 0.94, (95% CI 0.81-1.07, P<0.05) as well as in women (0.92, 95% CI 0.80-1.04, P<0.05), but alcoholism showed no such association among women showing, wider confidence interval; OD 0.90, (95% CI 0.74-1.09).

Conclusion: The prevalence of possible depression and depression have become public health problems in India. The intake of prudent foods, in particular fruits, vegetables, whole grains, and nuts mustard oil showed inverse association with depression whereas increased intake of Western type foods may increase the risk of depression. It is possible that increased intake of Indo-Mediterranean type foods (MIND), and decrease in western type foods, physical activity and cessation of tobacco and alcoholism can protect against depression.

Keywords: healthy diet, functional foods, inflammation, antioxidants in the diet

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Introduction

Depression is a leading cause of disability around the world and contributes greatly to the global burden of disease.¹⁻⁴ The effects of depression can be long-lasting or recurrent and can dramatically affect a person's ability to function and live a rewarding life.¹ Depression is a

common illness worldwide, with an estimated 3.8% of the population affected, including 5.0% among adults and 5.7% among adults older than 60 years.^{1,2} Approximately 280 million people in the world have depression, more common in women than men.² According to a new analysis, mental disorders have gone up 48 per cent worldwide in the

three decades since 1990.² Depressive and anxiety disorders remained among the top 10 contributors to the global disease burden in this period, the report showed. In 1990, an estimated 654.8 million cases of mental health disorders were recorded, which increased to 970.1 million cases in 2019, the Global Burden of Diseases (GBD) 2019 showed.²

Depression can lead to suicide, which is 4th important cause of death. There is effective treatment for mild, moderate, and severe depression. However, despite existing, effective treatments for mental disorders, more than 75% of people in low- and middle-income countries receive no treatment.⁴ Barriers to effective care include a lack of resources, and social stigma associated with mental disorders. It seems, the most important cause for delay in treatment is lack of trained health-care providers, who can diagnose depressive disorders in early stage of illness. In countries of all income levels, people who experience depression are often not correctly diagnosed, and others who do not have the disorder are too often misdiagnosed and prescribed drug therapy by antidepressants.¹⁻⁴ It seems that early identification of the contributing factors of depression is crucial for early diagnosis of depression. Therefore, there is an unmet need to find out behavioral risk factors of depression that can be identified at early stage, at beginning of the depressive disorder.

Since depression results from a complex interaction of social, psychological, and biological factors among subjects who have gone through adverse life events (unemployment, bereavement, traumatic events) are more likely to develop depression.¹⁻³ Depression can, in turn, lead to more stress and dysfunction and worsen the affected person's life situation.¹⁻³ It is possible that eating western diet, alcoholism, continuous mental stress, anxiety, sedentary behavior, short sleep and late night sleep are behavioral risk factors of depression.⁵⁻¹² Evaluation of these risk factors in early stage of the disease could be useful in the early diagnosis and prevention of depression. This study aims to find out the inverse association of Indo-Mediterranean Neuroprotective Diet (MIND) scores with risk of depression.

Subjects and methods

This epidemiological study was conducted after clearance from the ethic committee and written informed consent from the patients. The study included randomly selected 20 streets from the urban area of the city of Moradabad as reported earlier.¹³ In each street, subjects were randomly selected, with an aim of choosing, 40-100 adults, aged 25 years and above from each block, based on voter's list. If the random number fell to a subject, who was <25yrs or not available, it was assigned to next person in the list. In this examination, we contacted 2422 urban subjects aged 25 years and above, of which 220 (9.08%) refused to participate and rest 2002 (1016 men and 986 women) gave their consent to be included in the study.

The investigators performed detailed interviews, with the help of pretested and validated questionnaires, for assessment of clinical data based on guidelines of WHO and Indian Council of Medical Research. All the subjects were evaluated by a dietitian and physician administered questionnaire, and a physical examination. The criteria for sedentary behaviour were; walking <14.5 Km a week, or climbing <20 flights of stairs a week, during household or occupational activities or in presence of moderately vigorous spare time physical activity on five days a week. In Indians, assessment of tobacco intake may be difficult, because it is consumed in multiple forms; cigarettes, beedies, Indian pipes, raw tobacco and chewing tobacco

are all commonly consumed and people use tobacco in more than one form. It was therefore categorized users of any form of tobacco as smokers as was done in previous studies.¹³ Subjects who admitted to ingesting alcohol more than once a week were categorized as alcohol consuming and those drinking more than 10 drinks per week as alcoholism. Food intakes were assessed with the help 3-day food intake records by using dietary diaries by each subject. The diaries were examined by the dietitian to find out exact food intake from the subject by using food measures, food models and food portions. Western type food intake was considered, if more than one third of the foods were refined, bread, biscuits, cakes, refined and polished rice or sugar sweetened foods (>400g/day). Nutrient intakes were calculated based on Indian food composition tables.

The modified MIND diet score

The MIND diet designed by Morris et al.,¹⁴ contains advice regarding 15 food items; 10 food items considered to be healthy for the brain (i.e., green leafy vegetables (1), other vegetables (2), nuts (3), berries (4), beans (5), whole grains (6), fish (7), poultry (8), olive oil (9), and wine (10) and 5 unhealthy food items (i.e., red meat (11), butter and stick margarine (12), cheese (13), fast fried food (14), and pastries and sweets (15).

The Indian MIND diet, designed for this study, included, green leafy vegetables (1), other vegetables (2), nuts (3), berries (4), beans and soya bean (5), whole grains (6), fish (7), olive oil/ mustard oil (8), spices (9), wheat porridge (10), millets (11), cocoa products (12), tea and green tea (13), flex seeds (14), cottage cheese with whey proteins (15) are also considered healthy. We did not include poultry and wine, because there is controversy on the role of farm egg and wine intake on neuronal health. The above traditional foods, are commonly consumed in India, because of their health effects. Similarly, unhealthy foods, such as red meat (16), butter and stick margarine (17), industry cheese (18), fast fried food (19), and pastries, cakes, biscuits and sweets (20). Preserved foods; in particular, preserved meats (21) and farm eggs (22) and polished rice (23) and wines/alcohol (24) are pro-inflammatory that may predispose depression.

The Role of Modified Indo-Mediterranean Neuroprotective Diet (MIND) on Emotion, Cognition and Depression, has been described, which gives an overview of food items and their function.¹¹ Therefore, in our study, we have considered 16 healthy foods and 8 unhealthy foods, to find out adherence score for reducing cognitive impairment. (Appendix I). If the subjects used vegetable oils; mustard oil or soya bean oil as the primary cooking fat (> 50%), a 1 was assigned and a 0 otherwise. For each other food item, a 0 was assigned if subjects did not adhere to the recommendations, a 0.5 for moderate adherence, and a 1 for good adherence. Scores assigned to each food component were summed, obtaining a total score ranging from 0 to 24. A score of 24 and more was considered neuroprotective for reducing depression or cognitive impairment.

Criteria for diagnosis of depression

The criteria for the diagnosis of possible depression, and depression were modified from previous criteria.^{15,16} The diagnosis of depression was evaluated based on attributes of; no desire to get up in the morning (1), no desire to work (2), excess of anxiety and inability in thinking (3), tingling and heaviness on head (4) in association with memory dysfunction, agitation, fear and weeping (5) as reported earlier.¹⁶ The reliability of the modified version of this scale has been validated in about 30 subjects with depression. Clinically, a score ≥ 5 -9 is considered as possible depression and score of > 9 as depression.

Body mass index was calculated and obesity was defined as a body mass index > 30 kg/ m² and overweight when body mass index > 25 kg/m² to 29.9 Kg/M² Figures for criteria according to the Indian consensus group for overweight (> 23 kg/m²), were also calculated.

Assessment of tobacco intake may be difficult, because it is consumed in multiple forms; cigarettes, beedies, Indian pipes, raw tobacco and chewing tobacco are all commonly consumed and people use tobacco in more than one form. It was therefore categorized users of any form of tobacco as smokers as was done in previous studies. Subjects who admitted to ingesting alcohol more than once a week were categorized as alcohol consuming. Late night sleep was considered when the subject slept after 10 PM.

Statistical analysis

Clinical data were analysed by paired t test in case of continuous variables or Chi square test in case of ordinal variables. Multivariate logistic regression analysis was done, after adjustment of age and body weight, to find out the association of food intakes and adherence score with risk of grades of depression. Odds ratios and 95% confidence intervals were obtained for all the dietary factors to find out the level of significance. Only P values <0.05 and two tailed t test were considered significant.

Results

Among all 2002 subjects, the age and sex distribution of the sample were comparable with the age and sex ratio in the population in the city. The overall prevalence of depression was 6.84% (n=137). The prevalence was significantly lower among men, compared to women (6.10% vs 7.61%, n=62 vs 75, P<0.02). The prevalence of possible depression (n=82, 4.09%) were 4.23 % in men (n=43) and 3.95%

in women (n=39), without any significant gender difference. Rest 55 (2.74%) subjects had depression, with no significant differences between men (n=31, 2.92%) and women (n=24, 2.93%) respectively. The prevalence of depression showed a graded increase with increase in age, among both men and women from age 25 to 84 years and the trends were significant for both genders (Table 1).

The prevalence of mental stress, tobacco intake, alcoholism, western type diet and sedentary behavior were significantly more common, more so among patients with depression (Tables 2–4), (Figure 1).

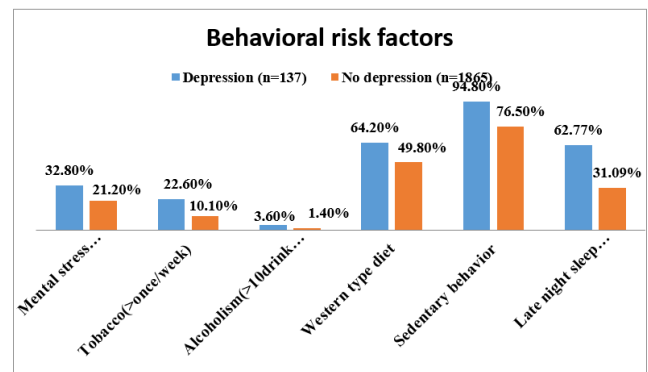


Figure 1 Behavioral risk factors of depression.

The food intakes are given in Table 4. The intake of total western type of foods was higher than the mean limit of 400g/day. These foods are refined foods such as bread, biscuits, rash, cakes, other ready prepared junk foods, sugar and syrups, red meat and eggs and salt (Table 4).

Table 1 Prevalence of depression by age and gender among urban population in North India

Age group	Men, n=1016		Women, n=986		Total, n=2002	
	No	Depression, n (%)	No	Depression, n (%)	No	Depression, n (%)
25-34	304	9(2.9)	354	8(2.3)	658	17
35-44	290	14(4.8)	254	24(9.4)*	544	38(7.0)*
45-54	182	13(7.1)	171	18(10.5)*	353	31(8.8)
55-64	128	11(8.6)	123	14(11.3)	251	25(10.0)
65-74	65	10(13.4)	54	8(14.8)	119	18(15.1)
75-84	47	5(10.6)	30	3(10.0)	77	8(10.4)
X2 for trend P		67.6 0.02		87.4 0.02		
Total	1016	62 (6.10)	986	75(7.61)	2002	137(6.84)

P value was obtained by Chi square test; *= P <0.02

Table 2 Prevalence of risk factors of depression among men and women

Risk factors of depression	Men (n=1016)	Women (n=986)	Total (n=2002)
Mental stress (family, occupation)	225(22.1)	215(21.8)	440(22.0)
Tobacco intake	202(19.8)**	18(1.8)	220(10.9)
Alcoholism(>10 drinks/week)	31(2.9)**	-	31(2.9)
Western type diet	518(51.0)	492(50.0)	1010(50.8)
Sedentary behavior	768(75.6)	789(80.0)	1557(77.8)
Late night sleep	337(33.16)	329 (35.14)	666(33.26)

*=P<0.05, **=P<0.01, by Chi square test, Values are number (%).

Table 3 Frequency of behavioral and biological risk factors among patients with depression compared to rest of the subjects in both sexes combined

Risk factors	Depression (n=137), n (%)	No depression (n=1865), n (%)
Behavioral risk factors		
Mental stress (Family, occupational)	45(32.8)*	395(21.2)
Tobacco(>once/week)	31(22.6)*	189(10.1)
Alcoholism(>10drinks/wk)	5(3.6)	26(1.4)
Western type diet	88(64.2)*	930(49.8)
Sedentary behavior	130(94.8)*	1427(76.5)
Late night sleep (Sleeping after 10PM)	86(62.77)*	580(31.09)

*=P <0.0, **= P<001, P values were calculated by Chi square test. Tobacco and alcohol are not common in women.

Table 4 Food consumption pattern among men and women based on dietary diaries

Foods (g/day)	Male (n=1016)	Female (n=986)
Prudent foods, g/day		
	Mean ±SD	Mean ± SD
Roots and tubers	81± 15.6	74±6.2
Nuts including pea nuts	53±11.4	41±5.2
Fruits and vegetables.	103± 34	109±27.5
Whole grains, millets and pulses	90±17.6	70±14.8
Milk and curd	214.5±28	203±23.3
Mustard/olive oil.	13.5±3.4	10.8±3.2
Sun flower, pea nut, soy bean oils	29.2±3.6	12.4±2.6
Spices (Fenugreek, cumin, turmeric, coriander)	21.5±3.46	16.8±3.02
Total prudent foods	605.7±230	539.0±201
Western type foods, g/day		
Refined wheat flour and rice	269±37.3	242± 21
Refined foods; bread, rash, biscuits etc	107.5±32.6	105.1±25.3
Sugar and syrups	60.0±15.5	41.1±12.6
Clarified butter, butter and trans fat	16.6±3.5	12.6±2.5
Meat and eggs.	65.6±14.2	49.1±8.8
Salt	12.2±3.1	10.2±2.0
Total Western type foods	630.9±33.5	538.1±25.5
Total foods	1236.6±262.2	1075.1±211

Values are mean (Standard deviation).

Table 5 Multivariate logistic regression analysis for association of risk factors with risk of depression, after adjustment of age and body mass index, among men and women

	Men (n=1016), Odds ratio (95% confidence interval)	Women (n=986), Odds ratio (95% confidence interval)
Total western type foods	0.78(0.69-0.87)**	0.79(0.74-0.88)**
Meat and eggs	0.89(0.76-1.01)*	0.89(0.74-1.08)
MIND diet score >24	0.89(0.81-0.99)**	0.87(0.80-0.97)**
Fruits, vegetables, nuts.	0.76(0.70-0.86)**	0.78(0.72-0.86)**
Sedentary behavior	0.88(0.77-1.00)*	0.93(0.71-1.03)*
Tobacco intake	0.94(0.81-1.07)*	0.92(0.80-1.04)*
Alcoholism	0.91(0.81-1.00)*	0.90(0.74-1.09)

Depression=All subjects graded as possible depression and depression were included under depression. *= P < 0.05, **= P, 0.001, P value was obtained by regression analysis.

Multivariate logistic regression analysis, after adjustment of age and body mass index, showed that fruit, vegetable and nuts intake were significantly and strongly but inversely associated with depression among both men, Odds ratio(OR) and 95 % confidence interval of difference; (0.76, ((95% CI 0.70-0.86)** as well as in women, Odds ratio and 95% confidence interval; (0.78, 95% CI 0.72-0.86)**, MIND diet score was also inversely associated with depression among both men (0.89, 95% CI, 0.81-0.99)* and women (0.87, 95% CI 0.80-0.97)*. Total western type food intake revealed positive association among both men (0.78, (95% CI 0.69-0.87)** and

women (0.79, 95% CI 0.74-0.88)**. The intake of meat and eggs also showed modest positive association with depression, in men (0.89, (95% CI 0.76-1.01)* but not among women because most women were vegetarian. Sedentary behavior was significantly associated with depression among both men (0.88, 95% CI 0.77-1.00)* and women (0.93, 95%CI 0.71-1.03)*. Tobacco intake showed significant modest association with depression among men 0.94, (95% CI 0.81-1.07)* as well as in women (0.92, 95% CI 0.80-1.04)*, but alcoholism showed no such association among women due to wider confidence interval; OD 0.90, (95% CI 0.74-1.09).

Discussion

This study shows that the overall prevalence of depression was 6.84% (n=137). The prevalence was significantly lower among men, compared to women (6.10% vs 7.61%, n=62 vs 75, $P<0.02$). The prevalence of possible depression (n=82, 4.09%), were 4.23% in men (n=43) and 3.95% in women (n=39), without any significant gender difference. Rest 55 (2.74%) subjects had depression, with no significant differences between men (n=31, 2.92%) and women (n=24, 2.93%), respectively. It seems that possible depression may be an early stage of depression which may simulate mood disorder. It seems that early diagnosis of depression is important, because in such situation, depression can be managed by increased consumption of fruits, vegetables, nuts and whole grains^{17,18} and other lifestyle risk factors. Other studies from India have estimated that the point prevalence of unipolar depressive episodes may be 1.9% for men and 3.2% for women, and the one-year prevalence was estimated to be 5.8% for men and 9.5% for women.¹⁸ If epidemiological transition continues, the burden of depression can increase to 5.7% of the total burden of disease. Several experts have estimated the prevalence of depression and the rates have varied from 1.7 to 74 per 1000 population.^{19,20} Reddy and Chandrasekhar,²⁰ in a meta-analysis, including 13 studies, among 33572 subjects, reported that the prevalence of depression were 7.9 to 8.9 per 1000 population and the prevalence rates were nearly double in the urban areas.²⁰ Nandi et al.,²¹ compared the prevalence of depression in the same catchment area after a period of 20 years and reported that the prevalence of depression increased from 4.9% to 7.3%, which is similar to our study. In South India, Chennai, among 24,000 subjects, the overall prevalence of depression was 15.1% after adjusting for age using the 2001 census data.²²

The prevalence of depression in developed countries may be slightly more. In Italians, (n=39,463), the prevalence of depressive symptoms in 2015 was 6.2%.²³ The rates of depression were slightly higher in Canada and USA; (8.2% vs 8.7% respectively).²⁴ Across the Asia Pacific region,²⁵ rates of current or 1-month major depression ranged from 1.3-5.5%, rates of major depression in the previous year ranged from 1.7% to 6.7%, and lifetime rates ranged from 1.1% to 19.9%, with a median of 3.7%. In Korea, among 4,949 subjects, the prevalence of depression was 6.7%.²⁶ In a population study, including 39,463 subjects, 34.4% of adults engaged in no leisure-time physical activity, 26.2% were cigarette smokers, 11.5% were excessive alcohol consumers, and 10.3% were obese.¹² People with depressive symptoms were more likely to be physically inactive, cigarette smokers and excessive alcohol consumers, compared with those without depressive symptoms. In people with Alzheimer's disease, Parkinson's and Huntington's diseases, one third of the subjects may have depression.¹⁻³ In Korea, there was consistent association between visit-to-visit fasting glycemic variability and depression.²⁷ There is an urgent need to prevent depression because higher risk of depression can cause significant increase in CVDs and diabetes as well as high risk of mortality.²⁸⁻³⁰

Our most interesting finding is that MIND diet score shows an inverse association with depression among both men (0.89, 95% CI, 0.81-0.99, $P<0.01$) and women (0.87, 95% CI 0.80-0.97, $P<0.01$). Multivariate logistic regression analysis, also found that after adjustment of age and body mass index, fruit, vegetable and nuts intake were significantly and strongly but inversely associated with depression among both men, Odds ratio (OR) and 95% confidence interval of difference; (0.76, (95% CI 0.70-0.86, $P<0.001$) as well as in women, Odds ratio and 95% confidence interval; (0.78, 95% CI 0.72-0.86, $P<0.001$). This finding is quite logical because MIND

diet is rich in certain vegetables, fruits and nuts as well as whole grains and mustard oil or olive oil. Total western type food intake revealed positive association among both men (0.78, (95% CI 0.69-0.87, $P<0.001$) and women (0.79, 95% CI 0.74-0.88, $P<0.001$). The intake of meat and eggs also showed modest positive association with depression, in men (0.89, (95% CI 0.76-1.01, $P<0.05$) but not among women because most women were vegetarian. Sedentary behavior was significantly associated with depression among both men (0.88, 95% CI 0.77-1.00, $P<0.05$) and women (0.93, 95%CI 0.71-1.03, $P<0.05$). Tobacco intake showed significant modest association with depression among men 0.94, (95% CI 0.81-1.07, $P<0.05$) as well as in women (0.92, 95% CI 0.80-1.04, $P<0.05$)*, but alcoholism showed no such association among women showing wider confidence interval; OD 0.90, (95% CI 0.71-1.09). The association of vegetable and fruit intake has been examined in several studies.^{6,7,17-18}

The SUN project among 10 094 healthy Spanish participants,¹⁸ median follow-up for 4.4 years, found 480 new cases of depression. The multiple adjusted hazard ratios (95% confidence intervals) of depression for the 4 upper successive categories of adherence to the Mediterranean dietary pattern (taking the category of lowest adherence as reference) were 0.74 (0.57-0.98), 0.66 (0.50-0.86), 0.49 (0.36-0.67), and 0.58 (0.44-0.77) (P for trend $<.001$). Inverse dose-response relationships were found for fruit and nuts, the monounsaturated- to saturated-fatty-acids ratio, and legumes. These results suggested a potential protective role of the Mediterranean diet with regard to the prevention of depressive disorders; additional longitudinal studies and trials are needed to confirm these findings.

In a cross-sectional survey among adults from United States,³¹ 4180 men and 4196 women aged 20-79 years in the 2007-2010 National Health and Nutrition Examination Surveys (NHANES), were included. The "Healthy" dietary pattern scores were inversely associated with the PHQ-9 depression scores and odd ratios (ORs) of depression after adjustment for covariates in women but not in men. The OR of depression in women with the highest quintile of "Healthy" dietary pattern scores was 0.60 (95% confidence interval [CI]: 0.42-0.85, $P < .001$) compared to the lowest quintile as a reference. Similar results were observed among mid-aged women³² as well as older adults overtime, during 7.2 years of follow up,³³ showing inverse association of Mediterranean dietary pattern and prevalence and incidence of depressive symptoms. The annual rate of developing depressive symptoms was 98.6% lower among persons in the highest tertile of a Mediterranean-based dietary pattern compared with persons in the lowest tertile group.³³ These results support the hypothesis that adherence to a diet comprised of vegetables, fruits, whole grains, fish, and legumes may protect against the development of depressive symptoms in older age. In a retrospective study of death records of decedents (n=2222), several of the decedents had mild to moderate depression (n=153, 6.88%) (men 6.64%, n=92; and women 7.28%, n=61).¹⁶

The prevalence of severely depressed victims was similar among men (1.08%, n=15) women 1.67% (n=14) with a total of 1.3% (n=29). The total prevalence of depression was 8.19% (n=182). Depression was an important risk factor of deaths due to CVDs and suicides. In the Finnish Health Care Survey,³⁴ a random sample of 5993, aged 15-75 were interviewed. In the past 12 months, smoking of 10 or more cigarettes daily (odds ratio (OR) 2.26; 95% confidence intervals (95% CI) 1.68, 3.04) and alcohol intoxication at least once a week (OR 2.99; 95%CI 1.70, 5.25) were associated with depression. Cigarette smoking and alcohol intoxication seem to be important risk factors for major depressive episode.

The exact food and nutrient which can modulate depression is not known. However, an earlier study published in 1995 reported deficiency of antioxidant vitamins, A, E and C and increased oxidative stress among patients with depression.³⁵ It has been found that fish oil,^{36,37} cocoa³⁸ and other polyphenols,^{39,40} flavonoid rich apples⁴¹ and other flavonoid rich fruits and vegetables^{42,43} omega-3 fatty acids⁴⁴⁻⁴⁹ and also other polyunsaturated fatty acids⁵⁰ as well as foliate⁵¹ may have a crucial role in the pathogenesis and management of depression. It seems that most of the nutrients act by modulating release of neurotransmitters and beneficial effects of neuro-synapsis due to decline in the neuro-inflammation,⁵²⁻⁵⁴ and cell signaling.⁴³ WHO has developed brief psychological intervention manuals for depression that may be delivered by lay workers to individuals and groups.¹ The Management Manual, describes the use of behavioral activation, stress management, problem solving treatment and strengthening social support, which are more effective during beginning of depressive symptoms.¹ It is possible that an advice on eating more fruits, vegetables, nuts, whole grains and olive oil as well as other oils rich in omega-3 fatty acids may be useful in the prevention of depression, at least early possible depression. A recent review has also reemphasized that a healthy diet, including vegetables, fruits, and avoiding junk foods, fast foods, and high meat intake may decrease the risk of depressive symptoms or clinical depression.⁵⁵

The exact mechanism how diet and nutrients provide benefits in depression is not known. It is possible that omega-3 fatty acids and amino acids such as tryptophan and tyrosine can activate formation of ethanolamine, dopamine and serotonin as well as other metabolites and endocannabinoid receptors in the brain, which may enhance the release of anandamides leading to pleasure and wellbeing with decline in depressive symptoms.⁵⁶

Conclusion

It seems that behavioral risk factors are associated with an increased risk for depression across the lifespan with some variability according to age groups. It is possible that western type diet, sedentary behavior, tobacco and alcoholism, sleep disorders and stressful life events and circumstances, parental depression, interpersonal dysfunction, may be the risk factors of depression. Eating, fruits, vegetables, whole grains and nuts as well as high MIND score may be protective against depression. Cohort studies and controlled trials would be necessary to confirm the role of Indo-Mediterranean style diet in depression.

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Conflicts of interest

The authors declare there is no conflict of interest.

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