REVIEW

Dietary intake and depressive symptoms: A systematic review of observational studies

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The importance of research into the possible role of dietary intake in depressive symptoms is emphasized by the fact that diet is modifiable. We systematically reviewed observational studies investigating the association between dietary intake and depressive symptoms published in English as of December 2008. Using the PubMed database, 34 publications (23 cross-sectional, 10 prospective cohort, and 1 case-control studies) were identified. The number of subjects (n = 80–27 111), age of subjects (15–97 years), dietary assessment method (dietary record, diet history interview, and validated and non-validated dietary questionnaire), depressive symptom assessment (discharge diagnosis, established scale, and self-reported information) varied among studies. Dietary variables most frequently investigated included long chain n-3 PUFA, fish, folate, and other B vitamins. Most studies found no association between dietary variables and depressive symptoms. However, most studies included at least one important methodological limitation, such as no inference for causality, unreliable or rough assessment of diet or depressive symptoms, inadequate treatment of potential confounding factors, and ignorance of the possible mediating or confounding influence of other dietary variables. Further evidence from well-designed observational studies is required to confirm or refute the association between dietary intake and depressive symptoms in free-living settings.

Keywords:
Depression / Epidemiology / Food / Free-living setting / Nutrient

1 Introduction

The importance of research into the possible role of dietary factors in depressive symptoms, a common problem in community medicine [1], is emphasized by the fact that diet is modifiable, although the literature indicates that the relationship between eating and mood is complex, situation specific, heavily influenced by individual history and psychological state, and measurement dependent [2]. For example, an association between depressive symptoms and low levels of several dietary B vitamins has been suggested, including for folate, riboflavin (vitamin B-2), pyridoxine (vitamin B-6), and cobalamin (vitamin B-12), possibly mediated by homocysteine or the synthesis of monoamines in the brain [3, 4]. Further, n-3 PUFA, of which alpha-linolenic acid, eicosapentaenoic acid, and docosahexaenoic acid are the most important representatives, may play various broad roles in brain function and activity and have been suggested to play a role in depression [5, 6]. Additionally, because food consumption pattern reflects complex interrelations and interactions among the individual, the culture, and society in which people live, social and psychological mechanisms in addition to biological mechanisms may be also possible [2].

From a prevention perspective, findings on associations between diet and depressive symptoms in observational human studies conducted in free-living settings are much more important than the extrapolation of results from animal studies or the results of human intervention trials, which are usually conducted in patients with clinically diagnosed depression. Despite the importance of the systematic collection, evaluation and application of previous findings to the evidence-based primary care of depressive

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symptoms, however, to our knowledge no systematic review of observational studies of the association between dietary intake and depressive symptoms has appeared.

Here, we systematically reviewed published observational studies examining the association between dietary variables such as nutrient and food intake and depressive symptoms. The purpose of this systematic review was to throw light on dietary strategies that may be helpful in the prevention of depression.

2 Materials and methods

We searched the PubMed database (National Library of Medicine, Bethesda, MD) for observational studies on the relation of dietary variables, including nutrient and food intake, with depression or depressive symptoms using the following search strategy: (''diet'' or ''food'' or ''dietary'' or ''consumption'' or ''intake'') and (''depression'' or ''depressive'' or ''depressed''). The search was limited to English-language reports published up to the end of December 2008. Studies included in this review were observational studies that used at least one quantitatively assessed dietary variable in the analysis, and had either depression or depressive symptoms as the outcome. Studies including only analyses of a purely descriptive nature (*e.g.* comparison of dietary intake between subjects with and without depressive symptoms without consideration of potential confounding factors or without the use of statistical testing) were excluded, because these studies provide no information on independent association between diet and depressive symptoms. Bibliographies of retrieved articles were also reviewed. A total of 34 articles were identified [7–40].

For each article, the following information was tabulated: authors and year of publication; dataset analyzed, settings, and study design; subject characteristics (such as age, sex, and number); dietary assessment instrument used (as well as information on validity for questionnaire-based assessment); depressive symptom assessment used; variables used for adjustment; and main findings (from the fully adjusted models), including the dietary variables examined and information on statistical testing. When men and women were analyzed separately, we retrieved these separate analyses. A meta-analysis (for each dietary variable) was attempted, but the degree of heterogeneity among study designs was prohibitive, particularly with respect to the age groups of participants and to dietary and depressive symptom assessment, and therefore a more qualitative assessment is presented. All reported *p*-values are two-tailed, with $p < 0.05$ considered statistically significant.

3 Results

A total of 34 articles on dietary intake and depressive symptoms were included. Major characteristics are shown in Table 1. The first study that met the inclusion criteria appeared in 2001, and more than two-thirds (24 out of 34) of the articles were published since 2005.

Studies were conducted in various countries: seven articles were reported from Finland; five each from Japan and France; three from the US; two each from New Zealand, The Netherlands, Spain, and China; one each from Australia, the UK, Canada, Norway; and one each from several European collaborating countries, namely France and Northern Ireland, and Finland, Italy, and the Netherlands. The majority of articles (23 out of 34) were cross-sectional in nature, while ten of the remainder used prospective and one used case-control analysis. Subject numbers ranged from 80 to 27 111, and age from 15 to 97 years. Seven articles were restricted to male subjects and 7 others to females; the remaining 20 examined both sexes, with 8 examining men and women separately and 12 in combination.

Dietary variables were measured using a variety of instruments. Five articles used dietary records, 3 used diet history interview, 15 used validated food frequency or diet history questionnaires, and 11 used non-validated questionnaire techniques. Twenty-one studies used crude (non-energy-adjusted) dietary variables while the other 13 used energy-adjusted variables. A total of 55 dietary variables were examined, with long-chain n-3 PUFAs, fish, folate, and other B vitamins being the most frequent.

Depressive symptoms were also measured using a variety of techniques. One paper used discharge diagnosis of depressive disorders. About four-fifths (27 out of 34) of the studies relied on validated scales (either full or modified) for depressive symptoms, such as the Center for Epidemiologic Studies Depression Scale; the Edinburgh Postnatal Depression Scale; the Beck Depression Inventory; the Hospital Anxiety and Depression scale; the Zung Self-rating Depression Scale; the mental health scale of the Short Form Health Survey 36; the Human Population Laboratory Depression Scale; a depressive mood scale; the Hopkins Symptom Checklist depression subscale; the brief-Patient Health Questionnaire; the Geriatric Depression Scale; the Depression, Anxiety and Stress Scales; and the Welsh Pure Depression sub-scale. The remaining six articles relied on information on depressive symptoms self-reported by each participant.

All studies adjusted for a wide range of potential confounding factors. Many but not all adjusted for well-known factors associated with depression such as age, sex, marital status, socioeconomic factors such as education and income, smoking, alcohol drinking, physical activity, and body mass index. Conversely, only a few studies adjusted for other dietary variables.

A summary of the results of the associations of dietary intake with depressive symptoms is shown in Table 2. Although several studies ($n = 1$–4) investigated the relationship of energy, macronutrients, and related dietary variables with depressive symptoms, with particular focus

Table 1. Findings from observational studies of the relations between dietary intake and depressive symptom

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
Cross-sectional design						
Tanskanen *et al.* [7]	Questionnaire survey, Finland, 1999, cross-sectional design	Random sample of community residents aged 25–64 years ($n = 1767$)	FFQ, 132 items, previously validated against DRs	BDI, 21 items, potential score of 0–63	Sex, age, marital status, education, employment status, work ability, area of living, financial status, general health, smoking, alcohol intake, coffee drinking, physical activity	Descriptive information of dietary intake and depressive symptoms not available. Significantly lower risk of being depressed (BDI $\geq$ 10) in frequent than more infrequent lake-fish consumers (OR (95% CI): 0.63 (0.43, 0.94))
Tanskanen *et al.* [8]	Survey of cardiovascular risk factors, Finland, 1992, cross-sectional design	Random sample of community residents aged 25–64 years ($n = 3204$)	FFQ, number of items not shown (only one item used), not validated	BDI, 21-items, potential score of 0–63	Age, marital status, employment status, current smoking, physical activity, sex, BMI, alcohol intake, coffee intake, education, serum cholesterol level	70% classified as frequent fish consumers (more than or equal to once a week) and 30% as infrequent fish consumers (less than once a week). Prevalence of depressive symptoms (BDI $\geq$ 10): 28%. Significantly higher risk of being depressed in infrequent than frequent fish consumers (OR (95% CI): 1.31 (1.10, 1.56))
Slivers and Scott, [9]	Combined data of 1996/1997 New Zealand Health Survey and 1997 Nutrition Survey, New Zealand, 1996–1997, cross-sectional design	Nationally representative sample of New Zealand adults aged $\geq$ 15 years ($n = 4644$)	FFQ, number of items not shown, not validated	Mental health scale of SF-36, nine items, potential score of 0–100 (higher score indicating better mental health)	Age, household income, smoking, alcohol consumption, eating pattern	2% of fish non-consumers. Significantly higher mental health score in fish consumers than non-consumers (mean: 78.8 *versus* 70.6, $p < 0.05$)
Tolmunen *et al.* [10]	Kuopio Ischemic Heart Disease Study, Finland, 1984–1989, cross-sectional design	2443 men aged 42–60 years	4-d DRs	HPLDS, 18 items, potential score of 0–18	Age, years of study, smoking habits, consumption of alcohol, appetite, BMI, living alone, education, adulthood SES, fat intake (energy-adjusted)	Mean dietary intake (energy-adjusted): 254 μg/day for folate; 9.5 μg/day for vitamin B-12; 1.9 mg/day for vitamin B-6; 2.2 mg/day for riboflavin. Prevalence of depressive symptoms: 10%. Significant inverse relation of folate intake (energy-adjusted) with the prevalence of depressive symptoms (OR (95% CI) for the lowest tertile compared with the highest: 1.46 (1.01, 2.12)). No relation of intake (energy-adjusted) of vitamin B-12, vitamin B-6, or riboflavin with the prevalence of depressive symptoms

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
Fulkerson *et al.* [11]	Project EAT (Eating Among Teens), USA, 1998–1999, cross-sectional design	4734 adolescents with mean age of 15 years (2377 boys and 2357 girls)	YAQ, 149 items, previously validated 24-h dietary recalls	Depressive mood scale, six items, potential score of 10–30	Race, grade	Descriptive information of dietary intake not available. Prevalence of moderate (depressive scale score = 18–22) and severe (depressive scale score $\geq$23) depressive symptoms: 27 and 7% for boys and 36 and 17% for girls, respectively. Significant positive relation of intake (crude) of soft drinks ($p = 0.005$), but not vegetables, fruits, energy, total fat (energy-adjusted), calcium, iron, sucrose, vitamin D, folate, vitamin B-6, and vitamin B-12, with the severity of depressive mood in boys. No relation of intake (crude) of vegetables, fruits, soft drinks, energy, total fat (energy-adjusted), calcium, iron, sucrose, vitamin D, folate, vitamin B-6, or vitamin B-12 with the severity of depressive mood in girls
Suzuki *et al.* [12]	Lung Cancer Database Project, Japan, 1999–2001, cross-sectional design	771 patients with newly diagnosed primary lung cancer	FFQ, 138 items, previously validated against DRs	HAD depression scale, seven items, potential score of 0–21	Age, sex, performance status, clinical stage, histology, pain, breathlessness, employment, smoking, alcohol consumption, BMI	Mean dietary intake (energy-adjusted): 0.9% energy for ALA; 0.03% energy for OTA; 0.02% energy for ETA; 0.16% energy for EPA; 0.04% energy for DPA; 0.27% energy for DHA; 0.44% energy for DHA+EPA; 1.4% energy for total n-3 PUFA. Prevalence of depressive symptoms (HADS depression scale$\geq$5): 57%. Significant inverse relation of intake (energy-adjusted) of ALA (OR (95% CI) for the highest quartile compared with the lowest: 0.50 (0.31, 0.71); p for trend = 0.004) and total n-3 PUFA (OR (95% CI) for the highest quartile compared with the lowest: 0.55 (0.35, 0.88); p for trend = 0.02) with the prevalence of depressive symptoms. No relation of intake (energy-adjusted) of OTA, ETA, EPA, DPA, DHA, or DHA+EPA

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
Timonen *et al.* [13]	Northern Finland 1966 Birth Cohort Study, Finland, 1997, cross-sectional design	1966 birth cohort (2721 men and 2968 women aged 31 years)	FFQ, number of items not shown (only one item used), not validated	HSCL depression subscale, 15 items, potential score of 0–3. Self-report of doctor-diagnosed lifetime depression	Alcohol intake, smoking, physical inactivity, marital status	Descriptive information of dietary intake not available. Prevalence of doctor-diagnosed and HSCL-based (HSCL depression scale >2.0) depression: 3.6 and 4.3% for men and 5.3 and 7.1% for women, respectively. Significantly higher risk of HSCL-based, but not doctor-diagnosed, depression in female rare (monthly or more seldom) fish eaters than female regular (weekly or more often) fish eaters (OR (95% CI): 1.4 (1.1, 1.8)). No relation of consumption frequency of fish with the risk of doctor-diagnosed and HSCL-based depression in men
Barberger-Gateau *et al.* [14]	Three-City Study, France, 1999–2000, cross-sectional design	9280 community dwellers aged $\geq$65 years (3647 men and 5633 women)	FFQ, number of items not shown, not validated	CES-D, 20 items, potential score of 0–60	Age, sex, education, city	11.7% reported eating fish less than once a week, 38.4% once a week, 49.9% more than once a week. Information on the prevalence of depressive symptoms (CES-D$\geq$17 for men and $\geq$22 for women) not available. Significant inverse relation of consumption frequency of fish with the prevalence of depressive symptoms (OR (95% CI) for the highest category compared with the lowest: 0.63 (0.52, 0.75))
Samieri *et al.* [15]	Three-City Study, France, 2001–2002, cross-sectional design	1724 community dwellers aged $\geq$65 years (647 men and 1077 women)	FFQ, 43 items, previously validated against a 24-h dietary recall. Five dietary clusters identified in both men and women	CES-D, 20 items, potential score of 0–60	Age, education, income, marital status	Mean score (SD) of CES-D: 6.0 (6.4) for men; 9.2 (8.2) for women. Significantly higher CES-D score in the ''pasta eaters'' cluster in men (β: 0.26; 95% CI: 0.06, 0.46; the reference for the variable cluster is the average of cluster levels). No relation of dietary clusters with CES-D score in women
Bonnet *et al.* [16]	Survey, France, 1998–2000, cross-sectional design	840 hypertensive patients with the metabolic syndrome (532 men and 308 women)	7-d dietary recall. Unhealthy diet score calculated based on intake of energy,	HAD depression scale, seven items, potential score of 0–21	Age, SES, marital status, personal history, presence of diabetes, BMI	Descriptive information of dietary intake not available. Prevalence of mild depression (HADS depression scale = 8–10) and marked depression (HADS

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
			cholesterol, alcohol, carbohydrate, total fat, SFA, MUFA, and PUFA (higher score indicating unhealthier diet)			depression scale $\geq$11): 13.7 and 7.3% for men and 26.0 and 13.0% for women, respectively. Significant positive relation of unhealthy diet score with the severity of depression in both men (p for trend = 0.01) and women (p for trend = 0.04)
Hintikka *et al.* [17]	Kuopio Depression Study, Finland, 1998, cross-sectional design	2011 adults aged 25–64 years (890 men and 1121 women)	FFQ, number of items not shown, not validated	BDI, 21-items, potential score of 0–63	Sex, age, marital status, basic education, vocational training, employment status, economic hardship, subjective health, smoking, alcohol drinking	22% reported daily drinking of tea. Prevalence of depression (BDI $\geq$15): 10%. Significant inverse relation of daily tea drinking with the prevalence of depression (OR (95% CI: 0.47 (0.27, 0.83)). No relation of consumption frequency of coffee, fresh vegetables, boiled vegetables, fruits, lake fish, or sea fish with the prevalence of depression
Kamphuis *et al.* [18]; Kamphuis *et al.* [19]	Zutphen Elderly Study, The Netherlands, 1990, cross-sectional design	332 men aged 70–90 years who were free from cardiovascular diseases and diabetes	DHI	ZSDS, 20 items, potential score of 25–100	Age, years of education, physical activity, living alone, energy intake. For EPA+DPA, also BMI, smoking, alcohol consumption, systolic blood pressure. For B vitamins, also self-reported health, disability in activities of daily living, cognitive functioning	Median (10th–90th percentiles) intake of EPA+DPA (energy-adjusted): 105 (8-463) mg/day in non-depressed men and 87 (6-355) mg/day in depressed men. Mean (SD) dietary intake (energy-adjusted): 194 (57) μg/day for folate; 1.65 (0.30) mg/day for vitamin B-6; 5.34 (3.14) μg/day for vitamin B-12. Prevalence of depressive symptoms (ZSDS $\geq$50): 22%. Significant inverse relation of EPA+DPA intake (energy-adjusted) with the prevalence of depressive symptoms (OR (95% CI) for the highest tertile compared with the lowest: 0.46 (0.22, 0.95); p for trend = 0.04). No relation of intake (energy-adjusted) of folate, vitamin B-6, or vitamin B-12 with the prevalence of depressive symptoms
Sanchez-Villegas *et al.* [20]	SUN (Seguimiento Universidad de Navarr[a)] cohort study, Spain, 1999–2004, cross-	9670 university graduates (4211 men and 5459 women)	FFQ, 136 items, baseline only, previously validated against DRs	Self-reported physician diagnosis of depression or use of regular	Age, marital status, employment status, weight, height, caffeine intake, alcohol intake, physical activity	Descriptive information on dietary intake and depression not available. No relation of intake (energy-adjusted) of folate, vitamin B-6, vitamin B-12, or

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
	sectional design			antidepressant medication	during leisure time, personality traits, chronic diseases, medication use	n-3 PUFA with the prevalence of depression in either sex
Woo *et al.* [21]	Community survey, China, cross-sectional design	3313 adults aged ≥65 years	FFQ, 267 items, previously validated against urine and serum biomarkers	GDS, 15 items, potential score of 0–15	Community Screening Instrument for Dementia score, age, gender, education level, SES, number of medical diseases, cigarette smoking, alcohol drinking, Physical Activity Scale of the Elderly	Descriptive information on dietary intake not available. Prevalence of depressive symptoms (GDS ≥8): 8%. Significant inverse relation of intake (crude) of vitamin A (OR (95% CI) for the highest tertile compared with the lowest: 0.47 (0.32, 0.69)), riboflavin (0.67 (0.45, 1.00), fiber (0.66 (0.46, 0.96)), and vegetables (0.63 (0.44, 0.92)) with the prevalence of depressive symptoms. No relation of intake of total fat, SFA (energy-adjusted), MUFA (energy-adjusted), PUFA (energy-adjusted), thiamin, niacin, vitamin C, iodine, cholesterol, carbohydrate, iron, fish and shellfish, fruits, or total isoflavone with the prevalence of depressive symptoms
Appleton *et al.* [22]	Questionnaire survey, UK, 2003, cross-sectional design	2982 adults entering an intervention study (1027 men and 1955 women)	FFQ, number of items not shown (only two items used), not validated	DASS-21, 21 items, potential score of 0–63	Sex, age, Index of Multiple Deprivation score, date of questionnaire completion	Mean intake (range) of essential n-3 long -chain PUFA from fish: 0.6 (0–6) portions of fatty fish/wk (or equivalent). Mean score (range) of DASS depressed mood score: 7.8 (0-42). No relation of essential n-3 long-chain PUFA from fish with DASS depressed mood score
Appleton *et al.* [23]	Prospective Epidemiological Study of Myocardial Infarction, Northern Ireland and France, 1991–1994, cross-sectional design	10 602 men aged 50–59 years (2747 men in Northern Ireland and 7855 men in France)	FFQ, number of items not shown; not validated	Welsh Pure Depression sub-scale of the Minnesota Multiphasic Personality Inventory, ten items, potential score of 0–10	Age, housing type, number of toilets, number of baths, number of cars, work type, years at school, level of education, intake of cake, cheese, eggs, fruit, nuts, offal potatoes boiled/baked, potatoes fried, vegetables raw, vegetables cooked	Descriptive information on food consumption not available. Mean depression score (SD): 1.6 (1.8) for Northern Ireland samples and 1.6 (1.9) for French samples. Inverse relation of fish intake (crude) with the depression score in both Northern Ireland (β: -0.09; 95% CI: −2.25, −0.01)

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
						and French (β: −0.14; 95% CI: −2.73, −1.17) samples
Liu *et al*. [24]	Survey conducted in seven cities of China, 2003–2004, cross-sectional design	2579 college students	FFQ, number of items not shown, not validated	Three items derived from the 20-item CES-D	Gender, grade, city, perceived weight, smoking level, alcohol use	Descriptive information on food consumption and depression score not available. Significant inverse relation of consumption frequency of fruit with the depression score ($p<0.0001$). Significant positive relation of consumption frequency of ready-to-eat food[c)] and fast food[d)] with the depression score ($p<0.05$). No relation of consumption frequency of snack food[e)] with the depression score
Merete *et al*. [25]	Massachusetts Hispanic Elderly Study, USA, 1993–1997, cross-sectional design	Representative sample of Hispanic elders ($n=618$) and a comparison group of non-Hispanic white elders ($n=251$)	FFQ, 118 items, previously validated against a 24-h dietary recall	CES-D, 20 items, potential score of 0–60	Age, sex, ethnicity, total energy intake, folate intake, education	Mean value (SE) of vitamin B-6 intake (crude) and CES-D score: 1.96 (0.04) mg/day and 15.4 (0.5) for Hispanics and 2.05 (0.06) mg/day and 10.0 (0.6) for non-Hispanic whites, respectively. Prevalence of depressive symptoms (CES-D ≥ 16): 41% for Hispanics; 23% for non-Hispanic whites. Significant inverse relation of vitamin B-6 intake (crude) with CES-D score (β: −0.30; SE: 0.14; $p<0.05$), but no relation with the prevalence of depressive symptoms
Murakami *et al*. [26]	Survey of municipal employees of two offices, Japan, 2006, cross-sectional design	301 men and 208 women aged 21–67 years	BDHQ, 56 items, previously validated against DRs and serum biomarkers	CES-D, 20 items, potential score of 0–60	Age, BMI, work place, marital status, occupational physical activity, leisure-time physical activity, current smoking, current alcohol drinking, job stress score	Mean dietary intake (SD) in men and women (energy-adjusted): 174 (55) and 224 (78) μg/1000 kcal for folate, 0.66 (0.17) and 0.77 (0.20) mg/1000 kcal for riboflavin, 0.62 (0.14) and 0.73 (0.16) mg/1000 kcal for vitamin B-6, 4.8 (2.3) and 4.8 (2.5) μg/1000 kcal for vitamin B-12, 1.31 (0.36) and 1.48 (0.38) % energy for total n-3 PUFA, 0.85 (0.23) and 1.00 (0.24) % energy for ALA, 0.14 (0.08) and 0.14 (0.08) % energy for EPA, and 0.23 (0.12) and 0.24 (0.12) %

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
						energy for DHA, respectively. Prevalence of depressive symptoms (CES-D $\geq$16): 36% for men and 37% for women. Significant inverse relation of folate intake (energy-adjusted) with the prevalence of depressive symptoms in men (OR (95% CI) for the highest quartile compared with the lowest: 0.50 (0.23, 1.06); p for trend = 0.045) but not in women. No relation of riboflavin, vitamin B-6, vitamin B-12, total n-3 PUFA, ALA, EPA, or DHA intake (energy-adjusted) with depressive symptoms in either sex
Sontrop *et al*. [27]	Prenatal Health Project, Canada, 2002–2005, cross-sectional design	2061 pregnant women between 10 and 22 wk' gestation	FFQ, 106 items, previously validated against DRs	CES-D, 20 items, potential score of 0–60	Age, marital status, education, income, occupational stress, smoking status, physical activity, meeting Canada Food Guide to Healthy Living guidelines, energy intake	68% reported fish consumption $\geq$once/wk. Median intake of EPA+DHA: 85.1 mg/day. Mean score (SD) of CES-D: 9.9 (8.0). No relation of intake (crude) of fish or EPA+DHA with CES-D score
Jacka *et al*. [28]	Hordaland Health Study, Norway, 1997–1999, cross-sectional design	5708 community residents (1220 men and 1726 women aged 46–49 years and 1241 men and 1521 women aged 70–74 years)	FFQ, 169 items, previously validated against DRs and serum and adipose tissue biomarkers	HAD depression scale, seven items, potential score of 0–21	Gender, age, waist-hip ratio, BMI, systolic blood pressure, education, income, smoking, alcohol consumption, physical activity	Mean value (SD) of magnesium intake (crude) and HADS depression scale: 391 (97) mg/day and 3.5 (2.9) for men aged 46–49 years, 321 (87) mg/day and 3.0 (2.9) for women aged 46–49 years, 334 (89) mg/day and 3.6 (2.9) for men aged 70–74 years, and 275 (83) mg/day and 3.5 (2.9) for women aged 70–74 years, respectively. Prevalence of depressive symptoms (HADS depression scale $\geq$8): 9.1%. Significant inverse relation of magnesium intake (energy-adjusted) with the depression score (β: $-$0.11; 95% CI: $-$0.16, $-$0.05), but no relation with the

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
						prevalence of depressive symptoms
Jeffery *et al.* [29]	Telephone survey, USA, cross-sectional design	4655 women aged 40–65 years enrolled in the Group Health Cooperative	FFQ, 30 items, not validated (developed based on a validated 60-item FFQ)	Brief PHQ, nine items, potential score of 0–27	Energy intake, BMI	Mean (SD) frequency of consumption: 1.77 (1.33) times/day for high-calorie sweets[f)]; 7.11 (2.78) times/day for high-calorie nonsweets[g)]; 2.81 (1.25) times/day for low-calorie foods[h)]. Mean score (SD) of brief PHQ: 5.1 (4.7). Significant positive relation of high-calorie sweets with brief PHQ score (β: 0.012; $p<0.01$). Significant inverse relation of high-calorie nonsweets (β: -0.018; $p<0.01$) and low-calorie foods (β: -0.027; $p<0.001$) with brief PHQ score
Case-control design						
Browne *et al.* [30]	Survey, New Zealand, case-control design	80 first-time mothers (41 with postnatal depression[b)] and 39 without postnatal depression), no mention for matching strategy	FFQ, number of items not shown, not validated. Dietary assessment conducted during pregnancy	EPDS, 10 items, potential score of 0–30. BDI, 21-items, potential score of 0–63	Household income, current breastfeeding	85% reported consumption of fish. No relation of consumption frequency of fish with the risk of postnatal depression
Prospective cohort design						
Hakkarainen *et al.* [31]	Alpha-Tocopherol, Beta-Carotene Cancer Prevention Study, Finland, 1985–1994, prospective cohort design (6-year follow-up)	27 111 male smokers aged 50–69 years (at baseline) participating in an intervention trial	DHQ, 276 items, baseline only, previously validated against DRs	Self-report of depressed mood (one item). Hospital treatment due to depressive disorder derived from the National Hospital Discharge Register	Baseline age, BMI, energy intake, serum total and high-density lipoprotein cholesterol levels, consumption of alcohol, education, marriage, self-reported anxiety, self-reported depression, smoking	Mean (SD) dietary intake (energy-adjusted): 39 g/day for fish; 0.5 g/day for n-3 PUFA from fish; 1.7 g/day for n-3 PUFA from vegetables; 2.1 g/day for total n-3 PUFA. Incidence of depression: 32% defined by self-report and 0.9% defined by discharge register. No relation of intake (energy-adjusted) of fish, n-3 PUFA from fish, n-3 PUFA from vegetables, or total n-3 PUFA with the risk of depression defined by self-report or discharge register
Jacka *et al.* [32]	Geelong Osteoporosis Study, Australia, 1994–2001,	Randomly selected community sample of women ($n=755$; aged 23–97 years)	FFQ, number of items not shown, not validated. Assessment	Self-report of depression based on DSM-IV criteria	Age, weight, smoking status	Mean (interquartile range) intake of n-3 PUFA (crude): 0.11 (0.05–0.22) g/d. 12.9% identified as depressed. No difference in

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
	prospective cohort design (6-year follow-up)		conducted at baseline, 2-, 4-, and 6-year follow-up and the average value used			n-3 PUFA intake (crude) between depressed and non-depressed women
Tolmunen *et al*. [33]	Kuopio Ischemic Heart Disease Study, Finland, 1984–2000, prospective cohort design (13-year follow-up)	2313 men aged 42–60 years	4-d DRs, baseline only	Discharge diagnosis of depressive disorder during the follow-up period obtained by computer linkage to the national hospital discharge resister	Age, examination center, current SES, baseline HPLDS score, intake (energy-adjusted) of fiber, vitamin C, total fat	Mean (SD) dietary intake (energy-adjusted): 256 (76) μg/day for folate and 9.5 (9.5) μg/day for vitamin B-12. Incidence of depression: 2%. Significantly higher risk of depression among those below the median of folate intake (energy-adjusted) than those above the median (OR (95% CI): 2.53 (1.17, 5.48)). No relation of vitamin B-12 intake (energy-adjusted) with the risk of depression
Miyake *et al*. [34]; Miyake *et al*. [35]; Murakami *et al*. [36]	Osaka Maternal and Child Health Study, Japan, 2001–2003, prospective cohort study (diet during pregnancy and postpartum depression)	865 women during pregnancy at baseline	DHQ, 150 items, previously validated against DRs and urine and serum biomarkers	EPDS, ten items, potential score of 0–30	Age, gestation, parity, cigarette smoking, family structure, occupation, family income, education, changes in diet in the previous one month, season in which baseline data were collected, BMI, time of delivery before the second survey, medical problems in pregnancy, baby's sex, baby's birth weight. For dietary glycemic index and glycemic load, intake of n-3 PUFA and riboflavin (energy-adjusted)	Mean (SD) dietary intake (energy-adjusted): 48 (28) g/day for fish; 2.3 (0.8) g/day for n-3 PUFA; 0.2 (0.2) g/day for EPA; 0.3 (0.2) g/day for DHA; 11.0 (2.9) g/day for n-6 PUFA; 286 μg/day for folate; 5.7 μg/day for vitamin B-12; 1.0 mg/day for vitamin B-6; 1.4 mg/day for riboflavin; 63.9 (3.9) for dietary glycemic index (crude); 80.1 (12.1)/1000 kcal for dietary glycemic load. 14% classified as having postpartum depression (EPDS $\geq$9). No relation of dietary intake (energy-adjusted) of fish, n-3 PUFA, EPA, DHA, n-6 PUFA, ratio of n-3 to n-6 PUFA, total fat, SFA, MUFA, cholesterol, LA, ALA, arachidonic acid, meat, egg, dairy products, folate, vitamin B-12, vitamin B-6, riboflavin, dietary glycemic index, or glycemic load with postpartum depression
Sanchez-Villegas *et al*. [37]	SUN (Seguimiento Universidad de Navarr[a)] cohort study, Spain,	7903 university graduates without physician-	FFQ, 136 items, baseline only, previously	Self-reported physician diagnosis of	Age, gender, incapacitating disease at baseline, energy intake, physical	Median (10th–90th percentiles) dietary intake (energy-adjusted): 0.87 (0.39–1.89) g/day for long

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
	1999–2006, prospective cohort design (2-year follow-up)	diagnosed depression at baseline	validated against DRs	depression, anxiety, or stress or use of antidepressant medication or tranquilizers during follow-up	activity during leisure time, change in physical activity since baseline	chain n-3 PUFA and 83 (36–162) g/day for fish. Incidence of mental disorders of 6.5%. No relation of long chain n-3 PUFA or fish intake (energy-adjusted) with mental disorders
Bots *et al.* [38]	Finland, Italy and the Netherlands Elderly Study, 1989–1995, prospective cohort design (5-year follow-up)	526 non-demented and non-depressed European men aged 70–89 years at baseline	DHI, baseline only	ZSDS, 20 items, potential score of 20–80	Age	Mean baseline dietary intake (SD) in non-depressed and depressed men (crude): 9739 (2445) and 10023 (2689) kJ/day for energy, 90.9 (29.1) and 90.9 (35.1) g/day for total fat, 14.3 (8.5) and 12.1 (6.5) g/day for PUFA, 36.5 (18.0) and 38.1 (24.8) g/day for SFA, and 282 (152) and 309 (203) mg/day for cholesterol, respectively. Incidence of depressive symptoms (ZSDS $\geq$48) of 11%. No relation of intake of energy, fat, SFA, PUFA, or cholesterol (crude) with depressive symptoms
Astorg *et al.* [39]; Astorg *et al.* [40]	SU.VI.MAX Study, France, 1994–2002, prospective cohort design (8-year follow-up)	1864 adults participating in an intervention trial (809 men aged 45–60 years and 1055 women aged 35–60 years at baseline)	6 $\times$ 24-h DRs collected during the first 2 years of follow-up	Self-report of antidepressant or lithium prescription during follow-up	Age, intervention group, family status, education level. For fatty acids and fish, also tobacco use. For folate, also socio-professional category, total energy intake	Mean intake (SD) of fish and seafood (crude), EPA+DPA+DHA (energy-adjusted), and folate (crude): 49 (35) g/day, 0.20 (0.15) % energy, and 342 (94) μg/day for men without any depressive episode, 49 (35) g/day, 0.18 (0.13) % energy, and 350 (109) μg/day for men with a single depressive episode, 34 (30) g/day, 0.18 (0.16) % energy, and 282 (87) μg/day for men with recurrent depressive episodes, 39 (29) g/day, 0.21 (0.16) % energy, and 289 (85) μg/day for women without any depressive episode, 37 (30) g/day, 0.21 (0.17) % energy, and 286 (93) μg/day for women with a single depressive episode, and 39 (34) g/day, 0.22 (0.21) % energy, and 297 (114) μg/day for women with recurrent depressive episodes, respectively. Occurrence of a single and

Table 1. Continued

References	Study	Subjects	Dietary assessment	Depressive symptom assessment[a)]	Adjustment for potential confounders	Main findings
						recurrent depressive episodes: 6 and 4% for men and 12 and 9% for women, respectively. Significant inverse relation of fish and seafood intake (crude) with the risk of recurrent depressive episodes (OR (95% CI) for the highest tertile compared with the lowest: 0.39 (0.16, 0.97); p for trend = 0.03), but not with the risk of any depressive episodes or a single depressive episode, in men. No relation of fish and seafood with depressive episodes in women. No relation of EPA+DPA+DHA intake (energy-adjusted) with depressive episodes in either sex. Significant inverse relation of folate intake (crude) with the risk of recurrent depressive episodes (OR (95% CI) for the highest tertile compared with the lowest: 0.25 (0.06, 0.98); p for trend = 0.046), but not with the risk of any depressive episodes or a single depressive episode, in men. No relation of folate with depressive episodes in women

ALA, alpha-linolenic acid; β, regression coefficient; BDHQ, brief diet history questionnaire; BDI, Beck Depression Inventory; CES-D, Center for Epidemiologic Studies Depression Scale; CI, confidence interval; DASS-21, Depression, Anxiety and Stress Scales (21-item version); DHA, docosahexaenoic acid; DHI, diet history interview; DHQ, diet history questionnaire; DPA, docosapentaenoic acid; DR, dietary record; DSM, diagnostic and statistical manual; EPA, eicosapentaenoic acid; EPDS, Edinburgh Postnatal Depression Scale; ETA, eicosatetraenoic acid; FFQ, food frequency questionnaire; GDS, Geriatric Depression Scale; HAD, hospital anxiety and depression; HPLDS, Human Population Laboratory Depression Scale; HSCL, Hopkins symptom checklist; LA, linoleic acid; OR, odds ratio; OTA, octadecatetraenic acid; PHQ, Patient Health Questionnaire; SE, standard error; SES, socioeconomic status; SF-36, Short Form Health Survey 36; SFA, saturated fatty acid; YAQ, Youth and Adolescent food frequency Questionnaire; ZSDS, Zung Self-rating Depression Scale

a) A higher score indicated a more depressed mood, unless otherwise indicated.

b) Mothers with a score of ≥9 on EPDS or a score of ≥10 on BDI classified as depressed.

c) Including instant noodles and frozen, canned, or microwave foods.

d) Including anything from a fast food restaurant.

e) Including potato chips, corn chips, and tortilla chips.

f) Including cake, chocolate, cornbread, sweetened soda, and sweetened fruit drinks.

g) Including French fries, potato salad, spaghetti, buttered bread, chips, mayonnaise, hamburger, steak, beef stew, fried chicken, fried fish, pork, eggs, margarine, lunch meat, bacon, butter, cheese, and whole milk.

h) Including orange juice, green salad, roast chicken, baked fish, low-fat milk, and cold cereal.

Table 2. Distribution of studies on the relation between dietary intake and depressive symptoms by type of finding[a)]

	Men						Women						Men and women not separated					
	Studies showing significant positive associations		Studies showing null associations		Studies showing significant inverse associations		Studies showing significant inverse associations		Studies showing significant inverse associations		Studies showing null associations		Studies showing null associations		Studies showing significant positive associations		Studies showing significant positive associations	
	n	Reference[b)]	*n*	References[b)]	*n*	References[b)]	*n*	Reference[b)]	n	Reference[b)]	n	Reference[b)]	n	Reference[b)]	n	Reference[b)]	n	Reference[b)]
Energy	0		0		2	[11, 38]	0		0		1	[11]	0		0		0	
Fat	0		0		2	[11, 38]	0		0		2	[11, 34]	0		0		1	[21]
SFA	0		0		1	[38]	0		0		1	[34]	0		0		1	[21]
MUFA	0		0		0		0		0		1	[34]	0		0		1	[21]
PUFA	0		0		1	[38]	0		0		0		0		0		1	[21]
n-3 PUFA	0		0		3	[20, 26, 31]	0		0		4	[20, 26, 32, 34]	0		1	[12]	0	
ALA	0		0		1	[26]	0		0		2	[26, 34]	0		1	[12]	0	
OTA	0		0		0		0		0		0		0		0		1	[12]
ETA	0		0		0		0		0		0		0		0		1	[12]
EPA	0		0		1	[26]	0		0		2	[26, 34]	0		0		1	[12]
DPA	0		0		0		0		0		0		0		0		1	[12]
DHA	0		0		1	[26]	0		0		2	[26, 34]	0		0		1	[12]
EPA+DHA	0		1	[18]	0		0		0		1	[27]	0		0		1	[12]
EPA+DPA+DHA	0		0		1	[39]	0		0		1	[39]	0		0		0	
n-3 PUFA from fish	0		0		1	[31]	0		0		0		0		0		2	[22, 37]
n-3 PUFA from vegetables	0		0		1	[31]	0		0		0		0		0		0	
n-6 PUFA	0		0		0		0		0		1	[34]	0		0		0	
LA	0		0		0		0		0		1	[34]	0		0		0	
arachidonic acid	0		0		0		0		0		1	[34]	0		0		0	
Ratio of n-3 to n-6 PUFA	0		0		0		0		0		1	[34]	0		0		0	
Cholesterol	0		0		1	[38]	0		0		1	[34]	0		0		1	[21]
Carbohydrate	0		0		0		0		0		0		0		0		1	[21]
Sucrose	0		0		1	[11]	0		0		1	[11]	0		0		0	
Dietary fiber	0		0		0		0		0		0		0		1	[21]	0	
Dietary glycemic index	0		0		0		0		0		1	[36]	0		0		0	
Dietary glycemic load	0		0		0		0		0		1	[36]	0		0		0	
Thiamin	0		0		0		0		0		0		0		0		1	[21]
Riboflavin	0		0		2	[10, 26]	0		0		2	[26, 35]	0		1	[21]	0	
Niacin	0		0		0		0		0		0		0		0		1	[21]
Vitamin B-6	0		0		5	[10, 11, 19, 20, 26]	0		0		4	[11, 20, 26, 35]	0		1	[25]	0	
Vitamin B-12	0		0		6	[10, 11, 19, 20, 26, 33]	0		0		4	[11, 20, 26, 35]	0		0		0	
Folate	0		4	[10, 26, 33, 40]	3	[11, 19, 20]	0		0		5	[11, 20, 26, 35, 40]	0		0		0	
Vitamin C	0		0		0		0		0		0		0		0		1	[21]
Vitamin A	0		0		0		0		0		0		0		1	[21]	0	
Vitamin D	0		0		1	[11]	0		0		1	[11]	0		0		0	
Calcium	0		0		1	[11]	0		0		1	[11]	0		0		0	
Magnesium	0		0		0		0		0		0		0		1	[28]	0	
Iron	0		0		1	[11]	0		0		1	[11]	0		0		1	[21]
Iodine	0		0		0		0		0		0		0		0		1	[21]

Table 2. Continued

	Men					Women					Men and women not separated				
	Studies showing significant positive associations		Studies showing null associations		Studies showing significant inverse associations		Studies showing significant inverse associations	Studies showing significant inverse associations		Studies showing null associations		Studies showing null associations	Studies showing significant positive associations		Studies showing significant positive associations	
	n	Reference[b)]	*n*	References[b)]	*n*	References[b)]	*n*	Reference[b)]	n	Reference[b)]	n	Reference[b)]	n	Reference[b)]	n	Reference[b)]
Isoflavone	0		0		0		0		0		0		0		1	[21]
Fish	0		2	[23, 39]	2	[13, 31]	0		1	[13]	4	[27, 30, 34, 39]	0		4	[7, 8, 9, 14]	3	[17, 21, 37]
Meat	0		0		0		0		0		1	[34]	0		0		0	
Egg	0		0		0		0		0		1	[34]	0		0		0	
Dairy products	0		0		0		0		0		1	[34]	0		0		0	
Fruit	0		0		1	[11]	0		0		1	[11]	0		1	[24]	2	[17, 21]
Vegetables	0		0		1	[11]	0		0		1	[11]	0		1	[21]	1	[17]
High-calorie sweets[c)]	0		0		0		1	[29]	0		0		0		0		0	
High-calorie nonsweets[d)]	0		0		0		0		1	[29]	0		0		0		0	
Low-calorie foods[e)]	0		0		0		0		1	[29]	0		0		0		0	
Ready-to-eat food[f)]	0		0		0		0		0		0		1	[24]	0		0	
Snack food[g)]	0		0		0		0		0		0		0		0		1	[24]
Fast food[h)]	0		0		0		0		0		0		1	[24]	0		0	
Tea	0		0		0		0		0		0		0		1	[17]	0	
Coffee	0		0		0		0		0		0		0		0		1	[17]
Soft drinks	1	[11]	0		0		0		0		1	[11]	0		0		0	

ALA, alpha-linolenic acid; DHA, docosahexaenoic acid; DPA, docosapentaenoic acid; EPA, eicosapentaenoic acid; ETA, eicosatetraenoic acid; LA, linoleic acid, OTA, octadecatetraenic acid; SFA, saturated fatty acid

a) Studies investigating dietary patterns [15, 16] not included.

b) References in square brackets: prospective cohort design; references in parentheses: case-control design; others: cross-sectional design.

c) Including cake, chocolate, cornbread, sweetened soda, and sweetened fruit drinks.

d) Including French fries, potato salad, spaghetti, buttered bread, chips, mayonnaise, hamburger, steak, beef stew, fried chicken, fried fish, pork, eggs, margarine, lunch meat, bacon, butter, cheese, and whole milk.

e) Including orange juice, green salad, roast chicken, baked fish, low-fat milk, and cold cereal.

f) Including instant noodles and frozen, canned, or microwave foods.

g) Including anything from a fast food restaurant.

h) Including potato chips, corn chips, and tortilla chips.

on n-3 long-chain PUFAs, almost all studies showed no association. Several papers ($n = 1$–7) investigated other nutrients such as vitamins, minerals, and isoflavones, with particular focus on folate and other B vitamins, but again almost all studies showed no association, with the exception for folate in men. Four articles reported a significant inverse relation between folate intake and depressive symptoms, while no association was observed in three. Several studies ($n = 1$–7) investigated a wide range of foods, but again almost all studies showed no association, with the exception of fish: seven articles (two in men, one in women, and four in men and women combined) reported a significant inverse relation of fish intake with depressive symptoms, while nine (two in men, four in women, and three in men and women combined) observed no association.

4 Discussion

In the present review, we systematically reviewed observational studies investigating the association between dietary intake and depressive symptoms in free-living humans (23 cross-sectional, 10 prospective cohort, and 1 case-control studies). The studies varied in the number and age of subjects, dietary assessment method used, and depressive symptom assessment applied. The most frequently investigated dietary variables included long-chain n-3 PUFAs, fish, folate, and other B vitamins. Most studies showed no association between dietary variables and depressive symptoms. However, most studies included at least one important methodological limitation, such as no inference for causality (*i.e.* in a cross-sectional study, since the exposure (*e.g.* diet) and outcome (*e.g.* depression) are measured at the same time, it is not possible to say which is cause and which is effect), unreliable or rough assessment of diet or depressive symptoms, inadequate treatment of potential confounding factors, and ignorance of the possible mediating or confounding influence of other dietary variables. Thus, firm conclusions regarding the association between dietary intake and depressive symptoms cannot be drawn at present. The present review, to our knowledge the first systematic review of observational studies on diet and depressive symptoms, may nevertheless be useful for future research on this important topic.

Although a meta-analysis of these studies would have been interesting, our review showed that the number of observational studies is relatively limited, with only one to seven studies for each dietary variable. Additionally, the reliability of meta-analyses depends the homogeneity of the subjects examined and methods used, which the existing research does not necessarily provide. We therefore consider that it is too early to conduct a meta-analysis of observational studies on dietary intake and depressive symptoms.

When comparing or summarizing the results of several studies, consideration should be given to differences among study subjects and in the methods used. Because depressive symptoms are difficult to define, the studies reviewed here defined them using a variety of methods, including discharge diagnosis, established scale, and self-reported information. More importantly, several articles relied on self-reported information without any validity investigation. These differences in the assessment of depressive symptoms may have influenced the results on these studies. Additionally, because most of the established scales were validated with clinical depressed patients, these may not be suitable for measuring mood in non-depressed participants. Further, some of the scales were designed for measuring anxiety as well as depressed mood. Efforts for developing scales on depressive symptoms suitable for epidemiologic research on healthy persons may be needed.

Dietary assessment methods also varied among studies. Most of the articles examined used relatively accurate methods such as dietary records, diet history interviews, and validated dietary questionnaires. Several articles used less accurate methods, however, such as non-validated dietary questionnaire. These differences in dietary assessment method may also have impacted the results of the association between dietary intake and depressive symptoms.

The misreporting of dietary intake, particularly by overweight subjects, is a serious problem in self-report dietary assessment [41]. Nevertheless, evidence suggests that error by misreporting can be cancelled by energy adjustment, at least in part [42, 43]. About 60% of the present studies used non-energy adjusted values, however, and further research using energy-adjusted dietary intake values is needed.

Although many studies controlled for well-known confounding factors, few took account of potential confounding or mediating dietary intake variables. More importantly, while there appear to be sex differences in the association between dietary intake and depressive symptoms (*i.e.* folate), analyses in the 60% (12 out of 20) of studies, which included both men and women were conducted with both sexes combined. Further research on this area should be conducted in men and women separately.

Although most of the studies reviewed were cross-sectional in nature (70%), the lack of association between dietary variables and depressive symptoms in most of both the cross-sectional and prospective cohort studies suggested that the overall results of this review were not materially affected by study design. Nevertheless, because a cross-sectional design hampers the drawing of conclusions on causal inferences between diet and depressive symptoms, further research with prospective cohort designs are needed.

In the present review, because the literature search was limited to only one database (PubMed), with a manual check of the reference lists of the included papers, articles appearing in journals not included in PubMed or in languages other than English were not identified. Additionally, research with negative results may likely remain unpublished (publication bias).

In conclusion, our systematic review identified only a limited number of observational studies investigating the

association between dietary intake and depressive symptoms (23 cross-sectional, 10 prospective cohort, and 1 case-control studies). The number and age of subjects, and the dietary and depressive symptom assessment methods used varied among studies. Dietary variables most frequently investigated included long-chain n-3 PUFAs, fish, folate, and other B vitamins. Most studies showed no association between dietary variables and depressive symptoms. However, most studies included at least one of important methodological limitation, such as no inference for causality, unreliable or rough assessment of diet or depressive symptoms, inadequate treatment of potential confounding factors, and ignorance of the possible mediating or confounding influence of other dietary variables. Given that the relationship between eating and mood is quite complex, and that food intake pattern reflects complex interrelations and interactions among the individual, the culture, and the society in which people live [2], firm conclusions regarding the association between dietary intake and depressive symptoms cannot be drawn at present. Because intervention trials are usually conducted in depressive patients rather than healthy persons, these inevitably provide information for treatment but not for prevention. Conversely, observational studies among healthy people provide information for prevention. Thus, further evidence from well-designed observational studies is required to confirm or refute the association between dietary intake and depressive symptoms in free-living settings.

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