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DEPRESSIVE SYMPTOMS ARE ASSOCIATED WITH FOOD INSUFFICIENCY AND NUTRITIONAL DEFICIENCIES IN POOR COMMUNITY-DWELLING ELDERLY PEOPLE

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Abstract: Depression is associated with nutritional deterioration in older persons and is highly prevalent among people of low socioeconomic status (LSES). *Objectives:* To determine the prevalence of depressive symptoms and food insufficiency, and to examine the relationship between dietary intake, food insufficiency and depression, in LSES community dwelling elderly. *Design:* Cross-sectional study. *Setting:* Lod, a town in the central Israel. *Participants:* Community-dwelling welfare recipients aged 60 to 92. *Measurements:* Depression was assessed by 15-item Geriatric Depression Scale (GDS-short version), using a score ≥ 10 as the cut off point for clinically important depressive symptoms. Dietary intake was evaluated using a 24-hour dietary recall. Food insufficiency was defined by participants reporting that they did not have enough food to eat "sometimes" or "often". *Results:* This study reports on 112 persons aged 60 years and above (27.1% men). The prevalence of depression in this population was 47%; 25% of the study sample was classified as "food insufficient". Macronutrients intake was similar for depressed and non-depressed persons, except for polyunsaturated fats which was lower among the depressed group (7.9±4.9 vs.11.0±7.5 g/day in the non-depressed, p=0.03). Vitamins and minerals intake was lower than recommended for both groups; vitamin E intake was associated with depression. In regression models controlling for confounding variables, an increase of 1 mg in vitamin E intake and 1 gram in polyunsaturated fatty acids (PUFA) intake was associated with lower risk for depression (OR=0.73, p=0.008 and OR=0.86, p=0.007 respectively) Participants who reported food insufficiency were 10 times more likely to be depressed compared with those who reported sufficient food. *Conclusions:* Given the evaluated adverse association between depressive symptoms and food insufficiency, more efforts are needed to guarantee adequate food intake, particularly foods rich in vitamin E and PUFA, in poor elderly people. Further studies are needed to clarify the temporal relationship between the emotional and nutritional domains in this vulnerable population.

Key words: Depressive symptoms, elderly, food insufficiency, vitamin E, polyunsaturated fatty acids.

Introduction

Although depression is less prevalent in older adults than among younger adults (1), its serious consequences such as higher risk of morbidity, suicide, decreased physical and cognitive functioning are associated with higher rates of mortality (2). Recent studies suggest that depression in the elderly can be predicted by "classical" risk factors such as illnesses, widowhood or physical dependency (3) as well as by more "modern" modifiable factors such as lack of physical activity or poor diet (4). Depressive symptoms are more prevalent in individuals with impaired nutritional status which is manifested in unintentional weight loss (5) and in those with decreased nutrient intakes and poor diet quality (6). Several studies showed that folate (7), vitamin B12 (8), vitamin B6 (9) and polyunsaturated fatty acids (PUFAs) (10) deficiencies are associated with depressive symptoms in older age. Moreover, intervention trials using folic acid supplements alone or in combination with vitamin B12 showed improved mood in patients with major depression (11, 12). Diet quality in turn, among the elderly is influenced by poor health status, impaired functional ability, social isolation and restricted financial resources (13, 14).

Food insufficiency is associated with deterioration in functional health and chronic diseases. Food insufficient elderly are at higher risk for low protein, calcium, vitamins A and B6 intake (15). Furthermore, a Canadian household survey among the general population (16) reported a 3.5 fold risk for major depression in food-insufficient compared with food-sufficient households.

Understanding the association between depression and modifiable factors such as poor dietary intake and diet quality or food insufficiency is important for focused nutritional and medical interventions and for the development of well-targeted community services for elderly people.

Since depression and nutritional status show a social slope (17) which is inherent in many populations, a study in a poor population may help to control for the socioeconomic confounding. Thus, our study aimed to examine depression, food insufficiency and dietary intake and the associations

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between them in community-dwelling elderly at low socioeconomic status (LSES).

Methods

Participants

The current study was conducted in the city of Lod, which is ranked by the Israeli Central Bureau of Statistics as town at intermediate-low socioeconomic status (rank 4 from of maximum 10) (18). At the time of the study, December 2003, the total population of the town was 66 800 inhabitants, 10% of whom were 65 years and older. Over 9% of the elderly were from LSES and received welfare benefits (comparing to 7.5% in the Israeli general population) (19).

A neighborhood cluster sample based on a list of welfare recipients was used to obtain a representative sample of older people.

Design

Cross-sectional study.

Measurements

The study was approved by the ethical committee of Soroka University Medical Center.

After signing an informed consent participants were interviewed at home by a trained interviewer. The questionnaire includes the following domains:

Depressive symptoms were evaluated by the 15-item Geriatric Depression Scale (GDS): a score of 10 or greater was shown to have 92% sensitivity and 89% specificity in differentiating depressed from non-depressed adults (20).

Cognitive status was assessed by a 30-question standardized version of the Mini-Mental State Examination (MMSE) (21): the MMSE score ranges from 0 to 30; a total score of less than 24 is used to indicate cognitive impairment.

Functional ability was measured by the Modified Barthel Index (MBI): the score ranges from zero to 100, where 0 represents being totally dependent and 100 totally independent (22,23).

Demographic characteristics were obtained from questions related to age, place of birth, years since immigration and education (years of schooling).

The prevalence of selected chronic conditions was determined by asking question "Has a doctor told you that you have diabetes, hypertension, anemia, hyperlipidemia, osteoporosis, cancer, stroke or myocardial infarction?"

Dietary intake was assessed by a 24-hour recall interview (24) which involved reporting of foods and beverages according to meal times with indication of the portion size consumed during 24 hours prior to 4 a.m. of the day before the interview. Energy intake was compared with the Estimated Energy Requirement (EER). Dietary intake of other nutrients intake was compared with the Estimated Average Requirement (EAR) or the Adequate Intake (AI) in order to determine the level of inadequacy (25).

Food insufficiency was evaluated by the question: "Over the past 12 months, did you have at home: (a) always enough food to eat and the kinds of food you wanted; (b) enough food to eat, but not always the kinds of food you wanted; (c) sometimes not enough food to eat; (d) often not enough food to eat". The question represents the USDA food sufficiency indicator used in dietary surveys (26) and has both external and face validity (27). Participants who answered (c) or (d) were classified as "food insufficient" and were asked for the reasons for not having enough food.

Eating- and digestive-related problems were assessed by using 10 questions from the Nutritional Risk Index (NRI) (28). The original NRI includes a list of 16 nutritional and health problems that may put the subject at nutritional risk: mechanics of food intake, prescribed dietary restrictions, morbid conditions affecting food intake, discomfort associated with the outcomes of food intake, and significant changes in dietary habits. To obtain information about swallowing and chewing problems, vomiting, avoidance of certain foods, constipation and diarrhea, trouble in the bowel, special diets, and conditions interfere with eating we used following yes/no questions: "Do you wear dentures?"; "Do you have any troubles with your bowels that make you constipated or gives you any diarrhea?"; "Do you have troubles biting or chewing any kind of food?"; "Did you have any trouble swallowing / nausea / vomiting at least 3 times on different days in the past month?"; "Do you have an illness or condition that interferes with your eating?"; "Are there any kinds of food that you don't eat because they disagree with you?" NRI items were analyzed separately as dichotomous (yes/no) variables.

Statistical analysis

Descriptive statistics of the study sample were used to summarize participant characteristics. Mann-Whitney U-test was used for comparison of two non-parametric means, differences in proportions were analyzed using Chi-square test. Bivariate Spearman's correlations were obtained for variables potentially appropriate for multivariate analysis.

In a multivariate logistic regression analysis, the outcome was the presence or absence of depression (according to GDS, cutoff point 10). The independent variables included nutrient intake variables of hypothesized interest such as daily intake of folic acid and PUFAs and food insufficiency. The covariates in the analysis were cognitive status, functional ability and history of myocardial infarction (MI). Adjusted odds ratios and their 95% confidence intervals (CI) were computed. The best model of the clinical relevance variables was determined by considering goodness of fit parameters, including -2 log likelihood differences and Nagelkerke's R^2.

All tests were two-tailed and statistical significance was defined as $p < 0.05$. The analyses were performed using the PASW Statistics 17.0 for Windows.

Results

Demographic and clinical characteristics of the study subjects

One hundred and twelve participants had complete data for all relevant variables and were included in our analysis (91.1% of the total study sample), 47.3 % (n = 53) of them were identified as depressed. The internal reliability of the GDS in this study was high (Cronbach's alpha = 0.79). Age, education, years since immigration and weight were similar in the depressed and non-depressed groups. No differences in rates of depression were detected between women and men (46.9% vs 48.4%, p-value=0.89).

Elderly people who were identified as depressed had poorer cognitive status and lower physical functioning scores than non-depressed study participants (Table 1). Additionally, no difference was found in history of selected health problems, except for myocardial infarction (24.5% among depressed vs. 10.2% among non-depressed, p-value=0.04), between the groups.

Table 1
Socio-demographic and health characteristics of the study sample [1,2]

Variable	Non-depressed n=59 (52.7%)	Depressed n=53 (47.3%)	P–value
Age, mean (SD)[3]	74.5 (6.6)	74.6 (7.8)	0.96
Male gender, n (%)	16 (27.1)	15 (28.3)	0.89
Education, years, mean (SD)	8.4 (4.7)	7.2 (4.8)	0.18
Less than 15 years since immigration, n (%)	18 (31.0)	11 (21.2)	0.24
Mini-Mental State Examination score, mean (SD)	22.9 (6.3)	20.4 (6.6)	0.02
Modified Barthel Index, mean (SD)	93.9 (14.8)	87.4 (16.5)	0.001
History of myocardial infarction, n (%)	6 (10.2)	13 (24.5)	0.04
Hyperlipidemia, n (%)	21 (35.6)	23 (43.4)	0.39
Diabetes, n (%)	12 (20.3)	17 (32.1)	0.16
Hypertension, n (%)	36 (61)	31 (58.5)	0.79
History of stroke, n (%)	4 (6.8)	5 (9.4)	0.61
History of cancer, n (%)	4 (6.9)	8 (15.1)	0.17
Anemia, n (%)	11 (18.6)	14 (26.4)	0.32
Osteoporosis, n (%)	12 (20.3)	17 (32.7)	0.14
Without mentioned chronic conditions, n (%)	12 (20.3)	6 (11.3)	0.19
Weight, mean (SD)	75.9 (16.5)	73.3 (15.5)	0.4

1. differences between means were tested by Mann-Whitney U- test; 2. differences between proportions were tested by Fisher exact χ^2 test; 3. SD – standard deviation

Depression and dietary intake

Macronutrients intake was compared between depressed and non-depressed participants as shown in Table 2. Mean daily energy intake was low in both groups, 1123.9 kcal for non-depressed and 1004.0 kcal for depressed participants. A statistically significant difference between the study groups was found only in the intake of polyunsaturated fatty acids (PUFA's): the intake of depressed elderly was lower than non-depressed (p-value = 0.03). More than 90% both non-depressed and depressed study participants reported inadequate energy and fiber intake; more than 60% of study participants reported protein intake below recommended levels.

A comparison of micronutrients intake between depressed and non-depressed participants is shown in Table 3 together with the EER, EAR or AI for older adults. Although more than 50% of study participants, both non-depressed and depressed, reported inadequate mean dietary intake of micronutrients, the intake of vitamin E (mean ±SD, 3.3 ±2.3 vs. 4.9 ±3.9) mg/day) and vitamin C (45.2 ±40.2 vs. 60.9 ±49.6) mg/day) was significantly lower among the depressed compared with non-depressed participants (p-values 0.01 and 0.02, respectively).

Table 2
Mean daily energy and macronutrient intake by presence of depressive symptoms with reference of EAR/AI (n=112)

Nutrients	EAR / AI	Non-depressed n=59 (52.7%)	Depressed n=53 (47.3%)	P-value[1]
Energy (kcal)	1900[2]	1123.9	1004.0	0.13
percentage with intake < EEA		98.3	98.1	0.94
Water (ml)	2600[4]	1194.2	1023.5	0.07
percentage with intake < AI		100.0	100.0	
Total protein (g/kg)	0.66[3]	0.63	0.62	0.72
percentage with intake < EAR		66.1	67.3	0.89
Total fat (g)	ND[5]	42.0	34.7	0.10
Saturated fat (g)	ND[5]	12.9	12.7	0.65
PUFA (g)	14.0[4]	11.0	7.9	0.03
percentage with intake < AI		100.0	100.0	
MUFA (g)	1.6[4]	14.2	11.1	0.09
percentage with intake < AI		0.0	1.9	
Cholesterol (mg)	ND[5]	183.0	155.9	0.86
Carbohydrates (g)	100.0[3]	146.8	135.7	0.28
percentage with intake < AI		23.7	34.0	0.23
Dietary fiber (g)	21.0[3]	12.3	11.1	0.17
percentage with intake < AI		93.2	90.6	0.61

1. Differences between means of nutrients daily intake according to presence of depressive symptoms were tested by Mann-Whitney U- test, $\alpha = 0.05$; 2. Estimated average daily energy allowance (EEA) for older adults (aged 70 and above); 3. Estimated average requirement (EAR) for older adults (aged 70 and above); 4. Adequate intake (AI); 5. Indicate value not determined

Depression and food insufficiency

A quarter of the total study participants reported food insufficiency during the last 12 months: 22.2% among women and 32.3% among men (p-value=0.27).

Figure 1 shows the prevalence of food insufficiency by depressive symptoms. The prevalence of food insufficiency was more than 4-fold higher among depressed (41.5%) compared to non-depressed (10.2%) study participants (p-value<0.001).

The most prevalent cause for food insufficiency were "difficulty to get to the market" for non-depressed elderly and "not enough money for food" for depressed participants. The absent of appetite was the second most common cause for non-depressed people, depressed elderly reported "difficulty to get to the market" as the second most common cause for food insufficiency.

Depression and eating- and digestive-related characteristics

Only one person (of the107 with valid data) had no problem associated with eating and digestion according to the selected items of NRI. The most frequent problem was lack of teeth (93.5%), the second was constipation or diarrhea (55%). Chewing was a problem for 50.5%, swallowing was a problem for 19.8%, vomiting for 13.5%, and nausea for 12.5% of

participants. Although, no difference between depressed and non-depressed participants in the number of mentioned eating and digestive problems was detected (data not presented), depressed participants reported significantly more diseases that interfere with their eating (57.7% vs. 39.0% in non-depressed, p-value=0.049) and more meals that were avoided (50.0% vs. 28.8% in non-depressed, p-value=0.02), these associations were not confounded by the presence of chronic conditions.

No difference in subjective appetite evaluation was detected between depressed and non-depressed, 12.6% of participants reported they have bad appetite or no appetite.

Table 3
Mean daily micronutrient intake by presence of depressive symptoms with reference of EAR/AI (n=112)

Nutrients	EAR/AI	Non-depressed n=59 (52.7%)	Depressed n=53 (47.3%)	P-value[1]
Iron (mg)	5[2]	6.2	11.2	0.35
percentage with intake < EAR		81.4	75.5	0.45
Calcium (mg)	1200[3]	432.4	416.2	0.71
percentage with intake < AI		98.3	100.0	0.34
Sodium (mg)	2300[4]	1953.1	1825.9	0.41
Potassium (mg)	4700[3]	1824.1	1631.5	0.13
percentage with intake < AI		100	98.1	0.29
Phosphorus (mg)	580[2]	714.2	680.7	0.35
percentage with intake < EAR		35.6	45.3	0.29
Zinc (mg)	6.8[2]	5.4	4.7	0.39
percentage with intake < EAR		76.3	81.1	0.53
Thiamin (mg)	0.9[2]	0.64	0.64	0.96
percentage with intake < EAR		91.5	81.1	0.11
Riboflavin (mg)	0.9[2]	0.97	0.98	0.58
percentage with intake < EAR		49.2	60.4	0.23
Niacin (mg)	11[2]	9.9	8.3	0.06
percentage with intake < EAR		71.2	83.0	0.14
Vitamin B6 (mg)	1.3[2]	0.99	0.91	0.34
percentage with intake < EAR		84.7	75.5	0.22
Vitamin B12 (µg)	2.0[2]	2.1	3.7	0.50
percentage with intake < EAR		61.0	67.9	0.45
Folic acid (µg)	320[2]	139.7	161.1	0.89
percentage with intake < EAR		100.0	90.6	0.02
Vitamin C (mg)	60[2]	60.9	45.2	0.02
percentage with intake < EAR		55.9	75.5	0.03
B-carotene	ND[5]	307.2	340.0	0.33
Vitamin A (µg)	500[2]	513.9	959.7	0.54
percentage with intake < EAR		52.5	58.5	0.53
Vitamin E (mg)	12[2]	4.9	3.3	0.01
percentage with intake < EAR		96.6	100.0	0.18
Magnesium (mg)	265[2]	172.2	152.8	0.24
percentage with intake < EAR		93.2	94.3	0.81
Copper (mg)	0.7[2]	0.89	0.93	0.49
percentage with intake < EAR		33.9	45.3	0.22

1. Differences between means of daily micronutrient intake according to presence of depressive symptoms were tested by Mann-Whitney test, $\alpha = 0.05$; 2. Estimated average requirement (EAR) for older adults (aged 70 and above); 3. Adequate intakes (AI); 4. Tolerable upper intake levels (UL) recommended; 5. Indicate value not determined

Association between depression, food intake and food insufficiency

In order to identify significant independent predictors of depression, variables that were related to depression in univariate analysis were examined using logistic regression models. They included food insufficiency, vitamin C intake, physical functioning and cognitive ability factors and history of MI. As vitamin E and PUFAs intakes were highly correlated (Spearman's r=0.86, p-value<0.001) they were not entered together into the regression model. Although folic acid, vitamin B12 or vitamin B6 intake were not related to depressive symptoms in the univariate analysis, existing evidence indicated their association with depression in aged persons, we therefore included them in the regression model analyses.

We then determined the model best fitted for examining depression associated parameters. Based on clinical relevance and taking into account issues of goodness of fit, including -2 log likelihood differences and Nagelkerke's R^2, we removed non-significant variables from the model namely; history of MI, vitamin C and vitamin B6 intakes. We obtained two equally well fitting logistic regression models (Table 4). The first describes the associations between vitamin E intake, food insufficiency and depression, and the second the relation between PUFAs intake, food insufficiency and depression; both models were controlled for folic acid and vitamin B12 intakes, cognitive and physical functioning.

In both models food insufficiency was associated with 10 fold risk of depression in comparison to the elderly who had enough food. As for dietary intake of specific nutrients, folic acid or vitamin B12 intakes were not associated with depression, however an increase of 1mg of vitamin E intake decreased the odds for depression by 27% (OR=0.73, 95%CI: 0.58-0.92)(Model 1). Similarly, an increase of 1 gram of PUFA intake decreased the odds for depression by 14% (OR=0.86, 95%CI: 0.81-0.97) (Model 2).

Figure 1
Food insufficiency in last 12 months among non-depressed and depressed participants (chi-square = 17.6, d.f.=3, p-value<0.01)

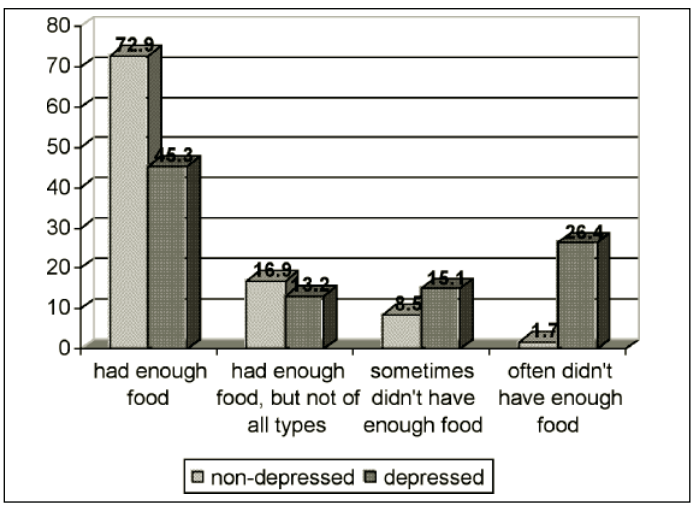

Table 4
Logistic regressions modeling variables associated with depression status (depressed versus non-depressed) elderly from a low socioeconomic population

Variables	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Vitamin E intake (mg/day)	0.73 (0.58-0.92), p=0.008	
PUFA intake (mg/day)		0.88 (0.81-0.97), p=0.007
Folate intake (μg/day)	1.01 (0.99-1.01), p=0.073	1.01 (0.99-1.01), p=0.08
Vitamin B12 intake (mg/day)	1.14 (0.89-1.46), p=0.31	1.09 (0.89-1.35), p=0.39
Food insufficiency	10.59 (3.04-36.9), p<0.001	10.34 (3.06-34.9), p<0.001
Cognitive ability (MMSE score)	0.94 (0.87-1.02), p=0.15	0.94 (0.86-1.02), p=0.13
Physical functioning (Modified Barthel Index)	0.97 (0.92-1.01), p=0.10	0.96 (0.92-1.01), p=0.09
-2 Log likelihood	109.3	110.9
Nagelkerke R^2	0.43	0.42

Discussion

In the present study of elderly persons we found that depressive symptoms are common among low socioeconomic subjects with an overall prevalence of 47% compared to a rate of 31.7% among physically disable older women (8) or 28% among elderly in short-term general hospitalization (29). The results of our study further support others findings that have shown strong negative association between dietary intake or eating patterns and depressive symptoms (30, 31). Our results highlight two aspects of nutritional status as being related to depression in the poor elderly population: general and specific nutrient intake and food insufficiency.

In the present study depressed participants reported lower intakes of polyunsaturated fatty acids (PUFAs), compared to non-depressed study participants. These findings echo those of Tiemeier (32) who reported significantly lower plasma levels of docosahexanoic acid (DHA) in depressed community-dwelling elderly than in non-depressed aged participants from the Rotterdam Study. It is important to emphasize, that even in this relatively food-insecure population we found the independent protective role of PUFA on depressive symptoms. The mechanism of the association is poorly understood, but there is a suggestion that the lipid composition of the human brain partially reflects dietary intake (33).

Although, serum levels of vitamin E were not related to depressive symptoms in older Rotterdam residents (34), depressed aged people in our study reported lower intake of vitamin E compared to non-depressed participants. Maes et al. (35) have found significantly lower serum vitamin E concentrations in persons with major depression, and suggested that lower levels of vitamin E indicate lower antioxidant defenses against lipid peroxidation, which is increased in major depression.

Similarly, serum vitamin C levels were found to be unrelated to depression in older people (the New Mexico Elder Health Survey) (36). We found that depressed study participants consumed less vitamin C than non-depressed participants. A recently published study by Binfare et al (37) showed that ascorbic acid administration produces an antidepressant-like effect.

At the same time, we found no associations between depressive symptoms and folic acid or vitamin B12 intake. Similar results were reported in the Zutphen Elderly Study (38), the New Mexico Elder Health Survey (36) and prospective European study (39). In contrast in the Rotterdam study (34) Tiemeier et al. reported an association between folate deficiency and depressive disorders due to physical comorbidity, and an independent association of vitamin B12 with depression.

Previous studies have documented association between depression and cognitive status or physical functioning (8,40) in elderly population. We however showed that in economically insecure community-dwelling elderly people the presence of depressive symptoms is associated mostly with food insufficiency rather than with other well-known variables such as age, gender, cognition and physical functioning. Our findings are in accordance with the opinion that food insecurity may affect mental and physical well-being either through changes in nutrient intake or may be independent of these changes (41) as we found in a multivariate risk, while controlling for other factors, a 10 fold increase in the OR for depression in food insecure elderly people.

Rose and Oliveira (15) have studied food insufficiency in the general US population and showed the strongest association between nutrient intakes and food insufficiency in the elderly. Thus the mean energy intake of aged persons from food-insufficient households was 58% of the recommended intake, food insufficient elderly individuals were significantly more likely to have low intakes of calcium, vitamins A, E, B6, B2, niacin and folic acid. Researches suggest that low caloric intake is a marker for decreased dietary intake in general and therefore places elderly persons at greater risk of nutrient inadequacy.

The high level of inadequate nutrient intake found in the present study may be partly due to the high percent of immigrants (26.4%) who have lived in Israel < than 15 years, which were included in the study sample. Immigration status is associated with social isolation, unfamiliarity with local foods; aged immigrants are frequently financially insecured, have less access to social care, food delivery programs and other social supporting networks resulting in reduced food choice and increased food insecurity.

The lack of association between weight and depressive symptoms may be explained by finding that more than 98% of both non-depressed and depressed study participants reported very low energy intake which was much below the recommendations. According to the previous studies (42,43), diets containing a low variety of energy-dense foods is associated with low energy intake and low body-mass index.

Findings from the present study may provide new insights into the relationship between depression and nutritional impairment in older adults. To our knowledge, this is the first study to investigate this relationship among aged LSES

population. The higher rate of food insecurity in depressed participants suggests that the relationship between depression and nutritional impairment may be in part explained by low quality of diet.

Some potential limitations of this study warrant comment. Because the sample in this study was limited to LSES older people with high prevalence of food insecurity, and people with low quality diet have higher rates of nutritional impairment, the association between depression and nutrition-related factors may not be generalizable to other elderly populations. Nevertheless, future work could investigate the association between depressive symptoms and nutrient intakes in older adults across levels of socioeconomic status. In addition, the significance of these results is limited by the cross-sectional nature of our data. Since a cross-sectional study does not differentiate between cause and effect, we cannot exclude the possibility that depression influences, by some biological or functional pathway, the nutritional habits. Further research based on longitudinal studies is needed to examine the causal association between nutritional impairment and depressive symptoms.

The stigmatization of mental illness and the cost of medication keep many older people from adhering to treatment of depression (44), therefore identification of modifiable factors that are associated with late-life depression can help support well-being of aged population.

Our findings highlight the potential significant public health implications of food insecurity on the mental health of aged population. Thus, surveillance of dietary intake may enable early detection and prevention of nutritional deficits. In addition, focusing greater attention on providing nutritional intervention programs for the elderly, particularly in lower SES, should be a priority among social services and public health professionals.

References

1. Hasin DS, Goodwin RD, Stinson FS, Grant BF. Epidemiology of major depressive disorder: results from the National Epidemiologic Survey on Alcoholism and Related Conditions. Arch.Gen.Psychiatry. 2005;5(10):1097-106
2. Blazer, D.G. Depression in late life: review and commentary. Focus. 2009;7(1):118-36.
3. Baldwin R, Chiu E, Katona C, Graham N, editors. Guidelines on depression in older people. practising the evidence. London: Martin Dunitz; 2002.
4. Rogers PJ. A healthy body, a healthy mind: Long-term impact of diet on mood and cognitive function. Proc Nutr Soc. 2007;60(01):135-43.
5. Morley JE. Anorexia, sarcopenia, and aging. Nutrition. 2001;17(7-8):660-3.
6. Benton D, Donohoe RT. The effects of nutrients on mood. Public Health Nutr. 1999;2(3A):403-9.
7. Alpert JE, Fava M. Nutrition and depression: The role of folate. Nutr Rev. 1997;55(5):145-9.
8. Penninx BW, Guralnik JM, Ferrucci L, Fried LP, Allen RH, Stabler SP. Vitamin B(12) deficiency and depression in physically disabled older women: Epidemiologic evidence from the Women's Health and Aging Study. Am J Psychiatry. 2000;157(5):715-21.
9. Hvas AM, Juul S, Bech P, Nexø E. Vitamin B6 level is associated with symptoms of depression. Psychother Psychosom. 2004;73(6):340-343.
10. Tanskanen A, Hibbeln JR, Tuomilehto J, Uutela A, Haukkala A, Viinamaki H, Lehtonen J, Vartiainen E. Fish consumption and depressive symptoms in the general population in Finland. Psychiatric Services. 2001;52(4):529-31.
11. Guaraldi GP, Fava M, Mazzi F, la Greca P. An open trial of methyltetrahydrofolate in elderly depressed patients. Ann Clin Psychiatry. 1993;5(2):101-5.
12. Reynolds E. Folic acid, ageing, depression, and dementia. Br Med J. 2002;324(7352):1512-5.
13. Payette H, Gray-Donald K, Cyr R, Boutier V. Predictors of dietary intake in a functionally dependent elderly population in the community. Am J Public Health. 1995;85(5):677-83.
14. Laraia BA, Borja JB, Bentley ME. Grandmothers, fathers, and depressive symptoms are associated with food insecurity among low-income first-time African-American mothers in North Carolina. J Am Diet Assoc. 2009;109(6):1042-7.
15. Rose D, Oliveira V. Nutrient intakes of individuals from food-insufficient households in the United States. Am J Public Health. 1997;87(12):1956.
16. Vozoris NT, Tarasuk VS. Household food insufficiency is associated with poorer health. J Nutr. 2003;133(1):120.
17. Lorant V, Croux C, Weich S, Deliege D, Mackenbach J, Ansseau M. Depression and socio-economic risk factors: 7-year longitudinal population study. Br J Psychiatry. 2007;190:293-8.
18. The Central Bureau of Statistics (Israel). http://www.cbs.gov.il [homepage on the Internet].
19. National Insurance Institute of Israel. www.btl.gov.il [homepage on the Internet].
20. Sheikh JI, Yesavage JA. Geriatric depression scale (GDS): Recent evidence and development of a shorter version. Clin Gerontol. 1986;5(1-2):165-73.
21. Folstein MF, Folstein SE, McHugh PR. Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12(3):189-98.
22. Mahoney FI, Barthel DW. Functional evaluation: The Barthel Index. Md State Med J. 1965;14:61-5.
23. Stroke Center at Barnes-Jewish Hospital and Washington University School of Medicine. http://www.strokecenter.org/ [homepage on the Internet].
24. Shai I, Rosner BA, Shahar DR, Vardi H, Azrad AB, Kanfi A, Schwarzfuchs D, Fraser D. Dietary evaluation and attenuation of relative risk: Multiple comparisons between blood and urinary biomarkers, food frequency, and 24-hour recall questionnaires: The DEARR study. J Nutr. 2005;135(3):573.
25. National Academy of Sciences. Institute of Medicine. Food and Nutrition Board. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. http://fnic.nal.usda.gov/ [homepage on the Internet].
26. Rose D, Oliveira V. Validation of a self-reported measure of household food insufficiency with nutrient intake data. Washington, DC: US Department of Agriculture. 1997:1-13.
27. Alaimo K, Briefel R, Frongillo Jr E, Olson C. Food insufficiency exists in the United States: Results from the third National Health and Nutrition Examination Survey (NHANES III). Am J Public Health. 1998;88(3):419-26.
28. Wolinsky FD, Coe RM, McIntosh W. Progress in the development of a Nutritional Risk Index. J Nutr. 1990;120(11 Suppl):1549-53.
29. German L, Feldblum I, Bilenko N, Castel H, Harman-Boehm I, Shahar DR. Depressive symptoms and risk for malnutrition among hospitalized elderly people. J Nutr Health Aging. 2008 May;12(5):313-8.
30. Bots S, Tijhuis M, Giampaoli S, Kromhout D, Nissinen A. Lifestyle-and diet-related factors in late-life depression-a 5-year follow-up of elderly European men: The FINE study. Int J Geriatr Psychiatry. 2008;23(5): 478-84.
31. Woo J, Lynn H, Lau W, Leung J, Lau E, Wong S, Kwok T. Nutrient intake and psychological health in an elderly Chinese population. Int J Geriatr Psychiatry. 2006;21(11):1036-43 .
32. Tiemeier H, van Tuijl HR, Hofman A, Kiliaan AJ, Breteler M. Plasma fatty acid composition and depression are associated in the elderly: The Rotterdam Study. Am J Clin Nutr. 2003;78(1):40-46.
33. Fernstrom JD. Can nutrient supplements modify brain function? Am J Clin Nutr. 2000;71(6):1669S-73S.
34. Tiemeier H, van Tuijl HR, Hofman A, Meijer J, Kiliaan AJ, Breteler MM. Vitamin B12, folate, and homocysteine in depression: The Rotterdam Study. Am J Psychiatry. 2002;159(12):2099-101.
35. Maes M, De Vos N, Pioli R, Demedts P, Wauters A, Neels H, Christophe A. Lower serum vitamin E concentrations in major depression another marker of lowered antioxidant defenses in that illness. J Affect Disord. 2000;58(3):241-6.
36. Lindeman RD, Romero LJ, Koehler KM, Liang HC, LaRue A, Baumgartner RN, Garry PJ. Serum vitamin B12, C and folate concentrations in the New Mexico Elder Health Survey: Correlations with cognitive and affective functions. J Am Coll Nutr. 2000;19(1):68-76.
37. Binfare RW, Rosa AO, Lobato KR, Santos AR, Rodrigues AL. Ascorbic acid administration produces an antidepressant-like effect: evidence for the involvement of monoaminergic neurotransmission. Prog Neuropsychopharmacol Biol Psychiatry. 2009; 33(3):530-40.
38. Kamphuis MH, Geerlings MI, Grobbee DE, Kromhout D. Dietary intake of B(6-9-12) vitamins, serum homocysteine levels and their association with depressive symptoms: The Zutphen Elderly Study. Eur J Clin Nutr. 2008;62(8):939-45.
39. Eussen SJ, Ferry M, Hininger I, Haller J, Matthys C, Dirren H. Five year changes in mental health and associations with vitamin B12/folate status of elderly Europeans. J Nutr Health Aging. 2002;6(1):43-50.
40. Patrick JH, Johnson JC, Goins RT, Brown DK. The effects of depressed affect on functional disability among rural older adults. Quality of Life Research. 2004;13(5):959-67.
41. Campbell CC. Food insecurity: A nutritional outcome or a predictor variable? J Nutr. 1991;121(3):408.
42. McCrory MA, Fuss PJ, Saltzman E, Roberts SB. Dietary determinants of energy intake and weight regulation in healthy adults. J Nutr. 2000;130(2):276.
43. Roberts SB, Hajduk CL, Howarth NC, Russell R, McCrory MA. Dietary Variety Predicts Low Body Mass Index and Inadequate Macronutrient and Micronutrient Intakes in Community-Dwelling Older Adults. Journals of Gerontology Series A: Biological and Medical Sciences. 2005;60(5):613.
44. Chapman DP, Perry GS. Depression as a major component of public health for older adults. Prev Chronic Dis. 2008;5(1):A22.