Depression in a healthy over-55 years old community-dwelling population: from prevalence to social-economic state, lifestyle and Nutrients – A population-based study

Mohammad Reza Shadmand Foumani Moghadam (mrsh13713@gmail.com)
Varastegan Institute for Medical Sciences https://orcid.org/0000-0001-7431-7869

Sharif Etemadi
Varastegan Institute for Medical Sciences

Sajedeh Jandari
Mashhad University of Medical Sciences

Mina Rashidipour
Varastegan Institute for Medical Sciences

Reyhane Bakhshipour
Varastegan Institute for Medical Sciences

Mohammad Amushahi
Varastegan Institute for Medical Sciences

Parnian Pezeshki
Varastegan Institute for Medical Sciences

Reza Rezvani (rezvanir@mums.ac.ir)
Mashhad University of Medical Sciences https://orcid.org/0000-0003-3585-9854

Zohreh Hosseini (hosseiniz@varastegan.ac.ir)
Varastegan Institute for Medical Sciences https://orcid.org/0000-0002-9811-7105

Research Article

Keywords: depression, lifestyle, nutrition, prevalence, aging

Posted Date: July 22nd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1531230/v2

Abstract

Background: The older adult population is increasing and depression is commonly observed within this community. This study is one of the firsts assessed depression and its risk factors in a healthy well-nourished over-55 years old population.

Method: Beck Depression Inventory-13 (BDI-13) was used to determine depression in 766 individuals. a full report of socioeconomic factors was gathered. Lifestyle and physical activity were assessed using Health Survey Questionnaire 36-Item Short-Form and International Physical Activity Questionnaire, respectively. The dietary nutrient intake was recorded using an adjusted dietary recall.

Result: A total of 58% of the population had mild to severe depression. The differences between depression groups for age, gender, SF-36 quality of life scores, and nearly all the social-economic factors were significant. females (OR=2.229 (95%CI:1.641-3.026), p<0.005) and higher age was associated with depression (OR=1.073 (95%CI:1.049-1.097), p<0.005). The impact of age, physical activity, having sport, economic level and smoking on depression were independent of all other factors. most nutrients and energy inversely associated with depression (protein (p=0.043), fiber (p=0.037), iron (p=0.041), vitamin B6 (p=0.011) and caffeine (p=0.009) was independent from the energy intake). The predictor decision tree model for depression according social-economic factors is also illustrated.

Conclusion: Depression can be prevalent in a nearly healthy population. Many factors can increase the risk of depression. Currently working in males and having sport, economical level, and living with someone in females were the main depression predictors. The impact of protein, fiber, iron, vitamin B6, and caffeine on depression was independent of energy intake.

Introduction

Depression is known as a complex mental condition. It is a treatable disorder that can negatively affect how people feel, think, and act (1-3). Evidence suggests depression significantly lowers people's performance during their day, which can negatively affect both qualities of life and health (1-3). Depression can occur at any age, but it is more common amongst teenagers and older adults (1, 2).

The relationship between depression and its risk factors is bi-directional (1, 3). In another word, the risk factors can elevate the risk of depression, and the resulted depression can affect its factors. In return, The affected factors increase the severity of the depression (1, 3). Some of the factors that can cause or exacerbate depression are ageing, social-economic status, and lifestyle quality, as well as environmental and personal factors like low self-esteem, experiencing violence, neglect, abuse, or poverty (4, 5). Additionally, previous literature has demonstrated the importance of overall dietary intake on the risk of depression (6, 7).

Despite the range of works on depression, the lack of sufficient studies that assess these factors in a healthy retirement age population is counting. There is low consideration to assess depression in healthy people that made mild to moderated levels of this disease undiagnosed for years (8). Retirement age is the time of change from an active schedule to an unscheduled lifestyle and experiencing the first major health issues even in healthy adults (8). Some of these experiencing issues during retirement are close to the risk factors of depression that can be linked to the high prevalence of depression and severe depression in older adults (6-8).

However, depression is a complex syndrome with several risk factors that may have temporary and permanent effects during the life stages (3). Assessment of depression in these healthy populations can have an important impact on early diagnosis and controlling this disorder in geriatrics.

To the authors' knowledge, there is no current data on the prevalence of depression in the over 55 years old community-dwelling well-nourished elderly healthy population. In addition, the predictors of depression to prevent or early diagnosis of depression in this population is still theoretical. To address these gaps in the literature, the authors performed this study to elucidate the effect of social-economic status, lifestyle, and dietary intake on depression in healthy older adults.

Material And Method

Data collection: The data was collected in two assessment centers; one at the Department of Nutrition assessment in Varastegan Institute for Medical Sciences and the other at a private nutrition clinic in Mashhad. This study was performed in collaboration with the Nutrition Department of Varastegan Institute for Medical Sciences, Welfare Organization of Khorasan Razavi Province, and Khorasan Razavi Retirement Association.

Population: The sample size was estimated by assuming the prevalence of depression to be 50% among retired aged population in Mashhad with confidence level of 95% (margin error: 3.5%). The data collection was performed through a random cluster sampling method in all 13-municipal areas of Mashhad-Iran. The inclusion criteria were the age of 55 or higher, currently living in one of the 13-municipal areas of Mashhad, lived in Mashhad during the last 20 years, and having no known mental and psychological health disorders and hospitalization during the last year. Excluding criteria were diagnosis of malnutrition using Mini Nutritional Assessment–Short Form (MNA®-SF), having any chronic diseases record which could elevate the risk of depression by an expert decision. This exclusion was made to make sure all the population included in the current study are as healthy as possible.

Questionaries: Demographic data (e.g., age, gender, sleep, living with, marital status, education, working situation) was recorded, and a short form of the Beck Depression Inventory (BDI-13) which was adjusted for the Iranian population, was used for assessment of their depression (9). BDI has shown to be a good instrument for surveying depression in community-based studies (10). According to the BDI-13 questionary with 0 to 39 scores, people with a

score less than 4 are non-depressed (control) and with scores of 5 to 7, 8 to 15, and more than 15 are categorized as mild, moderate, and severe depression, respectively. For lifestyle assessment, the Medical Outcomes Study Health Survey Questionnaire 36-Item Short Form (SF-36), which measures eight health-related quality of life domains, including physical functioning, role limitation because of physical problems, body pain, general health, vitality, social functioning, role limitation because of an emotional problem, and mental health by twelve criteria was used (11). All the criteria scored between zero and 100, and the reported health score was between -2 to +2. The financial states of each individual were determined according to the monthly income of the family in comparison with the normal expenses for an ordinary family in Iran by the time of assessment that the Iran National Bank published. In addition, International Physical Activity Questionnaire (IPAQ) was used to classify the individuals' physical activity into three groups with high, moderate, and low performance according to the instruction (12).

Nutritional intake assessment: Some general questions were recorded regarding the usual kind and frequency intake of grain, dairy, vegetable, fruit, and meat consumption, meals per day, special diet, or allergies. Then, according to the recorded data, the nutritional intake of each individual was recorded using the one-day recall method by a professional registered nutritionist and dietitian (RDN). This method is a common, short-time consumption method to evaluate the nutritional intake of a healthy population with no specific dietary intake change under special situations (13, 14). In this method, each individual was asked about the all-oral intakes of the last 24 hours, including all foods, drinks, and medicines during breakfast, lunch, dinner, before sleep, and the space between each. After observing the 1-day recalls, each individual's nutrient intake was observed using software designed for this purpose by summing the calculated nutrients of each food. The nutrients of each food are calculated based on the kind of food, the nutrient composite of each food, and the gram of consumed food using the same software. In this method, besides the one-day recall, to cover the biases and weaknesses of this method, the individuals were asked about their normal food consumption during the last years and the changes applied by an experienced registered nutritionist. The recalls were analyzed using the United States Department of Agriculture (USDA) food composite database, which was updated in December 2019 (https://fdc.nal.usda.gov) (15). The dietary intakes of nutrients were divided into individuals' weights (nutrients weight ÷ body weight) that were collected during the assessment with the accuracy of 100 grams. As a fact, weight plays the most important role in the quantity of daily foods consumption of individuals, and higher food intake results in higher nutrient intake (16). This division was made to remove the impact of weight on nutrients and its possible confounding effect on the impact of nutrients on depression.

Statistical analysis: All statistical analyses were performed using the software package IBM SPSS Statistics for Windows version 20.0 (IBM Co., Armonk, NY, USA). Homogeneity and adequacy of variances were assessed using Levene's test and Kaiser-Meyer-Olkin (KMO) and Bartlett's tests. After determining normality using the Shapiro-Wilk test, the comparison of continuous variables was ascertained using the One-Way analysis of variance (ANOVA) test or Mann-Whitney U Test (non-normal distribution). Chi-square test or Fisher's exact test were used for qualitative variables, and odds ratios (95% confidence intervals) indicated as OR between non-depressed (control) and depression groups (classified as mild, moderate, or severe) were obtained using binary logistic regression. Multivariate Analysis of covariance (ANCOVA) was used for adjusting multivariable analysis; stepwise regression analysis and Two-tailed Bivariate Correlation were used to assess the correlation (R) between BDI-13 Score and assessed variables. Decision tree is illustrated using CHAID (Chi-Square Automatic Interaction Detector) method. P-value 0.05 was considered statistically significant.

Result

From 766 individuals (65.14±6.84-year-old/ 256 male vs 510 female) who filled BDI-13, 322 (42%) of them didn't have depression (BDI-13 score=1.71±1.33); 254 (34%) individuals had mild (BDI-13 score=5.85±0.56), 131 (17%) moderate (BDI-13 score=10.50±2.33) and 59 (7%) of them had severe (BDI-13 score=19.47±3.22) depression.

The differences between depression groups for age, gender and nearly all the social-economic factors including current working condition, physical activity level, having sport activity, living with someone, education, marriage, economic level and smoking were significant between groups ($p<0.05$) without any adjustment (table-1). The findings indicated that females having higher OR of having one of three stages of depression than males (OR=2.229 (95% CI: 1.641-3.026), $p<0.005$) while higher age was directly associated with depression (OR=1.073 (95% ci: 1.049-1.097), $p<0.005$). Some people with specific educational degree (BSc, PhD), people living with wife

and children, and with higher income has lesser OR of depression while the OR is increased for those who are smoking and widowed.

After adjustment of all other factors, it seems the impact of age, physical activity level, having sport activity, economic level and smoking is independently from all other factors associated with the depression ($p<0.05$). From lifestyle indicators, the level of physical activity shows having higher levels of physical activity and having sport activities can negatively associated with depression independently from other factors (table-1). However, the difference for duration of sleep in these people was not significant before and after adjustment (figure-1).

The comparison between lifestyle quality indicators and depression according to SF-36 also shows the higher overall score of SF-36 questionnaire has negative impact depression which means the higher quality of life is associated with lesser risk of depression using this tool (OR=0.971 (95% CI: 0.963-0.979), $p<0.005$). The findings also show the OR of having depression ranging from 0.615 (95% CI: 0.502-0.754) in reported health score (the lowest) to 0.984 (95% CI: 0.979-0.989) in Role of Physical score (the highest) significantly ($p<0.005$).

Within nutrients intake, after dividing intakes to weight to understand the required metabolically intake, the findings of the current study show the overall higher intake of nearly all nutrients except copper, cholesterol and vitamin B12 has lower OR of depression. However, the relation only for protein ($p=0.043$), fiber ($p=0.037$), iron ($p=0.041$), vitamin B6 ($p=0.011$) and caffeine ($p=0.009$) was independent from the overall energy intake while the impact of other nutrients were dependent on the overall energy intake. the full report can be found in table-3. The very low OR can be explained by very small value of the variables which means these ORs can only use for the direction of the effect that reconfirmed in table-4.

The table-4 is showing the correlation between BDI-13 score and scaled variables which can confirm the findings. The strongest correlation was for SF-36 indicators that shows a moderate correlation while the weakest was related to nutrients intake that was significant but very week.

The decision tree (figure-1) also illustrated the impact of risk factors one depression. it seems working can be the best risk factor of depression in males while having any sport activity is more important in females. Within people who has sport, living with someone and in those who are not having sport, the level of income can predict the depression risk.

Discussion

This study is one of the first studies that assessed depression in a well-nourished over-55 years old population without any considerable disease. Generally, this idea that a healthy population is at low risk of depression prevents researchers from assessing the depression within this population. However, the current study's findings showed that the risk and prevalence of depression even in a healthy population can be notable. This study hazards regarding the high risk of depression in healthy populations as well as assessment of risk factors.

The overall findings show the impact of important dependent and independent risk factors on depression. The decision tree also provided a good insight to predict high depression risk populations for further studies; especially early diagnosis and preventing strategizing. The findings' suggested working is the best predictor for males while having sport, income and living with someone play important roles in females. However, in detail, there is more to consider.

Prevalence: In this healthy population, a total of 58% of population had one of three stages of depression. The reported prevalence in different countries was estimated to be about 1.5% in China to 15.2% in India before the pandemic, with a mean of 7% globally regardless of age (17, 18). However, this prevalence can be higher within the older adult population. As the result, one systematic review in 2019 estimated the prevalence of depression to be about 34.4% in the Indian 60 years old and above population (19). Another study in Brazil reported a prevalence of 11.1% and 25.6% for late-life depression and clinically significant depressive symptoms in individuals older than 70 years old (20).

High-quality population-based prevalence studies on the same population in Iran are not available. There is no recent data available to estimate the prevalence of depression in Mashhad either. However, one study in Yazd, Iran, reported a prevalence of 29% for depression in 2019 (11.1% mild, 12.2% moderate, and 6.9% severe depression) (21). Nevertheless, in a systematic review from 2001 to 2015 in Iranian people aged 50–90 years, the prevalence of severe depression and overall depression was estimated to be 8.2%, and 43%, indicating a close prevalence of depression with the current study (22).

The higher prevalence of depression in the current study can be explained by the special condition of Iranians in past few years. During the last few years, the political and negatively economic changes that were highly affected by the US sanction and political stands of the Islamic Republic government made a complicated condition (23, 24). The lower quality of life resulted from economic inflation, reduced purchasing power, liquidity reduction and livelihood problems can be the main reason of this level of depression (23, 24). In addition, By considering the impact of good and bad news on individuals, daily exposing of Iranians to more disappointing news provides a suitable condition to develop disappointment and depression (25, 26). However, the authors believe the findings of the current study encourage researchers to assess other healthy populations for depression and other mental health disorders.

Age: previous literature has established that increased age is one of the main risk factors for depression that reconfirmed with the current study (27-29). One of the newest hypotheses that can explain this situation can be brain aging (29, 30). In this thesis, when people stop routine activities, the brain may face some uncontrolled mental burdens including anxiety and worries. This pressure along with lowered annalistic power of brain generally leads to mental health disorders, especially depression (29, 30). Based on this new thesis, the effect of age on depression can be through brain aging, and the age itself may have no independent effect on mental health disorders (30). In this new hypothesis, keeping the mind active lowers the process of brain aging, mental disorders, and depression as a result (30). However it is thesis and more works specially trials are required.

Gender: In the current study, females had a significantly higher prevalence of depression when compared to males. The finding in different studies are varied; some studies suggested males (27, 31), and some others suggest females are at a higher risk of depression (18, 28, 32). The gender-related finding depends on the population, age, culture, and occupation change. The higher prevalence of depression in females in this population can be explained by the women's limitation in Islamic nations specially Iran that can lead to depression; limitation like systematic gender discrimination, hijab, religious patriarchy and considering lower value for females (33-35). However, this relation is not absolute and during the last few years, society started to provide more equality between genders (34).

Smoking: current smokers were at least 1.5 times more likely to be depressed in the current population while there was no different between those who never smoked or quit smoking. Smoking has always been a fixed risk factor in nearly all diseases, especially depression (36, 37). The relationship between smoking and depression can be bidirectional and we are not adding much to science (36). However, the findings can suggest quit smoking can be considering as a sign of lower depression.

Education and economic level: Generally, education and economic level have a direct relationship with each other, and people with higher educational levels are more likely to occupy better-income occupations (38, 39). In the current population, as was expected, people with higher income had a lower risk of depression as reported elsewhere (18, 40). The findings of current study shows having equal or higher income than expenses can have less prevalence of depression as previous finding reported Americans with less than 5000$ in savings are reported to be at a higher risk of depression (40). However, in the current study, there was no significant difference in the risk of depression between people with lower income or without income; but people with moderate- or higher-income levels have significantly 66% and 75% less OR of depression. In addition, income was the main predictor/risk factor within females who are not having any sport activity that shows the importance of this factor.

Despite the inverse relationship between educational level and the risk of depression (28, 40), the impact model of current study only was significant for PhD and BSc. Some reports suggest that the graduated population has a lower risk of depression than the under-graduated population that reconfirmed in the current study (18, 40). However, there was evidence that illiterate people are at the lowest risk of depression in other studies (21, 40). The best explanation for this factor can be related the impact of education on net income (38, 39).

Marriage and living with someone: The marital status is another indication of depression in current population. As expected, currently married people have a significantly lower prevalence than those who are widowed. The other studies' findings also confirmed that married people are at a lower risk of depression in comparison with people who had divorced, widowed, or never gotten married (18, 21, 27, 40). In addition to marriage the presence of family also can be effective in lowering the risk of depression (18, 27). Within the current study, people who currently living with their partner and children had a significant 40% lower OR of depression while this different was not significant for other categories. However, living with someone was the main depression predictor in females who has sport activity. These two simple findings show the importance of family and their presence in preventing depression.

Working and physical activity: The findings in the current population indicated that the effect of physical and sport activity on depression is independent of other factors. People who engage in higher physical activities are at a considerable lower OR of depression. The finding of previous studies also reported that inactive people were significantly at higher risk of depression (18, 28, 41). In addition, in the current population, people who had any sports activity ranging from swimming and volleyball to yoga and aerobics had a significantly lower OR of depression than the inactive population as previse findings (41). In addition, having sport was the first depression predictor within females that shows its impact.

Regarding working, There is evidence that people who are employed or currently working are at lower risk of depression (21, 28). The finding of the current study also showed that unemployed individuals are at higher OR

of depression compared with those who are working full-time or part-time. In addition, this factor was a main predictor of depression in males that shows importance of working in this group.

Life quality: The relationship between lifestyle factors including marital, economic, education, working, and physical activity status with depression are well established. To the authors' knowledge and online report of the World Health Organization (WHO), the SF-36 questionnaire is a good tool that considers physical function, general health, vitality, social, mental, and emotional function (11). In the current study, a 1% higher quality of life showed about 3.9% significantly lower OR of depression. The finding of other studies also reported the same inverse relationship between depression and higher quality of life (18, 21, 28, 40, 42). As evidence shows, this is one of the first studies that used this tool to score the populations' lifestyle in depression. As the result, authors suggest SF-36 can be easy to use, reliable, and a good tool to assess the quality of life in the depression risked populations that can consider all aspects of lifestyle quality. However, a validation study in this population is still required.

Diet and nutrition: In the current study, the nutrient intake was adjusted to the individual's weight to increase the efficacy and decrease the confounding effect. Weight is known as the main and the most effective component of BMR, and by this adjustment, a good comparison between groups was made that showed a more accurate effect of nutrient intake compared to the metabolic requirement of people (43). To the authors' knowledge, this study is the first study that used this method to study the relationship between nutrition with depression.

After adjustments, a significant difference had been found between the main nutrients such as water (g/kg), energy (Kcal/kg), protein (g/kg), carbohydrate and total lipid (g/kg) intake as well as most the micronutrients. However, the net energy intake of population was considerably lower than the standard (26 Kcal/kg VS 30 Kcal/kg) required energy (43). The lower energy intake in elderly populations was reported in previous studies either that conformed this situation is a trend in elderly (43-45).

Based on the findings, despite receiving overall lower energy intake than metabolically requirement, the lower intake of energy was associated with higher depression in this population. The findings regarding the energy intake in depression is varied. Despite some studies confirm the current study findings (46-49), some other reported a higher energy intake in depression groups (47, 50). It is also noted there was a trend to lower energy intake and malnutrition in depressed Iranians specially elderly population (48, 49). Nevertheless, the important of samples' populations age and culture also noted as the limitation for this varied finding (47).

The inverse association of most other dietary nutrients intake with depression in the current study can be explained by the impact of malnutrition with depression and the energy compound (46-50). Based on findings of the current study, higher intake of lipids, carbohydrates and most of their subcomponents were negatively associated with depression. Their impact was not independent from the energy intake indicating that their impact can be related to 4 Kcal/g and 9 Kcal/g energy density of carbohydrates and lipids (43). However, the previous studies reported higher carbohydrates intake specially sugars, simple carbohydrates, and starch as well as total lipids, saturated fats and cholesterol were associated with higher depression risk in all ages (6, 43, 51).

Protein was the most important macronutrient that independently was associated with depression in the current population confirming previous studies (43-45, 52, 53). The possible mechanism behind the anti-depressive impact of protein can be explained by amino acids. Based on evidences serotonin and norepinephrine that has tryptophan and tyrosine as the main components are confidentially associated to depression (54). However,

more works especially clinical trial with high-protein diet interventions are required to understand the practical impacts.

Caffeine was the other nutrient that was independently associated with depression. The impact of caffeine specially coffee consumption on lowering the risk of depression also indicated in the previous studies (43, 55). In addition to caffein, according to evidence, higher fiber intake (fruit and vegetable) can lower the risk of depression independently from other nutrients and energy that also reconfirmed in the current study (6, 7, 18, 43, 51).

From all minerals assessed within this study, only iron independently from energy intake was associated with depression. The result of one meta-analysis also indicates the inverse associations between dietary zinc and iron intake with the risk of depression that confirms findings of the current study (56). However, regarding minerals still more work required to make any firm conclusion (43, 57).

The information regarding impact of vitamins on depression also follows the same limitations as minerals. There was an independently significant difference between groups for vitamin B6 in this study that confirms previous reports (58, 59). Despite the relation of folate and vitamin D with depression were dependent to energy in current population, there are evidences that lower intake of these vitamins is associated with depression (57). In addition, promising findings regarding anti-depressive impact of vitamin D is reported several times (60).

The impact of food groups on body metabolism is through nutrients (43). Despite limited works based on nutrient, all studies agreed a healthy diet rich in fruits and vegetables, replacing red meats with white meats, and increasing the beans and lumen intake that is close to the Mediterranean diet can lower the risk of depression (6, 7, 18, 43, 51). As a main limitation, the impact of nutrients in studies using food patterns not assessed accurate. Food preparation process and density of nutrients can affect the dietary value of foods that should be considered as the other factor that may impact the results (43).

Suggestions, limitations, and strengths: The strengths of the current study are its accurate methodology, comprehensive report of a vast range of depression-related factors, and the big sample size that presents the overall healthy population of Mashhad, Iran, with a very low risk of biases between groups. As most studies categorize healthy populations as a low-risk group and do not assess them, this study is one of the first studies that evaluate a healthy population. Using a single BDI-13 questionnaire was the main limitation; however, this tools shown to be reliable in community-based studies (10). The other limitation was using a dietary recall instate of a Food Frequency Questionnaire (FFQ), but the main cause was decreasing the memory depending on such a detailed tool. However, tools limitation was covered by some specialized dietary questions about dietary habits and adjustments that were made by the RDN as well as the population size. Nevertheless, the present study's main limitation is its observational nature, which is uninformative on the temporal criterion for judging causality. However, this type of study provides a rationale for future research.

Based on the current study's findings and the importance of prevention, the authors suggest researchers study healthy populations more. Studying a healthy population have two major advantages. First, by understanding the risk factors and diagnosing diseases in healthy populations, designing prevention strategies will be easier, and second, people with the disease will be diagnosed sooner, and experts can treat the disease before getting severe.

Conclusion

Depression can be prevalent even in a healthy population. There is a range of risk factors that can increase the risk of depression. The impact of age, physical activity, having sport, economical level and smoking were independent of all other lifestyle indicators. Currently working in males and having sport, economical level, and living with someone in females were the main depression lifestyle predictors. In addition, higher SF-36 was associated with lower depression. Lower overall dietary intake was associated with higher depression and the impact of protein, fiber, iron, vitamin B6 and caffeine on depression were independent from energy intake. However, further studies are still needed.

Declarations

Ethics approval and consent to participate: The protocol of the current study is approved by an Ethical code: IR.MUMS.REC.1398.229 (http://ethics.research.ac.ir) from Mashhad University of Medical Science- Iran. All methods were carried out in accordance with relevant guidelines and regulations under the supervision of the Varastegan Institute for Medical Sciences and Mashhad University of Medical Sciences. All participants were provided with verbal and written explanations of the study objectives and methodology, and informed consent was obtained from them. The Welfare Organization of Khorasan Razavi Province screened the process of study at all stages.

Consent for publication: Not applicable as there is no information or images that can lead to identification of a study participant in this study.

Availability of Data and Material (ADM): The published data is available for review and further investigations. Please contact mrsh13713@gmail.com or *Hosseiniz@varastegan.ac.ir* for accessing the data.

Conflict of interest: The authors confirm that there is no conflict of interest.

Financial Support: The financial support was provided by the in-house research committee of Varastegan Institute for Medical Sciences.

Author contribution: Study concept and design: ZH, PP, MRSh, Drafting of the manuscript: MRSh, MR, SJ, Study implementation: MRSH, SE, MA, RB, Data validation and dietary intake analysis: MA, RR, MRSh, Statistical analysis and interpretation of data: MRSH, ZH, RR. All authors gave final approval of the version to be published and agree to be accountable for all aspects of the work. ZH and RR also accept all responsibility for the manuscript on behalf of all the authors.

Acknowledgment :We want to thank Varastegan Institute for Medical Sciences and Mr. Matin Etemadi who managed our online registration programs. We acknowledge the Welfare Organization of Khorasan Razavi Provence and Khorasan Razavi Retirement Association for supporting us and all those who help us in our registration, gathering data, and performing this assessment.

References

1. Bibring E. The mechanism of depression. 1953.

2. Beck DA, Koenig HG, Beck JS. Depression. Clinics in geriatric medicine. 1998;14(4):765-86.

3. Malhi GS, Mann JJ. Depression. The Lancet. 2018;392(10161):2299-312.

4. Mirzadehahari Z, Mohammadi-Nasrabadi F, Eini-Zinab H, Khosravi M, Mousavi N, Agasi M. Survey of association between major depression disorder in women and household food insecurity. Iranian Journal of Nutrition Sciences & Food Technology. 2015;10(1):9-20.

5. Khosravi M, Sotoudeh G, Majdzadeh R, Nejati S, Darabi S, Raisi F, et al. Healthy and unhealthy dietary patterns are related to depression: a case-control study. Psychiatry investigation. 2015;12(4):434.

6. Molendijk M, Molero P, Sánchez-Pedreño FO, Van der Does W, Martínez-González MA. Diet quality and depression risk: a systematic review and dose-response meta-analysis of prospective studies. Journal of affective disorders. 2018;226:346-54.

7. Marx W, Lane M, Hockey M, Aslam H, Berk M, Walder K, et al. Diet and depression: exploring the biological mechanisms of action. Molecular psychiatry. 2020:1-17.

8. Oshio T, Kan M. The dynamic impact of retirement on health: Evidence from a nationwide ten-year panel survey in Japan. Preventive medicine. 2017;100:287-93.

9. Dadfar M, Kalibatseva Z. Psychometric properties of the persian version of the short beck depression inventory with Iranian psychiatric outpatients. Scientifica. 2016;2016.

10. Lasa L, Ayuso-Mateos JL, Vázquez-Barquero JL, Díez-Manrique FJ, Dowrick CF. The use of the Beck Depression Inventory to screen for depression in the general population: a preliminary analysis. Journal of Affective Disorders. 2000;57(1):261-5.

11. Montazeri A, Goshtasebi A, Vahdaninia M, Gandek B. The Short Form Health Survey (SF-36): translation and validation study of the Iranian version. Quality of life research. 2005;14(3):875-82.

12. Moghaddam MB, Aghdam FB, Jafarabadi MA, Allahverdipour H, Nikookheslat SD, Safarpour S. The Iranian Version of International Physical Activity Questionnaire (IPAQ) in Iran: content and construct validity, factor structure, internal consistency and stability. World applied sciences journal. 2012;18(8):1073-80.

13. Knüppel S, Norman K, Boeing H. Is a Single 24-hour Dietary Recall per Person Sufficient to Estimate the Population Distribution of Usual Dietary Intake? The Journal of nutrition. 2019;149(9):1491-2.

14. Luo H, Dodd KW, Arnold CD, Engle-Stone R. A New Statistical Method for Estimating Usual Intakes of Nearly-Daily Consumed Foods and Nutrients Through Use of Only One 24-hour Dietary Recall. The Journal of nutrition. 2019;149(9):1667-73.

15. Carlson AC, Page ET, Zimmerman TP, Tornow CE, Hermansen S. Linking USDA Nutrition Databases to IRI Household-Based and Store-Based Scanner Data. 2019.

16. Rolfes SR, Pinna K, Whitney E. Understanding normal and clinical nutrition: Cengage learning; 2020.

17. Lim GY, Tam WW, Lu Y, Ho CS, Zhang MW, Ho RC. Prevalence of depression in the community from 30 countries between 1994 and 2014. Scientific reports. 2018;8(1):1-10.

18. Lotfaliany M, Hoare E, Jacka FN, Kowal P, Berk M, Mohebbi M. Variation in the prevalence of depression and patterns of association, sociodemographic and lifestyle factors in community-dwelling older adults in six low-and middle-income countries. Journal of affective disorders. 2019;251:218-26.

19. Pilania M, Yadav V, Bairwa M, Behera P, Gupta SD, Khurana H, et al. Prevalence of depression among the elderly (60 years and above) population in India, 1997–2016: a systematic review and meta-analysis. BMC public health. 2019;19(1):1-18.

20. da Costa Dias FL, Teixeira AL, Guimarães HC, Santos APB, Ritter SRF, Machado JCB, et al. Prevalence of late-life depression and its correlates in a community-dwelling low-educated population aged 75+ years: The Pietà study. Journal of affective disorders. 2019;242:173-9.

21. Mirzaei M, Ardekani SMY, Mirzaei M, Dehghani A. Prevalence of depression, anxiety and stress among adult population: results of Yazd Health Study. Iranian journal of psychiatry. 2019;14(2):137.

22. Salari N, Mohammadi M, Vaisi-Raygani A, Abdi A, Shohaimi S, Khaledipaveh B, et al. The prevalence of severe depression in Iranian older adult: a meta-analysis and meta-regression. BMC geriatrics. 2020;20(1):39.

23. Majdzadeh R, Yahyaei F, Sajadi HS, Danaei G. Time for more evidence: a scoping review of the effects of sanctions on Iranian health. 2020.

24. Caba-Maria F. Examining the Efficiency of Current International Economic Sanctions Concerning Iran. WSEAS Transactions on Business and Economics. 2021;18:462-71.

25. Grabe ME, Kamhawi R, Yegiyan N. Informing citizens: How people with different levels of education process television, newspaper, and web news. Journal of Broadcasting & Electronic Media. 2009;53(1):90-111.

26. Eborall HC, Virdee SK, Patel N, Redwood S, Greenfield SM, Stone MA. “And now for the good news…” the impact of negative and positive messages in self-management education for people with Type 2 diabetes: A qualitative study in an ethnically diverse population. Chronic illness. 2016;12(1):3-17.

27. Bulloch AG, Williams JV, Lavorato DH, Patten SB. The depression and marital status relationship is modified by both age and gender. Journal of affective disorders. 2017;223:65-8.

28. Maier A, Riedel-Heller SG, Pabst A, Luppa M. Risk factors and protective factors of depression in older people 65+. A systematic review. PloS one. 2021;16(5):e0251326.

29. Smith SM, Elliott LT, Alfaro-Almagro F, McCarthy P, Nichols TE, Douaud G, et al. Brain aging comprises many modes of structural and functional change with distinct genetic and biophysical associations. Elife. 2020;9:e52677.

30. Han LK, Dinga R, Hahn T, Ching CR, Eyler LT, Aftanas L, et al. Brain aging in major depressive disorder: results from the ENIGMA major depressive disorder working group. Molecular psychiatry. 2020:1-16.

31. Gao W, Ping S, Liu X. Gender differences in depression, anxiety, and stress among college students: a longitudinal study from China. Journal of affective disorders. 2020;263:292-300.

32. Pacheco JPG, Silveira JB, Ferreira RPC, Lo K, Schineider JR, Giacomin HTA, et al. Gender inequality and depression among medical students: A global meta-regression analysis. Journal of psychiatric research. 2019;111:36-43.

33. Mehryar AH, Mostafavi F, Agha H. Men and family planning in Iran: Ministry of Science, Research & Technology, Population Studies and Research …; 2001.

34. Rahimieh N. Iranian Culture: Representation and Identity: Routledge; 2015.

35. Cole JR. Iranian Culture and South Asia, 1500–1900. Iran and the surrounding world: interactions in culture and cultural politics. 2002:15-35.

36. Paperwalla KN, Levin TT, Weiner J, Saravay SM. Smoking and depression. Medical Clinics. 2004;88(6):1483-94.

37. Eysenck HJ. Smoking, health & personality: Routledge; 2018.

38. Leunig T. Mastering postgraduate funding: CentreForum; 2011.

39. Ssenyonga J, Nakiganda PB. Postgraduate Student Research Realities in Uganda. Postgraduate Research Engagement in Low Resource Settings: IGI Global; 2020. p. 150-72.

40. Ettman CK, Abdalla SM, Cohen GH, Sampson L, Vivier PM, Galea S. Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. JAMA network open. 2020;3(9):e2019686-e.

41. Siefken K, Junge A, Laemmle L. How does sport affect mental health? An investigation into the relationship of leisure-time physical activity with depression and anxiety. Human Movement. 2019;20(1):62-74.

42. Bhandari P, Paswan B. Lifestyle Behaviours and Mental Health Outcomes of Elderly: Modification of Socio-Economic and Physical Health Effects. Ageing International. 2020:1-35.

43. Raymond JL, Morrow K. Krause and Mahan's Food and the Nutrition Care Process E-Book: Elsevier Health Sciences; 2020.

44. De Groot C, Van Den Broek T, Van Staveren W. Energy intake and micronutrient intake in elderly Europeans: seeking the minimum requirement in the SENECA study. Age and ageing. 1999;28(5):469-74.

45. Roberts SB. Regulation of energy intake in relation to metabolic state and nutritional status. European Journal of Clinical Nutrition. 2000;54(3):S64-S9.

46. Østergaard L, Jørgensen MB, Knudsen GM. Low on energy? An energy supply-demand perspective on stress and depression. Neuroscience & Biobehavioral Reviews. 2018;94:248-70.

47. Mattar L, Huas C, Duclos J, Apfel A, Godart N. Relationship between malnutrition and depression or anxiety in Anorexia Nervosa: a critical review of the literature. Journal of affective disorders. 2011;132(3):311-8.

48. Vafaei Z, Mokhtari H, Sadooghi Z, Meamar R, Chitsaz A, Moeini M. Malnutrition is associated with depression in rural elderly population. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences. 2013;18(Suppl 1):S15.

49. Mokhber N, Majdi M, Ali-Abadi M, Shakeri M, Kimiagar M, Salek R, et al. Association between malnutrition and depression in elderly people in Razavi Khorasan: a population based-study in Iran. Iranian journal of public health. 2011;40(2):67.

50. Paans NP, Gibson-Smith D, Bot M, van Strien T, Brouwer IA, Visser M, et al. Depression and eating styles are independently associated with dietary intake. Appetite. 2019;134:103-10.

51. Quirk SE, Williams LJ, O'Neil A, Pasco JA, Jacka FN, Housden S, et al. The association between diet quality, dietary patterns and depression in adults: a systematic review. BMC psychiatry. 2013;13(1):1-22.

52. Oh J, Yun K, Chae J-H, Kim T-S. Association between macronutrients intake and depression in the United States and South Korea. Frontiers in psychiatry. 2020;11:207.

53. Khanna P, Aeri BT. Association of Quantity and Quality of Protein Intake with Depression and Anxiety Symptoms among Adolescent Boys and Girls (13–15 Years) Studying in Public Schools of Delhi. Journal of nutritional science and vitaminology. 2020;66(Supplement):S141-S8.

54. Islam M, Ali S, Karmoker JR, Kadir MF, Ahmed MU, Nahar Z, et al. Evaluation of serum amino acids and non-enzymatic antioxidants in drug-naïve first-episode major depressive disorder. BMC psychiatry. 2020;20(1):1-8.

55. Wang L, Shen X, Wu Y, Zhang D. Coffee and caffeine consumption and depression: A meta-analysis of observational studies. Australian & New Zealand Journal of Psychiatry. 2016;50(3):228-42.

56. Li Z, Li B, Song X, Zhang D. Dietary zinc and iron intake and risk of depression: A meta-analysis. Psychiatry research. 2017;251:41-7.

57. Sparling TM, Nesbitt RC, Henschke N, Gabrysch S. Nutrients and perinatal depression: a systematic review. Journal of nutritional science. 2017;6.

58. Khosravi M, Sotoudeh G, Amini M, Raisi F, Mansoori A, Hosseinzadeh M. The relationship between dietary patterns and depression mediated by serum levels of Folate and vitamin B12. BMC psychiatry. 2020;20(1):1-8.

59. Mahdavifar B, Hosseinzadeh M, Salehi-Abargouei A, Mirzaei M, Vafa M. Dietary intake of B vitamins and their association with depression, anxiety, and stress symptoms: A cross-sectional, population-based survey. Journal of Affective Disorders. 2021;288:92-8.

60. Parker GB, Brotchie H, Graham RK. Vitamin D and depression. Journal of affective disorders. 2017;208:56-61.

Tables

Table 1. The relation between social-economic factors and the risk of depression.

Factors	Values	overall (n=766)	non-depressed (n=322)	Depressed (n=444)			OR (95% CI)[a]	P-value[b]	P-value[c]
				Mild (n=254)	Moderate (n=131)	Severe (n=59)			
BDI-13 score	-	5.95±5.27	1.71±1.33	5.85±0.56	10.50±2.33	19.47±3.22	-	-	-
Age	year	65.14±6.84	63.31±6.17	66.59±6.62	66.15±7.44	66.58±7.65	**1.073 (1.049-1.097)****	**<0.001**	**0.035**
Gender	Male	256 (100%)	141 (55%)	56 (22%)	44 (17%)	15 (6%)	**Ref**	**<0.001**	0.390
	Female	510 (100%)	181 (35%)	198 (39%)	87 (17%)	44 (9%)	**2.229 (1.641-3.026)****		
Still Working	No	563 (100%)	197 (35%)	213 (38%)	103 (18%)	50 (9%)	**Ref**	**<0.001**	0.971
	Part-time	85 (100%)	49 (58%)	19 (22%)	13 (15%)	4 (5%)	**0.395 (0.249-0.629)****		
	Full-time	118 (100%)	76 (64%)	22 (19%)	15 (13%)	5 (4%)	**0.297 (0.196-0.450)****		
Physical Activity	low	158 (100%)	44 (28%)	43 (27%)	46 (29%)	25 (16%)	**Ref**	**<0.001**	**0.001**
	Low-moderate	236 (100%)	93 (39%)	91 (39%)	35 (15%)	17 (7%)	**0.593 (0.384-0.917)***		
	Moderate	283 (100%)	137 (48%)	99 (35%)	32 (11%)	15 (5%)	**0.411 (0.271-0.625)****		
	Over-moderate	89 (100%)	48 (54%)	21 (24%)	18 (20%)	2 (2%)	**0.330 (0.192-0.567)****		
sport activity	Yes	388 (100%)	193 (50%)	128 (33%)	47 (12%)	20 (5%)	**Ref**	**<0.001**	**<0.001**
	No	378 (100%)	129 (34%)	126 (33%)	84 (22%)	39 (10%)	**1.910 (1.428-2.556)****		
Living with someone	alone	72 (100%)	30 (42%)	17 (24%)	16 (22%)	9 (13%)	**Ref**	**<0.001**	0.091
	With wife	365 (100%)	145 (40%)	140 (38%)	57 (16%)	23 (6%)	1.084 (0.649-1.811)		
	With children	109 (100%)	31 (28%)	44 (40%)	24 (22%)	10 (9%)	1.0797 (0.960-3.363)		
	With wife and children	220 (100%)	116 (53%)	53 (24%)	34 (15%)	17 (8%)	**0.640 (374-1.097)***		
Sleep duration	Hrs	7.01±1.58	7.12±1.61	6.88±1.51	6.92±1.69	7.23±1.4	0.930 (0.849-1.018)	0.185	0.437
Education	Up to high school	241 (100%)	89 (37%)	99 (41%)	35 (15%)	18 (7%)	**Ref**	**0.005**	0.669
	High school	130 (100%)	43 (33%)	47 (36%)	31 (24%)	9 (7%)	1.185 (0.756-1.857)		
	Diploma	250 (100%)	109 (44%)	75 (30%)	45 (18%)	21 (8%)	0.757 (0.527-1.088)		
	BSc	81 (100%)	46 (57%)	19 (23%)	9 (11%)	7 (9%)	**0.446**		

							(0.267-743)**		
	MSc	30 (100%)	14 (47%)	7 (23%)	5 (17%)	4 (13%)	0.669 (0.312-1.436)		
	PhD	34 (100%)	21 (62%)	7 (21%)	6 (18%)	0 (0%)	**0.362 (0.173-0.759)***		
Marriage	Married	601 (100%)	268 (45%)	198 (33%)	93 (15%)	42 (7%)	**Ref**	**0.047**	0.872
	Single	12 (100%)	4 (33%)	5 (42%)	3 (25%)	0 (0%)	1.610 (0.480-5.403)		
	Devoice	17 (100%)	6 (35%)	8 (47%)	3 (18%)	0 (0%)	2.475 (539-4.042)		
	Widowed	136 (100%)	44 (32%)	43 (32%)	32 (24%)	17 (13%)	**1.683 (1.132-2.494)****		
Economic level	No	252 (100%)	76 (30%)	102 (40%)	54 (21%)	20 (8%)	**Ref**	**<0.001**	**<0.001**
	Lower	132 (100%)	44 (33%)	41 (31%)	27 (20%)	20 (15%)	0.864 (0.550-1.356)		
	Same level	279 (100%)	137 (49%)	86 (31%)	43 (15%)	13 (5%)	**0.448 (0.313-0.640)****		
	Higher	103 (100%)	65 (63%)	25 (24%)	7 (7%)	6 (6%)	**0.252 (0.156-0.409)**		
Smoke	No	582 (100%)	252 (43%)	187 (32%)	100 (17%)	43 (7%)	**Ref**	**<0.001**	**<0.001**
	Past	90 (100%)	39 (43%)	42 (47%)	7 (8%)	2 (2%)	0.999 (0.638-1.563)		
	Yes	94 (100%)	31 (33%)	25 (27%)	24 (26%)	14 (15%)	**1.552 (0.980-2.459)***		

[a] analyzed using Binary Logistic Regression between non-depressed and depressed (include mild, moderate and severe) groups. For nominal variables, O.R reported as in comparison with the first row. The reference factor is the first row for all factors.

[b] analyzed using ANOVA, Mann-Whitney U. Chi-square or Fisher's exact tests between non-depressed, mild, moderate and severe groups.

[C] ANCOVA, adjusted to other main factors: SF-36 score, gender, age, working, education, economic level, marriage, smoking, physical activity and living with someone

Percentage reported in the clinical stage of depression for each factor.

[t] More than 25% of subgroups in this category had less than 5 sample size.

Effect estimates with a p-value 0.05 are indicated in **bold** for both O.R and p.value. OR with P.value <0.05 reported * and <0.005 reported as ** (the P.value is not reported)

Table 2. The relation between lifestyle quality indicators (SF-36) and the risk of depression. the association between SF-36 score with depression is independent from other factors (gender, age, working, education, income, marriage, smoking, physical activity and living with) with p=0.008.

Factors	overall (n=766)	non-depressed (n=322)	Depressed (n=444)			OR (95% CI)[a]	P-value[b]
			Mild (n=254)	Moderate (n=131)	Severe (n=59)		
Physical Function score	60.36±32.13	76.79±25.79	55±29.02	39.94±29.88	31.49±30.64	**0.966 (0.959-0.973)****	**<0.001**
Role of Physical score	71.89±37.42	83.3±30.48	67.96±39.39	56.06±38.86	56.73±42.23	**0.984 (0.979-0.989)****	**<0.001**
Body Pain score	60.24±32.18	71.92±29.05	56.1±32.69	45.34±28.64	42.19±29.68	**0.978 (0.972-0.984)****	**<0.001**
General Health score	63.89±27.03	77.81±21.4	58.82±25.53	48.66±24.33	37.08±23.59	**0.958 (0.949-0.966)****	**<0.001**
Vitality score	68.38±26.62	81.66±19.81	64.3±25.48	52.42±25.75	42.65±25.55	**0.960 (0.952-0.968)****	**<0.001**
Social Function score	70.83±25.67	83.85±18.81	65.28±25.26	56.14±24.92	50.46±25.72	**0.955 (0.945-0.964)****	**<0.001**
Role of Emotional score	65.59±39.34	85.97±29.88	59.11±38.64	39.57±35.54	30.76±32.05	**0.972 (0.967-0.978)****	**<0.001**
Mental Health score	67.16±25.72	78.1±18.65	65.14±24.67	52.36±27.7	43.78±28.55	**0.964 (0.955-0.973)****	**<0.001**
Reported Health score	-0.3±0.89	-0.08±0.97	-0.45±0.81	-0.43±0.81	-0.59±0.64	**0.615 (0.502-0.754)****	**<0.001**
Physical Health score	62.59±25.09	76.58±20.98	58.35±22.74	44.43±18.49	38.49±19.09	**0.954 (0.946-0.963)****	**<0.001**
Mentally Health score	64.56±23.71	79.6±18.26	60.76±20.09	44.09±16.01	37.43±15.62	**0.938 (0.928-0.949)****	**<0.001**
Total Score	61.01±22.26	68.72±20.86	61.15±20.53	49.14±19.3	40.92±20.54	**0.971 (0.963-0.979)****	**<0.001**

[a] analyzed using ANOVA test between non-depressed, mild, moderate and severe groups

[b] analyzed using Binary Logistic Regression between non-depressed and Depressed (include mild, moderate and severe) groups.

Effect estimates with a p-value 0.05 are indicated in **bold** for both O.R and p.value. OR with P.value <0.05 reported * and <0.005 reported as ** (the P.value is not reported)

Table 3. The relation between dietary nutrient intake and the risk of depression.

Factors	overall (n=522)	non-depressed (n=219)	Depressed (n=303)			OR (95% CI)[a]	P-value[b]
			Mild (n=169)	Moderate (n=91)	Severe (n=43)		
Water (g/kg)	19.52±5.88	20.51±5.85	19.25±5.73	18.88±6.29	16.79±4.63	0.952 (0.928-0.976)**	<0.001
Energy (Kcal/kg)	26.05±5.03	27.44±5.19	25.28±4.44	25.3±5.23	23.5±3.87	0.906 (0.878-0.934)**	<0.001
Protein (g/kg)	0.88±0.21	0.92±0.23	0.85±0.19	0.84±0.21	0.82±0.21	0.176 (0.87-0.355)**	<0.001
Total lipid (g/kg)	1±0.32	1.07±0.4	0.95±0.2	0.95±0.25	0.98±0.33	0.254 (0.143-0.453)**	<0.001
saturated fatty acid (g/kg)	0.26±0.07	0.28±0.08	0.26±0.07	0.26±0.07	0.25±0.06	0.013 (0.002-0.099)**	<0.001
Cholesterol (mg/kg)	3.785±1.88	3.936±2.042	3.638±1.681	3.762±1.897	3.638±1.703	-	0.261
Carbohydrate (g/kg)	3.506±0.756	3.699±0.776	3.399±0.688	3.436±0.796	3.071±0.519	0.547 (0.447-0.670)**	<0.001
Sugars (g/kg)	1.224±0.389	1.291±0.424	1.174±0.322	1.23±0.431	1.056±0.259	0.456 (0.310-0.669)**	<0.001
Starch (g/kg)	0.643±0.284	0.685±0.283	0.63±0.286	0.606±0.287	0.556±0.236	0.404 (0.239-0.684)**	0.002
Dietary fiber (g/kg)	0.303±0.083	0.324±0.086	0.29±0.074	0.29±0.085	0.275±0.075	0.005 (0.001-0.030)**	<0.001
Caffeine (mg/kg)	0.697±0.305	0.727±0.311	0.702±0.297	0.675±0.325	0.563±0.221	0.574 (0.357-0.923)*	0.002
Calcium (mg/kg)	10.97±3.16	11.53±3.40	10.65±2.71	10.61±3.20	10.07±3.11	0.906 (0.864-0.950)**	<0.001
Iron (mg/kg)	0.199±0.053	0.21±0.054	0.192±0.052	0.194±0.052	0.179±0.045	0.001 (0.000-0.019)**	<0.001
Copper (µg/kg)	0.021±0.01	0.021±0.009	0.02±0.01	0.021±0.012	0.02±0.011	-	0.312
Magnesium (mg/kg)	3.889±0.953	4.124±1.008	3.752±0.829	3.745±1	3.512±0.73	0.626 (0.535-0.739)*	<0.001
Phosphorus (mg/kg)	15.14±3.72	15.95±3.94	14.65±3.15	14.63±3.91	14.0±3.54	0.901 (0.865-0.939)**	<0.001
Potassium (mg/kg)	33.83±8.76	35.91±9.33	32.46±7.22	32.63±9.63	31.04±7.23	0.953 (0.936-0.970)**	<0.001
Selenium (µg/kg)	1.573±0.463	1.641±0.451	1.53±0.46	1.558±0.497	1.417±0.402	0.572 (0.414-0.789)*	0.001
Vitamin C (mg/kg)	1.384±0.666	1.482±0.775	1.331±0.576	1.289±0.572	1.285±0.498	0.674 (0.536-0.847)**	0.005

Vitamin A (IU/kg)	88.54±43.88	93.03±45.67	85.66±41.28	85.11±43.8	84.03±43.9	**0.0996 (0.993-0.999)***	0.117
Vitamin D (IU/kg)	0.516±0.362	0.55±0.424	0.492±0.308	0.507±0.323	0.452±0.268	-	0.120
Vitamin E (mg/kg)	0.133±0.038	0.142±0.042	0.128±0.031	0.125±0.038	0.124±0.032	**0.000 (0.000-0.001)***	**<0.001**
Vitamin B6 (µg/kg)	0.021±0.005	0.023±0.006	0.021±0.005	0.02±0.005	0.02±0.004	**0.000 (0.000-0.001)****	**<0.001**
Vitamin B12 (µg/kg)	0.11±0.15	0.1±0.12	0.1±0.15	0.12±0.19	0.12±0.17	-	0.545

[a] analyzed using Binary Logistic Regression between non-depressed and Depressed (include mild, moderate and severe) groups. Non-significant OR are not reported to simplify the table

[b] analyzed using ANOVA test between non-depressed, mild, moderate and severe groups

[C] ANCOVA, adjusted to energy intake (Kcal)

All nutrients are divided into individuals' weight (kg).

The high OR for both Trans fatty acid (g/kg) and copper (µg/kg) is related to their very small value.

Effect estimates with a p-value 0.05 are indicated in **bold** for both O.R and p.value. OR with P.value <0.05 reported * and <0.005 reported as ** (the P.value is not reported)

Table 4. Correlations of the assessed numeric variables with the BDI-13 Scoring.

Factors	Correlation	p.value
Age	**0.168****	**<0.001**
Sleep	0.010	0.99
SF-36 Physical Function score	**-0.497****	**<0.001**
SF-36 Role of Physical score	**-0.272****	**<0.001**
SF-36 Body Pain score	**-0.335****	**<0.001**
SF-36 General Health score	**-0.495****	**<0.001**
SF-36 Vitality score	**-0.494****	**<0.001**
SF-36 Social Function score	**-0.457****	**<0.001**
SF-36 Role of Emotional score	**-0.490****	**<0.001**
SF-36 Mental Health score	**-0.448****	**<0.001**
SF-36 Reported Health score	**-0.177****	**<0.001**
SF-36 Physical Health score	**-0.547****	**<0.001**
SF-36 Mentally Health score	**-0.632****	**<0.001**
SF-36 Total Score	**-0.404****	**<0.001**
Water (g/kg)	**-0.161****	**<0.001**
Energy (Kcal/kg)	**-0.222****	**<0.001**
Protein (g/kg)	**-0.148****	**<0.001**
Total lipid (g/kg)	**-0.107****	**<0.001**
saturated fatty acid (g/kg)	**-0.118****	**<0.001**
Trans fatty acid (g/kg)	**-0.101****	**0.01**
Cholesterol (mg/kg)	-0.04	0.27
Carbohydrate (g/kg)	**-0.225****	**<0.001**
Sugars (g/kg)	**-0.156****	**<0.001**
Starch (g/kg)	**-0.122****	**<0.001**
Dietary fiber (g/kg)	**-0.184****	**<0.001**
Caffeine (mg/kg)	**-0.118****	**<0.001**
Calcium (mg/kg)	**-0.134****	**<0.001**
Iron (mg/kg)	**-0.156****	**<0.001**
Magnesium (mg/kg)	**-0.188****	**<0.001**
Phosphorus (mg/kg)	**-0.155****	**<0.001**
Potassium (mg/kg)	**-0.177****	**<0.001**
Selenium (µg/kg)	**-0.115****	**<0.001**
Vitamin C (mg/kg)	**-0.110****	**<0.001**
Vitamin A (IU/kg)	-0.07	**0.07**
Vitamin D (IU/kg)	**-0.072***	**0.05**
Vitamin E (mg/kg)	**-0.162****	**<0.001**
Vitamin B6 (µg/kg)	**-0.171****	**<0.001**
Vitamin B12 (µg/kg)	0.05	0.16

The negative symbol (-) shows an inverse relationship between the factor and the BDI-13 score
Effect estimates with a p-value0.05 are indicated in **bold**.
This table is showing the difference between BDI-13 Score with variables and is different from depression classification

Figures

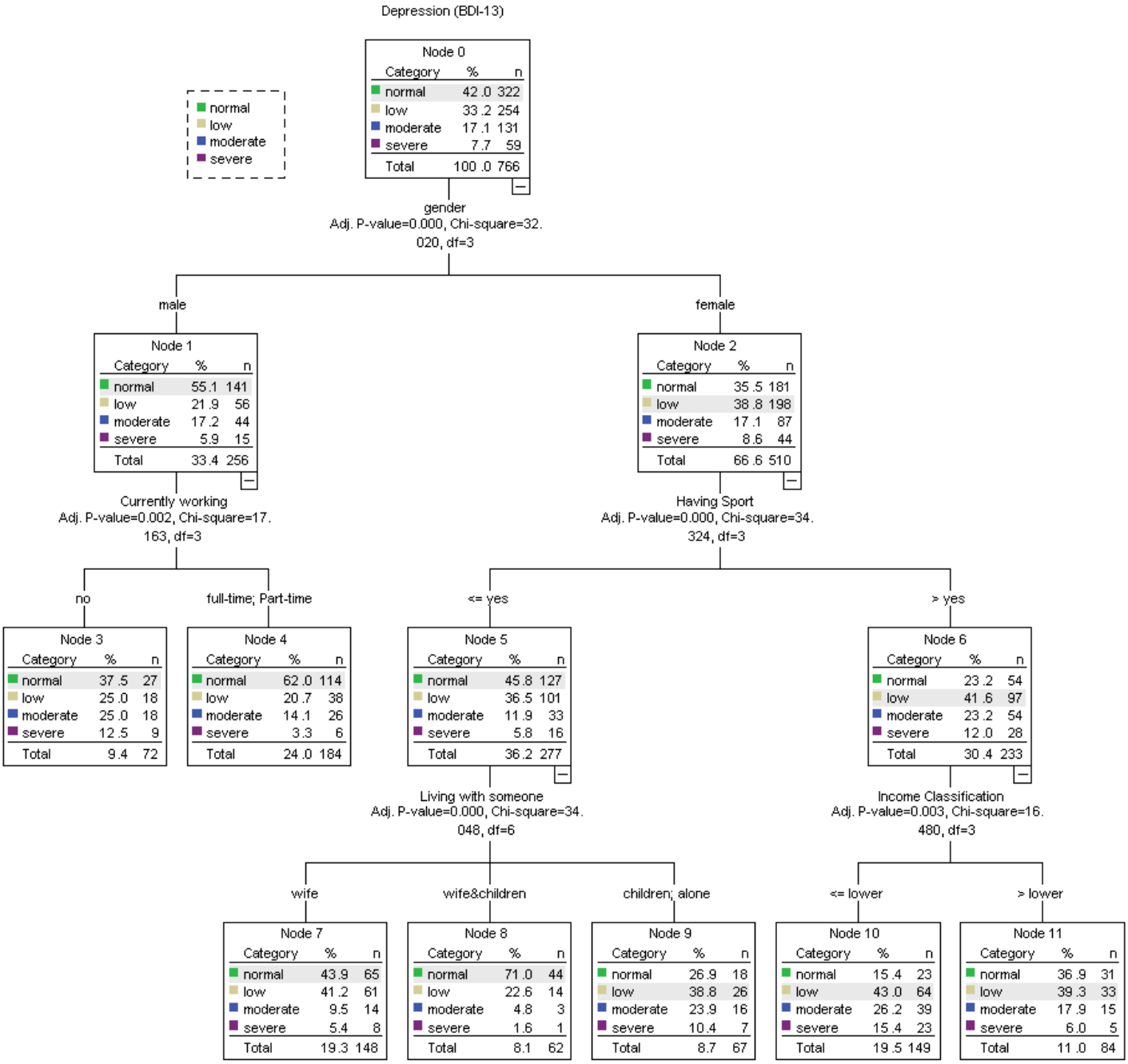

Figure 1

Decision tree model for predictors of depression in a healthy population. The model included the impact of gender, age, education, working, living with someone, having sport activity, income Classification, Physical activity, and smoking