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

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## Abstract

**Background**: The older adults are increasing and depression is commonly observed within this community. This study is one of the first that 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 analyzed using the USDA Food Ingredients Database.

**Result**: The prevalence of depression was 31.5% (62.5±6.6 years old). One hundred and thirty-two (17.2%), 93 (12.1%), and 19 (2.5%) individuals had mild, moderate, or severe depression. Males, higher age, not working, higher education, inactivity, living alone, lower-income, divorced, and widows had a higher odd-ratio (OR) of depression. lifestyle shows a 1% higher quality of life score in any component can have 3.8-1.1% significantly lower OR of depression. Trance fatty acids, starch, iron, and copper that are generally increased during oil reheating showed a higher OR for having depression. The correlation of quality of lifestyle components with the severity of depression (BDI-13 score) was the strongest and negative while the weakest correlation was for nutrients with BDI-13 score.

**Conclusion**: The risk of depression in healthy populations is high. Active lifestyle and healthy diet with the presence of family can reduce OR of depression in elderly populations. Food processes can be more important than diet.


## 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 aging, 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].

To the authors' knowledge, there is no current data on the prevalence of depression in aner-55 years old community-dwelling elderly healthy population. To address this gap 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 from July 2020 to May 2021. 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. For this study, an online registration program was utilized rather than the traditional paper and pencil method in a face-to-face interview.

# Population

The sample size was estimated to be at least twice the calculated sample size by assuming the prevalence of depression to be 30% among the population (0.5) and an odds ratio of 30% (OR = 0.3) with an alpha of 0.05 and power of 80%. 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 health disorders and hospitalization the during last year. Excluding criteria were, having any chronic diseases record which could elevate the risk of depression-like diabetes mellitus (DM), cardiovascular diseases (CVD), kidney disorders, cancer, asthenia, thalassemia, osteoarthritis, and rheumatoid arthritis (RA). This exclusion was made to make sure all the population included in the current study are healthy adults.

# 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]. 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 [10]. 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 [11].

# 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 [12, 13]. 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) [14]. 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 [15]. 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 16.0 (IBM Co., Armonk, NY, USA). The characteristics of participants' recorded data in the study were described as percentages, means, or SD values. 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 with Tukey's test as a post hoc pairwise comparison 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. Two-tailed Bivariate Correlation was used to assess the correlation (R) between BDI-13 Score and assessed variables. P-value 0.05 was considered statistically significant.

## Result

A total of 1253 individuals were screened. 487 individuals were excluded as they meet exclusion criteria and a total of 766 individuals were enrolled in this study. The mean age was 62.5 ± 6.6 years old. The majority of participants were females (66.6%). There was no significant difference in the number of participations across the 13-municipal areas of Mashhad (p.value = 0.742). the test of homogeneity of variances for age (Levene Statistic P = 0.093), weight (Levene Statistic P = 0.900), gender (KMO and Bartlett's Test P = 0.940), and physical activity (KMO and Bartlett's Test P = 0.893) also showed a high homogenization in main criteria within the population. The contribution of all data was normal that was linked with the sample size and homogenization.

In the current study, a total of 522 (68.1%) individuals had no depression, while 132 (17.2%), 93 (12.1%), and 19 (2.5%) of 766 individuals had mild, moderate, or severe depression. The overall mean BDI-13 score of the population was 3.55 ± 4.3. The mean BDI-13 score for the control group and mild, moderate, or severe depression groups was 1.14 ± 1.39, 5.87 ± 0.88, 10.82 ± 2.28, and 17.89 ± 1.69, respectively. No significant difference was found between all 13-municipal areas in the BDI-13 score (p.value = 0.198) and depression severity (p.value = 0.479).

Within social-economic factors, only sleep duration was not significant between depression groups (table-1). The odds ratio of having mild-, moderate- or severe- depression was compared with non-depression (table-1). Males, higher age, not working, higher education, divorced, and widow had a higher OR of having one of 3 stages of depression (p.value ≤ 0.05). In return, having a higher physical activity, working, living with family, and having a higher economical level significantly lowered the OR that showing the importance of these factors (p.value ≤ 0.05).

Within this population, all the lifestyle quality components had a considerable significant (p.value ≤ 0.001) relation with depression except for the reported health score (table-2). The OR for total Sf-36 score shows a significant 3.3% lower depression for each higher lifestyle quality score. In addition, all component of lifestyle shows an increasing 1% of the quality of life in any component can significantly lower the OR of depression between 3.8–1.1%.

In this study, nutrients were reported as intake per weight of individuals to remove the difference in diet value. The overall intake of energy, carbohydrate, protein, and total lipid was 30.7 ± 10.2 kcal/kg, 4.13 ± 1.46 gr/kg, 1.19 ± 0.40 gr/kg, and 1.19 ± 0.49 gr/kg respectively which present a well-nourished population. However, a significant difference had been found in intake of trance fatty acids, starch, iron, copper, selenium, and vitamin-B6 between groups (table-3). but the differences in main nutrients especially protein, total fat, carbohydrate and energy were not significant that can be linked to the effect of removed diet value. Despite there being a significant difference for selenium, and vitamin-B6 between groups but OR was not significant which can be linked to differences after transforming the four groups into two. On the other hand, trance fatty acids, starch, iron, and copper that are generally increasing during oil reheating showed a higher OR for having depression (p.value ≤ 0.05).

The correlation of some variables with BDI-13 score was assessed to understand the impact of these factors on the severity of depression (table-4). Age had a weak but significant correlation with the BDI-13 score that shows it correlated with severity of depression (R = 0.110, p.value = 0.002). Also, a moderate negative correlation (R< -0.300, p.value ≤ 0.001) has been found for most

of quality of lifestyle indicators based on SF-36 scores with severity of depression. Nevertheless, the correlation of nutrients with BDI-13 score was weak.

Gender differences show males had a significantly higher BDI-13 score in all categories of who are working, smoking, having physical activity and income classifications (Figure-1). The differences in working were significant for both groups of working and not working (p.value ≤ 0.05). The difference between genders also shows a significant difference between people with moderate physical activity between genders. In addition, males with low- or moderate-income classification had a higher BDI-13 score compared with females (p.value ≤ 0.001).

## Discussion

This study is one of the first studies that assessed depression in a healthy well-nourished over-15 years old population. 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.

# Prevalence

In this healthy population, a total of 31% of them suffered from depression. Of this 31%, one hundred and thirty-two (17.2%), ninety-three (12.1%), and nineteen (2.5%) of the population had mild, moderate, or severe 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 [16, 17]. 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 [18]. 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 [19].

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) [20]. 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 higher prevalence of depression than the current study [21]. The finding and comparisons have shown a high prevalence of depression in a healthy population. However, Iranian older adults can be at a higher risk of depression compared with other nations. This may be due to the special condition of Iranians during the last few years. The authors also believe the findings of the current study encourage researchers to concentrate on assessing 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 [22–24]. The current study's findings showed a significant association between age and depression (OR = 1.027, P-value 0.05). the weak correlation of age with the BDI-13 score (R = 0.110, P-value 0.002) also confirms the effect of age on depression severity. One of the newest hypotheses that can explain this situation can be brain aging [24, 25]. 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 [24, 25]. 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 [25]. In this new hypothesis, keeping the mind active lowers the process of brain aging, mental disorders, and depression as a result [25].

# Gender

In the current study, males had a significantly higher prevalence of depression when compared to females. The finding in different studies are varied, some studies suggested males [22, 26], and some others suggest females are at a higher risk of depression [17, 23, 27]. The gender-related finding depends on the population, age, and occupation change. In the Iranian tradition, especially in the current population, men have more and heavier responsibilities than females (because of tradition and culture) which can explain their higher risk of depression. In the Iranian traditional culture, generally, males represent the family in the society. They are responsible to provide all the family needs as well as protecting the family [28]. These burdens can put males at a higher depression risk. Nevertheless, there are several limitations for females but according to the current population's age and tradition, they were less stressful [28–30]. However, this relation is not absolute and during the last few years, the responsibilities between families started to be shared more equally while limitations for females are being removed [29].

# Smoking

Previous or current smokers were at least four times more likely to be depressed in the current population. Smoking has always been a fixed risk factor in nearly all diseases, especially depression [31, 32]. The relationship between smoking and depression can be bidirectional [31]. In the current population males who are not smoking had a significantly higher BDI-13 score. Nevertheless, in our population men and women who are smoking or quit smoking didn't have any significant difference in BDI-13 scores. This higher BDI-score in males who are not smoking can be explained by the other risk factors of depression that are more frequent in the male group.

# 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 [33, 34]. In the current population, as was expected, people with higher income had a lower risk of depression. There was no significant difference in the risk of depression between people with low income or without income. However, people with moderate- or higher-income levels have significantly 55% and 58% less OR of depression. The importance of income on the risk of depression is demonstrated in figure one, as a trend emerged correlating income with the severity of depression. The same finding has been reported elsewhere [17, 35]. For example, Americans with less than 5000$ in savings are reported to be at a higher risk of depression [35]. Regarding the differences between genders in our study, females in families with low and moderate incomes had a significantly lower BDI-13 score that required to be more investigation.

Despite the inverse relationship between educational level and the risk of depression [23, 35], people with higher educational levels had an increased risk of depression in the current study. Some reports suggest that the graduated population has a lower risk of depression than the under-graduated population [17, 35]. However, to confirm the effect of alliteration on depression in the current study, there was evidence that illiterate people are at the lowest risk of depression in other studies [35]. Another study in Iran also confirmed the inverse relationship between depression and education [20]. The best explanation for this difference in the findings can be related to the special condition of the Iranian population. During the last few years, the political and economic changes that were highly affected by the US sanction and political stands of the Islamic Republic government made a complicated condition [36, 37]. Generally, higher education people follow the news the most [38]. By considering the impact of good and bad news on individuals, this following up put this population in the exposed to more disappointing news than people with lower education which is a suitable condition to develop disappointment and depression [38, 39]. The other explanation can be related to the relationship between income and education. In Iran, experimentally, the income level is nearly independent of the education which can be a mental pressure on educated people [33, 34]. Correspondingly, no relationship between income and education was identified in the present population that confirm this relation ($p = 0.752$).

# Marriage and living with someone

The marital status is another indication of depression. As expected, in this population, currently married people have a significantly lower risk than those who are divorced or widowed. There was also a lower prevalence of depression between marriage groups in the single people who never married, but the odds ratio was insignificant. In addition, married people who live with their partner (with

or without children) had 44 to 47% lower OR of depression than people living alone. Another study by Lotfaliany et al. also reported the same finding [17]. Besides, other studies' findings confirm that married people are at a lower risk of depression in comparison with people who had divorced, widowed, or never gotten married [17, 20, 22, 35]. These two simple findings show the importance of family and their presence in preventing depression.

# Working and physical activity

In Iran, people continue working after their retirement to cover their living expenses. The findings in the current population indicated that people who engage in moderate physical activities are at 80% lower OR of depression. However, in comparison to moderate (80% decrease), high physical activity only decreased the OR of depression by 60 percent. Generally, having a highly active physical activity required a routine programmed sports activity that can provide a slight mental pressure to the individuals that can explain this relation [40]. The finding of previous studies also reported that inactive people were significantly at higher risk of depression [17, 23]. In addition, in the current population, people who had any sports activity ranging from swimming and volleyball to yoga and aerobics had a significantly 54% lower OR of depression than the inactive population. There is also evidence that people who are employed or currently have working status are at lower risk of depression [20, 23]. The finding of the current study also showed that unemployed individuals are at 2.5 times higher OR of depression compared with those who are working. As a result, having an active life, including moderate physical activity, any sport, and working, was shown to be suitable methods to lower the risk of depression and BDI-13 score at this age.

# Lifestyle

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. In the current study, an 1% higher quality of life showed about 3.3% significantly lower OR of depression. In the current population better physical function, general health, vitality, social, mental, and emotional function scores had a significant 3.8 to 1.1% inverse relationship with the risk of depression that is completely reported in table-2. The R of the lifestyle indicators also shows a significant moderate inverse relation (more than − 0.300) for nearly all factors with the severity of depression (BDI-13 score). The finding of other studies also reported the same inverse relationship between depression and higher quality of life [17, 20, 23, 35, 41]. As evidence show, this is one of the first studies that used this tool to score the populations' lifestyle in depression. 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

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 without the effect of food value [42]. After adjustment, no difference had been found between the main nutrients such as water (g/kg), energy (Kcal/kg), protein (g/kg), and total lipid (g/kg) intake which are the most important components to categorize foods in the food's groups [42]. To the authors' knowledge, this study is the first study that used this method to study the relationship between nutrition with depression. In the study, adjusted dietary starch, trans fatty acids, iron, copper, vitamin-B6 and magnesium intake are shown to be significantly associated with depression. However, the correlation with the BDI-13 score was significantly but weak. This difference between these nutrients' association with depression and BDI-13 shows the possibility that these nutrients are associated with the risk but have a small effect on the severity of depression that required research on more. The high OR in trans fatty acid and copper could be explained by both the high impact on depression reported previously [43] and the number of decimal places of factors.

This study did not find any difference between groups for dietary fiber, but according to other evidence, higher fruit and vegetable intake that has higher fiber can lower the risk of depression [6, 7, 17, 42, 44]. There was also a significant difference between groups for vitamin B6 in this study that confirms previous reports [45, 46], but neither the R nor OR were not significant for the risk of depression and BDI-13 score for this vitamin. In the present study, both trans fatty acid and starch had higher OR with depression. These two nutrients are the main components of cakes, cookies, crackers, and biscuits, known as depressive food groups that can explain this effect [6, 7, 42]. Nevertheless, there was no effect of sugar on depression in the current study. This situation can be explained by the dietary pattern of Iranians; but other studies confirm that higher sugar intake is associated with depression [6, 7, 42, 44].

It is well known that meats are a better source with more iron bioavailability than other food groups, especially plants [42]. While both meat and oils have higher fat concentrations, especially trans fats and cholesterol [42]. The current study's findings showed that the effect of meat and oil on depression can be related to their iron and trans-fat containing. However, in the case of copper, it must be considered that both vegetables and animals are the best sources but, in the present population, it presents higher organs like liver, brain, and head especially traditional foods named “kale-pache” (head, brain, buttocks, tongue and eyes) and “Jegaraki” (liver and tail) consumption that have the higher concentration of trans fatty acids either [42].

The effect of iron, copper and trans fatty acids on depression in the current study can explain the harmful effects of fast foods on depression described in previous studies [6, 7, 42, 44]. During food process, high oil temperature, and reheating, can be the main depressive effect of fast foods. During long-term or high-temperature heating and reheating that is common during the food process of fast foods, and even daily cooking in most of the Iranians cooking patterns, the trans fatty acids and elements like iron and copper increase and are more likely to be absorbed by the food from the oil [47]. By considering both the food processor and the current findings, it seems that fast foods in nature are not harmful, but it is the process of preparing these foods that increase the risk of depression. However, more investigation is needed.

Regardless of the finding of the current study, different studies show a healthy diet rich in fruits and vegetables, replacing red meats with white meats, increasing the beans and lumen intake that is close to the Mediterranean diet can lower the risk of depression [6, 7, 17, 42, 44]. However, the food processor and changes that can affect the dietary value of foods should be considered as the other factor that may elevate the depression risk.

# Suggestions, limitations, and strengths

The main strength of the current study is related to its population. As most the 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. The main finding of this study shows depression can be prevalent more than expected in healthy people. 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.

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. In addition, it is one of the first studies that has this comprehensive point of view on a vast range of depression factors in one single report. However, the limitation was using a one-day dietary recall instate of a 3-day dietary recall, but the main cause was decreasing the memory depending on such a detailed tool. However, this limitation was controlled by some specialized dietary questions about dietary habits and adjustments that were made by the RDN. 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.

## Conclusion

There is a range of risk factors that can increase the risk of depression. Overall, having an active, healthy lifestyle with the presence of the family and active mental can be a good method to prevent depression. This study also showed that a diet concentrated in trans-fat and metal elements that especially increase during oil oxidation at high temperature reheating during cooking can elevate the risk of depression. this finding suggests the food process has a bolder impact on depression than the food choice. However, further studies to understand the impact of food process rather than food contains on depression is 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.

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**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, MRSh, Statistical analysis and interpretation of data: MRSH, ZH. All authors gave final approval of the version to be published and agree to be accountable for all aspects of the work. ZH also accepts all responsibility for the manuscript on behalf of all the authors.

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# Tables

Table 1

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

| Factors | Values | Characterize (n=766) | non-depressed (n=522) | Depressed (n=244) | | | O.R[a] | P-value[b] |
|---|---|---|---|---|---|---|---|---|
| | | | | Mild (n=132) | Moderate (n=93) | Severe (n=19) | | |
| Gender | Female | 510 (66.6%) | 369 (70.7%) | 82 (62.1%) | 49 (52.7%) | 10 (52.9%) | **1.762*** | **0.002** |
| | Male | 256 (33.4%) | 153 (29.3%) | 50 (37.9%) | 44 (47.3%) | 9 (47.4%) | | |
| Age | year | 62.5±6.6 | 62.1±6.3 | 62.3±6.3 | 64.8±8.0 | 63.2±6.9 | **1.027**** | **0.004** |
| Still Working | Yes | 169 (22.1%) | 139 (26.6%) | 17 (12.9%) | 12 (12.9%) | 1 (5.3%) | **2.589*** | **0.001** |
| | No | 597 (77.9%) | 383 (73.4%) | 115 (87.1%) | 81 (87.1%) | 18 (94.7%) | | |
| Physical Activity | Low | 201 (26.2%) | 87 (16.7%) | 50 (37.9%) | 52 (55.9%) | 12 (63.2%) | Ref | **0.001** |
| | Moderate | 481 (62.8%) | 380 (72.8%) | 62 (47.0%) | 34 (36.6%) | 5 (26.3%) | **0.200*** | |
| | High | 84 (11.0%) | 55 (10.2%) | 20 (15.2%) | 7 (7.5%) | 2 (10.5%) | **0.402**** | |
| sport activity | Yes | 423 (55.2%) | 320 (61.3%) | 61 (46.2%) | 36 (38.7%) | 6 (31.6%) | **0.461*** | **0.001** |
| | No | 343 (44.8%) | 202 (38.7%) | 71 (53.8%) | 57 (61.3%) | 13 (68.4%) | | |
| Living with | Alone | 110 (14.4%) | 62 (11.9%) | 22 (16.7%) | 22 (23.7%) | 4 (21.1%) | Ref | **0.048** |
| | partner | 427 (55.7%) | 302 (57.9%) | 70 (53.0%) | 48 (51.6%) | 7 (36.8%) | **0.535*** | |
| | children and partner | 229 (29.9%) | 158 (30.8%) | 40 (30.3%) | 23 (24.7%) | 8 (42.1%) | **0.569*** | |
| Sleep duration | Hour | 7.0±1.5 | 6.9±1.5 | 7.1±1.7 | 6.9±1.7 | 7.4±1.4 | 1.065 | 0.284 |
| Education | illiterate | 274 (35.8%) | 209 (40.0%) | 38 (28.8%) | 22 (23.7%) | 5 (26.3%) | Ref | **0.024** |
| | Under Diploma | 140 (18.3%) | 78 (14.9%) | 35 (26.5%) | 21 (22.6%) | 6 (31.6%) | **2.556*** | |
| | Diploma | 250 (32.6%) | 171 (32.8%) | 36 (27.3%) | 38 (40.9%) | 5 (26.3%) | **1.485*** | |
| | Academic | 102 (13.3%) | 64 (12.3%) | 23 (17.4%) | 12 (12.9%) | 3 (15.8%) | **1.830**** | |
| Marriage | Married | 601 (78.5%) | 425 (81.4%) | 100 (75.8%) | 63 (67.7%) | 13 (68.4%) | Ref | **0.002[t]** |
| | Single | 12 (1.6%) | 9 (1.7%) | 1 (0.8%) | 2 (2.2%) | 0 (0.0%) | 0.811 | |
| | Divorced | 17 (2.2%) | 7 (1.3%) | 5 (3.8%) | 4 (4.3%) | 1 (5.3%) | **3.478*** | |
| | widower | 136 (17.8%) | 81 (15.5%) | 26 (19.7%) | 24 (25.8%) | 5 (26.3%) | **1.653*** | |
| Economic level | None | 174 (22.7%) | 101 (19.3%) | 36 (27.3%) | 30 (32.3%) | 7 (36.8%) | Ref | **0.011** |
| | Low | 281 (36.7%) | 186 (35.6%) | 49 (37.1%) | 39 (41.9%) | 7 (36.8%) | 0.695 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Moderate | 264 (34.5%) | 199 (38.1%) | 38 (28.8%) | 23 (24.7%) | 4 (21.1%) | **0.452*** | |
| | High | 47 (6.1%) | 36 (6.9%) | 9 (6.8%) | 1 (1.1%) | 1 (5.3%) | **0.423*** | |
| Smoke | No | 657 (85.8%) | 481 (92.1%) | 105 (79.5%) | 59 (63.4%) | 12 (63.2%) | Ref | **0.001** |
| | In past | 44 (5.7%) | 17 (3.3%) | 11 (8.3%) | 14 (15.1%) | 2 (10.5%) | **4.374**** | |
| | Yes | 65 (8.5%) | 24 (4.6%) | 16 (12.1%) | 20 (21.5%) | 5 (26.3%) | **4.705*** | |

[a] analyzed using ANOVA, Mann-Whitney U. Chi-square or Fisher's exact tests 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. For nominal variables, O.R reported as in comparison with the first row. The reference factor is the first row for all factors.

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 and the risk of depression.

| Factors | Characterize (n=766) | Non-depressed (n=522) | Depressed | | | O.R[a] | P-value[b] |
|---|---|---|---|---|---|---|---|
| | | | Mild (n=132) | Moderate (n=93) | Severe (n=19) | | |
| Physical Function score | 58.9±33.0 | 66.2±31.1 | 41.4±31.5 | 48.4±32.4 | 39.2±31.4 | **0.979**** | **0.001** |
| Role of Physical score | 93.1±38.0 | 78.6±34.3 | 65.9±42.4 | 58.8±41.4 | 50.0±48.9 | **0.989**** | **0.001** |
| Body Pain score | 58.4±33.3 | 65.4±31.4 | 44.4±30.8 | 44.4±35.8 | 41.6±31.5 | **0.980**** | **0.001** |
| General Health score | 63.3±28.2 | 70.2±26.2 | 47.7±26.3 | 51.5±27.2 | 44.7±29.6 | **0.972**** | **0.001** |
| Vitality score | 55.0±28.2 | 73.7±25.8 | 49.0±25.7 | 53.0±25.7 | 42.6±30.1 | **0.962**** | **0.001** |
| Social Function score | 72.9±22.9 | 76.0±23.5 | 65.1±19.2 | 68.6±20.7 | 66.6±24.0 | **0.982**** | **0.001** |
| Role of Emotional score | 64.2±39.7 | 73.4±36.6 | 44.8±38.3 | 46.9±41.2 | 39.3±38.1 | **0.982**** | **0.001** |
| Mental Health score | 66.3±28.0 | 72.4±23.9 | 52.6±31.5 | 56.9±30.2 | 44.6±35.3 | **0.976**** | **0.001** |
| Reported Health score | -0.27±0.90 | -0.20±0.93 | -0.46±0.69 | -0.39±0.96 | -0.30±1.03 | 0.760 | 0.145 |
| Physical Health score | 62.1±25.8 | 68.2±24.9 | 49.9±22.6 | 50.6±23.7 | 43.6±23.7 | **0.970**** | **0.001** |
| Mentally Health score | 64.2±24.5 | 70.0±23.6 | 51.5±21.0 | 54.0±22.5 | 47.5±24.6 | **0.969**** | **0.001** |
| Total Score | 63.1±23.8 | 68.8±22.9 | 51.4±20.8 | 52.6±22.1 | 45.9±22.8 | **0.967**** | **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 | Characterize (n=766) | Non-depressed (n=522) | Depressed | | | O.R[a] | P-value[b] |
|---|---|---|---|---|---|---|---|
| | | | Mild (n=132) | Moderate (n=93) | Severe (n=19) | | |
| Water (g/kg) | 22.5±7.4 | 22.3±7.1 | 23.3±8.7 | 22.6±7.3 | 22.0±7.4 | 1.012 | 0.505 |
| Energy (Kcal/kg) | 30.7±10.2 | 30.4±9.8 | 31.6±11.4 | 31.5±11.2 | 30.5±7.7 | 1.010 | 0.556 |
| Protein (g/kg) | 1.19±0.40 | 1.18±0.39 | 1.21±0.49 | 1.16±0.39 | 1.17±0.28 | 1.030 | 0.773 |
| Total lipid (g/kg) | 1.19±0.49 | 1.19±0.48 | 1.20±0.50 | 1.22±0.57 | 1.25±0.38 | 1.128 | 0.855 |
| saturated fatty acid (g/kg) | 0.311±0.117 | 0.309±0.113 | 0.325±0.135 | 0.296±0.120 | 0.327±0.087 | 1.353 | 0.291 |
| Trans fatty acid (g/kg) | 0.0095±0.0050 | 0.0084±0.0037 | 0.0084±0.0032 | 0.0164±0.0430 | 0.0095±0.0050 | **3347.8*** | **0.001** |
| Cholesterol (mg/kg) | 4.54±2.86 | 4.50±2.54 | 4.83±4.08 | 4.26±2.63 | 4.99±2.01 | 1.015 | 0.419 |
| Carbohydrate (g/kg) | 4.13±1.46 | 4.11±1.42 | 4.27±1.58 | 4.12±1.57 | 3.94±1.14 | 1.034 | 0.668 |
| Sugars (g/kg) | 1.44±0.60 | 1.44±0.58 | 1.51±0.68 | 1.34±0.63 | 1.28±0.47 | 0.962 | 0.137 |
| Starch (g/kg) | 0.753±0.399 | 0.731±0.357 | 0.764±0.386 | 0.862±0.601 | 0.726±0.233 | **1.498**** | **0.035** |
| Dietary fiber (g/kg) | 0.357±0.134 | 0.352±0.130 | 0.370±0.141 | 0.373±0.149 | 0.331±0.097 | 1.317 | 0.280 |
| Caffeine (mg/kg) | 0.803±±0.356 | 0.792±0.326 | 0.821±0.367 | 0.847±0.498 | 0.778±0.247 | 2.350 | 0.504 |
| Calcium (mg/kg) | 12.81±4.77 | 12.75±4.76 | 13.42±4.96 | 12.32±4.76 | 12.65±3.43 | 1.009 | 0.355 |
| Iron (mg/kg) | 0.252±0.249 | 0.235±0.095 | 0.250±0.136 | 0.358±0.650 | 0.222±0.085 | **3.079**** | **0.001** |
| Copper (µg/kg) | 0.026±0.030 | 0.025±0.15 | 0.027±0.031 | 0.037±0.068 | 0.023±0.013 | **487.4**** | **0.006** |
| Magnesium (mg/kg) | 4.60±1.69 | 4.51±1.51 | 4.76±1.88 | 4.87±2.30 | 4.41±1.1 | **1.093*** | 0.158 |
| Phosphorus (mg/kg) | 17.8±6.3 | 17.6±6.0 | 18.4±7.5 | 18.1±6.4 | 17.6±4.2 | 1.016 | 0.574 |
| Potassium (mg/kg) | 39.4±13.4 | 39.3±13.3 | 40.9±15.29 | 38.57±11.26 | 39.4±13.4 | 1.003 | 0.516 |
| Selenium (µg/kg) | 2.16±4.3 | 1.8±0.8 | 1.9±1.2 | 4.0±12.1 | 1.8±0.67 | 1.086 | **0.001** |
| Vitamin C (mg/kg) | 1.59±0.79 | 1.58±0.78 | 1.47±0.74 | 1.46±0.45 | 1.59±0.79 | 1.015 | 0.148 |
| Vitamin A (IU/kg) | 105.2±67.6 | 104.7±57.4 | 115.2±99.5 | 96.2±68.1 | 95.2±45.5 | 1.000 | 0.175 |
| Vitamin D (IU/kg) | 0.607±0.422 | 0.605±0.431 | 0.631±0.448 | 0.571±0.341 | 0.692±0.339 | 1.046 | 0.604 |
| Vitamin E (mg/kg) | 0.156±0.561 | 0.154±0.546 | 0.160±0.063 | 0.158±0.585 | 0.131±0.042 | 5.531 | 0.645 |
| Vitamin B6 | 0.042±0.278 | 0.0248±0.0076 | 0.0256±0.1017 | 0.1664±0.7897 | 0.0253±0.0554 | 140.9 | **0.001** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (µg/kg) | | | | | | | |
| Vitamin B12 (µg/kg) | 0.153±0.295 | 0.141±0.200 | 0.166±0.442 | 0.207±0.460 | 0.132±0.128 | 1.505 | 0.223 |

[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.

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 | **0.110** | **0.002** |
| Sleep | 0.053 | 0.141 |
| SF-36 Physical Function score | **-0.313** | **<0.001** |
| SF-36 Role of Physical score | **-0.257** | **<0.001** |
| SF-36 Body Pain score | **-0.300** | **<0.001** |
| SF-36 General Health score | **-0.341** | **<0.001** |
| SF-36 Vitality score | **-0.402** | **<0.001** |
| SF-36 Social Function score | **-0.184** | **<0.001** |
| SF-36 Role of Emotional score | **-0.337** | **<0.001** |
| SF-36 Mental Health score | **-0.324** | **<0.001** |
| SF-36 Reported Health score | **-0.130** | **0.009** |
| SF-36 Physical Health score | **-0.369** | **<0.001** |
| SF-36 Mentally Health score | **-0.365** | **<0.001** |
| SF-36 Total Score | **-0.374** | **<0.001** |
| Water (g/kg) | 0.025 | 0.496 |
| Energy (Kcal/kg) | 0.054 | 0.137 |
| Protein (g/kg) | 0.005 | 0.894 |
| Total lipid (g/kg) | 0.041 | 0.258 |
| saturated fatty acid (g/kg) | 0.023 | 0.524 |
| Trans fatty acid (g/kg) | **0.088** | **0.015** |
| Cholesterol (mg/kg) | 0.016 | 0.658 |
| Carbohydrate (g/kg) | 0.019 | 0.601 |
| Sugars (g/kg) | -0.039 | 0.281 |
| Starch (g/kg) | **0.093** | **0.010** |
| Dietary fiber (g/kg) | 0.031 | 0.387 |
| Caffeine (mg/kg) | 0.050 | 0.165 |
| Calcium (mg/kg) | 0.009 | 0.811 |
| Iron (mg/kg) | **0.083** | **0.023** |
| Magnesium (mg/kg) | 0.051 | 0.156 |
| Phosphorus (mg/kg) | 0.038 | 0.299 |
| Potassium (mg/kg) | -0.001 | 0.984 |
| Selenium (µg/kg) | **0.091** | **0.012** |
| Vitamin C (mg/kg) | -0.034 | 0.355 |
| Vitamin A (IU/kg) | 0.032 | 0.375 |
| Vitamin D (IU/kg) | 0.020 | 0.588 |

| | | |
|---|---|---|
| Vitamin E (mg/kg) | 0.043 | 0.238 |
| Vitamin B6 (µg/kg) | 0.080 | 0.057 |
| Vitamin B12 (µg/kg) | 0.036 | 0.141 |
| The negative symbol (-) shows an inverse relationship between the factor and the BDI-13 score<br>Effect estimates with a p-value⩽0.05 are indicated in **bold**. | | |

# Figures

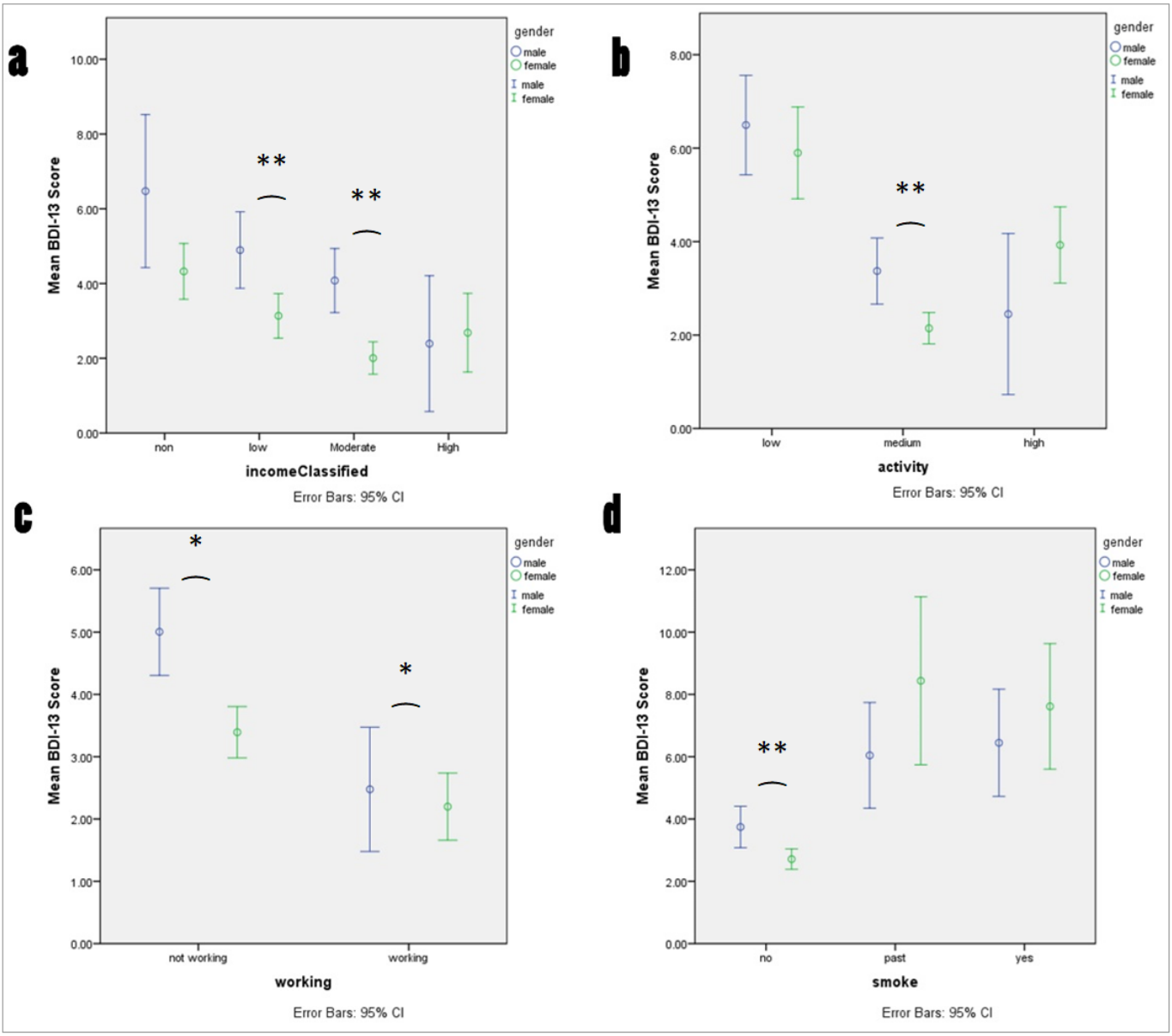


**Figure 1**

mean BDI-13 score in economical level (a), physical activity (b), working (c), and smoking (d) groups stratified by gender. * p-value⩽0.05, ** p-value⩽0.001