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Original Article

Serum Levels of Blood Minerals (Fe, Mg) and Vitamins (D, B12) in Suicide Attempters

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Abstract

Background: Suicide is an intentional act that results in the death of a person. Clinical researchers show that a new era has begun in understanding suicide pathophysiology. Our study assessed serum minerals (Fe, Mg) and vitamins (D, B12) to see if they are related to suicide attempts.

Methods: This is a cross-sectional study conducted in Ali-ebn-Abi Taleb Hospital, Rafsanjan City Central District, Kerman Province, Iran in 2022. Prior to measuring the quantity of essential minerals and vitamins in the blood, the degree of depression was assessed using the Beck depression severity scale. Chi-square, Independent T-test, Kruskal-Wallis, and Mann Whitney U test were performed to ascertain the existence of an association between these substances within the body and suicide attempts.

Results: Thirty-two attempted suicides (24 women and 8 men, mean age 14-46 yr) were included in this study. The mean and standard deviation of depression scores for 32 candidates was 16.43 ± 26.74. Moreover, our results show nearly 46.7% (50% women and 37.5% men) of participants suffer from vitamin D deficiency and 6.7% from Mg deficiency, half of them have also severe depression.

Conclusion: One of the reasons for the cause of depression and suicide attempt could be the status of minerals and vitamins in the body. Therefore, it is likely that a suitable diet and checking blood factors might help to reduce suicide attempts in a society.

Keywords: Depression; Attempted suicide; Minerals; Vitamins

Introduction

Currently, suicide rates vary greatly across countries, with low- and middle-income countries bearing the greatest burden of suicide (1, 2). It is estimated that suicide is the second leading cause

of premature mortality among 15-29-year-old (followed by traffic accidents), and the third leading cause among 15-44-year-old (3).

Suicide is more common in men. A majority of suicides are caused by psychiatric disorders, including mood, substance-related, anxiety, psychotic, and personality disorders (4). Unfortunately, depression can be a debilitating condition which negatively affecting daily life (5, 6). Furthermore, it is possible for a person with a mental disorder to display inappropriate behavior including suicide (7).

Interestingly, cognitive characteristics are different among depressed suicidal and depressed non suicidal persons (8). According to neuropsychological studies, suicide attempts display executive function abnormalities that may be linked to suicidality (9). Studies show that impairments in executive function, motor speed function, and overall neuropsychological functioning were associated with suicidal behaviors in patients with major depression (10, 11).

Since investigating the direct psychological and genetic causes of cognitive characteristics is not the main aim of our study, we will therefore examine the studies that show the effect of the lifestyle especially using the micronutrients (minerals and vitamins) in the diet of these cases. Recent studies are particularly interested in investigating the relationship between micronutrient deficiency and early cognitive development because micronutrients are associated with specific physiological processes (12, 13). Certain minerals (iron, magnesium, copper, and zinc) and vitamins (D, B12) could be involved in some mechanisms of action related to cognitive functions (14-16).

Iron deficiency is always one of the issues that neurologists and psychological experts pay attention to in patients with depression and mental disorders. Iron deficiency, which is a physical problem, is a result of a decrease in the capacity of blood to supply oxygen to different tissues, which can happen for a number of reasons. Potential mechanisms are related to the effects of iron deficiency during brain development on neurometabolism and neurotransmitter function. It can cause exhaustion, faintness, nervousness and depression (17-19).

Magnesium is also an essential cofactor for many enzymatic reactions, especially those involved in energy metabolism. Although the role of magnesium in neuronal function is not completely understood, a lowering of brain magnesium can induce seizures. Decreasing brain magnesium concentrations correlate with the alterations observed in extracellular brain magnesium concentrations in animals following dietary deprivation of magnesium (20, 21).

Vitamin D is one of the most important vitamins for health. Vitamin D insufficiency affects almost 50% of the population worldwide. Most humans depend on sun exposure to satisfy their vitamin D requirements (22). Women with low vitamin D had significantly higher risk of developing depressive mood over the follow-up periods (23, 24). However, understanding the potential causal pathway between vitamin D deficiency and depression requires further research.

Similarly, lack of vitamin B12, niacin, and folic acid are very common causes of anemia. They also cause paranoia, mental disorders, and even Alzheimer's disease (17). Psychiatric symptoms associated with vitamin B12 deficiency include aggression, irritation, confusion, and psychiatric diseases such as depression, bipolar disorder, psychotic disorders, and phobias (25-28).

The various studies in recent years, have been confirmed the relationship between minerals and vitamins deficiencies and depressive disorder that identify the correlation between the severity of these materials and depressive disorder (29-31). However, there are only few studies addressing the relationship between mineral and vitamin deficiencies and suicidal attempt. Therefore, the aim of the present study was to determine serum levels of minerals (Fe, Mg) and vitamins (D, B12) in cases of suicide attempts. Moreover, most of the previous studies have studied the impacts of the minerals and vitamins separately. In the present study, both minerals and vitamins were measured. At the same time, the level of depression was also investigated in suicidal patients.

Materials and Methods

This research is a cross-sectional study on the cases of attempted suicide admitted in Ali-ebn-Abi Taleb Hospital in Rafsanjan City, Kerman Province, Iran from Jan to May 2022, with the code of ethics IR.RUMS.REC.1399.090.

In this time, 41 cases were admitted and hospitalized in the emergency department of the hospital. A written consent form is filled out by patients after they have been informed about the aim of the study. The forms also asked about people's medical records. By considering that the normal level of minerals and vitamins in people with cardiovascular disease, diabetes, and high blood pressure is lower than normal, so these cases were excluded from the study. Moreover, some cases did not agree to participate. Finally, 32 patients were selected in the study and 5 cc of blood sample was collected of every case to measure and compare with the normal level (Table 1) of minerals and vitamins in the blood.

Table 1: The normal level of minerals and vitamins in the blood

Mineral/Vitamin	Normal level
Fe	Men: 40-170µg/dL
	Women: 30-165 µg/dL
Mg	Men: 1.8-2.6 mg/dL
	Women: 1.9-2.5 mg/dL
D	10-30 ng/mL
B12	160-950 pg/mL

Prior to measuring the quantity of essential minerals and vitamins in the blood, the degree of depression was assessed using the Beck depression severity scale. Beck questionnaires were completed by a psychologist.

The Beck Depression Inventory (BDI) questionnaire is one of the most reliable questionnaires widely employed to screen for depression and measure behavioral manifestations and severity of depression (32). The inventory contains 21 self-report items completed through multiple choice response formats. Each answer is scored on a scale ranging from 0-3. Measures of 0–9 indicate no depression, 10–18 indicate mild-moderate depression, 19–29 indicate moderate-severe depression and 30–63 indicate severe depression (32, 33). Demographic information such as gender, age, occupation, level of education, and residence of the patients were also recorded in the questionnaire.

Finally, the SPSS software, Version 22, (IBM Corp., Armonk, NY, USA) was used to analyze the data based on Beck questionnaire's results, demographic factors, and the results of the blood test.

Results

Overall, 32 attempted suicides (24 women (75%), and 8 men (25%)) were participated in our study. Age-wise, the mean (standard deviation) is 25.62 (9.90) and they range in age from 14 to 46. Among 32 candidates, the mean depression score was 26.74±16.43 which 75% are related to women. The kolmogorov-smirnov test, Skewness and Kurtosis indices were used to examine the normalization of data distribution. Gender, total depression score, magnesium serum level and vitamins D3 and B12 have a normal distribution. But the variable distribution of Fe serum level is not normal (Table 2).

Table 2: Minimum and maximum values, mean, standard deviation, and skewness and kurtosis of quantitative study variables

Variable	Min.	Max.	Mean	Std. Deviation	Skewness	kurtosis	*P*-value*
Age (year)	14.00	46.00	25.63	9.91	0.553	-.966	0.093
Depression score	2.00	57.00	26.74	16.43	0.130	-1.296	0.102
Fe level	37.00	249.00	85.97	48.32	1.714	3.401	0.019
Mg level	1.80	2.50	2.17	0.19	0.109	-.644	0.115
Vitamin D3	9.20	96.00	38.54	23.59	1.261	0.897	0.062
Vitamin B12	428.0	897.00	585.13	124.71	0.467	-.543	0.062

* kolmogorov-smirnov test: *P*>0.05 shows the normality hypothesis

The questionnaire results divided the candidates into 3 groups depending on their depression scores: normal (under 10), mild (from 11-30) and severe (in the range of 31-63). The results show 15 people (46.9%) were in severe condition, 7 (21.9%) in mild and 10 (31.2%) were in normal condition. The severe state in 66.7% of men and 52.4% of women, normal state in 33.3% of men and 14.3% of women and mild state in 33.3% of women. 24 people (75%) were women and the rest (8 people, 25%) were men. There were no reports of mild conditions in men. But based on the Chi-squared test, there isn't a significant difference between men and women (*P*=0.161).

The average level of Fe serum is compared by using the Mann-Whitney U and Kruskal-Wallis tests at different levels of the variables of gender, education level, place of residence and the state of depression scores. According to the results in Table 3, no significant difference was observed between the levels of qualitative variables in terms of the average iron serum level (*P*>0.05).

Table 3: Mean and standard deviation of Fe according to demographic variables and depression scores status

variable	Variable Levels	N(%)	Mean ± SD	*P*-value
Gender	Woman	24 (75.0)	87.00 ± 50.59	.819*
	Man	8 (25.0)	81.83 ± 41.75	
Education	Elementary	9 (28.1)	105.67 ± 65.63	.189**
	High School	12 (37.5)	87.67 ± 45.20	
	Diploma and University	11 (34.4)	64.00 ± 19.07	
Residence	Town	20 (62.5)	93.72 ± 50.88	.289*
	Village	12 (37.5)	74.33 ± 43.69	
Depression scores status	Normal	10 (31.3)	70.67 ± 21.25	.524**
	Mild	7 (21.9)	88.71 ± 48.66	
	Severe	15 (46.9)	94.43 ± 59.95	

*. Mann Whitney U test; ** Kruskal –Wallis test; Significance level less than 0.05

The average level of magnesium serum, has been compared at different levels of the variables of gender, education level, place of residence and the state of depression scores. According to the results of these tests, no significant difference was observed between the levels of qualitative variables in terms of the average level of serum magnesium (*P*>0.05) (Table 4).

Table 4: Mean and standard deviation of Mg according to demographic variables and depression scores status

Variable	Variable levels	N(%)	Mean ± sd	*P*-value
Gender	Woman	24 (75.0)	3.04 ± 4.26	.335*
	Man	8 (25.0)	2.18 ± 0.19	
Education	Elementary	9 (28.1)	2.27 ± 0.15	.501**
	High School	12 (37.5)	3.89 ± 6.02	
	Diploma and University	11 (34.4)	2.11 ± 0.25	
Residence	Town	20 (62.5)	3.33 ± 4.91	.429*
	Village	12 (37.5)	2.18 ± 0.20	
Depression scores status	Normal	10 (31.3)	2.14 ± 0.20	.213**
	Mild	7 (21.9)	5.10 ± 7.89	
	Severe	15 (46.9)	2.22 ± 0.20	

*. Independent samples t-test; ** One-way analysis of variance; Significance level less than 0.05

Tables 5 and 6, shows the comparison of the average amount of vitamin D3 and B12 at different levels of these variables, respectively. According to the results of independent t-tests and one-way analysis of variance, no significant difference was observed between the levels of qualitative variables in terms of average vitamin D3 and B12 (P>0.05). Only, the average vitamin B12 in men was significantly higher than that of women (P = 0.007).

Table 5: Mean and standard deviation of vitamin D3 according to demographic variables and depression scores status

Variable	Variable levels	N(%)	Mean ± sd	*P*-value
Gender	Woman	24 (75.0)	39.63 ± 25.87	.439*
	Man	8 (25.0)	34.17 ± 10.94	
Education	Elementary	9 (28.1)	38.89 ± 24.02	.712**
	High School	12 (37.5)	42.17 ± 21.20	
	Diploma and University	11 (34.4)	33.36 ± 27.79	
Residence	Town	20 (62.5)	42.62 ± 24.50	.242*
	Village	12 (37.5)	32.42 ± 21.70	
Depression scores status	Normal	10 (31.2)	47.89 ± 30.06	.376**
	Mild	7 (21.9)	33.86 ± 26.47	
	Severe	15 (46.9)	34.87 ± 16.59	

*. Independent samples t-test; ** One way analysis of variance; Significance level less than 0.05

Table 6: Mean and standard deviation of vitamin B12 according to demographic variables and depression scores status

Variable	Variable levels	N(%)	Mean ± sd	*P*-value
Gender	Woman	24 (75.0)	555.79 ± 103.46	.007*
	Man	8 (25.0)	702.50 ± 142.47	
Education	Elementary	9 (28.1)	620.56 ± 105.84	.270**
	High School	12 (37.5)	600.17 ± 151.66	
	Diploma and University	11 (34.4)	529.67 ± 91.30	
Residence	Town	20 (62.5)	570.28 ± 127.93	.430*
	Village	12 (37.5)	607.42 ± 121.66	
Depression scores status	Normal	10 (31.3)	590.89 ± 151.30	.419**
	Mild	7 (21.9)	531.29 ± 103.45	
	Severe	15 (46.9)	608.36 ± 116.19	

*. Independent samples t-test; ** One way analysis of variance; Significance level less than 0.05

Discussion

In this study, the demographic information (gender, age, occupation, level of education, and residence) and the level of minerals (Fe, Mg) and vitamins (D, B12) were analyzed. The results' investigation determines the status of minerals and vitamins in the patients.

For instance, about Fe deficiency, blood test results demonstrated, we have no cases with Fe deficiency (the normal Fe level is 40-170µg/dL in men and 30-165 µg/dL in women) but it is remarkable that we observed 10% of depression patients with high Fe level (more than the normal level). Since the increasing of Fe level in blood causes behavior disorders, because of the accumulation in the Amygdale that enhances aggression, it can be a reason to raise suicide thoughts in a person. However, looking at other studies, similar results are not obtained. For example, in a cross-sectional study, investigated participants consisted of 1000 individuals with self-reported depression history (mean age, 41.4 ± 12.3 yr; 499 women) and 10876 population-based controls (mean age, 45.1 ± 13.6 yr; 5185 women). Their results showed the rate of self-reported lifetime history of iron-deficiency anemia was higher in the depression group in both men (depression, 7.2%; control, 4.0%; P<0.001; odds ratio [OR], 1.86; 95% confidence interval [CI], 1.30-2.68) and women (depression, 33.4%; control, 25.8%; P<0.001; OR, 1.45; 95%CI, 1.19-1.76)(30). The lack of Fe was surveyed with Patient Health Questionnaire-9 depressive symptoms and depression among young adult males and females using the National Health and Nutrition Examination Survey (NHANES) 2017–2020. This study that was done on 18-25-year-old youth, confirmed the direct relationship between iron deficiency and depression (34). Of course, these studies do not conflict with the existing study, because the Fe content that reported in our study could be due to the continuous consumption of pistachios in the diet of the people of Rafsanjan. Pistachios contain fiber that helps prevent Fe deficiency and its complications such as anemia.

We found, by checking the amount of Mg in the blood of patients, 6.7% of attempted suicides suffer from Mg deficiency (half of them have severe depression). In a case report study, noted the improvement of depression patients by adding magnesium to their diet (21). Other similar studies confirm the direct relationship between the decrease in magnesium levels and the development of mental disorders, including depression and suicide attempts (35-37).

Examining the level of vitamin D in the blood of studied cases in present research, indicates the lack of vitamin D in patients, too. According to our research, nearly 46.7% (50% women and 37.5% men) of attempted suicides suffer from vitamin D deficiency. On the other hand, patients with vitamin D deficiency exhibit depression symptoms based on the Beck test. If we take a look to related studies, we can find the importance role of vitamin D in health. As an example, Ozkayar et al. (31) in a cross-sectional and descriptive study investigated 117 renal transplant recipients (44 females, 73 males; mean age, 39.0±11.7 yr) were included in the study. Patients were stratified into two groups with or without depression risk. The results of blood biochemistry showed the low vitamin D level in the groups with and without depression risk (15.2 ± 9.2 µg/L and 21.9 ± 12.7 µg/L, respectively; P=0.004) and a negative correlation was detected between depression score and vitamin D levels (r = -0.365, P<0.0001).

Deficient (<10 ng/mL) vitamin D levels were significantly associated with suicidal ideation (OR = 1.138, 95% Cl = 1.027-1.262). In contrast, there was no significant difference between the vitamin D-insufficient (10-19.99 ng/mL) and sufficient (≥20 ng/mL) groups (OR = 0.988, 95% Cl = 0.932-1.047) (38). In another study (39), vitamin D levels compared in suicide attempters (**n**=59), non-suicidal depressed patients (n=17) and healthy controls (**n**=14). Suicide attempters had significantly lower mean levels of vitamin D. In a review study, surveyed some researches that

focused on the role and importance of individual nutrients in the diet and the impact of nutrient deficiencies on the risk of depression in 2018-2023. The results of this 5-year survey showed, for example, approximately 80% of depressed patients do not take adequate daily doses of vitamin D (40).

As far as vitamin B12 levels are concerned, we did not observe any deficiency in patients but the level is less in severe depression cases than in mild and normal cases. The study conducted by Todorov et al. compares the vitamin B12 levels in healthy people and those in depression (included 74 candidates: 38 depressed and 36 healthy cases). The results showed the vitamin B12 level in depression cases is lower (41). Besides, the levels of serum ferritin and vitamin $B_{12}$was studied in late-life depression patients and its relationship with suicide attempts. The results showed the lack of ferritin and vitamin B_{12} may have some effects on suicide attempts (18).

Numerous studies conducted in this field fully show the importance of the subject but it seems more researchers need to determine whether a decrease or increase in mineral and vitamin levels in blood is linked to depression and attempted suicide. Because it can open up the world and a new way to reduce suicide numbers in every society. In this study, despite our efforts, we considered only 32 samples to survey in a cross-sectional design. However, it will be more effective if the future studies examine more cases in a longitudinal design.

Conclusion

In recent years, the impact of malnutrition and lack of minerals and vitamins in the occurrence of depression and suicidal behavior has been under more attention.

In fact, the conducted studies show the role and importance of minerals and vitamins on suicidal behaviors. In this cross-section study, we measured some minerals (Fe, Mg) and vitamins (D, B12) in suicidal patients to show the impact of these materials on the depression and incidence of suicide attempts. Our results can be considered as a starting point for future longitudinal studies to find a strong relationship between suicide behaviors, depression and the status of the micronutrients.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Data Availability Statement

The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available

Conflict of interest

The authors declare that there is no conflict of interests.

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