Makale

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Does Adequate Magnesium Intake prevent depression and anxiety and change eating behaviors?

Abstract

Magnesium is an essential mineral for the organism. Although the toxicity of magnesium is rarely seen, inadequate intake is more common and is found to be associated with many diseases. The aim of this study was to determine the intake of dietary Magnesium in university students and the consumption of Magnesium rich foods and to define its relationship between depressive symptoms, anxiety and eating behaviors. This study included 386 university students who were not diagnosed with any psychiatric disorder and were not using magnesium-containing nutritional supplements. A questionnaire of 7 sections including the general characteristics of participants, a food consumption frequency form containing magnesium-rich foods, Beck Depression Scale, Beck Anxiety Scale, 24-hour retrospective food consumption form, physical activity record form and Dutch Eating Behaviour Questionnaire were applied face to face and anthropometric measurements were obtained. Statistical analyzes were performed using SPSS IBM© version 23. The average magnesium intake of participants with a was $175,5\pm47,6$ mg/day in inadequate Mg intake group, and $353,4\pm107,23$ mg/day inadequate Mg group. Dietary Mg intake was evaluated according to Turkey Food and Nutrition Guide, it was determined that the Mg requirements of the inadequate level of Mg intake were only $48,2\pm12,09\%$ of the requirements were met. The factors such as smoking, BMI, n-3, n-6 fatty acids, and fiber intake were found to be related to magnesium intake. ($p < 0.05$). Dietary magnesium intake of 41,8% males and 33,8% of females was the under the reference value. It was concluded that psychiatric disorders frequency was not found to be lower in the participants having adequate Mg intake (OR: 1.035, 95% CI: 0,543-1,975, $p = 0.916$), and anxiety, restricting eating behaviors had no relationship with dietary Mg intake ($p > 0.05$), but emotional eating and external eating behavior scores had found lower in inadequate Mg intake group ($p < 0,05$) . According to this research, there is no relationship between adequate Mg intake and depression, anxiety, but further research needed.

Keywords: magnesium; depression; anxiety; eating behaviors

1. Introduction

Magnesium is the second most abundant element in the intracellular fluid after potassium (approximately 25 g), which is necessary for the ability of more than three hundred enzymes to function [1]. Mg plays an important role in electrical potential in nerve tissue and cell membranes [2]. It is used as a coenzyme in carbohydrate metabolism, glucose oxidation, and oxidative phosphorylation. It is an important mineral in the provision of fluid-electrolyte balance in body fluids [3].

According to the National Institutes of Health, recommended daily allowance for Mg is 400 mg for females, 310 mg for males aged-19-30 years [4]. Despite the physiologic role of Mg and its potential benefits, surveys have shown that dietary Mg intake is inadequate in Turkey as well as in other countries [5; 6]. Seventy-two percent of French [7], 86% of Americans [5] and 73,9% of Turkish people have been shown to consume less than the recommended quantity [6].

Green leafy vegetables, legumes, peas, nuts, spices, soy products, whole grain products [8], almonds [4], cocoa, sesame, black-eyed peas, soybeans, rice, yogurt, amaranth [9], chocolate, coffee [10], mint, pumpkin seeds, poppy, parsley, tahini [11] are the richest sources of Mg. However, it is still unclear what effects Mg absorption. High levels of calcium, vitamin D and phosphate are thought to reduce Mg absorption. High fiber contents reduce the bioavailability of the mineral; but, protein and fructose are thought to increase absorption [12; 13].

The first symptoms of Mg deficiency are neurological and neuromuscular manifestations due to impaired potassium flow. Anorexia, fatigue and weight loss can be observed in case of inadequacy [8]. Mg deficiency is thought to be associated with inflammation, oxidative stress, the aging process and also associated with non-communicable diseases such as cardiovascular diseases, diabetes, asthma, migraine, Alzheimer's disease [14].

Studies conducted to determine the relationship between Mg and mood, serum, plasma, and erythrocyte Mg levels are frequently encountered. The results of studies in which serum and plasma Mg values used are contradictory. Although most of the studies reported that serum/plasma Mg levels were low in depressive individuals [15; 16], there are studies reporting that this relationship is only valid in men [17] or only in long-term depression patients [16]. The limitation of studies using serum or plasma Mg levels is that 99% of the body Mg is located the

cell, and only 1% is outside of the cell. This causes serum/plasma Mg measurements not to reflect the total body Mg. The measurement of erythrocyte Mg level is thought to be more reliable than serum/plasma measurement; however, it is a costly method. Mg homeostasis is provided due to endocrine parameters between dietary intake, absorption and renal pulse [18].

Studies on Mg deficiency indicates that Mg has an important role in the etiology of mood disorders. One possible mechanism on the relationship between Mg and mood disorders is thought to be that Mg deficiency changes microbiota profile and affects individual's mood [19]. Another possible mechanism is that the limbic-hypothalamus-pituitary-adrenocortical axle is sensitive to the mineral Mg and it prevents corticosteroids from reaching the brain, bypassing the blood-brain barrier [20]. According to the studies, the last possible mechanism is Mg inhibiting N-methyl D-aspartate (NMDA) receptors, blocking glutamate entry into the cell and reducing depressive symptoms [21; 22]. Studies about dietary Mg intake and its relation with anxiety is limited [23; 24; 25]. In a study, it was concluded that there was no significant association between Mg intake and anxiety [25], but studies with experimental animals showed that inadequate Mg intake was increased anxiety level [23; 26]. Studies that aimed to investigate the relationship between dietary Mg intake and depressive symptoms have shown that changes in the microbiota composition affect Mg absorption first and then depressive behaviors [19; 27]. Although there are controversial results with Mg intervention in the treatment of psychiatric disorders [28; 29]; a study in which Mg intake increased, increased Mg levels in cerebrospinal fluid, and reduced anxiety [30]. A meta-analysis of seventeen studies concluded that there was a significant association between dietary Mg intake and depression [31]. Therefore, the aim of this study was to research the quantity of dietary Mg intake of college students and its relationship with depressive symptoms, anxiety and eating attitudes. Due to the limited research, this study planned for determining the dietary intake of Mg in Turkey and it is expected to make a significant contribution to the subject of this study.

2. Materials and Methods

2.1. Study Design and Population

This study is a cross-sectional study carried on randomly selected-386 university students between 1 April and 30 May 2017. A signed informed consent form in accordance with Helsinki Declaration was obtained from the participants who agreed to participate in the

study voluntarily. Ethical approval was obtained from the Ethics Committee of Hacettepe University, Ankara, Turkey (GO 17/229-37). Students, having a psychiatric diagnosis and using Mg containing supplements were excluded from the study. The data were collected by face-to-face interview method through the questionnaire form. An informed consent form was obtained from all participants. A total of 7 sections of the questionnaire including the general characteristics of participants, food consumption frequency form containing magnesium-rich foods, Beck Depression Scale, Beck Anxiety Scale, 24-hour recall, physical activity records, and Dutch Eating Behaviour Questionnaire were applied, anthropometric measurements such as body weight, height, waist circumference were taken.

2.2. Assessment of Depression, Anxiety and Eating Behaviours

Beck Depression Inventory

It is one of the most commonly used self-report instruments in clinical practice and research [32]. In order to measure the severity of depressive symptoms the scale developed by Beck et al. [33] in 1961 and validity to Turkish was performed by Hisli et al. [34]. The aim of the scale is not to diagnose depression but to objectively deduce the grades of depression symptoms [34]. The Cronbach alpha coefficient was found to be 0.74 in the validity and reliability study of the Turkish form [34]. A total of 21 items were rated with a 4-point Likert type. The points that can be taken range from 0 to 63 (0=Positive statements about depression, 3= Negative statements about depression) [35]. The cut-off point of the scale was determined as 17 points and above, indicating that the individuals receiving above this score had depression that required treatment [34]. The severity of depressive symptoms is interpreted as minimal between 0-9 points, mild between 10-16, moderate between 17-29, and severe between 30-63 [35].

Beck Anxiety Inventory

Beck et al. [36] was developed in 1988 and is used to determine the frequency of anxiety symptoms experienced by the individual. The scale validated for Turkish by Ulusoy et al. [37] in 1998. How often participants respond to specific symptoms within the last week (from 0=no to 3=frequently) is based on scoring between 0-3. The score obtained from the scale is accepted as minimal anxiety between 0-7, mild anxiety at 8-15, medium anxiety between 16-25 points and severe anxiety between 26-63 points [38]. The higher is the score on the scale, the more likely it is that the anxiety of the individual is so severe [39]. It has been developed so that anxiety can be easily distinguished from depression and diagnosed. Of the twenty-one questions, 4 are

related to anxiety and mood, 3 are related to specific fears, and the remaining 14 questions are about physiological symptoms that occur in anxiety disorders and panic situations. The questionnaire was determined to be valid for Turkey [37].

Dutch Eating Behaviour Questionnaire

The Dutch Eating Behaviour Questionnaire was developed in 1986 by Van Strein et al. [40]. The questionnaire, consisting of 33 questions in total, consists of 3 subscales that assess the behavior of emotional eating, external eating, and restrictive eating. The DEBQ was answered on a 5-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=frequent, 5=very often). Since there were no cut-off points for the sub-scales, the median values obtained from the study data were used as cut-off points. The Cronbach alpha coefficient was found to be 0,95 for restrictive eating, 0.94 for emotional eating and 0,80 for external eating [40]. Translation of the scale to Turkish was made by Tekok et al. [41] and the validity and reliability study in university students, by Bozan et al. [42].

2.3. Assessment of Dietary Magnesium Intake

Nutrient intake was assessed by a-24-hour food recording [43]. The portion quantities, consumed, was determined using "Food Photograph Catalogue" [44], and the average intake of energy, macronutrients, and micronutrients were assessed BEBİS (Nutrition Information System) version 8.1 [45]. The resulting data were evaluated according to Turkey Food and Nutrition Guide [46].

2.4. Anthropometric Measurements

Body weight, height and waist circumference of the participants were measured by the researcher; Body mass indexes were calculated from body weight and height values. Weight was measured wearing light clothes and no shoes by a portable scale; height was measured without shoes with a stadiometer, waist circumference was measured in the middle of the iliac prominence and the lowest rib of the participant with an inflexible tape [47; 48]

2.5. Statistical Analysis

Statistical analysis was performed using SPSS IBM© version 23 [49]. The sample size was obtained by calculating the minimum number of people to be reached according to 80% power level and p=0.05 significance level by Pass Out programme. The distribution of variables

was examined by Kolmogorov-Smirnov / Shapiro-Wilk tests, descriptive statistics were expressed as mean±standard deviation for normally distributed numerical variables, median and min-max values for not normally distributed numerical variables, and frequency tables for identifying categorical variables. In the evaluation of categorical data, x^2 and Fisher exact tests, Mann Whitney U test, Kruskal Wallis test or t-test in independent groups were used for numerical variables, Pearson correlation test was examined for normally distributed numerical values and correlation coefficients were determined by Alpar et al. [50]. For the multivariate analyses, the possible factors identified with univariate analyses were further entered into the logistic regression model analysis. If the variable has associated with both outcome and variable (p<0,05), it was considered a potential confounder and included into the model. Mg is also explored as an outcome of energy intake (milligrams of Magnesium/1000 kcal). Hosmer-Lemeshow goodness of fit statistics were used to assess model fit. A 5% type of error was used to infer statistical significance.

3. Results

General characteristics and anthropometrical measurements were shown according to DRI of Mg in Table 1. We evaluated 191 males and 195 females. The average age of participants is 22,2±2,42. Total Mg intake was 175,5±47,6 (meet the requirement 48,2±12,09%) mg in the inadequate Mg intake group and 353,4±107,23 mg (meet the requirement 102,8±32,58%) (Data is not shown) for adequate Mg intake group. General characteristics such as age, income status, alcohol use are not statistically different among groups, physical activity level was not different, either. However, it was observed that as smoking ratio increased, Mg intake was decreased (p<0,001). Weight, BKI, and body fat mass were found higher in inadequate Mg intake group in both genders (p<0,001). Waist circumference was statistically different in males (p<0,05) (p-value is not shown).

Daily energy and nutrient intakes of participants categorized by DRI of Mg were given in Table 2. Energy and contribution of protein to the energy of the diet were higher inadequate Mg intake group (p<0,05), but the contribution of other macronutrients such as fat and carbohydrates were not significantly different. It is showed that Mg intake was significantly associated with n-3 fatty acids, fiber, vitamin B_1, vitamin B_6, folate, vitamin C and iron intake (p<0,001).

Table 3 presents depression, anxiety and eating behavior scores of participants according to DRI of Mg. Depression scores were higher in both gender in inadequate Mg intake group (p=0,017). Anxiety scores were higher in both genders, too. But it was not statistically different. When looking at eating behaviors, emotional eating and external eating behaviors were higher inadequate Mg intake group compared to the inadequate intake group (p=0,009, p=0,008 respectively). External eating behavior is higher in both genders, but emotional eating was higher only females.

This data revealed that depression, emotional eating and external eating behavior was significantly different between the groups. However, after adjustments based on binary logistic regression model analysis, the difference between groups' depression scores had no longer significant (Table 4).

4. Discussion

Magnesium is the second most abundant element in the intracellular fluid after potassium, which is necessary for the ability of more than three hundred enzymes to function [1]. Despite the physiological role of Mg and its potential benefits, surveys have shown that dietary Mg intake is inadequate in Turkey as well as in other countries [5; 6; 7]. Mg deficiency is thought to be associated with inflammation, oxidative stress, the aging process and also associated with non-communicable diseases such as cardiovascular diseases, diabetes, asthma, migraine, Alzheimer's disease [14]. This cross-sectional study was planned to assess whether Mg intake and psychiatric disorders associated with each other. In our study, we have found no significant difference between groups of Mg intake in depression and anxiety scores of students. These findings were in line with a Spanish follow-up study in university graduates [29]. Derom at al., was studied among university graduates' individuals. Mg intake was assessed with a validated food frequency form, and depression assessed by self-reports. While the other methodologic aspects were similar, the assessment method of Mg intake was different between the two studies. Our samples were young and highly educated. Nevertheless, epidemiologic literature about magnesium intake and depression was contradictory. In a study conducted by Yary et al. among 2320 individuals 42-61 aged, it was reported that the individuals who consumed Mg in the lowest tertile had a higher risk of depression (HR: 0,53, Cl: 0,25-0,95, p=0,035). Similarly, in the Hordaland Health Study, 5780 individuals between 46-74 years were examined, Mg intake was evaluated by using a food consumption frequency form consisting of 169 foods and Hospital Anxiety and Depression Scale was used. The results showed that

depression was lower in the group of adequate Mg intake (OR: 0,86, Cl: 0,69-1,08). Mechanisms for the use of Mg in the treatment of depression have not been clarified yet. However, Mg is associated with the metabolism of many enzymes and hormones such as adrenocorticotropic hormone, gamma-aminobutyric acid, and glutamatergic neurotransmitters. It plays a role in the glutamatergic transmission of N-methyl-D-aspartate receptors that may be a part of the pathophysiology of depression. However, in this study, it was found that there was no relationship between depression and the adequate intake of Mg after adjusting according to various factors (OR: 1.66, Cl: 0.83-3.29). It is thought that there may be several reasons why different results have been obtained from these studies. The fact that the study sample consisted of young individuals may have decreased the frequency of depression and Mg deficiency. The difference in the methodology of evaluation of Mg intake and depression may have affected the results. It may also be an effective factor for the participants to have a high level of education and have healthy lives. Another reason is that Mg absorption depends not only on bioavailability but also on the absorption of dietary nutrients [29].

In this study, it was determined that the individuals had anxiety in 28.8% of the individuals with inadequate Mg and in 27% of the adequate Mg intake group (data not shown). When anxiety scores were compared according to magnesium intake levels, there was no difference between magnesium intake groups among the anxiety scores ($p > 0.05$). In a systematic review including 18 studies, the effect of Mg on different types of anxiety was investigated. Mg intake on postpartum anxiety was not effective, but it has been suggested to be effective in other types [21]. The cross-sectional studies examining the relationship between diet Mg intake and anxiety are limited. Three hundred mg/day Mg support was given to university students and the difference between anxiety scores between placebo and intervention groups was evaluated; however, no difference was found [51]. Hanus et al. [52] in a double-blind randomized clinical trial of Mg support were found to cure anxiety. The reason why we obtained different results from this study was thought to be this study had been a cross-sectional study and the methodology of research while evaluating anxiety.

This study is a first in terms of examining the association between diet Mg intake and eating behaviors. Since DEBQ does not have any cut-off points, the median values obtained from the study data were used as cut-off points for each behavior. While the eating behaviors of individuals according to Mg intake levels were examined, there was no difference between groups' restrictive eating behavior scores; but emotional eating and external eating behavior scores were found to be different in individuals with inadequate levels of Mg ($p < 0.05$). Both

emotional eating and external eating scores were found to be higher inadequate Mg group. This suggests that inadequate Mg intake may be not the reason but the result of emotional eating and external eating. Mg-rich foods like chocolate, almond, nuts are generally desirable foods that individuals with emotional eating and external eating behaviors tend to increase the consumption of them. So their Mg intake may increase [53].

This study is important in terms of evaluating the relationship between dietary Mg intake and mood. Since intake of psychotropic drugs and nutritional supplements would affect homeostasis, individuals with psychological support and treatment were excluded from the study. However, there were some limitations in our study. Moreover, participants may have misreported their psychiatric status because of social bias. Further prospective studies should have confirmed our findings.

Makale

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