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Original Article

# Investigation of the relationship between lipid profile and visceral adiposity index in patients with migraine

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## Abstract

**Objective:** Migraine is a neurovascular disease with a widespread prevalence that affects the quality of life of patients. In our study, we aimed to investigate blood lipid levels, body mass index (BMI) and visceral adiposity index (VAI) values and their relations with migraine severity in patients with migraine.

**Methods:** This prospective study was conducted with 227 patients diagnosed with migraine and 100 healthy volunteers. Participants' demographic characteristics were recorded, their blood lipid levels were measured, and BMI and VAI values were calculated.

**Results:** Of the migraine patients, 83.3% were female and 33.9% had migraine aura. Triglyceride (TG) levels in patients with migraine were statistically significantly higher than the control subjects ($p=0.006$). BMI in the migraine without aura (MWOA) group and VAI in the migraine with aura (MWA) group were significantly higher than in the control group ($p=0.021$, $p=0.019$). TG, BMI and VAI values were found to be significantly higher in patients with a Migraine Disability Assessment (MIDAS) Grade of 3-4 than in other participants ($p<0.05$).

**Conclusion:** In this study, we found significantly higher values of TG in patients with migraine, VAI in MWA, and BMI in MWOA compared to the control group. These results suggest that the use of a comprehensive index such as VAI in patients with migraine may be useful in demonstrating both increased vascular atherosclerotic risks and loss of function that may occur in relation to migraine in these patients.

**Keywords:** Migraine, triglycerid, visceral adiposity index.

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## INTRODUCTION

Migraine is a headache disorder with an annual prevalence of 15% in the general population and ranks second among the causes of disability (1). It is characterized by unilateral pain that increases with physical activity, photophobia, phonophobia, nausea and vomiting, and persists for 4 to 72 hours (2). An aura characterized by visual, sensory or motor, transient neurologic symptoms may be seen before pain in approximately one third of those with migraine (3).

Recent studies have identified migraine as a risk factor for stroke and cardiovascular diseases (4). As a matter of fact, vascular atherosclerosis is one of the important causes of ischemic stroke and has been associated with an increased risk of migraine (5). Atherosclerosis is characterized by lipid-rich plaques in the arterial wall, and high plasma levels of atherogenic lipids or lipoproteins play an important role in its development (6). In addition, the increased risk of vascular atherosclerotic diseases such as stroke and coronary heart disease in the context of migraine suggested that dyslipidemia, which has an important role in the etiology, may be related to the severity and frequency of migraine attacks (7).

In recent years, the prevalence of obesity and overweightedness has increased significantly in the world, and increased body mass index (BMI) has been associated with migraine prevalence and conversion to chronic migraine (8,9). In this context, it has been reported that the distribution of adipose tissue is more important than body mass index and total fat amount in the development of vascular complications in obesity (10). The Visceral Adiposity Index (VAI), which has been used frequently recently, is an indicator that includes not only anthropometric measurements, but also abdominal fat distribution, adipose tissue function, triglycerides (TG) and high-density lipoprotein-cholesterol (HDL-C) (11). Previous studies have associated visceral adiposity index, stroke, cardiovascular diseases, and increased risk of metabolic syndrome (12,13). Therefore, we thought that VAI could be a potential marker for assessing the risk and severity of migraine. To the best of our knowledge, the relationship between VAI and migraine has not been investigated before. In this context, with this study, we aimed to investigate blood lipid levels, BMI and VAI values and their relationship with migraine severity in patients with migraine.

## MATERIALS AND METHODS

### *Study Population*

The prospective study was approved by Ankara City Hospital Ethics Committee (E2-22-2956). All procedures were carried out in accordance with the principles set forth in the Declaration of Helsinki. A voluntary consent form was obtained from all participants who agreed to participate in the study. A total of 227 patients diagnosed with migraine who applied to the neurology outpatient clinic of our hospital were included in the patient group, whereas 100 healthy volunteers with no disease and applied to the outpatient clinic for check-up were included in the control group. Patients with chronic diseases (hypertension, diabetes mellitus, heart diseases, rheumatic diseases, oncological diseases, hematological diseases), chronic alcohol or drug use, were pregnant and those with acute or chronic inflammatory diseases were excluded from the patient group. Participants with a recent infection, any systemic disease or drug use were excluded from the control group.

### *Definitions*

The diagnosis of migraine was made according to the International Classification of Headache Disorders criteria (14). Patients were divided into two subgroups, namely migraine with aura (MWA) and migraine without aura (MWOA) groups. The severity of migraine pain was evaluated with the Visual Analogue Scale (VAS), and pain-related loss of function was evaluated with the Migraine Disability Assessment (MIDAS) (15). MIDAS is a short, easy to use questionnaire consisting of 7 items. Based on the scores obtained from MIDAS, patients that score between 0 and 5 are considered Grade I (minimal or infrequent disability) patients that score 21 or above are considered Grade IV (severe disability) (16).

All participants underwent blood tests, including HDL-C, TG and low-density lipoprotein- cholesterol (LDL-C) measurements via enzymatic colorimetric assay, after 12-hour fasting. BMI was calculated by dividing weight (kg) by height (meter) squared. In addition, VAI was calculated separately for females and males according to the following formulas. Accordingly, waist circumference (WC) was calculated in cm, HDL-C and TG were calculated

in mmol/L (17).

VAI for males= WC/(39,68+(1,88xBMI)x(TG/1,03)x(1,31/HDL-C); and

VAI for females = WC/(36,58+(1,89xBMI)x(TG /0,81)x(1,52/HDL-C).

### *Statistical analysis*

Statistical analyses were made using the SPSS 28.0 (Statistical Product and Service Solutions for Windows, Version 27.0, IBM Corp., Armonk, NY, U.S., 2021) software package. Descriptive statistics obtained from the collected data were expressed as mean with standard deviation and median with minimum and maximum values in the case of numerical variables and frequencies (number and percentage values) in the case of categorical variables. Normal distribution characteristics of the numerical variables were analyzed based on the skewness and kurtosis coefficients. Accordingly, given that the said coefficients were in the range of ±1.5, it was determined that the numerical variables conformed to the normal distribution. For this reason, parametric statistical methods were used in the study.

The differences between two independent groups were analyzed with the Independent Samplest-Test, and the differences between more than two independent groups were analyzed by One-Way Analysis of Variance (ANOVA) test. In the event a difference emerged as a result of the ANOVA test, Tukey's multiple comparison test was performed to determine the group from which the difference originated. The relationship between any two independent categorical variables was analyzedby chi-square test. The probability (p) statistics of < 0.05 were deemed to indicate statistical significance.

## RESULTS

Of the 272 migraine patients in the study population, 227 were included in the study sample (Figure 1). The mean age of the 227 migraine patients was 36.02±8.28 years. Of the migraine patients, 83.3% were female and 33.9% had migraine aura. According to the MIDAS scores, 32.6% of the migraine patients were Grade I, 36.6% Grade II, and 30.8% Grade III-IV. The mean VAS score of migraine patients was 8.06±1.38 (Table 1).

**Table 1. Demographic and clinical characteristics in migraine and control groups**

| | **Migraine (n=227) n(%)** | **Control (n=100) n(%)** | **Chi-square** | **P** |
|---|---|---|---|---|
| **Gender** | | | | |
| Female | 189 (83.3) | 79 (79.0) | 0.852 | 0.356 |
| Male | 38 (16.7) | 21 (21.0) | | |
| **MIDAS** | | | | |
| Grade I | 74 (32.6) | - | - | - |
| Grade II | 83 (36.6) | - | | |
| Grade III-IV | 70 (30.8) | - | | |
| **Aura** | | | | |
| Yes | 77 (33.9) | - | - | - |
| No | 150 (66.1) | - | | |
| | **Mean±SD** | **Mean±SD** | **T** | **P** |
| **Age** (year) | 36.02±8.28 | 37.36±11.18 | -1.074 | 0.284 |
| **VAS** | 8.06±1.38 | - | - | - |

***Abbreviations:*** t: Independent Sample T-Test. MIDAS: Migraine Disability Assessment, VAS: Visual Analogue Scale

Based on the results of one-way ANOVA test, the blood TG levels were statistically significantly higher in the MWA and MWOA groups than in the control group (p=0.006). HDL-C levels were significantly lower in the MWOA group than in the control group (p=0.021). BMI in the MWOA group was significantly higher than in the control group (p=0.021). Additionally, VAI in the MWA group was significantly higher than in the control group (p=0.019) (Figure 2) (Table 2).

**Table 2. Biochemical test results and differences by groups**

| | MWA | MWOA | Control | F | P | Difference (Tukey) |
|---|---|---|---|---|---|---|
| | Mean±SD | Mean±SD | Mean±SD | | | |
| **TG** (mg/dl) | 146.53±51.05 | 138.14±56.38 | 121.43±52.71 | 5.157 | **0.006*** | 3<1,2 |
| **LDL-C** (mg/dl) | 111.21±37.50 | 111.81±32.32 | 104.60±27.09 | 1.656 | 0.192 | - |
| **HDL-C** (mg/dl) | 49.61±10.05 | 49.21±10.87 | 53.02±11.88 | 3.907 | **0.021*** | 3>2 |
| **WC** (cm) | 92.34±7.14 | 93.99±7.82 | 92.43±9.74 | 1.501 | 0.224 | - |
| **BMI** (kg/m$^2$) | 23.65±3.18 | 24.17±3.34 | 22.94±3.64 | 3.947 | **0.020*** | 3<2 |
| **VAI** | 5.98±2.97 | 5.29±3.04 | 4.65±3.34 | 3.998 | **0.019*** | 3<1 |

***Abbreviations:*** F: One-way analysis of variance (ANOVA)*: p<0.05, MWA: Migraine with aura, MWOA: Migraine without aura, TG: Triglyceride, LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol, WC: Waist circumference, BMI: Body mass index, VAI: Visceral adiposity index.

In terms of migraine-related functional loss, the WC, TG, BMI and VAI values of the patients categorized as Grade III-IV according to the MIDAS scores were significantly higher than those of the patients categorized as Grade I and Grade II (p<0.05) (Figure 3). On the other hand, the HDL-C level of the patients categorized as Grade III-IV according to the MIDAS scores were significantly lower than other patients (p=0.001) (Table 3).

**Table 3. Comparison of differences and MIDAS score**

| | MIDAS I | MIDAS II | MIDAS III-IV | F | p | Difference (Tukey) |
|---|---|---|---|---|---|---|
| | Mean±SD | Mean±SD | Mean±SD | | | |
| **TG** (mg/dl) | 130.03±49.13 | 132.52±48.18 | 162.61±61.52 | 8.491 | **0.000*** | 3>1,2 |
| **LDL-C** (mg/dl) | 107.75±27.46 | 110.90±30.70 | 116.51±42.96 | 1.219 | 0.297 | - |
| **HDL-C** (mg/dl) | 50.21±11.52 | 51.71±9.56 | 45.61±9.79 | 7.034 | **0.001*** | 3<1,2 |
| **WC** (cm) | 92.31±7.99 | 92.05±6.39 | 96.24±7.91 | 7.316 | **0.001*** | 3>1,2 |
| **BMI** (kg/m$^2$) | 23.70±3.34 | 23.31±3.08 | 25.13±3.22 | 6.597 | **0.002*** | 3>1,2 |
| **VAI** | 5.15±2.66 | 4.84±2.35 | 6.73±3.72 | 8.835 | **0.000*** | 3>1,2 |

***Abbreviations:*** F: One-way analysis of variance (ANOVA) *: p<0.05, MIDAS Migraine Disability Assessment, TG: Triglyceride, LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol, WC: Waist circumference, BMI: Body mass index, VAI: Visceral adiposity index.

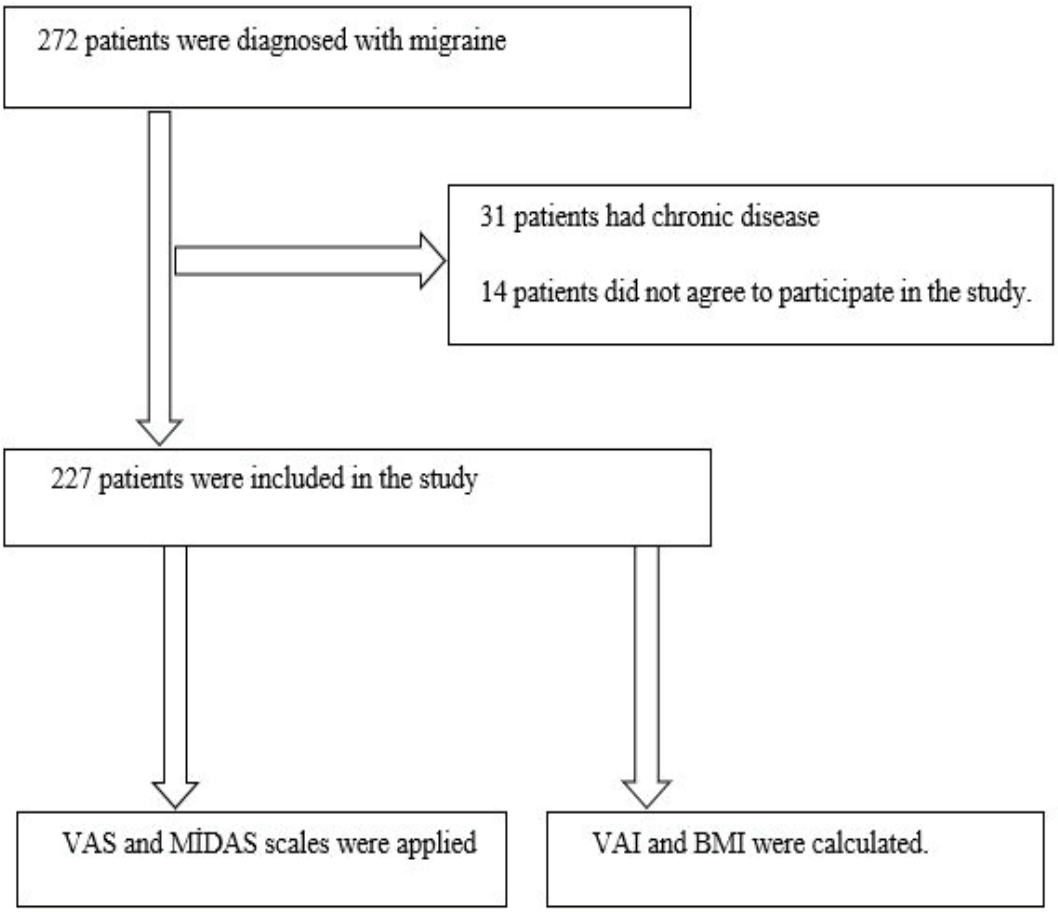


**Figure 1. Case selection criteria**

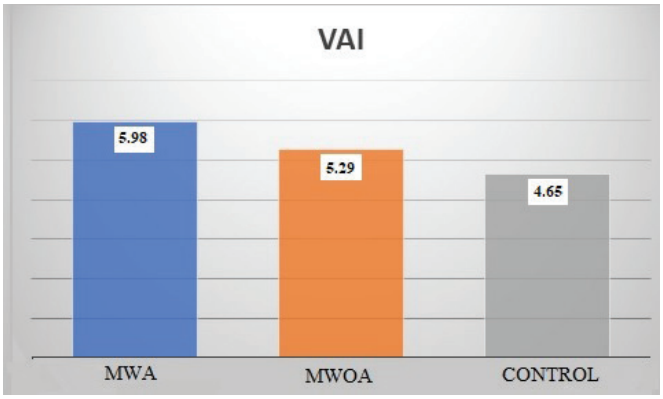


**Figure 2. Visceral adiposity index by groups**

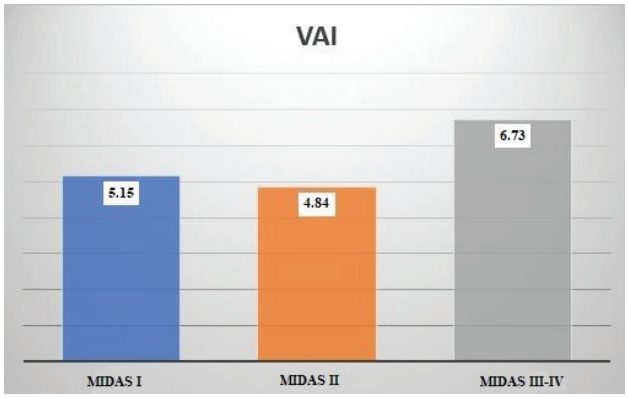


**Figure 3. Visceral adiposity index according to migraine severity**

## DISCUSSION

Migraine affects 18% of women and 6% of men. Migraine with aura is seen in 25% of the migraine patients with changes in neurovascular integration and cortical functions. In addition, migraine progresses to chronic migraine in 1 to 5% of the migraine patients. Chronic migraine, which causes a serious loss of function and thereby loss of workforce, is characterized by at least 15 migraine attacks per month for at least three months (18). In our study, 83.3% of the migraine patients were female, 33.9% had migraine with aura, and 32.6% were graded as Grade III-IV according to their MIDAS scores, indicating severe loss of function.

The relationship between migraine and vascular comorbidities has been known for a long time, and dyslipidemia is thought to increase this risk. Hypoperfusion and microembolic conditions seen in migraine have led to research on the causes that predispose to vascular atheroscleosis (19). In a study by Assarzadegan et al., blood cholesterol levels were found to be significantly higher in patients with migraine compared to the control subjects (20). In another study conducted with 1155 patients with headache, a relationship was found between migraine with aura and increased TG and total cholesterol levels (21). Similarly, in our study, TG levels were significantly higher and HDL-C levels were significantly lower in patients with migraine compared to the control subjects. In addition, TG levels were significantly higher in patients categorized as Grade III-IV according to their MIDAS scores. Along these lines, Tana et al. found a relationship between the frequency and intensity of migraine attacks with high cholesterol levels, while Ferrara et al., showed that a low-lipid diet reduced the number and severity of migraine attacks (22,23).

The prevalence of obesity and overweightedness, which have been associated with migraine prevalence and progression to chronic migraine in recent studies, has increased significantly in recent years (24). It is thought that that the high inflammatory response in the body in individuals with obesity may increase the frequency and severity of headache by increasing the sensitivity to stimuli and the neurovascular inflammatory response seen in migraine (25). In the meta-analysis of 12 studies by Gelaye et al., it was concluded that the risk of migraine increased by 27% in those with obesity compared to those with normal weight (26). In another cross-sectional study conducted with 3.733 women, Michelle Vo et al., showed that increased BMI increased the risk of migraine (27). Similarly, in our study, BMI values of the patients with MWOA were significantly higher than the control subjects. In addition, BMI values were significantly higher in migraine patients categorized as Grade III-IV according to the MIDAS scores compared to the patients categorized as Grade I and Grade II.

Most of the population-based studies on migraine and obesity in the literature have been based on BMI, and abdominal obesity has been evaluated in a few studies. Abdominal visceral fat, unlike other body fats, is seen as an independent risk factor for clinical complications (28). In a population-based study by Kristoffersen et al., both total body obesity (BMI ≥30) and abdominal obesity were found to be associated with a high prevalence of migraine (29). In another study, Santos et al. demonstrated that obesity and migraine were associated, but failed to demonstrate that abdominal obesity was associated with migraine (30). In our study, we found VAI values significantly higher in the MWA group than in the control group. Additionally, the VAI values were significantly higher in migraine patients categorized as Grade III-IV according to the MIDAS scorescompared to the patients categorized as Grade I and Grade II. We could not come accross any study that assessed VAI in patients with migraine in the literature. Since VAI is a parameter that consists of lipid values, abdominal fat distribution and BMI, it has been defined as a better cardio-metabolic risk marker than single anthropometric indices (31). Moreover, a positive correlation was found between VAI and carotid plaque risk in a recent large cohort study conducted in China (32).

### *Limitations:*

There were some limitations to our study. The sample size was relatively small and the MIDAS was administered as a self-report assessment tool. Therefore, a certain degree of error in the assessment of migraine-related loss of function might be expected. Another limitation is that VAI and BMI values do not compare with gender distribution.

## CONCLUSION

The study's findings indicated that we found high VAI, BMI and TG values in patients with migraine. There was a positive correlation between increased loss of function and VAI, BMI and TG in patients with migraine. These results suggest that the use of a comprehensive index such as VAI in patients with migraine may be useful in demonstrating both increased vascular atherosclerotic risks and loss of function that may occur in relation to migraine in these patients.

**Conflicts of interest:** The authors declare no conflict of interest.
**Financial support and sponsorship:** None.
**Peer review:** Externally peer-reviewed.
**Ethical approval and consent to participate:** The study was approved by Ankara City Hospital Ethics Committee (E2-22-2956). All procedures were applied in accordance with the principles of the Declaration of Helsinki.
**Author contributions:** Design of the study; GS -Supervision; OS -Data collection &/or processing; GS -Performed data analysis; GS -Literature search; OS -Written by; GS-Critical review; OS.

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