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The effects of a hatha yoga-based exercises program on pain with migraine in women: A randomized controlled study

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Abstract

Study aim: Migraine is a headache syndrome that may occur in all age groups. The purpose of this study was to examine the effects of hatha yoga (HY) exercises on pain in migraine patients.

Material and methods: Volunteer individuals aged 18–55, diagnosed with chronic migraine (n = 32; experimental group n = 15; control group n = 17) were included in this study (mean age of the experimental and control groups, respectively: 35.80 ± 7.78 years; 36.65 ± 9.62 years). The HY exercise program was planned for 12 weeks, 3 days a week, 30–90 minutes. Anthropometric measurements, the Visual Analogue Scale (VAS), the Headache Impact Test (HIT-6), and the Migraine Disability Assessment Questionnaire (MIDAS) were used. Measurements were carried out in three different time periods.

Results: There was a clinically significant decrease in the VAS, HIT-6, and MIDAS values measured at different times in the experimental group. The third measurement values were lower than the first measurement in the experimental group ($p = 0.001$). A significant difference was found between the third measurement values of VAS and HIT-6 values in the experimental and control groups (respectively $p = 0.014$; $p = 0.005$).

Conclusions: The results suggest that HY exercises have a positive effect in migraine patients on pain intensity, frequency and number of days lost due to pain. In our opinion, HY exercises can be recommended as a complementary treatment in migraine patients.

Keywords: Headache – Meditation – Relaxation techniques

Introduction

Characterized by periodic and usually unilateral pain, migraine is a headache syndrome that may occur in all age groups [2]. In 2021, approximately 4.5% of adults aged ≥18 years reported being considerably bothered by headache or migraine in the past 3 months, with the percentage among women higher than that among men [13]. For this reason, the establishment of an effective migraine treatment strategy is considered an important public health issue. Migraine treatment consists of two pharmacological and non-pharmacological treatment approaches. The primary purpose of treatment is to protect the individual from migraine attacks, teach the individual to live with pain, increase the quality of life of the individual by reducing the frequency, severity and duration of attacks and the use of medication [9, 27]. It is possible to reduce the burden of migraine with the latest developments in pharmacotherapy, but it is also reported that a significant proportion of individuals experience pharmacotherapy-resistant migraine and almost half of the patients may discontinue medication due to side effects or incomplete results [12, 37]. Therefore, it is suggested that different methods such as exercise, yoga and meditation can be used to cope with pain [1, 5, 28, 39]. Barber & Pace (2020) [5] reported that patients who cannot tolerate high-intensity exercise may benefit from low-intensity exercise such as yoga. John et al. (2007) [18] reported that yoga therapy provided a significant reduction in the frequency and duration of headache. In a study investigating the effect of yoga in individuals with migraine, Sharma et al. (2018) [38] reported a significant decrease in migraine symptoms in the yoga group. However, some studies have reported that migraine attacks are triggered and pain intensity increases during or after exercise [15, 26]. In a retrospective study conducted in a headache clinic, it was reported that the prevalence of exercise-induced attacks within 48

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hours after exercise was 38%. It was also reported that more than half of the patients who reported that attacks were triggered during and after exercise stopped exercising [20]. Winter et al. (2011) [44] observed no association between the level of physical exercise and the risk of developing migraine attacks. Apparently there is no clear evidence on the best type or duration of exercise, but the use of even low-intensity exercises can provide preventive effects [18].

The purpose of HY exercises is to train the mind through the body. The postures are effective in making the mind aware of the body and focus on the body and mind of the individual, reducing the factors that cause stress in the inner and outer world of the individual [7]. Postures, breath control exercises and deep breathing techniques, mental and physical coordination with repeated verbal expressions and meditation practices (attention and focus, mindfulness, etc.) constitute the components of yoga [32]. It is important to measure the meditation levels of people while practicing yoga with objective devices in order to ascertain how effective the yoga exercises are. The NeuroSky MindWave Mobile device enables real-time monitoring of brain areas [23] and allows for the assessment of mental states, using advanced data collection and analysis techniques [24]. Thus, in recent years, practical devices used as wearable technology have emerged for determining whether individuals are in a meditative state or not [16, 25, 45], and there is no research measuring the state of meditation of individuals with migraine during yoga.

According to the literature, there are different opinions about the effects of exercise on migraine patients [11, 29, 43]. Accordingly, the aim of this study was to research the effect of HY exercises on pain in migraine patients and to evaluate meditation point brain wave analysis.

Material and methods

Participants

Of the 70 women who responded to our recruitment effort, 45 met the study's requirements and were randomly assigned to either the control group (CG; n=25) or the hatha yoga group (HYG; n=20). The sample size of 32 participants for our study was determined through a power analysis conducted at a statistical significance level (α) of 0.05 and a power level (1-β err prob) of 0.95 (G*Power 3.1.9.4). For HYG criteria, individuals who had not entered menopause, who were diagnosed with chronic migraine, who did not use migraine medication regularly, who had not performed regular moderate/severe physical activity in the last three months (physical activity levels were found using the IPAQ questionnaire) [34], who has never practiced a yoga program before, who did not have any health problems that would prevent them from performing the yoga exercise program and who were dominantly right-handed were included in the study. For control group criteria, individuals who had not entered menopause, who regularly used migraine medication, and who did not participate in a regular moderate/severe physical activity program in the last three months and during the study period were included in the study. The Interventional Research Ethics Committee of Hitit University approved the study's design and procedures (2022-94). After the initial screening, the participants provided their written informed consent.

Research design

This study used single-center, controlled experimental research. The study design was developed according to CONSORT statement guidelines (Figure 1). The HY program was conducted by a certified HY instructor. HYG participants engaged in the training program 3 times a week for 12 weeks. The participants focused only on exercise in the 12 weeks of study with no formal education provided regarding other lifestyle habits such as diet. Participants in the CG and HYG were encouraged to maintain their usual daily lifestyles (diet, etc.). For HY exercises, it was ensured that the exercise environment was at a suitable temperature and quiet. A familiarization test was performed before the measurements to familiarize the individuals with the measurements, and the tests were performed at three different times. VAS and HIT-6 were used to determine the severity of pain, and MIDAS was used to determine the number of days lost due to headache [4, 11].

HY exercise program

The HY exercise program was planned for 12 weeks, 3 days per week and every other day (Monday, Wednesday and Friday). Exercises were performed in eight steps according to Iyengar HY. In each session of the exercise program and at the beginning of the class, yoga-specific alternate nostril breathing and pranayama exercises were performed for 5 minutes as a preliminary preparation. This system first consists of warming up (as asanas sukhasana, brahmadasana, kundalini, agnistambhasana, parivrtta dandasana, utthita hindolasana, urdhva mukha pasasana, trikonasana, malasana uttanasana vinyasa), asana movements (tadasana, urdhva tadasana, utkatasana, uttanasana, ardha uttanasana, adho mukha svanasana, urdhva mukha shavanasa, chaturanga dandasana, phalakasana, bhujangasana, virabhadrasana, balasana, marjaryasana, bitilasana, savasana), then sitting movements on the floor and finally relaxation movements. The HY exercise program started with 5 seconds of posture and 5 seconds of breathing between movements and gradually increased to 30 seconds of posture and 30 seconds of breathing. Rest was taken in the balasana pose or marjaryasana-bitilasana pose between sets. Classes started with a minimum duration of 30 minutes and gradually increased to 90 minutes (including warm-

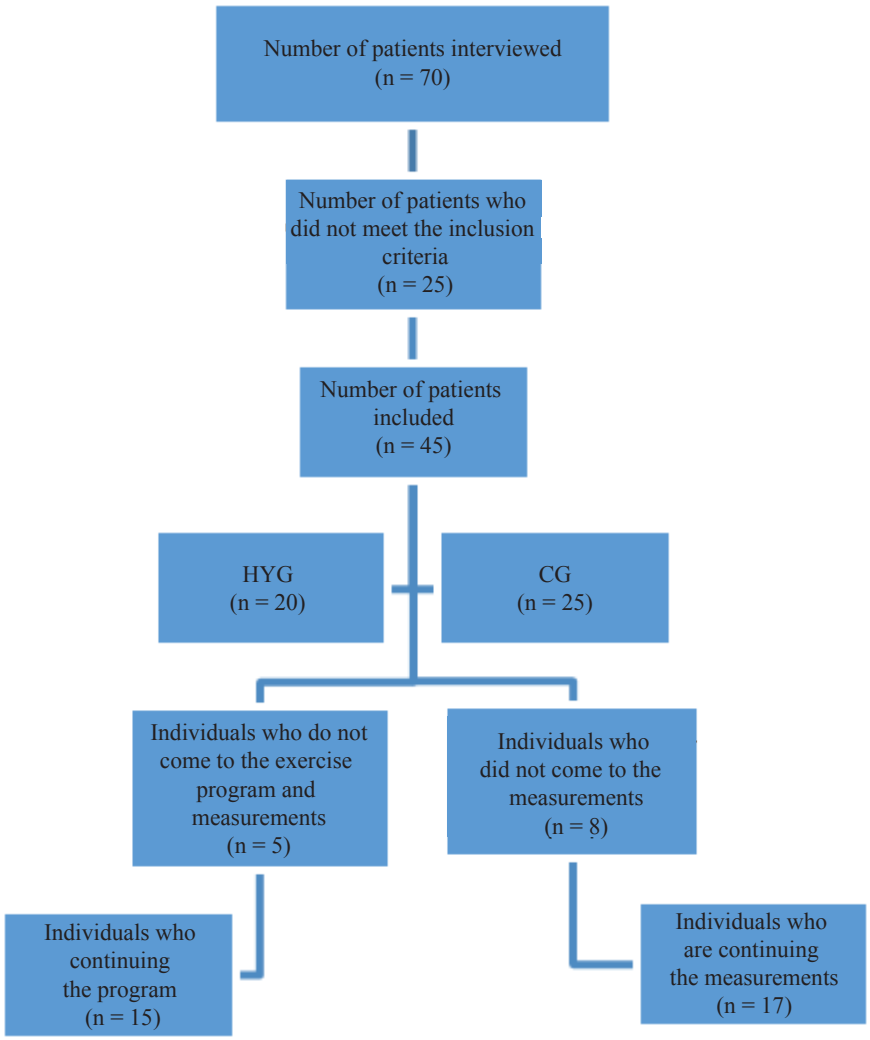

Figure 1. CONSORT flow diagram

up and cool-down) (Figure 2) [19, 22, 36, 41]. Breathing, sensory control, focusing, meditation and deep relaxation techniques were used in the determination of HY postures. Exercises involving stretching of the whole body followed by yoga poses coordinated with breathing. The Borg scale (between 6 and 20) was used to determine the degree of difficulty of exercise and movements [10, 40].

Anthropometric measurements

The body weight and height were taken for each participant while they were wearing light clothing and without socks and shoes. Height was measured to the nearest 0.1 cm using a calibrated stadiometer while weight was measured to the nearest 0.1 kg using calibrated scales [31].

NeuroSky mobile brainwave sensor

The NeuroSky MindWave Mobile 2 device can be used for purposes such as stress and anxiety reduction, attention measurement [8] and brainwave analysis [17, 35]. In this study, we measured whether individuals were in a meditative state or not. The device is a single-channel EEG headset that can wirelessly transmit EEG signals via Bluetooth [14]. Capable of effectively capturing brain signals [6], the MindWave device consists of a headset with a T-shaped headband, ear clip and a flexible arm (Figure 3). The reference and ground electrodes of the device are positioned on the ear and the EEG electrode is positioned on the forehead above the eye. This device has been validated for EEG recordings and its reliability has been demonstrated by comparison with other devices [33]. During meditation and under the guidance of the instructor, the degree of meditation of the participants in a relaxed position with their eyes closed was measured. Using NeuroSky, the participants' measurements were taken in a quiet environment before and at the beginning of the yoga exercise sessions. The first measurement was made at the beginning of the first session, the second measurement was made at the beginning of the nineteenth session, and the third measurement was made at the last exercise session, at the beginning of the thirty-sixth class.

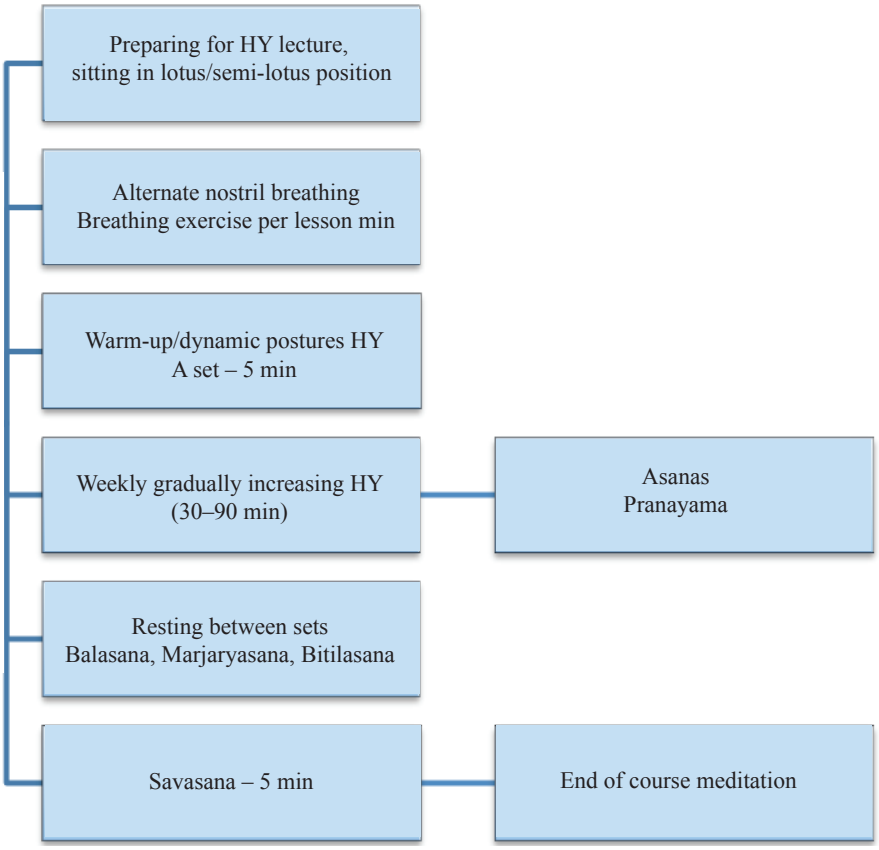

Figure 2. Hatha yoga exercises schedule

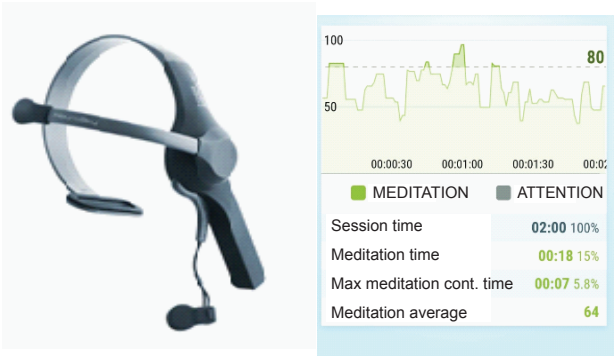

Figure 3. NeuroSky MindWave Mobile 2

Statistical analysis

Data were analyzed using IBM SPSS V23 software. Compliance with normal distribution was analyzed by the Shapiro-Wilk test. The independent samples t-test and one-way ANOVA were used to compare the data that fit the normal distribution, and the Mann-Whitney U test was used to compare the data that did not fit the normal distribution. The Friedman test was used to compare the measurements that did not fit the normal distribution in each group and multiple comparisons were made with Dunn's test. The Yates correction, Fisher's exact test and Pearson's chi-square test were used to analyze categorical variables by group. The thresholds for effect size statistics were as follows: <0.20 = trivial, 0.20–0.59 = small, 0.6–1.19 = moderate, 1.2–1.99 = large; ≥2.0 = very large. The analysis results were presented as mean ± standard deviation and median (minimum-maximum) for quantitative variables. The significance level was taken as $\alpha = 0.05$.

Results

The study revealed a significant improvement in the form of a clinically significant decrease in the VAS, HIT-6 and MIDAS values measured at different times in the experimental group ($p < 0.001$), and the third measurement values

Table 1. The descriptive characteristics of participants

	HYG (n = 15)		CG (n = 17)	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
Age [year]	35.80 ± 7.78	35.00 (23.00–53.00)	36.65 ± 9.62	39.00 (18.00–49.00)
Height [cm]	163.27 ± 4.79	164.00 (155.00–172.00)	163.24 ± 6.39	164.00 (152.00–176.00)
Body weight [kg]	69.63 ± 14.11	69.8 (51–93.7)	72.94 ± 20.45	70.3 (45.9–124.9)
BMI [kg/m^2]	26.01 ± 4.82	26.2 (20.4–35.7)	27.89 ± 8.32	26.7 (17.3–43.4)

$p > 0.05$; BMI: body mass index.

Table 2. Baseline characteristics of the subjects

Variables	HYG (n = 15) f (%)	CG (n = 17) f (%)
Working individuals	6 (40.0)	9 (52.9)
Married	9 (60.0)	12 (70.6)
School education (≥ 8 years)	12 (80.0)	13 (76.50)
Smokers	8 (53.30)	6 (35.30)
Alcohol user	6 (40.0)	4 (23.50)
History of migraine (<10 year)	10 (66.70)	12 (70.60)
Who using non-drug methods for migraine attacks*	13 (86.70)	15 (88.20)

$p > 0.05$; *Sleeping in a dark-quiet room, tying the head tightly with a wet cloth, drinking coffee/herbal tea, doing activity, walking outdoors, vomiting, burning incense, taking care of pets.

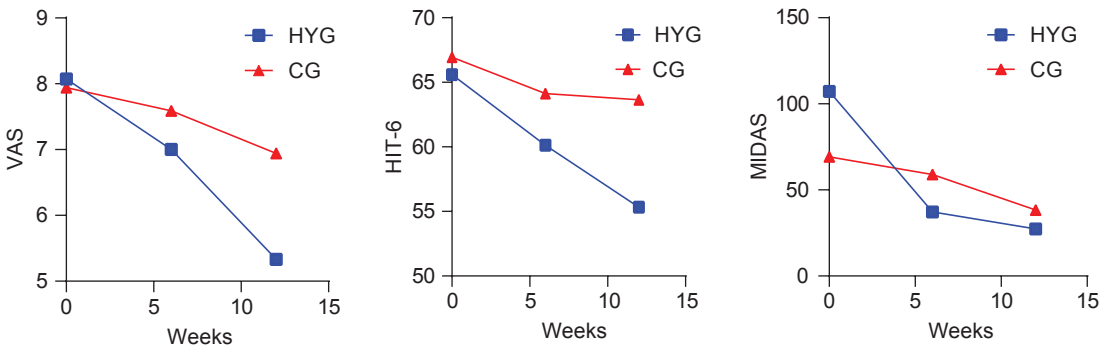

Figure 4. VAS, HIT-6 and MIDAS values

were lower than the first measurement ($p < 0.001$). A significant difference was found between the third measurement values of VAS and HIT-6 values in the experimental and control groups (respectively $p = 0.014$; effect size: –0.372; $p = 0.005$; effect size: –0.486). Regarding MIDAS values, there was a statistically significant decrease between the intragroup mean values measured at different times in the experimental group. A significant difference was observed between the second and third measurement values and the first measurement ($p < 0.001$). A significant difference was found between the experimental and control groups in the first measurement of MIDAS values ($p = 0.014$; effect size: 0.407). As for the control group, a statistically significant difference was found between the mean values of MIDAS measured at different times ($p = 0.010$).

No statistically significant difference was found between the meditation brainwave measurements made with the NeuroSky MindWave mobile 2 head set (EEG) device in the intragroup comparison of the experimental group ($p = 0.192$).

Table 3. The comparison of VAS, HIT-6 and MIDAS and meditation point brainwave measurement data

Variables	HYG (n = 15)		CG (n = 17)			
VAS	Mean ± SD	Median (min.–max.)	Mean ± SD	Median (min.–max.)	p-value	Effect size
Baseline	8.07 ± 1.62	9.00 (4.00–10.00)[a]	7.94 ± 0.75	8.00 (7.00–9.00)	0.189[1]	
6 weeks	7.00 ± 2.10	7.00 (3.00–10.00)[a]	7.59 ± 1.77	8.00 (3.00–10.00)	0.439[1]	
12 weeks	5.33 ± 1.80	5.00 (3.00–9.00)[b]	6.94 ± 2.19	7.00 (1.00–10.00)	0.014[1]	–0.372 small
p–value		<0.001[2]		0.129[2]		
HIT-6						
Baseline	65.60 ± 7.04	66.00 (45.00–76.00)[a]	66.94 ± 4.62	68.00 (55.00–74.00)	0.747[1]	
6 weeks	60.13 ± 7.60	61.00(44.00–74.00)	64.12 ± 7.52	65.00 (48.00–78.00)	0.126[1]	
12 weeks	55.33 ± 8.12	54.00 (42.00–69.00)[b]	63.65 ± 6.76	64.00 (40.00–70.00)	0.005[1]	–0.486 small
p–value		<0.001[2]		0.095[2]		
MIDAS						
Baseline	107.13± 48.30	90.00 (39.00–228.00)[a]	69.24 ± 35.67	60.00 (18.00 –150.00) a	0.014[1]	0.407 small
6 weeks	37.20 ± 28.12	38.00 (0.00–94.00)[b]	58.88 ± 42.94	47.00 (10.00–150.00) b	0.186[1]	
12 weeks	27.27 ± 19.04	28.00 (0.00–60.00)[b]	38.35 ± 22.31	33.00 (8.00–85.00) b	0.241[1]	
p–value		<0.001[2]		0.010[2]		
Meditation points						
Baseline	51.40 ± 12.21	50 (37–74)		–	–	–
6 weeks	58.33 ± 12.42	58 (38–77)		–	–	–
12 weeks	54.87 ± 9.88	53 (40–70)		–	–	–
p–value		0.192[3]		–	–	–

$p < 0.05$; [1]Mann Whitney U testi, [2]Friedman Test; [3]Anova test; a,b: There is no difference between measurements with the same letter in each group; MIDAS: Migraine Disability Assessment Scale; HIT-6: Headache Impact Test; VAS: Visual Analogue Scale.

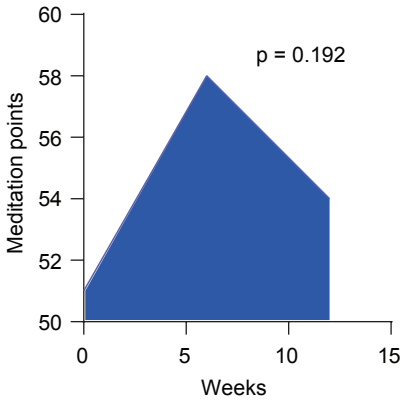

Figure 5. The comparison of meditation point brainwave measurement data

Discussion

The purpose of this study was to examine the effects of HY exercises on pain in migraine patients.

In this study, there was a clinical improvement in the VAS, HIT-6 and MIDAS measurement values of the HY group ($p < 0.05$). A significant difference was found in the VAS and HIT-6 values between the experimental and control groups at the end of the 12th week ($p < 0.05$) (Table 3; Figure 4). Boroujeni et al. (2015) [11] performed a 12-week study investigating the effect of yoga exercises on headache frequency and severity in migraine patients, in which yoga exercises were performed for 75 minutes,

3 days a week for 12 weeks. They reported that there was a significant decrease in the frequency and severity of headache in the yoga group. Kumar et al. (2020) [21] reported a significant decrease in VAS, HIT-6, MIDAS scores and the number of medications used in the yoga group in their study comparing a group receiving drug treatment and a group practicing yoga for three months in episodic migraine patients. It has been suggested that yoga as an adjunctive treatment in migraine disease gives better results than medical treatment alone and it may be beneficial to integrate a cost-effective and safe intervention such as yoga into migraine management. Vasudha et al. (2018) [42] aimed to examine the combined effect of yoga and ayurveda in individuals with migraine and reported that there was an improvement in MIDAS values in their study conducted 5 days a week, 40 minutes a day, for 3 months.

In a study evaluating the effectiveness of HY exercises and traditional treatment as complementary treatment in migraine patients, Kisan et al. (2014) [19] applied HY exercises 5 days a week for 6 weeks and observed a decrease in pain frequency and intensity in both groups, but the decrease was greater in the yoga group. In a randomized controlled trial investigating the effect of yoga exercises in the treatment of migraine without aura, John et al. (2007) [18] noted a significant improvement in the severity and frequency of headache in the yoga group as a result of the program applied 5 days a week for 12 weeks. The results of this study are similar to the studies mentioned above (Table 3). However, we believe that the significant decrease in number of days lost because of pain (MIDAS) in the control group in this study is due to regular medication use and doctor control. In addition to the use of both drug and non-drug methods, 88% of the participants used non-drug methods (Table 2). The effect of yoga therapy on migraine is reported to be associated with increased vagal tone, decreased sympathetic activity and improvement in cardiac autonomic balance. It is also suggested that the effect of yoga may be related to increasing the level of nitric oxide, which acts as an endothelium-derived relaxing factor-like substance [19]. However, it is known that tense muscles in the head, neck, shoulder and temporal region may trigger headache in migraine patients. It is also reported that yoga can reduce pain by exerting a relaxation effect on these muscles [19, 27, 40]. Furthermore, this healing effect is thought to be due to the fact that yoga activates the parasympathetic system by altering the level of brain neurotransmitter and β-endorphin release and initiates the release of the hormones dopamine and serotonin, leading to a decrease in pain, anxiety and stress [3].

In this study, no statistically significant intragroup difference was found between the meditation HYG measurements made with the NeuroSky MindWave-EEG device ($p > 0.05$). However, when one hundred was taken as the highest score for being in a meditative state, it was determined that they obtained a score above the average (Figure 3). We can say that the participants obtained approximately the same score (Table 3; Figure 5). There may be several reasons for the lack of a significant difference between the HYG meditation experimental group measurements: factors such as environmental variables, personal characteristics, duration of meditation experience, meditation protocol and duration may have affected the measurement. However, the small sample size may also have influenced the results. In the literature, there are studies on the measurement of attention, concentration, meditation and mental work performance with the NeuroSky MindWave Mobile device in different fields [8, 17, 24, 35]. However, no similar study was found to compare the data in Table 3 and Figure 5 in this study.

Strength and limitations

The limitations of this study include the small number of participants and the fact that it was conducted only on female individuals. Another limitation of this study is that sleep patterns were not monitored. Among the strengths of this study is that the meditation levels of the participants were measured with NeuroSky MindWave Mobile 2 head set.

Conclusion

It was found that HY exercises reduced pain intensity, pain frequency and number of days lost due to pain. Accordingly, we believe that HY exercises for at least 30 minutes, 3 days a week can be presented as a clinical recommendation to reduce pain.

Conflict of interest: Authors state no conflict of interest.

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