Original Article

Effect of Pranayama as Adjuvant to Medical Treatment on Severity, Frequency, and Duration of Headache in Migraine Patients: An Open-Label Randomized Controlled Trial

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Abstract

Background: Migraine is the second leading cause of disability worldwide with high rates of dissatisfaction for allopathic treatment among patients. Pranayama is an easy, convenient, and cost-effective method that can supplement existing standard medical treatment of migraine. **Objective:** To study the effect of pranayama as an adjuvant to standard medical treatment of migraine on clinical outcome variables of migraine. **Materials and Methods**: This was a randomized controlled trial conducted on 80 consecutive migraine patients who were diagnosed as per International Classification of Headache Disorders-3 (ICHD-3) criteria and were randomly allocated into two groups, that is, standard medical treatment (SMT) group and standard medical treatment plus pranayama (SMT + P) group. The effect of pranayama on clinical outcome variables of migraine was evaluated by using standardized questionnaires. The data was statistically analyzed using SPSS Statistics 20 software. A *P* value of ≤0.05 was considered statistically significant. **Results**: Intragroup analysis showed all clinical outcome variables of migraine reduced significantly in the SMT + P group whereas all clinical outcome variables of migraine except the duration of headache episodes reduced significantly in the SMT group. Although statistically non-significant, intergroup analysis demonstrates that reduction in headache severity, duration of headache episodes, and headache impact test-6 (HIT-6) score was more in the SMT + P group whereas reduction in headache frequency and migraine disability assessment (MIDAS) score was more in the SMT group. **Conclusion**: Pranayama supplements the standard medical treatment of migraine by reducing the duration of headache episodes in addition to the reduction in headache severity, headache frequency, HIT-6 scores, and MIDAS scores.

Keywords: CAM, HIT-6, migraine, MIDAS, yogic breathing

Introduction

The term "migraine" is derived from the Greek word "hemicrania" which was coined by Galen in 2000 AD.[1] It is the second leading cause of disability worldwide with a prevalence of 14.4% globally and 17–18% in India.[2] In addition to being a reason for a low quality of life, migraine adds to the economic burden of a nation due to the immense amount of capital and resources utilized for the prevention and treatment of migraine.[3]

It is characterized by recurrent episodes of moderate to severe unilateral pulsating headache lasting for 4–72 hours, aggravated by routine physical activity, and associated with nausea, vomiting, photophobia, or phonophobia.[4] Given the myriad of symptoms, migraine adversely affects the various aspects of life, interferes with the daily routines, reduces the ability to think and function normally, and is also one of the important reasons for a low quality of life, reduced academic performance, and absence from work.[5]

Despite the wide array of pharmaceutical options available for the treatment of migraine only a few are able to provide optimum relief to the migraine patients and a lot of them cause adverse effects. Consequently, a good proportion of migraine patients are dissatisfied with the pharmacological treatment of migraine.[6] Complementary and alternative medicine (CAM) is a group of non-conventional treatments that can act as an adjuvant to conventional care. Yoga is included as a mind-body practice under CAM.

John *et al.* (2007)[7] in a randomized controlled trial concluded that patients who received yoga intervention comprising of asanas, breathing exercises, and relaxation practices for 3 months showed significant improvement in headache intensity, frequency, pain rating index, anxiety and depression scores, and symptomatic medication use. In a study by Kisan *et al.* (2014),[8] the patients who practiced yoga which included loosening exercises, breathing exercises, and asanas showed

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significant improvement in the headache frequency, intensity, and cardiovagal balance after six weeks of intervention. Boroujeni *et al.* (2014)[9] showed that after three months of yoga intervention (including asanas, breathing exercises, and Savasana), the clinical parameters of migraine-like headache severity, headache frequency, and impact of headache on quality of life improved significantly. In a non-randomized study by Vasudha *et al.* (2018),[10] it was observed that ayurveda and yoga intervention (asanas, breathing exercises, loosening exercises, and chanting) improved the clinical parameters of migraine-like disability, perceived stress, sympathovagal balance, and decreased the frontalis muscle activity on EMG.

Wells *et al.* (2019)[11] reviewed the evidence from 2015 to 2018 on complementary and integrative therapy including mind/body treatment options of mindfulness, yoga, tai-chi, etc.; supplements like magnesium, riboflavin, feverfew, etc.; manual therapies like physical therapy, massage, osteopathic manipulative treatment, etc., for episodic migraine using various search engines and concluded that complementary and integrative treatment options improved headache frequency, pain tolerance, headache impact, and disability in migraine patients. Kumar *et al.* (2020)[12] in a randomized controlled trial (RCT) evaluated the effectiveness of yoga which included prayer, breathing exercises, relaxation techniques, asanas, and pranayama as an adjuvant to conventional medical management in migraine patients and observed a remarkable improvement in the outcome measures like headache frequency, headache intensity, headache impact test-6 (HIT-6) score, migraine disability assessment (MIDAS) score and the number of rescue pill count. Mehta *et al.* (2021)[13] compared the effectiveness of physical therapy (progressive muscle relaxation exercises, self-stretching of neck muscles, and cardiovascular endurance training) and yoga (asanas, pranayama, and relaxation) as an adjuvant to standard medical treatment in migraine patients and observed a significant reduction in headache frequency, pain rating, and visual analog scale (VAS) scores in the patients of yoga group compared to the patients of standard treatment group, which they concluded to be a result of the improvement in the dysfunctional hypothalamic-pituitary-adrenal axis that governs the autonomic nervous system.

Pranayama frequently acknowledged as a yogic breathing exercise is an easy, convenient, and cost-effective treatment that can be easily opted by patients to supplement their existing standard medical treatment of migraine. The current study was designed with the intent to investigate the effect of pranayama, on the clinical outcome variables of migraine such as severity, frequency, and duration of headaches along with the impact of headache on quality of life and disability caused due to migraine.

Materials and Methods

Based on a previous study by Boroujeni *et al.,*[9] the headache severity in patients with migraine after 12 weeks of yoga intervention was 5.27 ± 2.09 in the yoga group and 6.73 ± 2.41 in the control group. Using these results in Open Epi. Version 3.0, 95% confidence interval, 80% power, and 2-sided α error of 5%, the sample size was calculated to be 76, that is, 38 in each group. Assuming the dropout rate to be 5%, the sample size was inflated by 5%, and the new sample size of 80 was obtained.

The ethical approval was obtained from the Institutional Ethics Committee and the trial was registered with the Clinical Trials Registry-India (CTRI). This was an open-label RCT, conducted in the Department of Physiology of a tertiary care institute from December 2021 to August 2022. 80 consecutive migraine patients diagnosed as per the International Classification of Headache Disroders-3 (ICHD-3) criteria in the Department of Neurology were selected for the study. They fulfilled the following inclusion criteria: age between 18 and 65 years, informed consent, patients willing to practice pranayama at home, and willing to fill the migraine diary. The exclusion criteria were: patients already practicing pranayama, having previous bad experiences with pranayama, neurological and psychiatric conditions hindering communication with the patient, epilepsy, hypertension, cardiovascular diseases, and recent abdominal or thoracic surgery. By using the lottery method of simple randomization, the eligible patients were randomly allocated in a ratio of 1:1 in the two groups namely, the Standard Medical Treatment (SMT) group and the Standard Medical Treatment plus Pranayama (SMT + P) group. A detailed history was recorded from the patients in the personal record form regarding the headache frequency, the usual duration of headache episodes, triggering factors responsible for their previous episode of migraine, and the medications that were being taken by the patients. Following this, the height, weight, blood pressure, and pulse rate of all the patients were recorded. Subsequently, the patients were asked to fill up the VAS score for headache severity, the HIT-6 questionnaire for the impact of headache on quality of life, and the MIDAS questionnaire for disability due to migraine. The primary outcomes of this study were changes in the parameters like headache severity, headache frequency, headache duration, and the secondary outcomes were changes in HIT-6 score and MIDAS score.

All the enrolled migraine patients received the standard medical treatment of migraine in the form of prophylactic drugs (propranolol, topiramate, flunarizine, and amitriptyline) and symptomatic drugs (naproxen, triptans, paracetamol, and domperidone) which were prescribed by the consulting neurologist who conferred the decision to modify the drug prescription. However, the drugs prescribed to the patients were not changed during the course of the study period.

A predesigned set of six pranayamas including *Sheetali, Sheetkari, Suryabhedi, Anulom-vilom, Bhramari,* and *Udgeet ('Om' chanting)* was taught to the patients in the SMT + P group by a qualified yoga instructor on the day of enrollment in the Department of Physiology. Afterwards, the patients were advised to practice these pranayamas at home, empty stomach, early in the morning at 7:00 am by

attending the online pranayama sessions that were conducted and supervised by the yoga instructor five days a week for a period of three months. Each pranayama was practiced for five minutes making the total duration of the session equal to 30 minutes per day.

To ensure compliance the patients of both groups were contacted telephonically on a regular basis during the three months of the study period. A migraine diary was given to the patients to maintain a log of their headaches.

After three months of the study period, the change in the clinical outcome variables of migraine was statistically analyzed by adopting the per-protocol (PP) and the intention to treat (ITT) analysis using the SPSS® 20 Software [Flowchart 1]. In accordance with the last observation carried forward (LOCF) method of single imputation the baseline values of the clinical outcome variables of migraine were considered for the ITT analysis which is mentioned below in detail.

The qualitative variables like gender, headache characteristics, and symptoms associated with migraine were represented as percentages and the quantitative variables such as age, headache severity, headache frequency, headache duration, HIT-6 scores, MIDAS scores, height, weight, pulse rate, and blood pressure were represented as Mean ± SD. The quantitative variables were compared by using the *t*-tests. Unpaired *t*-test was used to compare the baseline variables of the two groups. Paired *t*-test was used to compare the pre- and post-intervention values of the clinical outcome variables in the two groups. Intergroup analysis of the change in the clinical outcome variables of migraine between the two groups was done by the unpaired *t*-test. A *P* value ≤0.05 was considered to be statistically significant.

Results

Baseline characteristics of the enrolled migraine patients (N = 80) like age, gender distribution, BMI, blood pressure, and pulse rate were comparable in both groups [Table 1]. Hypothyroidism was reported by three patients of the SMT group and one patient of the SMT + P group.

The clinical parameters of migraine-like total duration of the illness, migraine triggers, headache lateralization, headache character, symptoms associated with migraine, and medications used by the migraine patients were comparable between the two groups. Stress was the most common triggering factor for migraine, bilateral headache was a common feature, throbbing was the most common headache character, and nausea, photophobia, and phonophobia were the common symptoms associated with migraine in the patients of both groups. The most commonly prescribed prophylactic drug was propranolol and symptomatic drugs were naproxen and domperidone [Table 2].

The clinical outcome variables of migraine-like headache frequency, duration of headache episode, HIT-6 score, and MIDAS score were comparable in both the groups at baseline except headache severity (*P* value = 0.029), which was higher in the SMT group (9.03 ± 1.70 cm) as compared to the SMT + P group (8.13 ± 1.92 cm) [Table 3 and Supplemental Table 1].

Out of the 80 migraine patients enrolled in the study 65 completed the trial (N = 30 in SMT group, N = 35 in SMT + P group) after 3 months of the study period.

Both the PP and ITT analyses show similar results. The intragroup analysis of the clinical outcome variables of migraine showed a statistically significant reduction in the headache severity, headache frequency, impact of headache on quality of life, and disability caused due to migraine in both groups, whereas a statistically significant reduction in the duration of headache episodes was observed only in the SMT + P group. [Figures 1 and 2; Table 4; Supplemental Table 2; Supplemental Figures 1 and 2]. The intergroup analysis showed a statistically non-significant reduction in headache severity, duration of headache episode, and impact of headache on quality of life in the SMT + P group as compared to the SMT group, whereas headache frequency and disability caused by migraine in the SMT group was reduced more as compared to the SMT + P group [Table 5; Supplemental Table 3].

Discussion

In the present study, the intragroup analysis (PP and ITT) demonstrates that after 3 months of intervention, pranayama as an adjuvant to the standard medical treatment of migraine

Table 1: Baseline variables of patients in SMT (n=40) and SMT+P group (n=40)

Baseline Variables	SMT group (n=40)	SMT+P group (n=40)	*P*
Age (years) (Mean±SD)	35.98±8.69	37.10±10.20	0.597
Gender			
Males	2 (5%)	5 (12.50%)	0.432
Females	38 (95%)	35 (87.50%)	
BMI (kg/m^2) (Mean±SD)	23.59±4.87	22.70±4.53	0.400
Systolic blood pressure (mmHg) (Mean±SD)	112.55±10.67	116.50±14.33	0.166
Diastolic blood pressure (mmHg) (Mean±SD)	80.50±7.58	81.65±7.36	0.501
Pulse rate (beats/minute) (Mean±SD)	84.40±9.56	82.00±9.40	0.261

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group. BMI: Body mass index, SD: Standard Deviation

Table 2: Clinical parameters of migraine in SMT (n=40) and SMT+P group (n=40)

Headache characteristics	SMT group (n=40)	SMT+P group (n=40)	*P*
Total duration of illness (years) (Mean±SD)	9.28±9.35	6.38±6.67	0.114
Most common migraine trigger (Stress) (%)	36 (90%)	31 (77.5%)	0.225
Bilateral headache (%)	23 (57.5%)	22 (55%)	0.954
Throbbing character of headache (%)	9 (22.5%)	13 (32.5%)	0.453
Symptoms associated with headache			
Nausea (%)	31 (77.5%)	33 (82.5%)	0.781
Photophobia (%)	27 (67.5%)	30 (75%)	0.622
Phonophobia (%)	30 (75%)	30 (75%)	1.000
Medications used			
Propranolol (%)	19 (47.5%)	20 (50%)	1.000
Topiramate (%)	9 (22.5%)	5 (12.5%)	0.378
Flunarizine (%)	8 (20%)	7 (17.5%)	1.000
Amitriptyline (%)	16 (40%)	17 (42.5%)	1.000
Naproxen (%)	35 (87.5)	35 (87.5%)	1.000
Paracetamol (%)	4 (10%)	5 (12.5%)	1.000
Triptans (%)	2 (5%)	2 (5%)	1.000
Domperidone (%)	36 (90%)	34 (85%)	0.737

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group

Table 3: Clinical outcome variables of migraine in SMT (n=40) and SMT+P group (n=40)

Clinical outcome variables of migraine	SMT group (n=40)	SMT+P group (n=40)	*P*
Headache severity* (VAS score) (Mean±SD)	9.03±1.70	8.13±1.92	0.029*
Headache frequency (days/month) (Mean±SD)	16.95±12.10	13.80±17.40	0.350
Headache duration (hours) (Mean±SD)	26.51±30.21	25.88±22.93	0.915
Impact of headache on quality of life (HIT-6 score) (Mean±SD)	72.03±7.56	68.58±9.70	0.080
Disability due to migraine (MIDAS score) (Mean±SD)	41.83±40.55	33.43±40.28	0.356

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group, VAS: Visual Analog Scale, HIT-6: Headache Impact Test 6, MIDAS: Migraine Disability Assessment, SD Standard Deviation,* $P \leq 0.05$

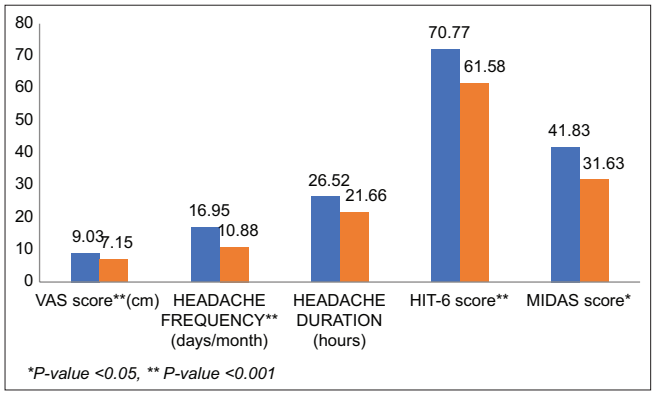


Figure 1: Effect of Standard Medical Treatment on Mean Values of Clinical Outcome Variables of Migraine after Three Months in Patients of SMT (Standard medical treatment) Group (N=40)

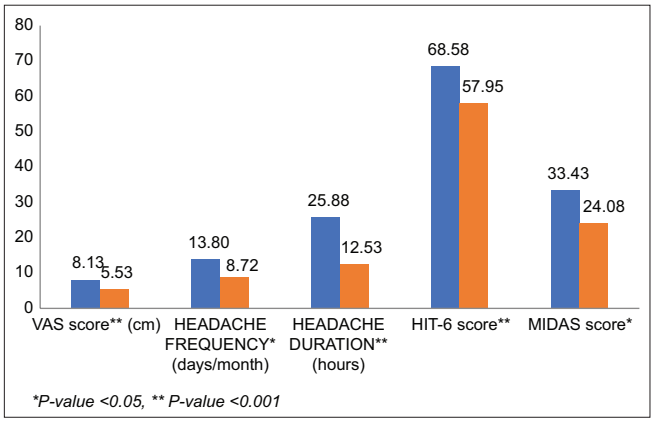
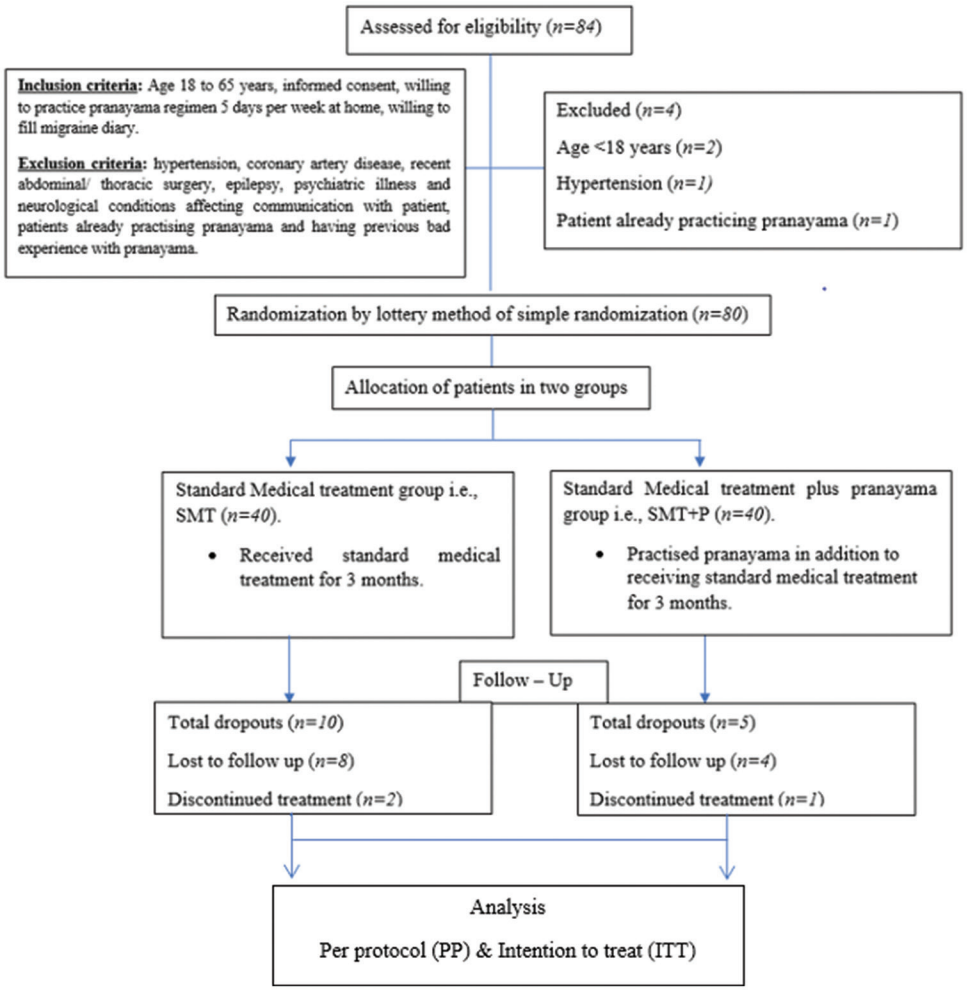


Figure 2: Effect of Pranayama as an Adjuvant to Standard Medical Treatment on Mean Values of Clinical Outcome Variables of Migraine after Three Months in Patients of SMT+P (Standard medical treatemnt plus pranayama) Group (N=40)

significantly reduced all the clinical outcome variables of migraine-like headache severity, headache frequency, duration of headache episodes, impact of headache on quality of life and disability due to migraine, whereas the standard medical treatment of migraine significantly reduced all the clinical outcome variables of migraine except the duration of headache episodes.

Furthermore, the intergroup analysis (both PP and ITT) demonstrates that both interventions led to a reduction in all the clinical outcome variables of migraine. On one hand, pranayama as an adjuvant to the standard medical treatment of migraine produced more reduction in headache severity,



Flowchart 1: Method of selection, enrollment, randomization, and analysis of patients included in the trial

Table 4: Comparison between the clinical outcome variables of migraine in SMT group (*n*=40) and SMT+P (*n*=40) group after three months of intervention

Clinical outcome variable of migraine	SMT group (*n*=40) (baseline)	SMT group (*n*=40) (post-intervention)	*P*	SMT+P group (*n*=40) (baseline)	SMT+P group (*n*=40) (post-intervention)	*P*
Headache severity (VAS score) (Mean±SD)	9.03±1.70	7.15±3.41	0.000**	8.13±1.92	5.53±3.21	0.000**
Headache frequency (days/month) (Mean±SD)	16.95±12.10	10.88±11.63	0.000**	13.80±17.40	8.72±16.77	0.002*
Headache duration (hours) (Mean±SD)	26.52±30.21	21.66±26.08	0.138	25.88±22.93	12.53±16.23	0.001**
Impact on quality of life (HIT-6 score) (Mean±SD)	72.03±7.56	61.58±21.06	0.001**	68.58±9.70	57.95±17.91	0.001**
Disability due to migraine (MIDAS score) (Mean±SD)	41.83±40.55	31.63±39.74	0.035*	33.43±40.28	24.08±37.81	0.008*

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group, VAS: Visual Analog Scale, HIT-6: Headache Impact Test-6, MIDAS: Migraine Disability Assessment, SD: Standard Deviation,*$P \leq 0.05$, **$P \leq 0.001$

duration of headache episodes, and impact of headache on quality of life, and on the other hand, the standard medical treatment of migraine produced more reduction in headache frequency and disability due to migraine.

The results of the present study are consistent with those reported in the reviewed literature.[8-13] A statistically significant reduction in headache severity as assessed by VAS score was observed in both groups as has been observed by Kisan *et al.*,[8] Kumar *et al.*,[12] Mehta *et al.*[13] Boroujeni *et al.*,[9] however observed a statistically significant reduction in the VAS scores of the patients receiving yoga intervention but not in the patients receiving conventional care. Streeter *et al.*[14] reported that asanas, pranayama, and meditation including chanting can shift the sympathovagal balance to vagal dominance, enhance the activity of the gamma-aminobutyric acid system, and rectify the dysfunctional hypothalamic-pituitary-adrenal axis which helps in reducing the severity of pain perceived by the migraine patients. Pranayama helps to reduce the effect of

Table 5: Comparison between the change in clinical outcome variables of migraine in SMT group (*n*=40) and SMT+P (*n*=40) group after three months of intervention

Change in clinical outcome variable of migraine	SMT group (*n*=40)	SMT+P group (*n*=40)	*P*
Headache severity (VAS score) (Mean±SD)	1.88±2.57	2.60±2.59	0.213
Headache frequency (days/month) (Mean±SD)	6.09±10.01	6.08±9.70	0.653
Headache duration (hours) (Mean±SD)	4.83±20.31	13.35±23.84	0.091
Impact on quality of life (HIT-6 score) (Mean±SD)	10.45±19.30	10.62±18.34	0.967
Disability due to migraine (MIDAS score) (Mean±SD)	10.20±29.50	9.35±21.25	0.883

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group, VAS: Visual Analog Scale, HIT-6: Headache Impact Test-6, MIDAS: Migraine Disability Assessment, SD: Standard Deviation

stressful events that disturb the hypothalamic-pituitary-adrenal axis leading to increased levels of cortisol which acts on various sites and alters the structure and function of different regions of the brain. The systems involved in the modulation of pain are also affected by pranayama and the pain threshold is increased.[15]

Results similar to our study showing a statistically significant reduction in headache frequency were observed by Kisan *et al.*[8] after 6 weeks of yoga intervention. Kumar *et al.*[12] and Mehta *et al.*[13] also observed similar results after three months of yoga intervention in migraine patients. In a study conducted by John *et al.*[7] a statistically significant reduction in headache frequency was observed after three months of yoga intervention, however, in contrast to our study, a statistically significant increase in headache frequency was observed in the control group. In the migraine patients, the cortical excitability is increased resulting in prompting migraine episodes by stimuli that normally do not evoke pain in healthy individuals.[14] Pranayama by shifting the autonomic balance toward parasympathetic dominance decreases the cortical excitability, keeps the body's nervous system more relaxed daily, and regulates the vascular tone thereby the initial narrowing of the blood vessels that predisposes someone to a migraine might be eliminated and the chances of the migraine are minimized, which reduces the headache frequency.

A statistically non-significant reduction in the duration of headache was observed in the SMT group and statistically significant reduction in headache duration after 3 months of adjuvant pranayama intervention was observed in the SMT + P group. John *et al.*[7] observed that there was a statistically non-significant increase in headache duration in the migraine patients of the control group as compared to the yoga group who showed a significant reduction in headache duration after three months of yoga intervention. The results similar to ours were witnessed by Boroujeni *et al.,*[9] however, the results were statistically non-significant. One of the main pain-relieving behaviors implemented by the migraine patients is sleeping during which, the sympathetic system drive decreases. Similar to this, pranayama by increasing vagal tone and decreasing sympathetic system drive causes a relief in migraine headaches thereby reducing the duration of headache episodes.[15]

In the present study, a statistically significant reduction in HIT-6 score was observed in the SMT and SMT + P group after 3 months of intervention. These findings are congruent with those by Kisan *et al.*[8] and Kumar *et al.*[12] Boroujeni *et al.,*[9] in contrast to our study, observed an increase in the HIT-6 scores of migraine patients of the control group and a statistically significant reduction in the HIT-6 scores in the yoga group. Yogic breathing is a unique method that balances the autonomic nervous system by increasing parasympathetic drive and calms the stress response systems.[9] This improves the quality of life in the migraine patients.

We also observed a statistically significant reduction in the disability caused by migraine in both groups, which was assessed by MIDAS questionnaire. Similar results were demonstrated by Vasudha *et al.*[10] wherein they found that disability caused due to migraine reduced significantly after 90 days of combined ayurveda and yoga intervention. Kumar *et al.*[12] also reported similar results in the migraine patients after 3 months of yoga intervention. An overall reduction in headache severity, frequency, duration of headache, and impact of headache on quality of life decreases the disability caused by migraine, which reduces the MIDAS score.

Kumar *et al.* (2020)[12] observed a significant reduction in clinical outcome variables of migraine that was more in the yoga group as compared to the control group. However, the intergroup analysis of the clinical outcome variables of migraine in our study showed that the reduction in duration of headache episode, headache severity, and impact of headache on quality of life was more in the SMT + P group as compared to the SMT group, whereas the SMT group showed more reduction in headache frequency and disability due to migraine as compared to the SMT + P group. The reduction in the clinical outcome variables of migraine is comparable in both groups. However, due to the higher dropout rate, the PP analysis may be associated with attrition bias and the ITT analysis may overestimate the benefits conferred by the pranayama intervention.

The results of our study are promising and indicate that the practice of pranayama, one of the eight limbs of yoga, which is a convenient, cost-effective, and easy-to-practice modality, is as good as other CAM modalities and benefits the migraine patients by reducing the various outcome variables of migraine.

Pranayama which is defined as the manipulation of breathing movements, obtains its benefits by affecting different systems of

the body. The precise mechanism by which pranayama interacts with the nervous system is not clearly elucidated; however, Jerath *et al.*[16] in 2006 hypothesized that voluntary slow breathing stretches the slowly adapting stretch receptors and fibroblasts in the lungs which produces inhibitory signals and hyperpolarization currents, respectively. These signals propagate and functionally reset the autonomic nervous system, synchronize the neural elements in the heart, lungs, limbic system, and cortex and shift the autonomic balance toward parasympathetic dominance.

Limitations of the study

The study had some limitations. Due to the COVID-19 pandemic, the pranayama sessions were conducted in an online mode and though robust measures were taken to ensure compliance of the patients, still a few patients dropped out from the study. This was an open labeled RCT; therefore, the outcome assessment could not be blinded.

Conclusion

In our study, the standard medical treatment of migraine decreased the headache frequency and disability due to migraine in the migraine patients and pranayama proved to be a favorable practice that reduced the headache severity, duration of headache episodes, and impact of headache on quality of life. However, in order to strengthen the role of pranayama as an adjuvant to the medical treatment of migraine multi-centric trials with a large sample size, long-term practice of pranayama, robust measures to minimize the dropout rates and assessment of biochemical markers (like calcitonin gene-related peptide; CGRP) of migraine is recommended.

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Conflicts of interest

There are no conflicts of interest.

References

1. Farooq M, Gupta A, Goyal M, Walia R. Migraine: Diagnosis and prophylactic management. Indian J Pharm Pharmacol 2016;3:33-8.
2. Stovner LJ, Nichols E, Steiner TJ, Abd-Allah F, Abdelalim A, Al-Raddadi RM, *et al*. Global, regional, and national burden of migraine and tension-type headache, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2018;17:954-76.
3. Bonafede M, Sapra S, Shah N, Tepper S, Cappell K, Desai P. Direct and indirect healthcare resource utilization and costs among migraine patients in the United States. Headache 2018;58:700-14.
4. HIS. The International Classification of Headache Disorders. 3rd ed. UK: Cephalgia; 2018.
5. Hainsworth KR, Salamon KS, Khan KA, Mascarenhas B, Davies WH, Weisman SJ. A pilot study of yoga for chronic headaches in youth: Promise amidst challenges. Pain Manag Nurs 2014;15:490-8.
6. Bigal M, Rapoport A, Aurora S, Sheftell F, Tepper S, Dahlof C. Satisfaction with current migraine therapy: Experience from 3 centers in US and Sweden. Headache 2007;47:475-9.
7. John PJ, Sharma N, Sharma CM, Kankane A. Effectiveness of yoga therapy in the treatment of migraine without aura: A randomized controlled trial. Headache 2007;47:654-61.
8. Kisan R, Sujan MU, Adoor M, Rao R, Nalini A, Kutty BM, *et al*. Effect of Yoga on migraine: A comprehensive study using clinical profile and cardiac autonomic functions. Int J Yoga 2014;7:126-32.
9. Boroujeni MZ, Marandi SM, Esfarjani F, Sattar M, Shaygannejad V, Javanmard SH. Yoga intervention on blood NO in female migraineurs. Adv Biomed Res 2015;4:259.
10. Vasudha MS, Manjunath NK, Nagendra HR. Changes in MIDAS, perceived stress, frontalis muscle activity and non-steroidal anti-inflammatory drugs usage in patients with migraine headache without aura following ayurveda and yoga compared to controls: An open labelled non-randomized study. Ann Neurosci 2018;25:250-60.
11. Wells RE, Beuthin J, Granetzke L. Complementary and integrative medicine for episodic migraine: An update of evidence from the last 3 years. Curr Pain Headache Rep 2019;23:10.
12. Kumar A, Bhatia R, Sharma G, Dhanlika D, Vishnubhatla S, Singh RK, *et al*. Effect of yoga as add-on therapy in migraine (CONTAIN): A randomized clinical trial. Neurology 2020;94:e2203-12.
13. Mehta JN, Parikh S, Desai SD, Solanki RC, Pathak AG. Study of additive effect of yoga and physical therapies to standard pharmacologic treatment in migraine. J Neurosci Rural Pract 2021;12:60-6.
14. Streeter CC, Gerbarg PL, Saper RB, Ciraulo DA, Brown RP. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. Med Hypotheses 2012;78:571-9.
15. Gazerani P, Cairns BE. Dysautonomia in the pathogenesis of migraine. Exp Rev Neurother 2018;18:153-65.
16. Jerath R, Edry JW, Barnes VA, Jerath V. Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. Med Hypotheses 2006;67:566-71.

Supplemental Table 1: Clinical outcome variables of migraine in SMT ($n=30$) and SMT+P group ($n=35$)

Clinical outcome variables of migraine	SMT group ($n=30$)	SMT+P group ($n=35$)	*P*
Headache severity* (VAS score) (Mean±SD)	9.01±1.66	7.87±1.91	0.013*
Headache frequency (days/month) (Mean±SD)	16.43±12.68	11.14±10.91	0.079
Headache duration (hours) (Mean±SD)	30.68±33.44	26.86±24.17	0.595
Impact of headache on quality of life (HIT-6 score) (Mean±SD)	70.77±8.25	68.17±9.9	0.239
Disability due to migraine (MIDAS score) (Mean±SD)	41.63±44.93	27.80±38.56	0.186

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group, VAS: Visual Analogue Scale, HIT-6: Headache Impact Test 6, MIDAS: Migraine Disability Assessment, SD Standard Deviation,* $P \leq 0.05$

Supplemental Table 2: Comparison between the clinical outcome variables of migraine in SMT group ($n=30$) and SMT+P ($n=35$) group after three months of intervention

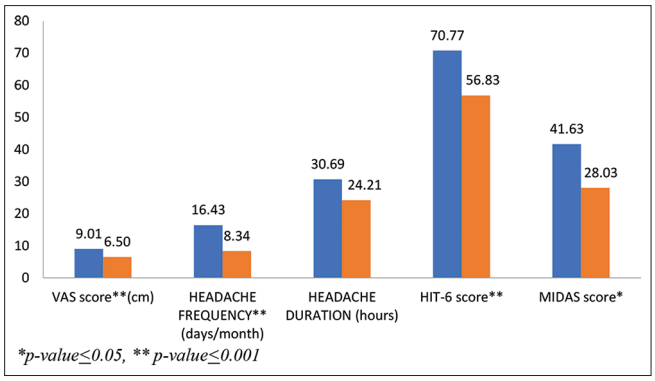
Clinical outcome variable of migraine	SMT group ($n=30$) (baseline)	SMT group ($n=30$) (post intervention)	*P*	SMT+P group ($n=35$) (baseline)	SMT+P group ($n=35$) (post intervention)	*P*
Headache severity (VAS score) (Mean±SD)	9.01±1.66	6.50±3.57	0.000**	7.87±1.91	4.89±2.91	0.000**
Headache frequency (days/month) (Mean±SD)	16.43±12.68	8.34±10.97	0.000**	11.14±10.91	5.34±7.62	0.002*
Headache duration (hours) (Mean±SD)	30.69±33.44	24.21±29.16	0.139	26.86±24.17	11.60±16.86	0.001**
Impact on quality of life (HIT-6 score) (Mean±SD)	70.77±8.25	56.83±22.39	0.001**	68.17±9.19	56.03±17.76	0.001**
Disability due to migraine (MIDAS score) (Mean±SD)	41.63±44.93	28.03±43.33	0.034*	27.80±38.56	17.11±33.56	0.008*

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group, VAS: Visual Analogue Scale, HIT-6: Headache Impact Test-6, MIDAS: Migraine Disability Assessment, SD: Standard Deviation,* $P \leq 0.05$, ** $P \leq 0.001$

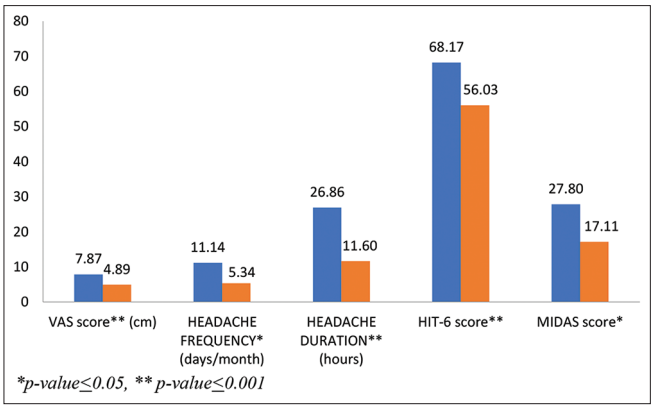
Supplemental Table 3: Comparison between the change in clinical outcome variables of migraine in SMT group ($n=30$) and SMT+P ($n=35$) group after three months of intervention

Change in clinical outcome variable of migraine	SMT group ($n=30$)	SMT+P group ($n=35$)	*P*
Headache severity (VAS score) (Mean±SD)	2.51±2.70	2.98±2.56	0.474
Headache frequency (days/month) (Mean±SD)	8.09±10.86	5.80±10.06	0.382
Headache duration (hours) (Mean±SD)	6.48±23.32	15.25±24.94	0.150
Impact on quality of life (HIT-6 score) (Mean±SD)	13.93±21.22	12.14±19.15	0.722
Disability due to migraine (MIDAS score) (Mean±SD)	13.60±33.50	10.68±22.44	0.678

SMT group: Standard medical treatment group, SMT+P group: Standard medical treatment plus pranayama group, VAS: Visual Analogue Scale, HIT-6: Headache Impact Test-6, MIDAS: Migraine Disability Assessment, SD: Standard Deviation



Supplemental Figure 1: Effect of Standard Medical Treatment on Mean Values of Clinical Outcome Variables of Migraine after Three Months in Patients of SMT (Standard medical treatment) Group (*N*=30)



Supplemental Figure 2: Effect of Pranayama as an Adjuvant to Standard Medical Treatment on Mean Value of Clinical Outcome Variables of Migraine after Three Months in Patients of SMT+P (Standard medical treatemnt plus pranayama) Group (*N*=35)