

A scoping review of conventional and laser acupuncture as a modality of treatment for migraine

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Abstract

Introduction: Migraine is a common neurological disorders that typically manifests with repeated episodes of unilateral frequent throbbing headaches. Globally, the prevalence of migraine is around 10%. Despite the wide variety of pharmacological medications, patients still experience frequent attacks or are unable to get complete relief from the prescribed medications. Conventional and laser acupuncture are alternative therapeutic treatment modalities that have been widely used for people with migraine. The purpose of this study was to review the collective evidence on the role of acupuncture in alleviating the symptoms of migraine.

Methods: A scoping review of current literature was performed. The inclusion criteria for including interventions in this study were: (a) published in English language between 2013 and January 2018; (b) indexed in MEDLINE/PubMed, CINAHL, AltHealthWatch, and SCOPUS; (c) quantitative evaluations of acupuncture as a modality of treatment; (d) original, peer-reviewed research articles; and (e) utilized patients diagnosed with migraine.

Results: A total of 23 interventions with a combined total of 1,714 study participants met the inclusion criteria. Findings indicate that acupuncture is a promising approach in the treatment of migraines accompanied with or without an aura. Limitations of this review included varied dosage of acupuncture among different studies, small sample sizes, and lack of behavioral theory-based approaches in promoting this modality.

Discussion and Conclusion: The present evidence indicates that acupuncture may provide symptomatic relief and improvement in quality of life among migraine patients. It has a promising role as an adjuvant to conventional drug therapy. More randomized controlled trials for efficacy and effectiveness testing are needed.

KEY WORDS: Acupuncture; alternative and complementary health; headache; migraine; public health research; review.

Riassunto

Introduzione: L'emicrania è uno dei disturbi neurologici comuni che tipicamente si manifesta con ripetuti episodi di frequente cefalea pulsante unilaterale. A livello globale la prevalenza dell'emicrania è intorno al 10%. Nonostante l'ampia varietà di rimedi farmacologici, i pazienti continuano a soffrire di frequenti crisi o non riescono a trovare un pieno ristoro dai farmaci prescritti. L'agopuntura laser e convenzionale sono opzioni terapeutiche alternative che sono state ampiamente usate nelle persone affette da emicrania. Questo studio ha la finalità di revisionare l'evidenza collettiva sul ruolo dell'agopuntura nell'alleviare i sintomi dell'emicrania.

Metodi: Una scoping review della letteratura corrente è stata effettuata. I criteri di inclusione relative agli interventi inclusi nello studio sono stati i seguenti: a) studi pubblicati in inglese dal 2013 al gennaio 2018; b) studi indicizzati in MEDLINE/PubMed, CINAHL, AltHealthWatch e SCOPUS; (c) valutazioni quantitative dell'agopuntura come modalità di trattamento; (d) articoli di ricerca originali soggetti a peer review; (e) studi su pazienti con diagnosi di emicrania.

Risultati: Un totale di 23 interventi con un totale di 1.714 partecipanti hanno rispettato i criteri di inclusione. I risultati indicano che l'agopuntura è un approccio promettente al trattamento dell'emicrania con o senza aurea. Le limitazioni di questa review includono la presenza di una dose di somministrazione dell'agopuntura diversificata tra i differenti studi, campioni di studio piccoli ed una mancanza di approcci basati sulla teoria comportamentale nel promuovere questa modalità terapeutica.

Discussione e Conclusione: L'evidenza attuale indica che l'agopuntura può fornire un beneficio dei sintomi ed un miglioramento nella qualità della vita di questi pazienti. Essa ha un ruolo promettente come adiuvante alla terapia convenzionale effettuata con i farmaci. Più trial clinici randomizzati controllati per testarne l'efficacia e l'incisività sono necessari.

TAKE-HOME MESSAGE

As our scoping review showed, acupuncture can provide symptomatic relief for migraine patients and improve their quality of life, and has a role as an adjuvant to traditional drug therapy in migraine care.

Competing interests - none declared.

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INTRODUCTION

Globally, migraine is one of the most prevalent headache disorders that requires immediate medical attention. The worldwide prevalence of migraine is around 10% [1]. Over 36 million (about 14 percent) Americans are affected by migraine [2], and approximately three out of four diagnosed individuals with migraine are women and may be attributed to hormonal imbalances in women [3]. Migraine primarily affects individuals between ages 15 and 55 years of age [4]. Migraine is a common neurological disorder that typically manifests with recurrent episodes of unilateral frequent throbbing pain on one or both sides of the head. Migraine headache attacks are pulsating in nature, usually aggravated by routine physical activity and can last for several hours to 2-3 days [1, 5, 6]. Recurring migraine attacks are sometimes triggered by an “aura”, visual disturbances, stress, anxiety, lack of food or sleep, hormonal changes, dietary variations and bright or flashing lights triggers [7]. The frequency of migraine attack can range from once a year to several times a week with or without accompanying nausea and/or vomiting [8, 9]. Migraine is of public health importance since it is associated with chronic headache, associated significant disability, reduced quality of life, psychological distress, and substantial health care costs [1, 5, 10, 11]. Prevention and treatment of migraine typically involves a two-pronged approach (pharmacological interventions and behavioral treatments) that aims at relieving the symptoms or preventing the occurrence of attacks [7]. The effectiveness of pharmacological interventions in management of migraine is generally well accepted [8, 12–15]. However, despite the wide variety of pharmacological interventions, migraine patients still experience frequent attacks or are unable to get complete relief from the medications. Furthermore, pharmacological interventions often present side effects, adverse effects and unwelcome drug interactions. Behavioral treatments are gaining popularity in the treatment of migraine attacks. These include physical management strategies such as isometric neck exercises,

aerobic exercises, relaxation techniques and biofeedback mechanisms, designed to reduce the occurrence and severity of attacks and increase daily comfort [7]. Acupuncture as a modality of treatment is also gaining significance. Few studies have been conducted to determine the comparative efficiency of the aforementioned techniques or effectiveness using the techniques individually. Acupuncture is among the few non-pharmacological techniques with which some research has been conducted.

Acupuncture is a Traditional Chinese Medicine healing technique with a history that dates to over 3,000 years [16]. Traditional Chinese Medicine is based on the ancient philosophy that describes the universe and body as two opposing forces ‘yin’ and ‘yang’ that are complementary to each other and must be in balance for a healthy body. A disruption in the flow of energy forces to the yin and yang can lead to illness, pain or lack of body function [16, 17]. Conventional and laser acupuncture are alternative therapeutic treatment modalities that have been widely used for people with migraine. Conventional acupuncture involves the use of fine, sterile, single-use needles inserted into the specific sites on the skin [17]. Laser acupuncture is the use of pressure or heat or electrical stimulation on specific anatomic sites known as acupuncture points or acupoints [17, 18]. Stimulation of acupoints relieves pain, promotes natural healing, improves body functioning and sense of well-being [18].

Clinical studies have shown the holistic effects of acupuncture treatment on various organ systems particularly nervous system [19], endocrine system [20], digestive system [18], immune system [21], and cardiovascular system [22, 23]. Clinical studies have also shown the efficacy and effectiveness of acupuncture in the treatment of migraine [24], depression [25], dysphagia after a stroke [26], insomnia [27], infertility [28], nausea [18], chronic knee pain [29], low back pain [30], and neck pain [31]. The frequency, modality and number of acupuncture treatments required to experience relief varies from one

individual to another.

A literature review published in 2009 appraised several randomized control trials to determine whether acupuncture is more effective for migraine [32]. The study included 25 studies and found strong positive effects of acupuncture on migraine patients though there were several methodological shortcomings. The study provided no reference to either laser or conventional acupuncture. The most recent systematic review and meta-analysis of 14 randomized control trials published in 2018 [33], assessed the therapeutic and preventive effect of acupuncture treatment in patients with a clinical diagnosis of 'migraine without aura (MWOA)'. The meta-analysis shows that the effectiveness of acupuncture is still uncertain, although it may be relatively safer than medication therapy in MWOA. However, this suggests that further evidence is needed in determining the efficacy and effectiveness of acupuncture in migraine especially when it can be delivered either through conventional or laser therapy.

Despite a long history of acupuncture in the treatment of migraine, the question remains as to whether laser and conventional acupuncture are effective in the treatment of migraine with or without aura. Hence, the purpose of this study was to review the collective evidence of the current medical literature on the role of acupuncture in alleviating the symptoms of migraine. This review addresses four questions: (a) Is acupuncture an efficacious approach for reducing migraine episodes in patients compared to conventional drug therapy? (b) Is the data provided by the studies sufficient to draw conclusions regarding the efficacy of acupuncture in migraine treatment? (c) Are there methodological limitations of the current research studies and how can these be addressed through future research? (d) What common outcome measures were identified, and which can be inferred as important outcome measure(s) for future studies?

METHODS

A scoping review of current literature was conducted using the following databases:

Medline/PubMed, CINAHL (Cumulative Index to Nursing and Allied Health, AltHealthWatch, and SCOPUS to retrieve studies involving acupuncture for treatment of migraine. The inclusion criteria for selected interventions in this study were: (a) published in English language between 2013 and January 2018; (b) quantitative evaluations of acupuncture as a modality of treatment (c) original, peer-reviewed research articles; (d) utilized patients diagnosed with migraine. Articles were excluded from this study based on the following criteria: (a) studies that did not utilize a quantitative design approach; (b) did not sample patients diagnosed with migraine; (c) did not include selected outcome measures; and (d) were not indexed in selected databases. Grey literature was not searched for this study. (this is a limitation and a potential bias for a review).

Data review for this study was conducted in three phases. In phase I, Medline/PubMed, CINAHL, AltHealthWatch, and SCOPUS database searches were conducted. Boolean operators and search terms were used to identify studies that meet the criteria for inclusion: 'Acupuncture AND migraine' or 'Acupuncture AND migraine treatment' or 'Acupuncture AND migraine prophylaxis' or 'Acupuncture AND migraine prophylaxis' or 'Acupuncture AND migraine prevention'. Date limits for the time period January 2013 to January 2019 was used.

The aforementioned search terms/phrases yielded 1,240 articles: 256 were returned from Medline/Pubmed, 178 from CINAHL, 47 from AltHealthWatch, and 655 from SCOPUS. In Phase II, screening of 984 titles/abstracts was conducted with exclusion of 256 duplicates and 897 irrelevant articles. In Phase III, a full-text review of 87 manuscripts was conducted. Hence, a total of 23 articles with a combined total of 856 study participants met the eligibility criteria. Figure 1 provides diagrammatic representation of the review.

RESULTS

A total of 23 studies met the eligibility criteria after the data extraction process was com-

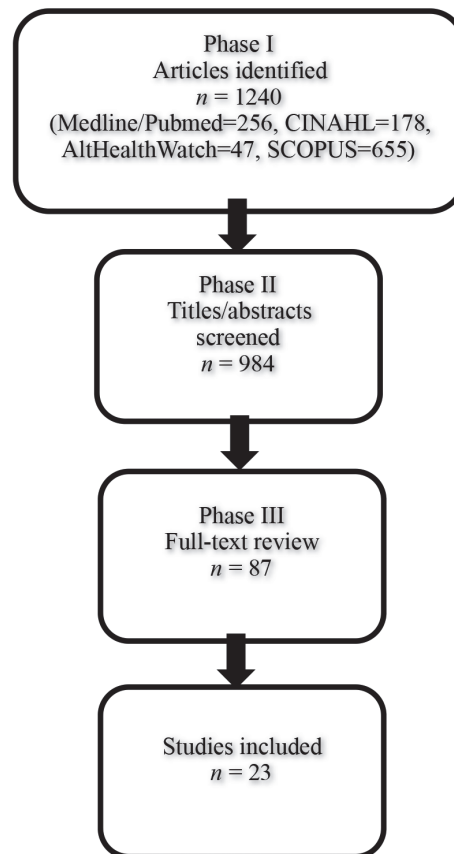


Figure 1. Diagrammatic representation of the review.

pleted. Table 1 presents a summary of the articles including year of publication, authors/country where the study was performed, study design and sample size, age of participants, intervention modality, intervention dosage, outcome measures, and the salient findings. The studies are arranged by year of publication in the ascending order starting from 2013. Within a given year, studies are arranged alphabetically by the last name of the first author.

Of the 23 interventions, the majority were conducted in China ($n = 8$), followed by Turkey ($n = 4$), and Iran ($n = 4$). Each one study was implemented in U.S.A., Canada, Italy, Taiwan, India, Czech Republic and Australia. Of the 23 interventions, 17 were randomized control designs or its variants, four were quasi-experimental design, one used a pretest-posttest design and another one was a longitudinal cohort study. The mean sample size calculated for all 23 studies in this systematic review was 70.74, with a standard

deviation of 58.17 and a range of 18-249 participants. Total sample sizes (n) were typically between 30 and 100, with five studies having less than 30 and two studies having more than 100. The sites of the acupuncture intervention for relieving migraine were in Neurology and Acupuncture Departments at Hospitals ($n = 9$), Psychiatry and Neurology outpatient clinics ($n = 2$), acupuncture clinic ($n = 2$), community settings ($n = 1$), acupuncture research practice center ($n = 5$), neurology clinic ($n = 2$) and pain clinic ($n = 1$). Type of acupuncture used was identified as Traditional Chinese Acupuncture (TCA) by 19 studies and Electro acupuncture by three studies. One study identified the use of both Traditional Chinese Acupuncture and Yamamoto New Scalp Acupuncture (YNSA).

The number of sessions of acupuncture treatment varied from 5 sessions to 32 sessions with the least session lasting for 30 minutes and only one session lasting for 15 minutes. The duration period for acupuncture tre-

atment varied from 2.5 weeks to 20 weeks. The most common outcome measure was the pain intensity scales including Pain Relief Score (PRS), Visual Analogue Scale (VAS), Verbal Pain Rating scale. Pain intensity was measured by 19 studies with Visual Analogue Scale (VAS) as the most commonly used scale. Besides pain intensity measurement scales, 1 study used the Pressure Pain Threshold (PPT) to measure participants sensitivity to pain. Disability due to migraine was measured by six studies using Migraine Disability Assessment (MIDAS). To assess the severity and impact of headache on a patient's life, one study used the HIT-6 questionnaire. A combination pain characteristics and presence of complications was assessed by one study using the Pain Visual Analogue Scale (VAS) and Migraine Therapy Assessment Questionnaire (MTAQ)], respectively. Duration and frequency of headache attacks was measured by two studies.

Psychological outcomes measures included Short-Form 36 (SF-36) quality of life, WHO Quality of Life BREF (Biomedical Research and Education Foundation) questionnaire anxiety and depression scales, Pittsburgh Sleep Quality Index (PSQI) ($n = 1$), Migraine-specific quality-of-life questionnaire, (MSQ) ($n = 1$), the Zung self-rating anxiety scale [SAS] ($n = 2$), and Zung self-rating depression scale [SDS] ($n = 2$). Physiological measures were measured by three interventions using Magnetic Resonance Imaging ($n = 3$), and blood samples to measure serum Nitric oxide (NO) and matrix metalloproteinase (MMP-2) concentration and activity [34]. A summary of findings from the 23 studies demonstrated a reduction in duration and frequency of migraine attacks [20, 35–37]. Usage of relief medication for migraine attacks was evidently reported in four studies [20, 35, 38, 39].

DISCUSSION

This study reviewed studies published from 2013 to February 2019 to examine whether acupuncture can be alternative and complementary therapeutic approach for managing

migraine. A total of 23 studies met the inclusion criteria. This review addressed four questions. The first question addressed by this review; Is acupuncture an efficacious approach for reducing migraine episodes in patients compared to conventional drug therapy? All six studies [35, 38, 40, 47, 50, 52] that compared the use of acupuncture and conventional drug therapy showed positive improvements in psychological or physiological outcome measures in the patients that received acupuncture compared to patients that received conventional drug therapy. In a study by Facco et al. (2013) [35], patients who received acupuncture treatment had no complaints regarding treatment while patients who received a prophylactic treatment (Valporic acid), reported adverse effects including nausea, constipation, abdominal pain, weight gain, drowsiness and itching. The patients who received acupuncture showed better improvements in pain intensity and reduced intake of rizatriptan, a medication used to relieve headache and pain compared to patients who received the prophylactic treatment [35]. Another study by Yang et al. (2013) [20], demonstrated that patients with throbbing symptoms in the traditional Chinese acupuncture group had significantly greater reduction in mean moderate/severe headache days per week than in patients without throbbing symptoms ($P = 0.004$) while there was no significant difference in the topiramate group although medication dosage was increased weekly. The findings of this study are in agreement with a previous systematic review published in 2017 by Zhang, Yue, Golianu Sun, and Lu which concludes that acupuncture may be effective at relieving chronic knee pain [29].

Of all 23 studies that showed positive results, 17 studies used a randomized design. This design is considered the most rigorous as it avoids selection bias by randomizing participants or group to experimental or control group, fulfills assumptions underlying tests for statistical inference, enlists pretests and posttests design and minimizes threats to internal and external validity. This can be seen in the randomized control trial from China

Table 1. Summary of Conventional and Laser Acupuncture Interventions for Migraine Done Between 2013 and 2019 ($n = 23$).

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2013	Facco E [35] Italy Traditional Chinese acupuncture and Valproic acid (Depakin Chrono)	Randomized prospective study n=100; Valproic Acid group [(Group V) (n=50)] and Traditional Chinese acupuncture [(Group A) (n=50)]. All patients had migraine without aura Mean age for Valproic Acid group is 34 years and Acupuncture 40 years	Traditional Chinese acupuncture group submitted to 2 courses of 10 acupuncture applications each, twice a week with one-week rest between two courses (20 sessions) Valproic group received valproic acid extended release 300 mg daily increased to 600 mg daily within one week in 3 months All patients received 10 mg of Rizatriptan wafer to treat attacks and a second dose after two hours if pain persisted	Italian version of MIDAS Index (MI), measured overall level of patient's suffering, number of days with pain and intensity of pain Pain Relief Score (PRS) assessed the impact of treatment Record of the total number of Rizatriptan wafers taken in 90 days and adverse events of the prophylactic treatment	MI improved at T1 and T2 ($P<0.0001$). Improvement in Midas score was similar in both groups both at Time 1 (T1) with a pvalue of 0.10 and Time 2 (T2) with a pvalue of 0.10 Group A showed a lower intake of Rizatriptan than Group V at T2 ($p=0.001$) Group A showed better improvements in Pain Intensity ($p=0.02$) and PRS ($p=0.02$) While all patients in Group A had no complaints, in Group V, 48.8% of patients reported adverse effects including nausea, constipation, abdominal pain, weight gain, drowsiness and itching
2013	Yang C [20] Taiwan Traditional Chinese acupuncture and Topiramate	Randomized Control Trial (RCT) using Secondary data n=66 consecutive patients Traditional Chinese acupuncture (n=33) and Topiramate group (n=33) Mean age 47.88 years	The traditional Chinese acupuncture group received 24 sessions over 12 weeks Topiramate group had a 4-week titration at 25 mg/d increased to 25 mg/d weekly to a maximum of 100 mg/d followed by an 8-week maintenance period	Migraine Disability Assessment (MIDAS), Short-Form 36 (SF-36) measured quality of life based on 8 domains: physical function, bodily pain, role physical, general health, vitality, role emotional, social function, and mental health) Beck Depression Inventory –II and Hospital Anxiety and Depression Scale (HADS)	Greater change in mean number of moderate/severe headache days per 4 weeks for high moderate/severe headache days (>20 d) than in low days (≤ 20 d) (-12 ± 1 vs. -10 ± 2 d, $P=0.015$) in acupuncture group. In the traditional Chinese acupuncture group, patients with throbbing symptoms had significantly greater reduction in mean moderate/severe headache days per 4 weeks than in patients without throbbing symptoms ($p=0.004$). There was no significant difference in the topiramate group
2014	Cayir Y [34] Turkey Traditional Chinese acupuncture	Pretest posttest design n=30 of which 27 completed the study All patients had migraine with or without aura Mean age 32.1 ± 11 years	10 sessions of traditional Chinese acupuncture treatment for 5 weeks, two sessions a week	Visual Analogue Scale (VAS) for pain severity Quality of life using Short Form-36 (SF-36) Blood sample collected three times to measure matrix metalloproteinase (MMP-2) concentration and activity	VAS scores analyzed using paired comparisons showed a decrease after 10 sessions of acupuncture ($p<0.0001$) Significant difference in all SF-36 scores after acupuncture compared with the pretreatment values ($p<0.0001$) Post treatment presented significant changes in the disruption of the blood-brain barrier during attacks in patients with migraine, which suggests that patients with increased MMP-2 levels could benefit from the use of MMP inhibitor (eg. acupuncture)

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2014	Foroughipor M [36] Iran Traditional Chinese acupuncture and sham acupuncture	Randomized control design n=100 Sham group (n=50) and Traditional Chinese acupuncture (n=50) were patient whose number of attacks did not reduce by 50% after receiving prophylactic drugs for 3 months Mean age of 36.5 years	All patients in both groups continued their prophylactic treatment and, additionally, received 12 sessions of either traditional Chinese acupuncture or sham acupuncture	Number of headache attacks per month	No significant difference in the frequency of attacks between the two groups before intervention. The number of reported headache attacks was significantly lower in the group receiving Traditional Chinese acupuncture than in the sham acupuncture group after 1-month treatment ($p < 0.001$), and continued during months 2, 3 and 4
2014	Gündüztepe Y [41] Turkey Traditional Chinese acupuncture	Randomized control design n=22 volunteer migraine patients and n=22 healthy control subjects Mean age for female is 33 and mean age for male is 30	The acupuncture treatment received 5 sessions with 2 sessions per week.	Verbal Pain Rating Scale assessed pain severity Blood samples were collected before performing acupuncture, after the 1st session and after the 5th session of the acupuncture In the control group, blood samples were collected only once Mean serum Nitric oxide (NO), levels in the control group (healthy people) were (3,58±0,53) while NO levels in the intervention group with migraine group were (5,55±0,70) Serum NO levels were 55 % higher in migraine group compared to the control group	A statistically significant difference ($p < 0.05$) was found in serum nitric oxide levels between migraine patients group and the control (healthy) group After the 5th acupuncture treatment serum nitric oxide (NO) levels were reduced to (3.85 ± 0.62) 30.63% in migraine group and were statistically lower ($p < 0.05$).
2014	Rezvani M [37] Iran Yamamoto New Scalp Acupuncture (YNSA) versus Traditional Chinese Acupuncture (TCA)	Randomized clinical trial n=80 patients with migraine headache Mean age for YNSA is 35.5 years and TCA is 35.4	Patients received 18 sessions of acupuncture treatments (30 minutes each) in three courses. Each course included six sessions of acupuncture treatments given every other day, with 1-week rest between the courses Questionnaires were completed at the end of the second and eighth weeks of treatment and 1 month after the last session of treatment	Utilized a combined questionnaire [Pain visual analogue scale (VAS) and Migraine therapy assessment questionnaire (MTAQ)], that assessed pain characteristics and presence of complications Questionnaire was completed treatment, after 6 and 18 sections of treatment, and 1 month after completion of therapy	The frequency and severity of migraine attacks significantly decreased in YNSA and TCA groups Recovery from headache and ability to continue daily activities 2 hours after medical treatment showed similar improvement in both YNSA and TCA groups ($p > 0.05$)

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2014	Vijayalakshmi I [38] India Electro acupuncture treatment	Randomized interventional study n=60 patients Acupuncture group, n=30 (Group A) and Drug group n=30 (Group D) No mean age but participants were between 20 to 40 years old	Group A received electro acupuncture for 10 sessions, delivered on different days, over a period of 30 days Group D received tab flunarizine 20 mg OD along with tab paracetamol 500 mg SOS for 30 days	Psychological parameters were assessed by using WHO Quality of Life BREF (Biomedical Research and Education Foundation) questionnaire Disability due to migraine was assessed by MIDAS (Migraine Disability Assessment) questionnaire	The acupuncture group showed a better response and was thus found to be more effective as compared to the drug group (p = 0.005 to 0.000) The domains of WHO QOL BREF showed a significant greater improvement in the acupuncture group than the drug therapy group. MIDAS scores remained significantly higher in drug therapy than in acupuncture therapy, thus, disability in acupuncture therapy group was lesser than the drug therapy group
2014	Zhao L [39] China Traditional Chinese acupuncture	Randomized controlled trial n=80 migraineurs without aura Two groups: active acupuncture group (n=40) and inactive acupuncture group (n=40) Mean age of 33.34 years	Migraineurs without aura were enrolled to receive either active acupoint acupuncture or inactive acupoint acupuncture treatment for 8 weeks Migraineurs received 32 sessions of acupuncture treatment for 30 minutes each session. Twenty patients from each group were randomly selected for functional magnetic resonance imaging (fMRI) scan at the end of baseline and at the end of treatment	Headache diary records to record the severity, frequency and duration of headache Visual Analog Scale (VAS) score 0–10 measured the intensity of headache HIT-6 questionnaire assessed the severity and impact of headache on a patient's life	Both active and inactive acupuncture methods were helpful in treating migraine after 8 weeks of therapy (p<0.05) Acupuncture at active acupoints was significantly superior to acupuncture at inactive acupoints in alleviating pain intensity (p= 0.015) The fMRI (neuroimaging data) indicated that long-term active acupoint therapy led to exceptional cerebral response compared with acupuncture at inactive acupoints
2014	Fang Z [42] China Electroacupuncture	Randomized control trial Electroacupuncture for (n=64) Migraine Without Aura Two group Treatment group (n=34) and Control group (n= 34) Mean age of electroacupuncture treatment group patients was 46.79 and Control group was 48.59	Both two groups were treated five times per week Two weeks made one course. After two courses, the therapeutic effects were assessed	Observation of therapeutic effects included observed indexes (Numbers of headache attack, pain degree using Visual Analogue Scale- VAS, lasting period of headache and headache index The improvement of the clinical symptoms= (Headache index before treatment Headache index after treatment) ÷ Headache index before treatment × 100%	After treatment, the differences in observed indexes between the two groups were statistically significant (p 0.05), the scores in observed indexes were lower in the treatment group than those in the control group

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2015	Li K [43] China Traditional Chinese acupuncture	Quasi experimental Comparison between 24 patients diagnosed with MWoA (migraine without aura, n=12) and healthy control (HC) subjects (n=12) Mean age of MWoA patients was 28.1 and HC subjects 29.8	All MWoA patients received standard acupuncture treatment for 4 weeks, 5 times per week (from Monday to Friday) which lasted for 30 minutes each time All MWoA patients received two separate resting-state functional magnetic resonance imaging (fMRI) scanning, before and after the acupuncture treatment course respectively The HC subjects participated in one resting-state scanning as control	Visual Analog Scale (VAS) scores measured intensity of headache Duration and frequency of migraine attacks fMRI images	VAS scores, duration and frequency of migraine attacks showed significant decrease ($p < 0.05$) after 4 weeks' of acupuncture treatment MWoA patients had significantly decreased functional connectivity with the right frontoparietal network (RFPN), in the left precentral gyrus, the left supramarginal gyrus, the left inferior parietal lobule, and the left postcentral gyrus. Decreased functional connectivity of brain regions in MWoA patients was negatively correlated with their VAS scores before treatment ($r = -0.6289$, $p = 0.0494$) After the acupuncture treatment, MWoA patients showed significantly increased functional connectivity with the RFPN in the left precentral gyrus, the left inferior parietal lobule, and the left postcentral gyrus. Increased functional connectivity of brain regions in MWoA patients was negatively correlated with the decrease of VAS scores after treatment ($r = -0.6633$, $p = 0.0370$)
2015	Wang X [44] Australia Traditional Chinese acupuncture	Randomized control trial n=50 frequent migraineurs Groups: real acupuncture (RA, n=26) or sham acupuncture (SA, n=24) groups Mean age for RA was 41.6 and SA was 43.8 years	16 sessions of either real acupuncture (RA=26) or sham acupuncture (SA=24) for 20 weeks This occurred twice per week for four weeks (eight sessions) followed by once per week for another four weeks (four sessions), then once every two weeks for four weeks (two sessions), then once per month for another two months (two sessions)	The primary outcome measures: A 0–10 Visual Analogue Scale (VAS) and a Six-Point Likert scale measured the intensity of migraine Percentage of patients with more than 50% reduction in the number of days with migraine attack at the end of treatment The secondary outcome measures were: The usage of the relief medication for migraine. The severity and quality of migraine, and quality of life. Pressure pain threshold (PPT), measured individual's sensitivity to pain, in a standard sequence at 11 sites with 1 kg/cm ² force	RA group reported significant less migraine days (RA: 5.2 ± 5.0 ; SA: 10.1 ± 7.1 ; $p = 0.008$), less severe migraine (RA: 2.18 ± 1.05 ; SA: 2.93 ± 0.61 ; $p = 0.004$), more responders (RA: 19 versus SA: 7), and increased pressure pain thresholds Group differences maintained at the end of the three-month follow-up, but not at the one-year follow-up. Traditional Chinese acupuncture is an effective and safe treatment for short-term relief of frequent migraine in adults

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2015	Zhang, L [45] China Traditional Chinese acupuncture	Quasi experimental Comparison between 24 study participants. Patients diagnosed with MWOA (migraine without aura, n=12) and healthy control (HC) subjects (n=12) Mean age for MWOA patients: 28.1±6.8 years and HC subjects: 29.8±7.2 years	All MWOA patients received regular manual acupuncture for 4 weeks, 5 times per week (Monday to Friday) and lasted for 30 minutes per time All MWOA patients received two separate resting-state functional magnetic resonance imaging (fMRI) scanning, before and after the acupuncture treatment course, respectively The healthy control subjects participated in one resting-state scanning	Visual analogue scale (VAS) for pain intensity Duration and frequency of migraine attacks Pittsburgh Sleep Quality Index (PSQI) was measured as a secondary outcome	The results of VAS and PSQI scores, and the duration and frequency of migraine attacks showed significant decrease after a 4-week acupuncture treatment course (p<0.01) After acupuncture treatment, brain regions showing decreased functional connectivity revealed significant reduction in MWOA patients compared with before acupuncture treatment
2017	Zhao L [55] China Electroacupuncture treatment	Randomized control trial n=249 eligible patients with migraine without aura True acupuncture (n=83), Sham acupuncture (n=80) and Waiting list (n=82) Mean age for True acupuncture group was 36.4, Sham acupuncture 39.1 and Waiting list 38.8 years	Participants in the true acupuncture and sham acupuncture groups received 20 sessions of electroacupuncture treatment, once per day, 5 days per week for 4 weeks Participants in the waiting-list group did not receive acupuncture but were informed that 20 sessions of acupuncture would be provided free of charge after 24 weeks Patients with intolerable headache received ibuprofen 300-mg capsules	Diaries to record migraine attacks: to assess change in the frequency of migraine attacks from baseline to week 16 and record ibuprofen usage. Secondary outcome measures included the migraine days, average headache severity, and medication intake every 4 weeks within 24 weeks. Migraine-specific quality-of-life questionnaire (MSQ), and pain-related impairment of emotion (the Zung self-rating anxiety scale [SAS] and Zung self-rating depression scale [SDS] were assessed at baseline and at the 4-week visit	Change in frequency of migraine attacks differed significantly among the 3 groups at 16 weeks after randomization (p<0.001) A greater reduction in attacks was observed in the true acupuncture than in the sham acupuncture group (p=0.002) and in the true acupuncture vs waiting-list group (p<0.001) Sham acupuncture was not statistically different from the waiting-list group (p=0.07) TA group showed a significant improvement in all subscales of the MSQ and SAS scores (p<0.05) True acupuncture may be associated with long-term reduction in migraine recurrence compared with sham acupuncture or assigned to a waiting list

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2017	Naderinabi B [40] Iran Traditional Chinese Acupuncture	Randomized control trial n=230 eligible patients with chronic migraine True acupuncture-Group A (n=50), Botulinum toxin-A- Group B (n=50) and Control group- Sodium Valproate – Group C (n=50) Mean ages for True acupuncture was 37.2, Botulinum toxin-A was 36.8 and Control Group- Sodium Valproate was 37.6 years	Participants in the True acupuncture received 30 treatment session in 60 days in 2 cycles with 1-week rest between two cycles Participants in the Botulinum toxin-A group received injection done in 30 trigger zones over the facial and pericranial muscles at a total dosage of 155U Participants in the Sodium valproate 500mg/day for 3 months pa	Pain severity, decreased medication use, number of days per month of pain, the number of days per month with the need of medications and the number of days missed out due to headache Pain intensity was assessed using Visual Analogue Scale (VAS)	VAS pain score decreased in all group with a higher significant decrease in true acupuncture group (p=0.0001) The number of days per month with migraine, absence from work and the need for medication significantly decreased in three groups at 3 times of evaluation (p<0.05) with fewer side effects in group A (p=0.021)
2017	Li Z [46] China Traditional acupuncture	Randomized control trial n=100 MwoA patients and n=46 matched Healthy Controls (HC)	20 sessions of acupuncture treatment with a duration of 30 min per session, each administered over a period of 4 weeks (5 sessions per week) No verum acupuncture nor sham acupuncture (SA) treatments were applied on HC and MwoA patients in the waiting-list group	Migraine intensity and frequency of migraine attacks. Headache intensity was evaluated with a 0–10 visual analogue scale (VAS). The self-rating anxiety scale (SAS) and the self-rating depression scale (SDS) were administered to assess the MwoA patients' anxiety and depression status. fMRI data	Verum groups showed significant improvement in VAS score (p< 0.05). VA1 and VA3 groups showed significant improvement in headache frequency (p<0.05), while VA2 group showed a tendency to improve headache frequency (p=0.111) SA showed insignificant improvement in VAS score and headache frequency (p>0.05) Compared with HCs, MwoA patients showed significant ALFF increases at the left posterior insula and left putamen/caudate, and ALFF decreases in the bilateral middle occipital cortex/cuneus and bilateral rostral ventromedial medulla (RVM)/ trigeminocervical complex (TCC). ALFF value in RVM/TCC was negatively associated with VAS (r=-0.426, p=0.001).

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2017	Biçer M [47] Turkey Traditional acupuncture	Randomized control trial n= 54 patients with a diagnosis of migraine Three groups: Drug treatment group n=25 Acupuncture group n=29 The control group consisted of a n=29 healthy individuals Drug treatment mean age 32.0±9.1 years Acupuncture group mean age 30.3+7.4 years. The control group mean age 30.3+7.4 years	Drug treatment patients were treated with venlafaxine 75-225 mg/day for a period of three months Acupuncture treatment was administered in a total of 26 sessions, first three days a week (12 sessions), then two days a week	Blood serotonin levels were assessed before and after treatment Pre-treatment and post-treatment headache frequency and duration, analgesic drug and triptan usage was evaluated using visual analog scale (VAS) and Migraine Disability Assessment (MIDAS)	Number and duration of attacks was found to be significantly lower in both acupuncture and drug treatment groups, compared to the pre-treatment values (p<0.0001) Lower mean analgesic use during study in both the acupuncture and the drug treatment groups compared to the same duration before study (p<0.001 and p<0.001, respectively). Lower mean VAS values after therapy when compared to values before therapy in the acupuncture and the drug treatment groups, (p<0.001 and p<0.001, respectively). Mean MIDAS values were significantly lower after therapy in comparison to before therapy in the acupuncture and the drug treatment groups (p<0.001 and p≤0.001, respectively). Serotonin levels in the acupuncture and drug therapy groups were significantly higher compared to the pre-treatment values (p<0.001) Serotonin levels were found to be significantly lower in healthy individuals compared to the study groups (p<0.0001)
2017	Li F [48] China Traditional acupuncture	Randomized control trial n=64 migraine patients Two groups: Observation group (n=32) and a control group (n=32) Observation group mean age 37.3 years Control group mean age 36.9 years	Oral flunarizine hydrochloride capsules were used for cases in the control group, 10 mg for each dose, 1 dose a day Shaoyang meridian treatment was done once every day, 5 times a week at 2-day interval between two courses. Cupping treatment was done once a week 2 weeks constitutes course of treatment. Patients in the two groups were treated for 2 courses	Severity of headache was assessed using Visual Analogue Scale (VAS) The migraine disability assessment questionnaire (MIDAS) to evaluate patients' quality of life (QOL)	The total effective rate and recovery and marked effective rate in the observation group were 93.8% and 71.0% respectively, versus 78.1% and 43.8% in the control group, showing statistically significant differences (both p<0.05) Significant decreases in VAS and MIDAS scores after treatments in both groups (both p<0.05) VAS and MIDAS scores in the observation group were significantly different from those in the control group (both p<0.05)
2018	Farahmand S [49] Iran Traditional Chinese acupuncture	Randomized clinical trial 60 eligible patients with migraine without aura Acupuncture (n=30) Placebo (n=30) Mean age of 31.4 years	Unknown	Pain intensity was measured based on visual analogue scale (VAS)	Significant difference between the two groups on the checkpoints of 15, 30, 45, and 60 minutes after acupuncture (p<0.05) Pain scores were not statistically different between the two groups on two, three, and four hours after intervention (p>0.05)

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2018	Musil F [50] Czech Republic Traditional Chinese acupuncture	Randomized clinical trial Intervention group n=42 Waiting-list control group n=44 Acupuncture group mean age 45.6 years. The control group mean age 46.5 years	12-week treatment period, acupuncture treatment was performed 14 times Acupuncture occurred twice a week in the first 4 weeks, once a week during weeks 5-8 and once every 14 days during the last month	Number of migraine days Reduction in migraine attacks, headache intensity (mm) and duration (hours), reduction in the use of relief medication and the number of patients with a reduced monthly frequency of migraine days by 50% over 4-week period Pain intensity using visual analog scale (VAS) Migraine-specific quality of life was also evaluated using the Migraine Disability Assessment Scale (MIDAS)	12 weeks post acupuncture, migraine days reduced by 5.5 and 2.0 days in the acupuncture vs. waiting-list control groups, with a statistically significant inter-group difference of 2.0 migraine days (95% CI: -4 to -1). Greater reduction in the number of migraine days per 4 weeks at the end of the 6-month follow-up period in the acupuncture vs. control groups (Δ -4.0; 95% CI: -6 to -2). No significant differences in pain intensity and duration were noticed within or between the groups Acupuncture group showed a larger reduction (-3.2) in symptomatic medication intake compared to the control group (-1.2) baseline to 3 months (Δ -2.7; 95% CI: -5.2 to -0.7) and at the 9-month follow-up (Δ -3.0; 95% CI: -5.8 to -0.7). A significantly greater percentage of responders to treatment was noted in the intervention vs control groups at the 6-month follow-up (81% vs 36%; $p < 0.001$). Migraine-specific quality of life questionnaire as measured MIDAS significantly decreased in both acupuncture vs. control groups and no inter-group difference was detected (-18.2 vs -10.7; $p > 0.05$)
2018	Gu T [51] China Traditional Chinese acupuncture	Quasi experimental n=45 1) migraine without aura n=15 2) cervicogenic headache n=15 and 3) healthy Controls n=15 Migraine without aura and cervicogenic headache received verum acupuncture. Healthy controls received a sham treatment	Five sessions; one session per day from Monday through Friday during the treatment week	Headache intensity (measured using VAS) Headache frequency Duration of each headache attack Proton magnetic resonance spectroscopy imaging	Acupuncture led to a significant reduction in the mean VAS score in MWoA patients ($p < 0.001$) Reduction in the mean duration of headache attacks was also observed in MWoA ($p = 0.023$) A significant increase in N-acetylaspartate/creatine was observed in bilateral thalamus in MWoA after the acupuncture treatment

Year	First Author, Country, & Intervention Modality	Design, Sample, & Age	Intervention Dosage	Outcome Measures	Salient Findings
2018	Tastan K [52] Turkey Traditional Chinese acupuncture	Quasi experimental - Comparative cohort trial n=90 patients Group 1 acupuncture n=30, Group 2 hypnotherapy n=30, and pharmacotherapy n=30 Mean age of the participants was 33.0 years	Acupuncture received 10 acupuncture sessions; occurred 3 days a week Hypnotherapy received 10 standardized hypnosis sessions that occurred 2 days a week for 45 minutes Pharmacotherapy received acetaminophen 650 or 1300 mg twice daily during the first 10 days	The visual analog scale (VAS) to assess pain levels Migraine Disability Assessment (MIDAS) questionnaire to assess migraine disability	The VAS and MIDAS scores of all three groups decreased significantly (p<0.001) Reduction in the VAS score at the third month in the acupuncture and hypnotherapy groups was significantly higher than that of the pharmacotherapy group (p<0.001) Reduction in the MIDAS score at the third month in the acupuncture and hypnotherapy groups was significantly higher than that of the pharmacotherapy group (p=0.007 and p=0.002, respectively).
2018	Yu X [53] Canada Traditional acupuncture (Verum acupuncture [VA]) Acupressure (AP) group Control acupuncture (CA)	Randomized controlled pilot study n=18 patients Three groups: verum acupuncture (VA) group n=7, acupressure (AP) group n=6, and control acupuncture (CA) group n=5 Mean age for all participants was 35.5 years	Nine sessions within a 3 cycle-month menstrual period	The number of MM days per cycle-month. Average pain per cycle-month. Peak pain per cycle-month Total duration period of MM (menstrual migraine) The percentage of patients with ³ 50% reduction in the number of MM days per cycle-month	MM days in the postintervention were significantly less than in the preintervention period, regardless of intervention methods (p<0.05) Average pain in the postintervention period was significantly less than in the preintervention period regardless of intervention (p<0.05) Both VA and AP were more effective than CA for reducing peak pain (p<0.05) Peak pain in the postintervention period was significantly less than in the preintervention period, regardless of intervention (p < .05) The percentage of patients with ³ 50% reduction was higher in VA (61.90%) and AP (66.67%) than CA (46.67%) No serious adverse events were reported
2018	Graff D [54] U.S.A. Traditional acupuncture (auricular acupuncture)	Prospective, interventional, cohort study of n= 19 children with the diagnosis of status migraine Mean age for all enrolled adolescents was 14 years	15 minutes of auricular acupuncture	Change in preintervention and postintervention pain scores using visual analog scale (VAS)	Mean change in the VAS scores was both clinically and statistically significant at 7.03 (interquartile range, 6-8.5) with a p<0.001

[39], which had three groups: (a) participants in the true acupuncture (b) participants in the sham acupuncture group, and (c) waiting list group. Participants in true and sham acupuncture were blinded while those in the waiting list were not. Participants in the true acupuncture and sham acupuncture groups received 20 sessions of electroacupuncture treatment, once per day, five days per week for four weeks. Change in frequency of migraine attacks differed significantly among the three groups at 16 weeks after randomization ($P < 0.001$). A greater reduction in attacks was observed in the true acupuncture than in the sham acupuncture group ($P = 0.002$) and in the true acupuncture vs waiting-list group ($P < 0.001$). Sham acupuncture was not statistically different from the waiting-list group ($P = 0.07$). TA group showed a significant improvement in all subscales of the MSQ and SAS scores ($P < 0.05$).

Consequently, a study by Cavir et al. (2014) [34], conducted in Turkey used the pre-test-posttest design to match pre acupuncture and after Traditional Acupuncture. Pretest to posttest scores showed a decrease in pain severity ($P < 0.0001$) and improved quality of life ($P < 0.0001$) after 10 sessions of Traditional Chinese acupuncture for 5 weeks, when matched with the pre acupuncture scores. Although this design is the least costly and simplest, it is relatively weak in terms of its ability to minimize threats to internal validity such as maturation and history. In the absence of a control group for comparison, future studies that wish to adopt the acupuncture treatment method used in this study should use robust single randomized control design or group randomized control design depending on feasibility of design. The second and third questions addressed by this review were the following: 'Is the data provided by the studies sufficient to draw conclusions regarding the efficacy of acupuncture in migraine treatment?' and 'Are there methodological limitations of the current research studies and how can these be addressed in future research?' This scoping review included 23 studies of which 17 were randomized control desi-

gnis. Findings of these studies can be used to draw relatively positive conclusions, but some limitations should be addressed. To interpret the efficacy of acupuncture in migraine treatment, one of the shortcomings identified in the studies include the small sample sizes identified in some studies. Only five studies had a sample size of 100 or more. This could have been improved by power calculations and justification of sample sizes. Multicentric or large-scale studies have not been conducted to measure the efficacy of acupuncture as a treatment modality for migraine. Consequently, future research should look at the possibility of conducting large scale studies. The acupuncture interventions were unable to identify a central checklist that can be replicated at other acupuncture treatment centers. This can be evidently seen by the lack of standardization and acupuncture doses. The lack of standardizations of the acupuncture interventions and varying dosages of the acupuncture treatment should also be considered when interpreting the efficacy of the acupuncture intervention. The wide variability in duration of sessions range from 2.5 weeks to 20 weeks. The wide variability of intervention dosages also ranged from 5 sessions to 32 sessions with the least session lasting for 30 minutes in two studies and 15 minutes in one study. The 30 minutes intervention from China and Iran successfully demonstrated that acupuncture is an effective mode of treatment for migraine. The 15 minutes intervention was conducted in U.S.A. with adolescents. However, the long-term efficacy of acupuncture treatment remains questionable. Out of 23 studies, 3 studies used 10 sessions of acupuncture to reduce migraine attacks and 2 comparison studies delivered acupuncture treatment for 4 weeks, 5 times per week with each lasting for 30 minutes. The field of acupuncture should develop a checklist of essential elements and feasible dosages that can be replicated.

The fourth and final question this review examined was the following: 'What common outcome measures were identified, and which can be inferred as important outcome

measure/s for future studies?’ Studies used both psychological and physiological studies, however psychological measures were commonly used and reported by all, except one study that reported only the statistically significant difference ($P < 0.05$) found in serum nitric oxide levels between migraine patients’ group and the control (healthy) group. The most common outcome measure was the pain intensity and severity scale which was used in 22 studies except one study that only measured the number of headache attacks in each month. The Visual Analogue Scale (VAS) was reportedly used by 16 studies and should be considered as a relatively effective migraine pain measurement scale. Future studies can consider physiological measures including functional Magnetic Resonance Imaging (fMRI) to measure brain functional connectivity and blood samples to measure matrix metalloproteinase (MMP-2) and Nitric oxide (NO) to report changes before and after acupuncture treatment intervention.

Study limitations

This scoping review had several limitations. The studies included in this review had varied dosage of acupuncture and different types of acupuncture treatments which resulted in inconclusive evidence to support a dosage protocol. Thus, we were unable to synthesize the dosage and type of treatment used in one review. Some studies also utilized non-randomized control designs, consequently the review was unable to eliminate treatment bias in treatment assignment. The small sample sizes reduced the chances of the inferential

statistics to generalize from a sample to a population. The different outcome measures identified in various studies resulted in the insufficient data to provide definite support for a given study or outcome measurement among studies. There was a lack of behavioral theory-based approaches in promoting acupuncture as a treatment modality. The use of few principles in parsimonious theories in future studies will explain how acupuncture serves as a promising scientific modality for treating acupuncture

CONCLUSION

Migraine is of public health importance since it is associated significant disability, reduced quality of life, psychological distress, and substantial health care costs. Medications and behavioral interventions have been commonly used as a two-way approach for relieving the symptoms or preventing the occurrence of attacks. A total 23 interventions from 2013 to 2019 looked at acupuncture and its efficacy in alleviating migraine headaches. All 23 interventions were able to find positive effects in physiological and/or psychological outcome measures related to migraine. Despite the limitations posed by studies, the present evidence indicates that acupuncture provides relief and improves quality of life among migraine patients and has a role as an adjuvant to conventional drug therapy in treatment of migraine in migraineurs with or without aura. All practitioners that encounter migraineurs should encourage acupuncture treatment as one of the approaches to reduce migraine headache attacks.

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