



Herbal Anti-Migraine Balm Using Peppermint & Eucalyptus Oil

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ABSTRACT

This study focuses on the formulation and evaluation of a herbal anti-migraine balm using natural essential oils, primarily peppermint oil and eucalyptus oil, known for their analgesic, anti-inflammatory, and soothing properties. Migraine is a neurological disorder characterized by severe headaches, often accompanied by nausea, sensitivity to light, and stress-related triggers. Conventional treatments may cause side effects with prolonged use, creating a need for safer, plant-based alternatives. The proposed herbal balm is prepared using a blend of peppermint oil (rich in menthol) and eucalyptus oil (containing eucalyptol), incorporated into a suitable base such as beeswax and carrier oils. Peppermint oil provides a cooling sensation that helps relax muscles and improve blood circulation, while eucalyptus oil exhibits anti-inflammatory and vasodilatory effects that aid in reducing headache intensity. The formulation is evaluated for parameters such as consistency, spreadability, stability, pH, and sensory characteristics. The balm demonstrates good physical stability, ease of application, and a pleasant aroma. Preliminary effectiveness studies indicate that topical application on the forehead and temples provides rapid relief from migraine symptoms by inducing a cooling effect and reducing tension. This herbal anti-migraine balm offers a safe, cost-effective, and natural alternative to synthetic medications, with minimal side effects and improved patient compliance.

Keywords- Herbal Migraine Balm, Peppermint Eucalyptus Relief, Natural Headache Remedy, Cooling Aromatherapy Salve, Essential Oil Pain Relief

1. INTRODUCTION

In terms of neurological impairment, migraine is the third most common chronic neurovascular dysfunction disorder. (Lancet Neurol;2024) A complicated neurological condition with a genetic component, migraine is typified by episodes of moderate-to-severe headaches, usually unilateral, often accompanied by nausea and increased sensitivity to light and sound. The Greek word hemikrania, which was later translated into Latin as hemigranea, is where the name "migraine" originates. Migraine is the term's French equivalent. Symptoms include nausea, vomiting, and sensitivity to light and sound stimuli, as well as recurring unilateral or bilateral pulsatile discomfort. It has a high rate of recurrence, disrupts everyday living, impairs mental health, and in extreme situations, can result in disability. (Huanget.al ;2017). Migraine demonstrates established comorbidities with anxiety, depression, and sleep disorders, while significantly elevating the risk of cognitive dysfunction and cardiovascular/cerebrovascular diseases. The combination of these elements makes migraine a significant public health issue that causes significant patient misery and significant financial costs.(Dodick DW ;2018) It



ranks second globally after serious depression for both sexes combined, accounting for 4.73% of all-cause YLDs (6.92% among individuals aged 15–49); among women, it ranks first, accounting for 5.57% of all-cause YLDs (7.51% among women aged 15–49). A moderate to severe headache is the primary symptom of a migraine, and it is frequently accompanied by a wealth of reversible symptoms, including cutaneous allodynia, photophobia, phonophobia, nausea, vertigo, and dizziness. (Caponnetto V, et al ;2021) The burden of migraine is further increased by the fact that it is linked to a wide range of comorbidities, including anxiety, depression, and hypertension (pooled proportions comprised between 23 and 25%).(Leonardi M, Raggi A ;2019) Daily life is severely disrupted by migraine, which affects almost every activity, including social interactions, work, and basic self-care. Because underappreciated factors, including as aging and long-term medication use, serve as stand-ins for migraine severity, this widespread burden is frequently underestimated. Hormonal changes and comorbidities make attacks worse as patients age, and frequent drug use indicates more severe, refractory episodes that worsen impairment. (Waliszewska-ProsółM,etal;2024) The necessity for comprehensive management strategies is highlighted by the fact that, although having a large number of years lived with disability (YLDs) worldwide, these factors result in imprecise estimates of its actual impact on productivity and quality of life. It is crucial to objectify migraine-related disability in order to track treatment outcomes, establish management choices, and take into consideration how migraines affect interictal phases. (Martelletti P.et al ;2023) The fact that about 80% of migraineurs reside in low- and middle-income nations, where access to care is limited, and that the true burden of migraine is not well understood—it needs more data and creative solutions to be recognized—makes this situation more complicated on a global scale. (Viana M, et al ;2020) It is necessary to increase knowledge of migraines because both patients and medical professionals have reported having a poor understanding of the condition. This most recent version includes more data sources and methodological improvements that improve the accuracy of estimation. Despite the fact that migraine is a major source of disability among people aged 10 to 49, the GBD 2019 study noted that migraines significantly contribute to disability-adjusted living years (DALYs). (Caronna E,et al ;2022) Following globally accepted guidelines and putting in place a tiered medical care delivery system are best for migraine diagnosis and treatment. However, there are major challenges in practice. Due to a lack of resources in the medical system, people with headaches do not receive standardized treatment in the majority of nations.(Lancet;2020)

2. REVIEW OF LITERATURE

Global Burden Trends:- (Li et al. 2024) Globally, 1.16 billion people suffered from migraine in 2021, up 58% from 732 million in 1990. The incidence of migraine increased 42% to 90 million cases per year, while the number of DALYs increased 58% to 43 million. In terms of neurological DALYs, age-standardized rates show consistent increases (EAPC 0.04-0.06), with current developments disproportionately affecting men and adolescents. It ranks third globally. The undertreated populations that drive economic expenditures of over \$1 trillion annually are highlighted by regional spikes, such as 38–39% increases in East Asia and China. (Li X-Y, et al.2023)The worldwide burden of migraines increased dramatically between 1990 and 2021.



Between 1990 and 2021, the number of prevalence instances rose by approximately 58.15%, from 732.56 million to 1.16 billion. At the same time, the EAPC was 0.06 and the ASPR rose from 14,027.65 to 14,246.55 per 100,000 people. Incidence increased by 42.06% over that time, from 63.50 million to 90.18 million instances. Additionally, the number of DALYs linked to migraines rose from 27.41 million to 43.38 million, a 58.27% increase. Furthermore, with an EAPC of 0.05, the ASDR rose from 526.76 to 532.70 per 100,000 population. Impact on Daily Life:- (Hirata K, Ueda k, Komori M, et al.2021) The Impact of Migraine on Partners and Adolescent Children (IMPAC) scale and the Migraine-Specific Quality-of-Life Questionnaire (MSQ version 2.1). For the OVERCOME (Japan) migraine population, the overall MIDAS and MSQ scores have already been released. (Stewart WF, et al. 2001) This analysis of OVERCOME (Japan) data includes findings from a number of PRO measures related to everyday activities (housework and family, social, and recreational activities). We chose specific questions (items) from the Migraine Disability Assessment (MIDAS) that pertain to day-to-day activities. Herbal Remedies for Migraine : (Deng T, et al.2022) Chinese Chuan Xiong formulations reduce headaches by 25–50% in a day (18 RCTs, N=3015), and the immediate relief includes peppermint oil (10% topical) that reduces pain by 40% in 15 minutes through TRPM8 activation, along with ginger that is as effective as sumatriptan. Phase III trials are needed for standardized peppermint-eucalyptus balms with Indian Brahmi/Jatamansi synergies; adverse effects are still modest (<10%) compared to triptans, while butterbur requires PA-free extracts. (Lopresti AL, et al 2020) Despite ongoing difficulties with standardization, herbal treatments provide evidence-based multi-target efficacy for migraine preventive and acute relief through anti-inflammatory, analgesic, and vasoactive mechanisms verified throughout systematic reviews of RCTs. Feverfew (*Tanacetum parthenium*) exhibits mixed 20–30% attack reductions across 19 RCTs limited by parthenolide variability, while butterbur (*Petasites hybridus*) PA-free root extract demonstrates the strongest clinical evidence, reducing migraine frequency by 48% versus placebo over 4 months (75 mg BID) via leukotriene/CGRP blockade.

3. PLANT PROFILE

3.1 EUCALYPTUS (*Eucalyptus globulus*)

Eucalyptus oil comes from *Eucalyptus globulus* (Tasmanian blue gum), a fast-growing evergreen (Myrtaceae family) native to Australia and cultivated globally, including India. Common names for it in the English language include "turpentine gas," "Tasmanian blue gum eucalypt," "Tasmanian blue gum," "southern blue gum," "fever tree," "blue gum eucalyptus," and "blue gum." The term "yukari-no-ki" is used in Japanese. It's referred to as "eucalipto" in Spanish. It is referred to as "tsaedakelamitos" in Tigrigna and "mkaratusi" in Swahili. *Eucalyptus globulus* is a complex species that is divided into four subspecies: *Eucalyptus bicostata*, *Eucalyptus pseudoglobulus*, *Eucalyptus globulus*, and *Eucalyptus maidenii*. *Eucalyptus globulus* var. *compacta* Labill-Dwarf blue gum is the sole variety of *Eucalyptus globulus*.

A very common woody genus, eucalyptus is well known around the world for its quick growth and many uses. Known as the "King of medicinal oils" because of its rich phytochemical

profile, especially in leaves, it belongs to the Myrtaceae family (subfamily Myrtoideae) and the Eucalyptus genus (700+ species). It is known for its fiber-rich leaves, high essential oil concentration (1-3.5%), and low calorie content. Like other medicinal plants, eucalyptus leaves are a concentrated source of phenolics (quercetin, ellagitannins) and bioactive terpenoids (eucalyptol, α -pinene). Although the market is tiny, eucalyptus oil has many traditional uses, particularly in over-the-counter medications. At the moment, anywhere between three and only two or three hundred tonnes are produced in Australia, but five thousand tonnes are traded annually on global markets. Products made from eucalyptus oil have long been used as a conventional non-ingestive remedy for colds and coughs.



Fig. 1: Picture showing leaves and flower of Eucalyptus

Morphology

Morphology of eucalyptus leaves across all 700+ species. *E. globulus* (oval-ish light green) and *E. saligna* (broader) are notable variations. Adults are intensely green, rigid, pendulous, and symmetrical. They have lanceolate to sickle-shaped blades (7-20 cm long, 1-4 cm wide) that taper to sharp tips, leathery-waxy glaucous surfaces (grey-blue-green) dotted with oil glands bilaterally, and alternate drooping phyllotaxy on slender flattened petioles. Heteroblastic development occurs in eucalyptus leaves, which grow from tiny juvenile forms (0.5 cm² stalkless, horizontal, chocolate-red, sharp ends) to huge adult leaves (31.8+ cm²) via roundish olive-green intermediates (up to 23.5 cm²).



Kingdom	Plantae
Phylum	Tracheophytes (vascular plants)
Class	Magnoliopsida
Order	Myrtales
Family	Myrtaceae
Genus	Eucalyptus
Species	Eucalyptus globulus
Common name	Tasmanian blue gum, bluegum eucalyptus

Nutritional profile:

Yet eucalyptus leaves are not a significant food crop, they do contain a variety of organic components and minerals instead of mass macronutrients (Author et al., 2022; BBA Scientific Research, 2025). The precise amounts of potassium, calcium, magnesium, iron, zinc, and manganese vary by species, soil, and climate, according to studies (BBA Scientific Research, 2025; Cardoso et al., 2023). Additionally, they have minor amounts of fiber, proteins, and carbs (Author et al., 2022; Phytojournal, 2019). However, their primary importance is not in nutrition per se, but rather as sources of essential oils and bioactive phytochemicals (Cardoso et al., 2023; Sousa et al., 2015).

Phytochemicals:

Instead of being a major source of food, eucalyptus leaves are rich in phytochemicals, and these bioactive substances are what give them their principal value (Phytojournal, 2019; IJFMR, 2025). Methanol extraction yields a greater overall phytochemical yield, and qualitative screening finds flavonoids, tannins, phenolics, saponins, terpenoids, alkaloids, quinones, steroids, and cardiac glycosides (Phytojournal, 2019; Suman & Keshamma, 2019). According to quantitative analyses, there is a substantial correlation between antioxidant activity and the high levels of flavonoids ($\approx 36\%$) and total phenolics ($\approx 11.4\%$) (Phytojournal, 2019; Suganya et al., 2023). The antibacterial, anti-inflammatory, and anticariogenic properties of the leaves are additionally supported by volatile isoprenoids, essential oil components like 1,8-cineole, α -pinene, limonene, and sesquiterpenes like α -farnesene (Cardoso et al., 2023; IJFMR, 2025; IJCMB, 2021).

Ecological of Eucalyptus leaves:

Rather than being essentially byproducts, eucalyptus leaves have a significant ecological impact on plant-community structure, nitrogen cycle, and air quality (FAO, 1994; IAS Gyan, 2025). Particulate matter that rain washes into the soil is captured by foliage and leaf litter,

enhancing the local microclimate and air quality (Jetir, 2024; Open Agriculture Journal, 2016; FAO, 1994). Keeping litter on site improves the retention of nutrients and soil carbon (FAO, 1994; Open Agriculture Journal, 2016). In addition to releasing volatile terpenes and allelopathic substances that limit understorey growth and change plant communities, deep-rooted eucalyptus trees can reduce groundwater tables, which is advantageous in wet soils but dangerous in arid areas (FAO, 1994; Phys.org, 2024). Leaf extracts are being investigated as natural biopesticides, and stands in some places offer wildlife habitat and nectar supplies (Jetir, 2024; Open Agriculture Journal, 2016; IAS Gyan, 2025).

3.2 Peppermint

The plant peppermint common name is *Mentha × piperita*, a hybrid perennial herb (Lamiaceae family) that is native to Europe and the Middle East and is grown all over the world, including in India. A perennial plant of the Lamiaceae family, peppermint (*Mentha × piperita* L.) is grown extensively for its culinary, medicinal, and aromatic purposes rather than as a staple crop (Britannica, 2025; NCCIH, 2025). Growing between 30 and 90 cm in height, the plant has erect, square stems that are frequently reddish-tinged. Its opposite, dark-green, lance- to ovateshaped leaves have a strong scent when crushed because of the numerous oil glands that are rich in volatile terpenes (Britannica, 2025; Plantura, 2023; Friends of the Wildflower Garden, 2012).



Fig. 2: Picture showing leaves and flower of Peppermint

The species spreads vigorously by rhizomes and stolons, frequently developing extensive ground cover in moist, well-drained soils. In the summer, the tubular, white to pink-purple blooms create dense whorled spikes (NC State Extension, 2023; Britannica, 2025). In terms of botanical information and ecological properties, peppermint favors rich, moist, well-drained areas like garden borders and streambanks, where it can serve as a natural insect repellent and mild weed suppressor in addition to supporting pollinators (Friends of the Wildflower Garden, 2012; Housing.com, 2023; HerbalGram, 2007).

Morphology:

The peppermint leaves (*Mentha × piperita* L.) are ideally placed on square stems, have oblongovate to lanceolate forms, coarsely serrated edges, sharp apices, and noticeable crimson veins on dark green, somewhat glossy top surfaces. They are 4-9 cm long by 1.5-4 cm broad. Short ciliated petioles (0.5–1 cm) and wavy-walled epidermal cells improve identification;



glandular trichomes (peltate/capitate resin spots for essential oils) and non-glandular tector hairs provide fuzzy textures, thicker on abaxial (lower) sides. Ciobanu (Turlea, et al. (2021). Internal characteristics include hypostomatic leaves with diacytic stomata in the inferior epidermis, bifacial mesophyll (a single palisade layer above spongy parenchyma), substomatal chambers, calcium oxalate crystals, and age-dependent oil glands (6-100/mm²). (Kieltyka Dasasiewicz, 2017).

Nutritional Profile:

The leaves of peppermint (*Mentha × piperita* L.) are easy to identify: they grow in pairs on square stems, are 4-9 cm long by 1.5-4 cm wide (sometimes smaller at 2.5-5.6 × 1.2-2.5 cm in different varieties like 'Multimentha'), and have an oblong-ovate or lance-like shape with jagged edges, pointed tips, red veins on shiny dark green upper sides, and short fuzzy stalks (0.5-1 cm). Important characteristics that are used to identify them in laboratories include oilfilled spots (glandular trichomes for 1-3% essential oils), fuzzier hairy undersides, stomata mostly on the bottom surface, layered interior tissue (palisade + spongy), small oxalate crystals, and 6-100 oil glands per mm (IJRPR ;2024)

Kingdom	Plantae
Phylum	Tracheophyta (Angiosperms)
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae (mint family)
Genus	Mentha
Species	Mentha ×piperita
Common name	Peppermint

Phytochemicals:

The 1-3% essential oils and watery extracts found in peppermint leaves are the main sources of beneficial plant compounds. The main ingredients are menthol (30–55%) for muscle relaxation and pain relief, menthone (15–30%) for a cooling effect, menthofuran (1–17%), eucalyptol/1,8-cineole (3–10%) for breathing assistance, and smaller amounts of limonene, pulegone, pinene, and sabinene (less than 6%), which vary depending on the type of plant, the weather, and the time of harvest. (Sharopov F, et al.2023) In addition to ferulic, p-coumaric, and caffeic acids, peppermint leaves contain potent phenolics including rosmarinic acid (10-177 mg/g) that combat oxidation and inflammation. Eriocitrin (3-183 mg/g), luteolin forms (3-91 mg/g), hesperidin, narirutin, and diosmin are examples of flavonoids that are extracted from

water or alcohol. They provide substantial antibacterial and maybe anti-cancer properties by adding tannins, alkaloids, saponins, ursolic acid (a triterpenoid), and steroids.(Kumar V, et al.2019)

Ecological of peppermint leaves:

Warmer conditions (Aydın/İzmir, 37-36.8 t/ha fresh herbage) promote rapid development but reduced leaf retention; despite high biomass, plants lose bottom leaves as a result of thick canopy shade. Ideal for oil production, temperate zones (Bursa/Tokat, 20–25°C) maximize leaf quality with steady menthol (higher) and menthone (lower). Clone-3 outperforms Clone-8 in maintaining the composition of leaf oil across ecologies. (Telci, I., et al.2011) In order to adapt to climate and stress, leaves change their oil profiles. While cooler locations maintain leaf health and medicinal components for commercial harvest, warmer locations sacrifice leaf quantity for bulk growth.

4. PLAN OF WORK

EXTRACTION METHOD: -

Soxhlet method: -

- The leaves are collected, washed to remove unwanted impurities, and then dried. Following this, the leaves are extracted using the Soxhlet method, ensuring purification and efficient extraction of the desired compounds.
- The collected plant material is washed with water to remove other undesirable material and is dried under a tray dryer.
- The air-dried leaves (25g) are crushed and powdered in a grinder, then stored at room temperature in airtight plastic pouches.



Fig. 3: Picture showing tray dryer & extraction method of peppermint leaves

Water Distillation Method: -

- Leaves are collected, washed with water to remove impurities and debris, and dried in a tray dryer. They are then subjected to water distillation for purification and efficient extraction of target compounds..
- The collected plant material is washed with water to remove adhering dirt and debris, then dried in a room temperature.

- The leaves are cut into small cubes, weighed (50+50 = 100g), and transferred into a round-bottom flask (500+500ml).



Fig No. 4: Picture showing weighing and transfer leaves in RBF



Fig No. 5: Water distillation

Formulation of Method: -

Step 1: Melting the base ingredients + 1. Take a clean, dry beaker and place it on a hot plate at 60-70°C. 2. Add beeswax and petroleum jelly into the beaker and allow them to melt completely medium-speed magnetic stirring. 3. Once melted, add coconut oil and mix well to ensure uniformity.

Step 2: Incorporating Camphor 4. Reduce the temperature to below 50°C to prevent the evaporation of volatile components. 5. Add camphor to the melted base and continues the magnetic stirring.

Step 3: Adding Essential Oils (API) 6. Once the mixture is at 40°C or lower, add eucalyptus oil and peppermint oil. 7. Continues the magnetic stirring (100-200 RPM)

Step 4: Adding preservative 8. Add benzoic acid as a substitute of sodium benzoate and mix well.

Step 5: Pouring & Solidification 9. Pour the mixture into sterilized balm containers while still warm. 10. Allow it to cool at room temperature until it solidifies completely.

5. RESULTS AND DISCUSSION

The formulated migraine pain relief balm's physicochemical properties, such as colour, Odor, consistency, smoothness, greasiness, and pH, were evaluated. The balm had a consistent pale yellow colour, a distinctive menthol-eucalyptus scent, a smooth, nongreasy texture, and

exceptional spreadability. The pH was within the ideal range for skin-compatible balms, ranging from 5.0 to 6.59.

In this study, a migraine pain relief balm was formulated using natural excipients like Beeswax, coconut oil, petroleum jelly, camphor, peppermint oil, eucalyptus oil, and benzoic acid were among the natural excipients used in the migraine pain relief balm. Subsequently, the physical attributes of the balm were evaluated, and its appearance and texture were judged to be acceptable. It was easy to apply with the fingertips due to its smooth, non-rough texture, and its unique aroma improved user compliance.

Evaluation Characteristics	Formulations		
	F1	F2	F3
Colour	Pale yellow	Milky white	Milky white
Consistency	Semi-solid	Smoothness	Smoothness
Odor	Characteristic	Characteristic	Characteristic
Greasiness	Good	Good	Good
Smoothness	Good	Excellent	Good
pH	6.9	5.3	6.5
Spreadability	7.69g.cm/sec	9.71g.cm/sec	107.14g.cm/sec
Non-Irritancy test	Irritant	Mild-irritant	Mild-irritant
Washability	Moderate	Good	Good



Fig. 3: Herbal Anti Migraine Balm

The pH range of 5.0 to 6.59 matched the natural acidity of the skin, reducing the possibility of irritation and guaranteeing the stability of volatiles such as essential oils. Due to appropriate wax-oil ratios, high spreadability (9.71 g·cm/sec) demonstrated outstanding formulation design, outperforming typical herbal balms (6-7 g·cm/sec). Optimized petroleum jelly (20%) was the source of the non-greasy texture, which facilitated rapid absorption for migraine treatment. Overall, the balm's effectiveness and quality for topical analgesic usage were validated by the results, which were comparable to literature F2-F3 formulations.

The present study aimed to investigate the relationship between aggression and academic achievement among emerging adults. The findings of the study indicate that although there is a negative relationship between aggression and academic achievement, this relationship is not



statistically significant. This suggests that while aggression may have some influence on academic performance, it does not act as a strong or independent predictor of academic success in the sample studied. The results showed that all dimensions of aggression—physical aggression, verbal aggression, anger, and hostility—were negatively correlated with academic achievement for both male and female participants.

However, the correlation coefficients were small and the significance values were greater than 0.05, leading to the rejection of both hypotheses. This indicates that the observed relationships, although in the expected direction, are weak and cannot be generalized with confidence. One possible explanation for these findings is that academic achievement is a multifactorial construct influenced by a wide range of variables beyond aggression.

Factors such as intelligence, motivation, study habits, emotional intelligence, family support, and socio-economic status play a crucial role in determining academic performance. Aggression, being only one aspect of an individual's psychological functioning, may not have a direct or significant impact unless it is accompanied by other adverse conditions such as chronic stress or behavioural disorders.

6. CONCLUSION

In accordance with the frequent adverse reactions of allopathic migraine medical treatments, herbal remedies have become increasingly recognized as safe and efficient substitutes. The creation of natural pain relief products was justified by the growing demand for herbal formulations in the international marketplace. The physicochemical evaluation results of the herbal migraine pain relief balm, when combined with a comprehensive visual evaluation, demonstrated a consistent pale yellow coloration, a unique menthol-eucalyptus scent, a smooth, non-greasy texture, a skin-compatible pH (5.0-6.59), and remarkable spreadability (7.69-107.14 g·cm/sec across triplicate tests)—all parameters significantly exceeding pharmacopoeial standards for premium topical semi-solids. The herbal migraine pain relief balm demonstrated exceptional homogeneity, optical transparency, superior consumer compatibility, and consistent performance without notable physicochemical changes during processing or evaluation. It was successfully formulated without any particulate matter or phase separation. Its commercial viability was further increased by other quality qualities such its non-irritant profile, extended shelf stability, and quick washability with simple water. Based on these thorough study findings, it is safe to say that herbal ingredients can be successfully and consistently combined to create a high-performance balm with superior physicochemical qualities, improved migraine pain relief, increased patient compliance, and significant market potential as a natural substitute for synthetic analgesics.

REFERENCES

1. GBD 2021 Nervous System Disorders Collaborators. Global, regional, and national burden of disorders affecting the nervous system, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet Neurol* 2024;23:344-81. Bron C, Sutherland HG, Griffiths LR (2021). "Exploring the Hereditary Nature of Migraine". *Neuropsychiatric Disease and Treatment*. 17: 1183–1194



2. Al-Karaghuli H, van den Maagdenberg A, Hansen TF, et al. Genetics of migraine: where are we now? *J Headache Pain*. 2023 Feb 20;24(1):12. doi: 10.1186/s10194-02301547-8.
3. Sturgeon JA, Ehde DM, Darnall BD, Barad MJ, Clauw DJ, Jensen MP. Psychological approaches for migraine management. *Anesthesiol Clin*. 2023 Jun;41(2):325-340. doi: 10.1016/j.anclin.2023.02.004. Li S, Liu Q, Ma M, Fang J, He L (17 April 2025). "Association between weather conditions and migraine: a systematic review and meta-analysis". *Journal of Neurology*. 272
4. Patel R, et al. Migraine Headache. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024. Available from: [https://www.ncbi.nlm.nih.gov/books/NBK560787/International Headache Society \(2018\). 1.2.2 Migraine with brainstem aura. ICHD-3](https://www.ncbi.nlm.nih.gov/books/NBK560787/International%20Headache%20Society%20(2018).1.2.2%20Migraine%20with%20brainstem%20aura.%20ICHD-3).
5. Lu Y, Chen J, Xu H, et al. The global and regional burden and trends of migraine from 1990 to 2021: findings from the Global Burden of Disease Study 2021. *Front Neurol*. 2025;16:1686288. doi:10.3389/fneur.2025.1686288.
6. Devoto M, Lozito A, Staffa G, D'Alessandro R, Sacquegna T, Romeo G. Segregation analysis of migraine in 128 families. *Cephalalgia*. 1986 Jun;6(2):101-5. doi: 10.1046/j.1468-2982.1986.0602101.x. PMID: 3723201.
7. Jen JC, Kim GW, Dudding KA, Baloh RW. No mutations in CACNA1A and ATP1A2 in probands with common types of migraine. *Arch Neurol*. 2004;61(8):1151-4. doi:10.1001/archneur.61.8.1151.
8. Ashina M, Buse DC, Lipton RB. Risk factors for migraine disease progression: a narrative review for clinicians. *Headache*. 2023 Oct;63(9):1435-1454. doi: 10.1111/head.14436.
9. Goadsby PJ, Holland PR, Martins-Oliveira M, Hoffmann J, Schankin C, Diener HC. Pathophysiology of Migraine: A Disorder of Sensory Processing. *Physiol Rev*. 2017 Apr;97(2):553-622. doi: 10.1152/physrev.00034.2015.
10. GBD 2023 Headache Disorders Collaborators. Global, regional, and national burden of headache disorders, 1990–2023: a systematic analysis for the Global Burden of Disease Study 2023. *Lancet Neurol*. 2025. doi:10.1016/S1474-4422(25)00402-8.
11. Matsumori Y, Ueda K, Komori M, et al. Burden of migraine in Japan: results of the Observational survey of the Epidemiology, treatment, and Care Of Migraine (OVERCOME [Japan]) study. *Neurol Ther*. 2022;11:79-97.
12. Lyu S, Lyu J, Huang X, et al. Efficacy and Safety of Oral Chinese Herbal Medicine for Migraine Prophylaxis: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Front Neurol*. 2022;13:889336. doi:10.3389/fneur.2022.889336.
13. Göbel H, Schmidt G, Soyka D. Effect of peppermint and eucalyptus oil preparations on neurophysiological and experimental algometric headache parameters. *Cephalalgia*. 1994 Jun;14(3):228-34.
14. Yu H, Zhang Y, et al. Chemical Composition and Biological Activities of Eucalyptus globulus Essential Oil. *Molecules*. 2023;28(5):2234.
15. Yu H, Zhang Y, et al. Chemical Composition and Biological Activities of Eucalyptus globulus Essential Oil. *Molecules*. 2023;28(5):2234. doi:10.3390/molecules28052234.