**Abstract**:

Background: Given the safety concerns regarding pharmacological agents, and the considerable impact of headache and migraine on the sufferer’s quality of life, many people seek other treatment options beyond conventional medication and care to address their symptoms; this includes complementary and alternative medicine (CAM). Some CAM interventions have shown promising results in clinical trials of headache and migraine management. Nonetheless, there has been little research exploring the reasons for using CAM, and the types of CAM used, among this population.

Objective: The study aimed to answer the following questions: 1) Which CAM modalities are used most frequently among migraine/headache sufferers?; and 2) What are the self-reported reasons for CAM use among migraine/headache sufferers?

Methods: This secondary analysis of data from the 2012 U.S. NHIS (a national cross-sectional survey) examined the use of CAM among migraine/headache sufferers, including the main reasons related to CAM use. Data were weighted and analyzed using STATA 14.0.

Results: The sample of 34,525 adults included 6,558 (18.7%) headache/migraine sufferers. Of the headache/migraine sufferers, a substantial proportion (37.6%, n=2,427) used CAM for various conditions; however, CAM use specifically for headache/migraine was much less prevalent (3.3%, n=216). Of those who used CAM for headache/migraine, about half used CAM in conjunction with prescription (47.8%, n=100) or over-the-counter medication (55.1%, n=113). As severity of headache/migraine increased so did the likelihood of using CAM (severe migraine odds ratio [OR]=2.32; 95% confidence interval [CI]: 1.41, 3.82; both recurring headache/severe migraine OR=3.36; 95% CI: 2.08, 5.43; when compared to those with recurring headache only). The most frequently used CAM modality among all headache sufferers (N=6,558) was manipulative therapy (22.0%, n=1,317), herbal supplementation (21.7%, n=1,389) and mind-body therapy (17.9%, n=1,100). The top three reasons for using CAM for headache were general wellness (28.7%, n=60/209), improving overall health (26.8%, n=56/209), and reducing stress (16.7%, n=35/209).

Conclusions: Although CAM is used by many sufferers of headache/migraine, the use of CAM specifically for the treatment of headache/migraine is relatively low in the United States. The study also assesses the key differences of CAM use among headache/migraine sufferers in NHIS 2012 compared with those in NHIS 2007, and identifies shortfalls in the evidence-base of several CAM modalities used by U.S. adults for headache/migraine. This information may assist health providers and consumers in making informed decisions about the safest and most appropriate approach to managing headache/migraine.

**Introduction**

Migraine and other recurrent headache disorders are a common and major public health problem. Headache disorders are one of the most common neurological disorders, with a general prevalence of approximately 50% among adults globally. 1 The lifetime prevalence of migraine is 14%, reaching 46% for tension type headache.2 According to the 2012 National Health Interview Survey (NHIS), 13.8% of U.S. adults aged 18 years or older reported having migraine or severe headache in the previous three months. 3

Migraine and headache disorders are prominent causes of personal suffering and decreased economic productivity. The burden of the disorder is substantial because of the high prevalence, accompanying significant disability, and risk for other comorbidities. Headache is among the top twenty reasons for outpatient medical visits and the top five reasons for Emergency Room visits in the U.S. 4 In addition, over 12 million office visits for migraine occurred in 2009 in the U.S., and over six million prescriptions were issued for antimigraine drugs, indicating that roughly half of all outpatient visits for headache result in the prescription of an antimigraine agent. 4

Pharmacological agents constitute an important part of conventional medical management of headache and migraine.5,6 While many patients report benefits from these treatments, pharmacological therapy does not work for all patients, with many failing to achieve optimal control of the disorder or experiencing undesirable side effects from the use of these pharmacological interventions. 5 For instance, amitriptyline - one of the most widely used preventive antimigraine agents - is associated with several unpleasant side effects ranging from drowsiness, dry mouth, constipation, and weight gain, to precipitation of cardiac arrhythmias, seizures, or exacerbation of closed-angle glaucoma. 5 While many patients may turn to over-the-counter (OTC) conventional medications such as acetaminophen for the relief of symptoms, prolonged or frequent use of such OTC medication is not recommended by the American Headache Society due to concerns regarding long-term use,7 including the increased risk of liver damage and gastrointestinal bleeding.8,9

Given the safety concerns around these pharmacological agents, and the considerable impact of headache and migraine on the sufferer’s quality of life,10 it is not surprising that many people seek other treatment options beyond conventional medication and care to address their symptoms; options that include complementary and alternative medicine (CAM). Some CAM interventions, including acupuncture,11,12 mind-body therapies, 13 and spinal manipulation,14,15 have shown promising results in clinical trials of headache and migraine management.16,17

The findings of one review point to a high prevalence of CAM use concurrent to conventional medicine treatment among people with headache and migraine;18 notwithstanding, there has been little research on the reasons for using CAM, and the types of CAM used, among this population. While an earlier analysis of 2007 NHIS data attempted to shed some light on these parameters,19 this data is now over nine years old; further, the study reported CAM use for those who had headache/migraine within a relatively short period of CAM use (i.e. previous three months). As such, there remains a gap in the contemporary understanding of CAM use for headache and migraine as well as the prevalence of CAM use among those who reported having headache/migraine over a more extended time period. The study reported in this paper addresses these gaps by analyzing 2012 NHIS data to describe CAM use among all migraine/headache sufferers in the previous three and twelve months, as well as examining the characteristics and factors related to CAM use. The objectives of this study were to: 1) describe the CAM modalities that are used most frequently among migraine/headache sufferers; and 2) explore the self-reported reasons for CAM use for migraine/headache sufferers.

**Methods**

**Study design:** This study is asecondary analysis of 2012 U.S. National Health Interview Survey (NHIS) data. As the study used publicly available data that were not individually identifiable, and it did not actively recruit human subjects, it was exempt from institutional review board review and approval.

**Data Source:** The NHIS is a cross-sectional survey conducted annually by the U.S. National Center for Health Statistics (NCHS) and the U.S. Centers for Disease Control (CDC) that gathers health-related data on the civilian, non-institutionalized U.S. population. The survey uses a complex, multi-stage sampling design and oversamples minorities to achieve population representation. The 2012 survey includes 34,525 U.S. adults with a conditional response rate of 79.7%. 20 Every five years, the survey includes questions about CAM use. The 2012 CAM supplement serially asked participants whether they saw a practitioner for, or used, a given CAM modality within the past 12 months. Respondents were asked to rank the top three CAM modalities they used and to state whether they used these modalities to address one or more symptoms or health conditions. For each of the top three CAM modalities, the survey also asked about disclosure to healthcare providers, use of medical treatments, sources of information about CAM, and the reasons, motivations, outcomes, and perceived helpfulness of CAM use.

**Measures:**

*Headache conditions*: the respondents were asked two questions regarding headache/migraine: 1) have you had recurring headaches in the past 12 months (yes/no); and 2) have you had severe headache/migraine in the past three months (yes/no). Those who responded yes to either of these questions were defined as headache/migraine sufferers. Headache sufferers were then divided into three groups: having recurring headache in the past 12 months, having severe headache/migraine in the past 3 months, and having both aforementioned conditions.

*CAM use:* CAM use was defined as a positive response to use of any of the listed CAM modalities within the past 12 months. CAM modalities were categorized into one of six groups:21 (1) herbs and non-vitamin non-mineral supplements; (2) manipulative therapies (chiropractic, osteopathic manipulation, massage, craniosacral therapy); (3) mind body therapies (hypnosis, biofeedback, meditation, imagery, progressive relaxation, and mind body exercise [yoga, tai chi, qi gong]); (4) special diets (vegetarian or vegan, macrobiotic, Atkins, Pritikin, Ornish, or saw a practitioner for dietary counseling); (5) movement therapies (Feldenkrais, Alexander technique, Pilates, Trager psychological integration); and (6) other practitioner-based CAM modalities (acupuncture, ayurveda, chelation, energy healing, homeopathy, naturopathy, traditional healers). CAM modality use was estimated conservatively, such that those who selected “Refused,” “Not ascertained,” and “Don’t know” were recoded as missing for a given modality; thus, coding only reflected those who had confirmed use or non-use of a modality.

*Characteristics of CAM use*: The most important reasons for CAM use were assessed. Also assessed was concomitant use of prescription medication or over-the-counter medication for headache/migraine. These variables were only captured for the top three therapies deemed by the respondent to be most important to their health.

Most important reasons for using the top three CAM therapies is a categorical variable, which asked respondents to select the most important reasons from a list of general reasons for CAM use, motivated behavior changes and outcomes after CAM use. The general reasons for CAM use included: general wellness or general disease prevention; improving energy; improving immune function; improving athletic or sports performance; or improving memory or concentration. The motivations for changing health behaviors after CAM use included: eating healthier; eating more organic foods; cutting back/stop drinking alcohol; cutting back/stop smoking cigarettes; and exercising more regularly. The outcomes following CAM use included: sense of control over one's health; reduced stress level or relaxation; better sleep; feeling better emotionally; easier to cope with health problems; improved overall health and feeling better; improved relationships with others; and improved attendance at job or school.

*Socio-demographic characteristics*: The sociodemographic characteristics examined included sex, age, ethnicity, region of residence, highest educational qualification, marital status, annual household income, and health insurance status.

*Health-related characteristics*: These variables included perceived health status, comorbidities (see below), body mass index (BMI), and health risk behaviors (i.e. smoking and alcohol use). For comorbidity, we adopted the scoring method used by Dosset,21 in which each respondent was assigned a point for heart disease (coronary heart disease, ever had a heart attack, other heart condition), hypertension, pulmonary disease (emphysema, chronic obstructive pulmonary disease, asthma, or chronic bronchitis), mental health concern in the last 12 months (depression, anxiety, other mental health disorder), neurological issues (memory loss, stroke, other neurological problem), weak/failing kidneys, or ever diagnosed with cancer, diabetes, or arthritis. The sum of these scores was used to generate a comorbidity score, with possible scores ranging from 0 to 10.

**Statistical analyses**: Data were analyzed using STATA 14.0 (StataCorp. 2015. Stata Statistical Software: College Station, TX: StataCorp LP). As the 2012 NHIS used a multistage probability sample design with clustering and stratification, the NHIS Sample Adult Weight was applied using Stata “svy” commands to account for the complex sampling design of the survey and to obtain statistically accurate estimates of percentages of headache and CAM use for the civilian, non-institutionalized U.S. population. Listwise deletion was used in bivariate and multivariate analyses for missing values, including 27 cases, out of the 34,525 cases in the data set, where headache status was not reported. Bivariate tests, including chi-square and Wald tests, were used to detect differences in proportions and means between CAM users and non CAM users as well as among different headache/migraine conditions, respectively. Approximately 1% of the 6,558 headache sufferers were excluded from the logistic regression due to missing values for one or more demographic characteristics. Multivariate logistic regression was used to identify predictors for the use of CAM for headaches among headache and migraine sufferers only. All socio-demographic and health-related characteristics were considered as covariates, however only those predictors that demonstrated statistically significant odds ratios were included in the final model. The significance level was set as p<0.05.

**Results**

The sample of 34,525 adults included 6,558 (18.7%, estimated 43.9 million) headache/migraine sufferers. Among the headache sufferers, 1,713 (26.2%, estimated 11.5 million) had recurring headache in the past 12 months, 2,180 (34.4%, estimated 15.1 million) had severe headache/migraine in the past 3 months, and 2,665 (39.5%, estimated 17.3 million) had both aforementioned conditions. Of the headache/migraine sufferers, 2,428 (37.6%, estimated 16.6 million) had used CAM including 216 (3.3%, estimated 1.5 million) who had used CAM for headache and 2,212 (34.3%, estimated 15.1 million ) for other conditions.

**Socio-Demographic and Health Related Characteristics**

Headache/migraine sufferers vs. Non-headache/migraine sufferers

Table 1 compares the socio-demographic and health-related characteristics of respondents with and without headache/migraine. Headache/migraine sufferers differed significantly from non-headache/migraine sufferers for most socio-demographic variables, with sufferers more frequently being younger, female, employed, not in a relationship, and having a lower annual income. Health characteristics were also significantly different between headache/migraine sufferers and non-headache/migraine sufferers, with the magnitude of the group difference depicted by delta (∆). A higher proportion of headache/migraine sufferers reported being obese (i.e. BMI of 30 kg/m2 and higher, ∆≈6.0%, p<.001), and having poorer health status (poor to fair status, ∆≈12.3%; very good to excellent status, ∆≈-13.9, p<.001) when compared with non-headache/migraine sufferers. Higher proportions of current smokers were reported in the headache/migraine group (23.2%) than in the non-headache/migraine group (16.9%, p<.001). By contrast, only 14.8% of the headache/migraine sufferers were moderate to heavy drinkers compared to 21.8% of non-headache/migraine sufferers (p<.001). On the composite comorbidity score, individuals with headache or migraine had on average 0.59 more comorbid conditions than those not reporting headache or migraine (p<.001).

<insert table 1 here>

CAM use vs. non-CAM use among headache/migraine sufferers

The associations between the socio-demographic and health-related characteristics of headache/migraine sufferers who used CAM versus those who did not use CAM are presented in Table 2. Among all headache/migraine sufferers, CAM use was highest amongst those aged between 30 and 64 years. A significantly greater proportion of CAM users were also female, non-Hispanic White and Asian American, college-educated, employed, partnered, and had a higher annual income. The Midwest and West U.S. exhibited the highest level of CAM use, with the South having the lowest prevalence.

Amongst the headache/migraine sufferers, a higher proportion of CAM users reported normal weight (BMI 18.5 to 24.9 kg/m2) (38.1%) and very good or excellent health status (54.4%) compared to non-CAM users (31.2% and 45.4%, respectively, p<.001). A smaller proportion of current smokers reported CAM use (20.7%) relative to non-CAM use (26.0%); yet, a higher proportion of 'light' and 'moderate or heavy' drinkers reported CAM use than non-CAM use (55.5% vs. 44.4%, and 18.8% vs. 11.4%, respectively). About half of the headache sufferers who used CAM also used conventional drugs (prescription drugs 47.7%, and over-the-counter drugs 55.1%) for headache or migraine.

<Insert Table 2 here>

**CAM use by headache/migraine conditions**

The categories of CAM used by persons with different headache/migraine conditions (no headache/migraine, recurring headache/migraine in the past 12 months, severe headache/migraine in the past three months, and having both recurring and severe headache/migraine) is presented in Table 3. With increasing severity of headache status (from no headache/migraine to having both recurring and severe headache/migraine), the proportion of CAM users increased from 27.8% to 40.2%. Regardless of headache condition, the most frequently used CAM modality for headache amongst all headache sufferers (N=6,558) was manipulative therapy (22.0%, n=1,317), followed by herbal supplementation (21.7%, n=1,389) and mind-body therapy (17.9%, n=1,100).

<Insert Table 3 here>

In addition to the 216 headache/migraine sufferers who used CAM for headache/migraine, 54 non-headache/migraine sufferers also reported having used CAM for headache in the past 12 months. Among those 270 who reported using CAM for headache, over half (51.5%) reported using manipulative therapies, slightly more than one quarter (27.7%) reported using mind body therapies, and over one tenth (11.9%) reported using other practitioner-based CAM therapies. The use of herbal (5.3%), dietary (3.2%), and movement therapies (0.4%) was substantially less prevalent. Due to the small sample size, the above results are deemed unstable and no population estimate was calculated.

Logistic regression revealed that among the headache/migraine sufferers, more severe headache/migraine conditions significantly increased the likelihood of using CAM for headache (severe migraine OR=2.32; 95% CI: 1.41, 3.82; both recurring headache/severe migraine OR=3.36; 95% CI: 2.08, 5.43) when compared to those with headache only. Other predictors of using CAM for headache included being female (OR=2.36; 95% CI: 1.54, 3.63); being aged 30-39 years (OR=2.68; 95% CI: 1.59, 4.52) or 40-49 years (OR=2.15; 95% CI: 1.21, 3.82) relative to being 18-29 years; having a college degree (OR=2.27; 95% CI: 1.38, 3.71), or being employed (OR=1.75; 95% CI: 1.20, 2.54). Hispanic, Black, and Asian respondents had substantially lower odds of using CAM for headache than Whites (OR=0.20; 95% CI: 0.10, 0.40; OR=0.19; 95% CI: 0.09, 0.40; and OR=0.23; 95% CI: 0.13, 0.40, respectively). Current smokers also had 39% lower odds of using CAM for headache than non-smokers (Table 4).

<Insert Table 4 here>

**Most important reasons for using CAM for headache/migraine conditions**

Of the headache/migraine sufferers who used CAM for their condition, 97% (209/216) reported the reason why they used CAM for headache in one of their top three listed CAM modalities. However, the relatively small sample, combined with the 18 possible responses on “reason for CAM use” produced somewhat unstable estimates with sample weighting, and as such, only unweighted percentages were provided for these items. The reported top five reasons for the use of CAM were general wellness (28.7%, n=60/209), improving overall health (26.8%, n=56/209), reducing stress (16.7%, n=35/209), coping with health problems (10.5%, n=22/209) and improving job attendance (2.9%=, n=6/209). All the remaining reasons were much less common (<4%).

**Discussion**

The findings of this analysis are comparable with that reported by Wells and colleagues19, who drew upon 2007 NHIS data; this suggests that headache/migraine sufferers are more likely to use CAM (37%) than those who do not have this condition (27%). At first glance, it appears that CAM use was less prevalent among severe headache/migraine sufferers in the 2012 NHIS (39%) than the 2007 NHIS (49%)19. This discrepancy can be explained by differences in the two surveys; in particular, the way in which deep-breathing exercise was measured. In the 2007 NHIS, the use of deep-breathing exercises was asked as a stand-alone question, but in the 2012 NHIS, the use of deep-breathing exercise was captured as part of other approaches, including hypnosis, biofeedback, meditation, guided imagery, progressive relaxation, yoga, tai chi, and qi gong 23. Whether used independently or as part of other approaches, deep breathing exercises were the second most commonly used CAM approach in 2002 (11.6%), 2007 (12.7%), and 2012 (10.9%)23. With the exclusion of deep breathing exercise data, overall CAM use in the past three months among those who had headache/migraine was found to be similar (i.e. approximately 37%) in the 2007 and 2012 surveys. The two surveys were also comparable in that less than 5% of headache/migraine sufferers reported the use of CAM specifically for headache19. However, non-headache/migraine sufferers reported lower CAM use in 2012 (28.1%) relative to 2007 (33.9%), suggesting overall prevalence of CAM use was down in the 2012 sample.

Our study is one of the two first analyses to draw upon 2012 NHIS data to examine CAM use among headache/migraine sufferers. Our study has assessed all adults with different headache/migraine conditions, while the other study included only those who reported having severe headache or migraine in the past three months 22. With the broader inclusion criteria, our study was able to assess the relationship between CAM use and headache/migraine severity that previous analyses were not able to. For instance, Wells et al only examined CAM use in the past three months among those with headache/migraine19, and Rhee and Harris only include self-reported severe headache/migraine in the past three months19,22. Our study revealed that the greater the severity of headache/migraine, the more likely sufferers would use CAM. By comparison, our study estimated the severity of headache/migraine at three levels: recurring headache in the past 12 months, severe headache/migraine in the past three months and both. Although this distinction may be rough, the relationship between rising severity of headache/migraine and increasing likelihood of CAM use does warrant further investigation. For instance, does the conventional management of chronic pain and headache/migraine (i.e. the predominant focus on physical symptoms)24 fail to address the non-physical symptoms/needs of people with more severe headache, and does this in turn drive people to try CAM treatment instead of and/or in addition to conventional medicine?

A finding that was consistent with previous analyses of NHIS data was the main reason for CAM use among headache/migraine sufferers; that is, general wellness/disease prevention19. Our findings also revealed that headache/migraine sufferers use CAM to improve overall health, improve general wellness, reduce stress, and to cope with health problems. This is consistent with that reported by Rhee and Harris, which suggested that women with migraines/severe headaches may benefit from using CAM for their mental distress 22. Given that stress can exacerbate headache and migraine, and that can in turn impact the physical and emotional/mental aspects of quality of life 25,26, it is possible that headache/migraine sufferers are seeking out options like CAM to regain overall wellness while trying to manage their symptoms. In light of this notion, further examination of the types of CAM predominantly used by headache/migraine sufferers, and the evidence or reasons behind such use, is critical to improving the quality of headache/migraine care.

This study found that manipulative therapy was the most frequently used category of CAM among persons with headache/migraine. Insurance coverage for certain manipulative and body-based therapies such as chiropractic care may account for the higher use of this category as compared with other types of CAM use in the US.27 The emerging evidence-base for these therapies may be a contributing factor also, with studies of moderate quality suggesting that manual therapies, like spinal manipulation, might be effective in reducing cervicogenic headaches28. In addition, a recent systematic review has revealed that existing trials, mostly of good quality, support the effectiveness of manual therapy for chronic tension-type headache, albeit there were no trials on chronic migraine and chronic cluster headache13. At this stage, trials examining the effectiveness of manual therapy for migraine remain limited and of poor quality with conflicting results29. Evaluation of the effectiveness and cost-effectiveness of manual therapies in reducing headache, using sufficiently powered, pragmatic randomized trial designs, should be recognized as a priority for trialists and clinicians.

Although herbal supplements were also popular among headache/migraine sufferers, the evidence of their effectiveness for the treatment of headache/migraine needs to be carefully examined. According to the American Academy of Neurology (AAN) 2012 guideline for migraine prevention, some supplements or herbs, such as MIG-99 (feverfew), magnesium and riboflavin (Vitamin B2), may be effective according to level B (i.e. moderate) evidence30.

Butterbur (*Petasites hybridus*) was reported to be effective for migraine prevention31,32,and recommended by AAN in 2012 with level A (i.e. strong) evidence30. However, doubts and concerns have been increasing about the long-term safety of this supplement given the risk of liver damage35,36.Hence, any recommendations relating to the use of herbal supplements for headache/migraine should be made with caution until further evidence of effectiveness emerges.37,38

By contrast, there is an accumulating evidence-base for the use of mind-body therapies for headache/migraine. The US Headache Consortium Guidelines for prevention of migraine reported Grade A evidence in support of several non-pharmacological interventions, including relaxation training, thermal biofeedback combined with relaxation training, electromyographic (EMG) biofeedback, and cognitive behavioral therapy (CBT).39 However, studies examining the effectiveness of narrowly defined mind-body exercise such as yoga,40 or meditation41-43 for headache are still in their infancy and as such, no conclusions can yet be drawn about the effectiveness of these interventions. As Wells and colleagues pointed out in their review, future research that “adheres to published guideline recommendations and is designed to properly answer key questions is most likely to lead to progress in these goals”44.

Of the less frequently used ‘other’ CAM practitioner-based therapies reported in this analysis, there is a large body of evidence supporting the effectiveness of acupuncture as a treatment for migraine. According to the findings of a 2016 Cochrane review, acupuncture is on par with prophylactic drugs in reducing migraine frequency, and a course of acupuncture consisting of at least six treatment sessions can be a valuable option for people with migraine12, with the notion that difference between true and sham acupuncture is small and overall quality of the evidence is moderate. Cautiously optimistic, acupuncture is considered beneficial and cost-effective in reducing clinical symptoms45. Despite the body of supporting evidence for this therapy, our findings showed that acupuncture use among headache/migraine sufferers in the U.S. was much less prevalent compared to the aforementioned CAM modalities. Future research should focus on exploring the reasons for the low utility of such evidence-based CAM interventions amongst headache/migraine sufferers.

It is worth mentioning that close to half of headache sufferers in this analysis used CAM in conjunction with conventional treatment to manage their headache. This is consistent with prior observations that most CAM therapies are used in conjunction with conventional medical services46-48. Although this finding needs to be interpreted with caution due to the small sample size, it may prompt health care professionals to consider the trend towards the integration of complementary and alternative medicine (CAM) therapies with the practice of conventional medicine49. It may also prompt clinical discussions about the potential for interactions between CAM and conventional interventions.

The level of CAM use varied across different socioeconomic groups. Our study showed that the demographic and socioeconomic characteristics of headache sufferers who used CAM were similar to that of general CAM users23 and were consistent with the most recently reported findings on CAM use among headache/migraine sufferers22; that is, CAM use was more prevalent among middle-aged, college-educated, employed, white, non-smoking women. The analysis also revealed that CAM use was more prevalent among headache sufferers reporting a normal BMI and better self-reported health status. While this might reflect a positive influence of CAM use on health, it could also mean that headache sufferers with worse overall health are less likely to turn to CAM for symptom management. While the findings of this analysis identified some interesting patterns of CAM use for headache, many questions remain unanswered. Rather than seeking a profile of CAM users in general, it is important to understand specific types of CAM use in specific populations.50 Understanding the needs of headache/migraine sufferers, including how and why they choose particular treatment options, will be an important area of future research.

This study has a number of strengths, including a large sample drawn from a representative nationwide survey, and the provision of a detailed analysis of patterns of CAM use among adults self-reporting headache/migraine. Nonetheless, the study is limited by a reliance on cross-sectional self-reported data and as such, it is not possible to know the full extent to which headache drives CAM use or whether other covariates are more important determinants. Moreover, the headache conditions in NHIS were self-diagnosed and self-reported, which may not necessarily yield an accurate estimate of the prevalence of headache/migraine in the U.S. The wording of certain CAM items in the NHIS, particularly the restriction of responses to the top three identified CAM modalities, which often resulted in much smaller sample sizes, also limited the ability to draw stable conclusions about CAM use, as well as underestimating the prevalence of CAM use for headache. The changing definitions of CAM across the different NHIS studies also meant that direct comparisons between NHIS studies were difficult to achieve. Although categorizing certain CAM modalities together increased the power to assess those CAM modalities being used less frequently, it limited our ability to describe the individual CAM modality in detail and to compare our findings with other studies that reported as such. Future work could use qualitative methods and/or longitudinal study designs to explore in more depth the reasons for and predictors of CAM use among people with headache/migraine.

**Conclusions**

This study sheds light on the use of CAM among headache/migraine sufferers in the U.S. and the reasons for such use. It also highlights a number of areas in need of further investigation, including an understanding of why headache/migraine sufferers choose particular treatment options. Although CAM has long been used for the treatment of headache/migraine, the prevalence of such use is relatively low in the United States, particularly for less severe migraine/headache. It is important to note that close to half of headache sufferers in this analysis used CAM in conjunction with conventional treatment. Future research that can lead to a deeper understanding of the comparative effectiveness of different conventional and CAM treatment options may assist health providers and consumers in making informed decisions regarding the safe and effective management of headache/migraine.

**Declarations**

Ethics approval and consent to participate: Not applicable

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available the CDC’s site: 2012 NHIS data release <https://www.cdc.gov/nchs/nhis/nhis_2012_data_release.htm>

Competing interests: The authors declare that they have no competing interests

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Authors' contributions: YZ and JD conceived the study and initiated the data analyses. All authors contributed to the writing of the manuscript. All authors read and approved the final manuscript.

Table 1: Characteristics of adults with and without headache/migraine conditions (N=34,525)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | With headache/Migraine (n=6,558) % | Without Headache/Migraine (n=27,940) % | Chi-Squareb | P-Value |
|
|
|  | Raw frequency count, n | Weighted % | Raw frequency count, n | Weighted % |  |  |
| Socio-Demographic Characteristic |  |  |  |  |  |  |
| Age |  |   |  |   |   |   |
| 18 to 29 | 1,456 | 25.74 | 4,956 | 20.67 | 547.59 | <0.001 |
| 30 to 39 | 1,402 | 20.04 | 4,608 | 16.13 |   |   |
| 40 to 49 | 1,341 | 21.83 | 4,387 | 17.00 |   |   |
| 50 to 64 | 1,634 | 23.47 | 7,340 | 26.35 |   |   |
| 65 or greater | 725 | 8.92 | 6,649 | 19.85 |   |   |
| Gender |   |   |   |   |   |   |
| Male | 1,955 | 32.97 | 13,307 | 51.62 | 731.24 | <0.001 |
| Female | 4,603 | 67.03 | 14,633 | 48.38 |   |   |
| Ethnicity |   |   |   |   |   |   |
| Non-Hispanic White | 3,865 | 66.61 | 16,959 | 67.30 | 26.89 | 0.001 |
| Hispanic | 1,240 | 16.08 | 4,616 | 14.60 |   |   |
| Black | 1,040 | 12.01 | 4,241 | 11.85 |   |   |
| Asian | 323 | 4.29 | 1,841 | 5.49 |   |   |
| Other | 90 | 1.01 | 283 | 0.76 |   |   |
| Region |   |   |   |   |   |   |
| Northeast | 995 | 15.76 | 4,775 | 18.77 | 48.75 | <0.001 |
| Midwest | 1,390 | 24.73 | 5,795 | 22.25 |   |   |
| South | 2,358 | 35.49 | 10,171 | 36.65 |   |   |
| West | 1,815 | 24.02 | 7,199 | 22.34 |   |   |
| Education |   |   |   |   |   |   |
| Less than college | 2,818 | 40.60 | 11,593 | 40.23 | 0.28 | 0.7073 |
| Some college or more | 3,720 | 59.40 | 16,216 | 59.77 |   |   |
| Employment |   |  |   |  |   |   |
| Not employed | 2,925 | 42.49 | 11,472 | 38.33 | 38.17 | <0.001 |
| Employed | 3,627 | 57.51 | 16,400 | 61.67 |   |   |
| Marital status |   |   |   |   |   |   |
| not in relationship | 3,419 | 41.66 | 13,961 | 39.19 | 13.33 | 0.0041 |
| in relationship | 3,132 | 58.34 | 13,908 | 60.81 |   |   |
| Annual Personal Earnings in 2011 ($USD) |   |   |   |   |   |   |
| Up to 19,999 | 1,381 | 37.22 | 4,611 | 29.11 | 125.05 | <0.001 |
| 20,000 to 34,999 | 865 | 22.78 | 3,379 | 21.32 |   |   |
| 35,000 to 54,999 | 672 | 19.12 | 3,313 | 21.89 |   |   |
| 55,000 to 74,999 | 337 | 9.38 | 1,727 | 11.89 |   |   |
| 75,000 and more | 338 | 11.50 | 2,094 | 15.77 |   |   |
| Did not work for pay | 2,472 | 35.36 | 10,031 | 33.20 |  |  |
| Refused/Don't know | 493 | 8.66 | 2,785 | 11.13 |  |  |
| Health Related Characteristics |   |   |   |   |   |   |
| Body Mass Index (BMI, kg/m2) |   |   |   |   |   |   |
| up to 18.49 | 128 | 2.33 | 447 | 1.60 | 131.27 | <0.001 |
| 18.5 to 24.9 | 2,121 | 34.24 | 9,419 | 35.21 |   |   |
| 25-29.9 | 1,877 | 30.05 | 9,592 | 35.88 |   |   |
| 30 and more | 2,164 | 33.37 | 7,406 | 27.30 |   |   |
| Self-reported health status |   |   |   |   |   |   |
| Poor to fair | 1,734 | 22.93 | 3,528 | 10.63 | 785.77 | <0.001 |
| Good | 1,905 | 27.98 | 7,721 | 26.40 |   |   |
| Very good to excellent | 2,910 | 49.09 | 16,683 | 62.97 |   |   |
| Health related behaviors |   |   |   |   |   |   |
| Smoking |   |   |   |   |   |   |
| Non smoking | 3,654 | 57.19 | 16,566 | 60.35 | 147.27 | <0.001 |
| Former smoking | 1,289 | 19.60 | 6,294 | 22.76 |   |   |
| Smoking  | 1,567 | 23.21 | 4,867 | 16.89 |   |   |
| Alcohol consumption |   |   |   |   |   |   |
| Abstainers  | 1,309 | 19.49 | 6,133 | 21.39 | 198.79 | <0.001 |
| Former drinker, abstained last 12 months. | 1,119 | 16.06 | 4,278 | 14.17 |   |   |
| Light  | 3,026 | 49.66 | 11,235 | 42.72 |   |   |
| Moderate to heavy | 969 | 14.79 | 5,704 | 21.72 |   |   |
| Comorbidity scorea (mean) | 6,527 | 1.75 | 27,885 | 1.16 | 358.43(Wald Test) | <0.001 |

aSubjects were given a point for heart disease (coronary heart disease, ever had a heart attack, other heart condition), hypertension, pulmonary disease (emphysema, COPD, asthma, or chronic bronchitis), mental health concern in the last 12 months (depression, anxiety, other mental health disorder), neurological issues (memory loss, stroke, other neurological problem), weak/failing kidneys, or ever diagnosed with cancer, diabetes, or arthritis.

bAll Chi-square values presented are from the svy procedure in STATA that yields higher values than chi square values based on the actual proportions.

Table 2: Characteristics of adults who reported using or not using CAM among headache/migraine sufferers (n= 6,558)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Used CAM(n=2,427)% | Did not use CAM (n=4,131) % | Chi-Squareb | P-Value |
|
|
|  | Raw frequency count, n | Weighted % | Raw frequency count, n | Weighted % |  |  |
| Socio-Demographic Characteristic |  |  |  |  |  |  |
| Age |  |  |  |  |  |  |
| 18 to 29 | 495 | 21.38 | 961 | 28.37 | 257.81 | <0.001 |
| 30 to 39 | 568 | 22.96 | 834 | 18.29 |  |  |
| 40 to 49 | 522 | 22.71 | 819 | 21.30 |  |  |
| 50 to 64 | 620 | 25.76 | 1,014 | 22.08 |  |  |
| 65 or greater | 222 | 7.19 | 503 | 9.97 |  |  |
| Gender |   |   |   |   |  |  |
| Male | 631 | 28.88 | 1,324 | 35.43 | 85.46 | 0.004 |
| Female | 1,796 | 71.12 | 2,807 | 64.57 |   |   |
| Ethnicity |   |   |   |   |   |   |
| Non-Hispanic White | 1,694 | 76.80 | 2,171 | 60.47 | 1226.36 | <0.001 |
| Hispanic | 337 | 11.19 | 903 | 19.03 |   |   |
| Black | 233 | 6.79 | 807 | 15.15 |   |   |
| Asian | 136 | 4.44 | 187 | 4.20 |   |   |
| Other | 27 | 0.78 | 63 | 1.15 |   |   |
| Region |  |   |   |   |   |   |
| Northeast | 366 | 15.82 | 629 | 15.73 | 792.03 | <0.001 |
| Midwest | 583 | 27.85 | 807 | 22.86 |   |   |
| South | 670 | 27.19 | 1,688 | 40.48 |   |   |
| West | 808 | 29.15 | 1,007 | 20.93 |   |   |
| Education |   |   |   |   |   |   |
| Less than college | 675 | 25.63 | 2,143 | 49.63 | 2017.35 | <0.001 |
| Some college or more | 1,750 | 74.37 | 1,970 | 50.37 |   |   |
| Employment |   |   |   |   |   |   |
| Not employed | 888 | 36.06 | 2,037 | 46.36 | 549.43 | <0.001 |
| Employed | 1,538 | 63.94 | 2,089 | 53.64 |   |   |
| Marital status |   |   |   |   |   |   |
| Not in a relationship | 1,203 | 37.09 | 2,216 | 44.41 | 195.37 | <0.001 |
| In a relationship | 1,222 | 62.91 | 1,910 | 55.59 |   |   |
| Annual Personal Earnings in 2011 ($USD) |  |   |   |   |   |   |
| up to 19,999 | 495 | 19.94 | 886 | 21.37 | 797.00 | <0.001 |
| 20,000 to 34,999 | 357 | 14.07 | 508 | 11.96 |   |   |
| 35,000 to 54,999 | 305 | 13.19 | 367 | 9.21 |   |   |
| 55,000 to 74,999 | 199 | 7.67 | 138 | 3.80 |   |   |
| 75,000 and more | 199 | 10.03 | 139 | 4.28 |   |   |
| Did not work for pay | 708 | 27.83 | 1,764 | 39.88 |  |  |
| Refused/Don't know | 164 | 7.27 | 329 | 9.50 |  |  |
| Health Related Characteristics |  |   |   |   |  |  |
| Body Mass Index (BMI, kg/m2) |  |   |   |   |   |   |
| Up to 18.5 | 49 | 2.48 | 79 | 2.24 | 233.47 | <0.001 |
| 18.5 to 24.9 | 889 | 38.66 | 1,232 | 31.50 |   |   |
| 25-29.9 | 700 | 29.19 | 1,177 | 30.59 |   |   |
| 30 and more | 729 | 29.66 | 1,435 | 35.67 |   |   |
| Self-reported health status |   |   |   |   |   |   |
| Poor to fair | 518 | 18.22 | 1,216 | 25.77 | 417.24 | <0.001 |
| Good | 684 | 27.84 | 1,221 | 28.07 |   |   |
| Very good to excellent | 1,223 | 53.94 | 1,687 | 46.16 |   |   |
| Health related behavior |   |   |   |   |   |   |
| Smoking |   |   |   |   |   |   |
| Non smoking | 1,384 | 58.03 | 2,270 | 56.69 | 189.26 | <0.001 |
| Former smoking | 552 | 22.54 | 737 | 17.80 |   |   |
| Smoking  | 489 | 19.43 | 1,078 | 25.51 |   |   |
| Alcohol consumption |   |   |   |   |   |   |
| Abstainers  | 332 | 12.39 | 977 | 23.87 | 1361.73 | <0.001 |
| Former drinker (abstained in the last 12 months) | 342 | 13.45 | 777 | 17.67 |   |   |
| Light  | 1,286 | 56.09 | 1,740 | 45.69 |   |   |
| Moderate to heavy | 449 | 18.07 | 520 | 12.77 |   |   |
| Comorbidity scorea (mean) | 2420 | 1.81 | 4,107 | 1.71 | 1.23(Wald Test) | 0.27 |

aSubjects were given a point for heart disease (coronary heart disease, ever had a heart attack, other heart condition), hypertension, pulmonary disease (emphysema, COPD, asthma, or chronic bronchitis), mental health concern in the last 12 months (depression, anxiety, other mental health disorder), neurological issues (memory loss, stroke, other neurological problem), weak/failing kidneys, or ever diagnosed with cancer, diabetes, or arthritis

bAll Chi-square values presented are from the svy procedure in STATA that yields higher values than chi square values based on the actual proportions.

Table 3: Weighted percentage and count of CAM categories used among respondents, by headache/migraine symptoms (n=34,525).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CAM Types**  | No headache | Recurringa Headache | SeverebMigraine | Headache & Migrainec | Chi square (p value)d | Any headachee | Chi squaref (p value) |
|  | N=27,977  | N=1,713 | N=2,180 | N=2,665 |  | N=6,558 |  |
| **Any CAM** | 27.77 (7747) | 33.29 (554) | 37.84 (838) | 40.18 (1035) | 265.19 (<0.001) | 37.58 (2427) | 241.95 (<0.001) |
| **Herbs** | 16.96 (4580) | 20.99 (345) | 21.22 (455) | 22.58 (589) | 80.01 (<0.001) | 21.7 (1389) | 77.80 (<0.001) |
| **Manipulative** | 14.00 (3657) | 18.90 (282) | 21.37 (452) | 24.64 (583) | 267.71 (<0.001) | 22.03 (1317) | 242.65 (<0.001) |
| **mind body** | 11.25 (3001) | 14.36 (229) | 19.75 (414) | 18.50 (457) | 228.28 (<0.001) | 17.85 (1100) | 202.06 (<0.001) |
| **Diet** | 2.79 (766) | 2.42 (50) | 3.78 (85) | 5.34 (126) | 56.89 (<0.001) | 4.05 (261) | 27.45 (<0.001) |
| **Movement** | 2.02 (512) | 2.26 (30) | 3.14 (66) | 3.34 (70) | 26.76 (0.002) | 2.99 (166) | 21.36 (<0.001) |
| **Practitioner based** | 3.92 (1108) | 5.60 (100) | 7.16 (130) | 9.10 (219) | 171.43 (<0.001) | 7.52 (449) | 144.17 (<0.001) |
| a Recurring headache in the past 12 months b Severe headache/migraine in the past three monthsc Both recurring headache in the past 12 months and severe headache/migraine in the past three monthsdAll Chi-square values presented are from the svy procedure in STATA that yields higher values than chi square values based on the actual proportions. eThis variable is a composite of individuals in all three headache categories to the left |
| fChi square values in this column represent comparison of any headache versus no headache |
| NOTE: Sample sizes differ by modality above, due to different numbers of "Refused," "Not ascertained," and "Don't Know" responses, i.e., non-response, which we conservatively excluded rather than labeling as not using that CAM modality |

Table 4. Weighted logistic regression odds ratios predicting use of CAM for headache among headache and migraine sufferers only (n=6,485)

|  |  |  |  |
| --- | --- | --- | --- |
|  Significant predictors  | Odds Ratio | 95% CI | p value |
| Headache status (recurring Headache only=ref) |  |  |  |
| Severe headache/Migraine in the past three months | 2.32 | [1.41,3.82] | 0.001 |
| Both recurring and severe headache & Migraine | 3.36 | [2.08,5.43] | <0.001 |
| Female (male=ref) | 2.36 | [1.54,3.63] | <0.001 |
| Age (in years, 18-29=ref) |   |   |   |
| 30 to 39 | 2.68 | [1.59,4.52] | <0.001 |
| 40 to 49 | 2.15 | [1.21,3.82] | 0.009 |
| 50 to 64 | 1.66 | [0.90,3.09] | 0.107 |
| 65 or greater | 1.18 | [0.50,2.80] | 0.7 |
| Race/ethnicity (Non-Hispanic White=ref) |   |   |
| Hispanic | 0.20 | [0.10,0.40] | <0.001 |
| Black | 0.19 | [0.09,0.40] | <0.001 |
| Asian | 0.23 | [0.13,0.40] | <0.001 |
| Other | 0.47 | [0.11,2.02] | 0.312 |
| College degree (Less than college =ref) | 2.27 | [1.38,3.71] | 0.001 |
| Employed (unemployed=ref) | 1.75 | [1.20,2.54] | 0.004 |
| Smoking status (non-smoker=ref) |   |   |
| Former smoking | 0.74 | [0.48,1.14] | 0.171 |
| Current smoker | 0.61 | [0.38,0.98] | 0.039 |

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