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Permalink

<https://escholarship.org/uc/item/7gc6x27b>

Journal

Neurology, 99(14)

ISSN

0028-3878

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Publication Date

2022-10-04

DOI

10.1212/wnl.0000000000200941

Peer reviewed

Migraine, Migraine Disability, Trauma, and Discrimination in Sexual and Gender Minority Individuals

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Neurology® 2022;99:e1549-e1559. doi:10.1212/WNL.0000000000200941

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Abstract

Background and Objectives

This study sought to describe migrainous headache frequency and severity and to examine the relationship between trauma, discrimination, and migraine-associated disability in a sample of sexual and/or gender minority (SGM) adults.

Methods

We performed a cross-sectional study of SGM people in The Population Research in Identity and Disparities for Equality Study from August to October 2018. The primary exposure was any trauma or discrimination, regardless of attribution. The primary outcome was moderate-severe migraine disability, as defined by a Migraine Disability Assessment (MIDAS) Questionnaire score of ≥ 11 . We performed descriptive analysis comparing respondents with any migrainous headache with those without. Multivariable logistic regression examined the association between trauma/discrimination and migraine disability, controlling first for sociodemographic and clinical factors and then for psychiatric comorbidities.

Results

Of the 3,325 total respondents, 1,126 (33.9%) screened positive for migrainous headache by ID-Migraine criteria. Most people with migraine self-reported moderate ($n = 768$, 68.2%) or severe ($n = 253$, 22.5%) intensity. The median MIDAS score was 11 (interquartile range 5–25). Most respondents with migraine ($n = 1,055$, 93.7%) reported a history of trauma or discrimination. In unadjusted analysis, exposure to both trauma and discrimination was associated with higher odds of moderate-severe disability (OR 1.76, 95% CI 1.34–2.32). After adjustment for self-reported psychiatric comorbidities of anxiety, depression, and posttraumatic stress disorder, this association lost statistical significance.

Discussion

Migrainous headache is common among our sample of SGM adults, and prior experiences with trauma and discrimination are associated with increased migraine disability. Our findings suggest that psychiatric comorbidities play a significant role in this relationship, identifying a potentially modifiable risk factor for disability in SGM people with migraine.

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Go to [Neurology.org/N](https://www.neurology.org/N) for full disclosures. Funding information and disclosures deemed relevant by the authors, if any, are provided at the end of the article.

The Article Processing Charge was funded by the authors.

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Glossary

IQR = interquartile range; **MIDAS** = Migraine Disability Assessment; **PRIDE** = Population Research in Identity and Disparities for Equality; **PTSD** = posttraumatic stress disorder; **SAAB** = sex that was assigned to them at birth; **SGM** = sexual and/or gender minority; **VIF** = variance inflation factor.

Migraine is a common and often debilitating neurologic condition. Migraine is second only to stroke as the leading contributor to disability-adjusted life-years globally.¹ Migraine is associated with a number of comorbidities, including higher rates of ischemic stroke, gastrointestinal disorders, and psychiatric disorders, which can contribute to further disability.^{2,3} Studies suggest greater odds of migraine in presumably cisgender lesbian women, cisgender gay men, and bisexual people of any gender^{4,5}; however, little is known about migraine prevalence and severity in transgender and gender nonbinary individuals. Risk factors for migraine-associated disability in sexual and/or gender minority (SGM) individuals (an inclusive term used to describe individuals whose sexual orientation and/or gender identity do not align with societal expectations based on their birth-assigned sex, including, but not limited to, those who identify as lesbian, gay, bisexual, transgender, and queer) are also unknown. Studies in other populations, namely, cisgender women and adolescents, have demonstrated associations between a history of trauma and greater prevalence and severity of migraine.⁶⁻⁸ In particular, studies suggest a dose-response relationship between more instances of trauma and both higher migraine disability^{8,9} and evolution of migraine from episodic to chronic.¹⁰ This relationship may, in part, be mediated through mental health. A study of 1,051 young adults found that migraine was associated with the development and severity of posttraumatic stress disorder (PTSD) symptoms, not trauma exposure itself.¹¹

SGM communities face a particular risk for trauma, including a high prevalence of interpersonal violence and assault in the setting of societal stigma and discrimination.¹²⁻¹⁵ SGM people experience a higher risk of mental and physical disability compared with heterosexual, cisgender (i.e., nontransgender) peers^{16,17} and have a disparate prevalence of mental health concerns, including higher rates of depression, anxiety, and PTSD.¹⁷⁻¹⁹ It is also unknown whether SGM individuals experience barriers to accessing neurologic care for the treatment of migraine, such as prolonged wait times,²⁰ issues with health insurance,²¹ or not being offered appropriate treatment options.²² Understanding the current state of migraine care is an essential step toward improving the neurologic health of SGM individuals.

The purpose of this study, therefore, was to describe migrainous headache frequency, severity, and access to care in a cohort of SGM adults and to examine the relationship between a history of trauma and/or discrimination and migraine-associated disability in SGM individuals.

Methods

Study Design

We performed a cross-sectional study of SGM individuals in The Population Research in Identity and Disparities for Equality (PRIDE) Study—a national, online, prospective longitudinal cohort study of the physical, mental, and social health of SGM adults.²³ We developed a 68-question survey, incorporating validated measures for screening for migraine-type headache and migraine disability (see Measurements below)²⁴⁻²⁷ and using previously created items in The PRIDE Study to identify a history of traumatic and discriminatory experiences (eAppendix, links.lww.com/WNL/C193). The survey was reviewed by The PRIDE Study's Participant Advisory Committee, Research Advisory Committee, and leadership for clarity and language appropriateness before distribution to all participants in The PRIDE Study through its online research platform between August 2018 and October 2018.

Standard Protocol Approvals, Registrations, and Patient Consents

The University of California San Francisco Institutional Review Board (#18-26982) and the Stanford University School of Medicine Institutional Review Board (#48707) approved this study. All procedures performed in this study were in accordance with the ethical standards of the universities' institutional review board and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all participants through The PRIDE Study's online platform.

Study Sample

The PRIDE Study participants were recruited through convenience/volunteer sampling using a variety of online advertising, social media, community-based advertising, and word of mouth. In addition, The PRIDE Study's Community Partners sent directed requests to their constituents as facilitated by PRIDEnet—the community engagement vehicle that works with The PRIDE Study (pridestudy.org/pridenet). Eligible participants were at least 18 years at the time of enrollment, lived in the United States or its territories, identified as SGM, and comfortable reading and writing in English.

Participants

This study exploring headache in SGM individuals was offered to all participants in The PRIDE Study. Those with any self-reported history of headache, as determined by an initial screening question, were offered the full survey. Because the goal of the study was to investigate the care experiences and

disability of those with migrainous headaches, those without a self-reported history of headache were only asked demographic questions.

We identified individuals with migrainous-type headache using the ID-Migraine screening tool (see Measurements below). We excluded individuals with missing responses to the ID-Migraine questions and those who did not meet this screening criterion for migraine from the final analysis.

Measurements

Participants were asked for current gender identity (*gender-queer, man, transgender man, transgender woman, woman, or another gender identity with a write-in response such as agender or nonbinary*), with the ability to select multiple identities. Participants selected the sex that was assigned to them at birth (SAAB; *female, male*).²⁸ Participants were asked how they described their current sexual orientation (*asexual, bisexual, gay, lesbian, pansexual, queer, questioning, same-gender loving, straight/heterosexual, or another sexual orientation with a write-in response such as demisexual or polysexual*), with the ability to select multiple identities. Participants' age, race/ethnicity, and education level at the time of ancillary study completion were linked through unique participant identifiers to existing demographic data collected in The PRIDE Study online research platform, which has been described elsewhere.²³ Participants identifying as "Native Hawaiian or other Pacific Islander" and "American Indian or Alaska Native" were included in the "another race" category because of the small number of participants who endorsed these identities.

We identified individuals with migrainous-type headache using the validated ID-Migraine tool, in which answering "yes" to 2 of 3 dichotomous (yes/no) questions (having headache associated with nausea, photophobia, or impaired functioning in the past 3 months) is defined as screening positive for migrainous headache.^{25,27} Respondents who answered "yes" or "I don't know" to the initial headache screening question and met ID-Migraine criteria were classified as having migrainous headache. Those who answered "yes" and did not meet criteria were classified as having non-migraine-type headaches, as were those who responded "I don't know" and reported at least 1 headache in the prior 3 months. Migraine disability was assessed using the Migraine Disability Assessment (MIDAS) Questionnaire, in which participants reported the number of days in the past 3 months in which they missed or had reduced productivity in work, school, household tasks, or social events because of headache through a series of 5 questions.²⁴

We asked participants whether they had ever used gender-affirming hormone therapy (feminizing, such as estrogen, or masculinizing, such as testosterone) because these may affect migraine frequency and severity.²⁹ We asked about prior diagnosis of stroke and associated medical comorbidities (hypertension, hyperlipidemia, or diabetes), history of psychiatric diagnoses (anxiety, depression, or PTSD), current mood using

the Patient Health Questionnaire-9, and current or former tobacco use; these comorbidities have all been associated with migraine occurrence and frequency.

To evaluate access to care, participants were asked about any prior use of headache abortive and preventive medications, with a list of possible medication options provided to those who responded "yes" or "I don't know" to the initial questions. Participants were asked whether they had ever wanted or asked to see a neurologist for headache management, whether they had trouble finding a neurologist for those interested, and about the primary barrier encountered in finding a neurologist for those who had difficulty.

The primary exposure was a history of violent events, trauma (referred to collectively as "trauma" hereafter), and a history of discrimination events. This exposure was assessed through a series of dichotomous (yes/no) questions assessing lifetime exposure to violence (physical assault, intimate partner violence, or sexual assault), harassment (harassed/name called in public by a stranger or police harassment), and discrimination (unfair treatment in accessing employment, housing, education, physical or mental health care, or in accessing services at a business). Previous studies in migraine have predominantly described the association between exposure to trauma and migraine diagnosis/disability, whereas research on the influence of discrimination is less robust. To explore the potential difference in these exposures, we grouped the exposure variables into those that represented forms of trauma (physical assault, intimate partner violence, or sexual assault) and those that represented forms of discrimination (harassment in public; unfair treatment in employment, housing, education, health care, or accessing services at a business; or police harassment) for analysis. Any history of trauma and/or discrimination was included regardless of the participant's attribution for the experience (i.e., because of sexual orientation, gender identity/expression, or race/ethnicity). For exploratory analyses, we created a continuous variable of the number of different types of experiences, defined as the sum of the number of different types of trauma and discrimination exposures a participant reported (totaling 0–11), which has been used in a previous study.³⁰

Study Outcomes

The primary outcome was moderate-severe migraine disability (vs none-mild), defined as a MIDAS score of 11 or greater, consistent with prior literature and clinical practice.²⁶ Secondary outcomes included the number of migraine days over the prior 3 months and self-reported migraine severity (mild, moderate, or severe).

Statistical Analysis

For univariate analysis, we divided the population into those who screened positive for migrainous headache, those with nonmigraine headache, and those without headache. Because those without headache were not offered the full survey, we used respondents with nonmigraine headache as the comparison

group for all analyses other than demographics. We used the χ^2 test to compare categorical variables (gender identity, SAAB, sexual orientation, race, ethnicity, education, and comorbidities) and the analysis of variance to compare the continuous variable of headache days across headache categories. We used the Mann-Whitney *U* test to compare age because it was not normally distributed.

For multivariable analysis, we examined the association between migraine disability as a dichotomous outcome (moderate-severe vs none-mild) and a history of any trauma or discrimination using a logistic regression model. The first logistic regression model controlled for sociodemographic and clinical factors associated with migraine occurrence and/or disability: age, race/ethnicity, education, SAAB, and gender-affirming hormone use. The second logistic regression model added psychiatric diagnoses (self-reported history of depression, anxiety, or PTSD). A variance inflation factor (VIF) was checked to ensure that levels of multicollinearity across psychiatric comorbidities were acceptable (VIF: depression 1.21, anxiety 1.26, and PTSD 1.22). Because migraine research has not historically analyzed both SAAB and gender identity as distinct variables, it was unclear whether gender identity should also be included in the logistic regressions. We therefore performed a sensitivity analysis with and without a dichotomous gender identity variable (gender minority vs cisgender). For this dichotomous variable, cisgender was defined as those participants whose current gender identity was exclusively “man” and SAAB was “male” as well as those whose gender identity was exclusively “woman” and SAAB was “female”; all other participants were defined as a gender minority. Because only 2% of respondents identified as straight/heterosexual, sexual orientation was not included as an independent variable in the multivariable analyses. There were 34 (3.0%) missing race/ethnicity responses, 26 (2.3%) missing education responses, 10 (0.9%) missing gender-affirming hormone use responses, 4 (0.4%) missing SAAB responses, and 1 (0.1%) missing age response. These observations were excluded from the regression models.

To further explore the associations between migraine disability and different forms of trauma or discrimination, we created 3 dichotomous outcomes (history of trauma alone, history of discrimination alone, and history of both trauma and discrimination) and repeated the same logistic regression models. We assessed the relationship between migraine disability and a history of any trauma or discrimination using the MIDAS as a continuous outcome through a linear regression model with the same independent variables.

We performed a series of exploratory analyses. We used the number of trauma/discrimination experiences as a continuous variable to increase power and to explore the effect of accumulating different forms of trauma and/or discrimination over the lifetime. Using the number of experiences and controlling for age, race/ethnicity, education, SAAB, gender-affirming hormone use, and psychiatric diagnoses, we repeated the logistic regression model for migraine disability as a dichotomous variable (severe-moderate vs

none-mild) and repeated the linear regression model for migraine disability as a continuous variable (MIDAS score sum).

Statistical significance was set at $\alpha < 0.02$ (Bonferroni correction of 0.05/3) for both the univariate and multivariate analyses. Statistical analyses were performed using Stata (version 16, StataCorp; College Station, TX).

Data Availability

Members of SGM communities have experienced significant stigma and discrimination from society, including the medical and investigational communities. As such, we are ethically bound to upholding the principle of nonmaleficence; we promise our participants to not let any data (including deidentified) fall into the hands of people who may use it to publish stigmatizing results about the SGM communities. As such, The PRIDE Study developed an ancillary study process in which investigators submit an application that is reviewed by both a Research Advisory Committee (composed of scientists) and a Participant Advisory Committee (composed of participants and SGM community leaders) to affirm appropriate data use that aims to improve the health of SGM people. Details about The PRIDE Study’s ancillary study process are available at pridestudy.org/collaborate or by contacting us at research@pridestudy.org or 855-421-9991 (toll-free).

Results

A total of 3,325 individuals completed the survey, of which 2,142 (64.4%) had a history of headache. Of those individuals, 1,126 respondents (52.6%) screened positive for migrainous headache (hereafter referred to as respondents with migraine for brevity) using the ID-Migraine criterion (33.9% of the total sample). Respondents predominantly identified as White, not Hispanic/Latinx, and most had obtained at least a 4-year college degree (Table 1). The median age was 32.3 years (interquartile range [IQR] 25.9–43.7). About 40% identified as transgender, genderqueer, or another gender identity ($n = 876$, 40.9%), and the majority reported a non-heterosexual sexual orientation ($n = 2,113$, 98.6%). Overall, 398 (18.6%) respondents with a history of headache had ever used gender-affirming hormone therapy (Table 1).

Migraine in SGM Individuals

Respondents with migraine were younger and less likely to have a graduate degree compared with respondents with nonmigraine headache or no headache history (Table 1). Those with migraine were more likely to have been assigned female sex at birth (Table 1). Gender minority respondents were more likely to have migraine headache (46.3% migraine vs 34.9% nonmigraine headache and 27.5% no headache, $p < 0.0001$). Those who identified their sexual orientation as asexual, queer, or pansexual were more likely to have migraine headache, whereas respondents who identified as gay were less likely (Table 1).

Respondents with migraine were more likely to report having ever had a diagnosis of depression, anxiety, and/or PTSD and

Table 1 Population Characteristics for Sexual and Gender Minority Individuals With and Without Headache

	Migraine ^a (n = 1,126)	Non-migraine-type headache (n = 1,016)	No headache ^b (n = 1,036)	p Value ^c
Age (median, IQR)	30.8 (25.2–39.3)	34.3 (26.5–48.8)	33.8 (26.5–51.2)	<0.0001
Gender identity^d				
Genderqueer	289 (25.7)	160 (15.7)	118 (11.4)	<0.0001
Man	250 (22.2)	391 (38.5)	521 (50.3)	<0.0001
Transgender man	149 (13.2)	113 (11.1)	74 (7.1)	<0.0001
Transgender woman	46 (4.1)	52 (5.1)	66 (6.4)	0.0560
Woman	534 (47.4)	409 (40.3)	351 (33.9)	<0.0001
Another gender identity ^e	171 (15.2)	92 (9.1)	58 (5.6)	<0.0001
Sex assigned at birth				<0.0001
Female	864 (76.7)	595 (58.6)	482 (46.6)	
Male	262 (23.3)	421 (41.4)	554 (53.5)	
Sexual orientation^d				
Asexual	153 (13.6)	90 (8.9)	79 (7.6)	<0.0001
Bisexual	323 (28.7)	258 (25.4)	222 (21.4)	0.0005
Gay	279 (24.8)	392 (38.6)	485 (46.8)	<0.0001
Lesbian	274 (24.3)	213 (21.0)	218 (21.0)	0.0967
Pansexual	227 (20.2)	122 (12.0)	106 (10.2)	<0.0001
Queer	503 (44.7)	356 (35.0)	276 (26.6)	<0.0001
Questioning	23 (2.0)	32 (3.1)	15 (1.4)	0.0287
Same-gender loving	59 (5.2)	42 (4.1)	30 (2.9)	0.0235
Straight/heterosexual	15 (1.3)	27 (2.7)	19 (1.8)	0.0803
Another sexual orientation ^e	44 (3.9)	30 (3.0)	13 (1.3)	0.0007
Race				0.0044
Asian	27 (2.5)	33 (3.3)	49 (4.9)	
Black/African American	22 (2.0)	29 (2.9)	30 (3.0)	
White	959 (87.8)	873 (88.3)	881 (87.3)	
Another race ^f	84 (7.7)	54 (5.5)	49 (4.9)	
Hispanic/Latinx ethnicity	59 (5.4)	53 (5.3)	73 (7.2)	0.13
Education				<0.0001
No schooling, high school, or vocational training	78 (7.1)	51 (5.1)	47 (4.6)	
Some college or 2-y degree	279 (25.4)	214 (21.6)	184 (18.1)	
4-y degree	382 (34.7)	327 (33.0)	357 (35.1)	
Graduate degree	361 (32.8)	399 (40.3)	430 (42.2)	
Gender-affirming hormone use	218 (19.5%)	180 (19.1%)	—	0.82
Feminizing	49 (4.4%)	54 (5.3%)	—	
Masculinizing	168 (14.9%)	128 (12.6%)	—	
Comorbidities				

Continued

Table 1 Population Characteristics for Sexual and Gender Minority Individuals With and Without Headache (*continued*)

	Migraine ^a (n = 1,126)	Non-migraine-type headache (n = 1,016)	No headache ^b (n = 1,036)	p Value ^c
Stroke	19 (1.7)	15 (1.5)	—	0.70
Hypertension	213 (18.9)	224 (22.0)	—	0.0726
Diabetes or prediabetes	198 (17.6)	167 (16.4)	—	0.48
History of depression	874 (77.6)	608 (59.8)	—	<0.0001
Current depression ^d	522 (46.4)	227 (22.3)	—	<0.0001
Anxiety	812 (72.1)	524 (51.6)	—	<0.0001
Posttraumatic stress disorder	422 (37.5)	217 (21.4)	—	<0.0001
History of tobacco use	693 (61.5)	588 (57.9)	—	0.0835
Current tobacco use	147 (13.1)	71 (7.0)	—	<0.0001
Experiences				
Violence/trauma only	40 (3.6)	60 (5.9)	—	0.0099
Discrimination only	202 (17.9)	222 (21.9)	—	0.0233
Both trauma and discrimination	813 (72.2)	577 (56.8)	—	<0.0001

Abbreviation: IQR = interquartile range.

Data are n (%), unless otherwise indicated.

^a Defined as an ID-Migraine score of 2 or 3.

^b Respondents without a history of headache were only asked demographic questions.

^c p value reflects the comparison of all 3 headache categories for demographics (age, gender, sex assigned at birth, sexual orientation, race, ethnicity, and education) and the comparison of migraine vs non-migraine-type headache for gender-affirming hormone use, comorbidities, and experiences.

^d These were not mutually exclusive categories because respondents could select multiple identities.

^e Selection of this option prompted a write-in response.

^f Includes American Indian or Alaska Native, Middle Eastern or North African, Native Hawaiian or other Pacific Islander, and those who selected another race with a write-in option.

^g Defined as a PHQ-9 score of >9.

current tobacco use compared with respondents with non-migraine-type headaches (Table 1). Most respondents with migraine self-reported a headache severity of moderate (n = 768, 68.2%) or severe (n = 253, 22.5%). The median MIDAS score was 11 (IQR 5–25). Gender minority respondents with migraine mirrored this pattern, with most self-reporting a headache severity of moderate (n = 365, 70.7%) or severe (n = 106, 20.5%) and with a median MIDAS score of 12 (IQR 6–30).

Of the 1,126 respondents with migraine, 218 (19.5%) had ever used gender-affirming hormone therapy (49 [4.4%] estrogens and/or spironolactone, 168 [14.9%] testosterone). There was no statistically significant difference in the prevalence of moderate-severe migraine disability between those who had used hormones compared with those who had not (32.2% vs 29.4%, respectively, p = 0.285).

Access to Care in SGM Individuals With Migraine

Most respondents with migraine (n = 971, 88.0%) had access to a clinic or doctor's office for routine care (Table 2). Forty-two percent (n = 456) of those with migraine reported that they had wanted to see a neurologist for headache (Table 2). Of these individuals, 170 (37.2%) reported that they had difficulty accessing a neurologist. The most commonly endorsed reasons

for this difficulty were lack of insurance approval for the visit (n = 35, 20.6%), primary care doctor not placing a referral (n = 36, 21.2%), or the neurologist not accepting new patients (n = 31, 18.2%). Ten respondents with migraine (5.9%) reported no neurologist in their town/city, and 7 (4.1%) reported that the neurologist had refused to see them.

Those with migraine were more likely to report prior use of headache abortive and preventive medications compared with those with nonmigraine headache (Table 2). Ibuprofen (n = 730, 64.8%), acetaminophen (n = 534, 47.4%), and acetaminophen/aspirin/caffeine combination tablets (n = 510, 45.3%) were the most common abortive medications used. One hundred respondents with migraine (8.9%) reported using sumatriptan. Topiramate (n = 123, 10.9%), magnesium (n = 92, 8.2%), and riboflavin (n = 78, 6.9%) were the most common preventive agents used. One respondent used erenumab as a preventive medication, and no respondents reported the use of neuro-modulatory devices for prevention.

Migraine and Trauma/Discrimination

The majority of respondents with migraine (n = 1,055, 93.7%) reported a history of trauma and/or discrimination. Of those respondents, most (n = 813, 72.2%) reported a history of both trauma and discrimination, whereas 202

Table 2 Access to Care for Sexual and Gender Minority People With and Without Migraine-Type Headache

	Migraine (n = 1,126)	Non-migraine-type headache (n = 1,016)	p Value
Headache days in the prior 3 mo (mean, SD)	12.6 (17.2)	4.5 (9.2)	<0.0001
Migraine treatments			
Ever used an abortive medication	929 (83.4)	703 (74.1)	<0.0001
Ever used triptan as an abortive medication	308 (27.4)	94 (9.3)	<0.0001
Ever used a preventive medication	288 (25.7)	64 (6.7)	<0.0001
Location to receive routine care			0.32
Clinic or health center	971 (88.0)	846 (89.6)	
None	102 (9.2)	81 (8.6)	
Other ^a	30 (2.7)	17 (1.8)	
Wanted or asked for a neurologist for headache treatment	456 (42.1)	157 (16.9)	<0.0001
	Migraine (n = 170) ^b	Non-migraine-type headache (n = 23) ^b	p Value
Primary barrier to seeing a neurologist for headache treatment			0.16
Primary provider did not place a referral	36 (21.2)	5 (21.7)	
Insurance would not approve the visit	35 (20.6)	5 (21.7)	
Neurologist not accepting new patients	31 (18.2)	1 (4.3)	
No health insurance	14 (8.2)	0 (0)	
No neurologist in the city/town	10 (5.9)	3 (13.0)	
Neurologist refused	7 (4.1)	0 (0)	
Other reason	37 (21.8)	9 (39.1)	

Data are n (%), unless otherwise specified.

^a Includes emergency department and having multiple locations for routine care.

^b Question only offered to those who wanted to access a neurologist but experienced difficulty.

(17.9%) reported a history of discrimination alone, and 40 (3.6%) reported a history of trauma alone (Table 1). Those with migraine who reported a history of trauma and/or discrimination were significantly more likely to report a lifetime history of depression (837 [79.3%] vs 37 [52.1%], $p < 0.0001$), current depression (506 [48.0%] vs 15 [22.5%], $p < 0.001$), anxiety (779 [73.8%] vs 33 [46.5%], $p < 0.0001$), PTSD (416 [39.4%] vs 6 [8.5%], $p < 0.0001$), or a history of tobacco use (668 [63.3%] vs 25 [35.2%], $p < 0.0001$) compared with those without a history of trauma and/or discrimination. There was no significant difference in migraine days in the prior 3 months between those with migraine with a history of trauma/discrimination and those without (mean 12.7 [SD 17.5] vs 10.1 [SD 11.5], $p = 0.23$). Respondents with migraine with a history of trauma and/or discrimination were more likely to have used abortive (884 [84.2%] vs 45 [70.3%], $p = 0.0038$) and preventive (279 [26.4%] vs 9 [13.8%], $p = 0.0241$) medications than those without a history of trauma and/or discrimination.

In respondents with migraine, in both the unadjusted and adjusted analyses, a history of any experience of trauma or

discrimination was not associated with moderate-severe migraine disability (Table 3). These results did not change significantly when performing the analysis with gender identity included in addition to SAAB compared with using SAAB alone (Table 3). A history of any trauma or discrimination was also not associated with chronic migraine (defined as ≥ 15 headache days per month; OR 5.28, 95% confidence interval [CI] 0.72–38.55).

Using the dichotomous variables of prior experiences of trauma alone, discrimination alone, or both trauma and discrimination, a history of both trauma and discrimination was associated with moderate-severe migraine disability (OR 1.76, 95% CI 1.34–2.32) in unadjusted analysis (Table 3). This association persisted after adjusting for sociodemographic and clinical factors (adjusted odds ratio [aOR] 1.78, 95% CI 1.34–2.36); however, significance was lost after adjusting for psychiatric comorbidities (Table 3). Those with prior experiences of discrimination alone had lower odds of moderate-severe migraine disability in both the unadjusted analysis (OR 0.63, 95% CI 0.46–0.87) and when adjusting for sociodemographic and clinical factors (aOR 0.62, 95% CI

Table 3 Association Between Moderate-Severe Migraine Disability and a History of Trauma and/or Discrimination

	Unadjusted analysis (98% CI)	Adjusted model 1a ^a (98% CI)	Adjusted model 1b ^b (98% CI)	Adjusted model 2a ^c (98% CI)	Adjusted model 2b ^d (98% CI)
Regression analysis using the MIDAS score as a dichotomous variable					
	OR	OR	OR	OR	OR
Any trauma/discrimination	1.49 (0.81–2.73)	1.59 (0.83–3.06)	1.52 (0.79–2.93)	1.09 (0.56–2.15)	1.07 (0.54–2.10)
Trauma only	0.51 (0.23–1.13)	0.59 (0.26–1.31)	0.60 (0.27–1.33)	0.65 (0.28–1.51)	0.66 (0.28–1.52)
Discrimination only	0.63 (0.43–0.92)	0.62 (0.42–0.92)	0.63 (0.43–0.93)	0.78 (0.52–1.17)	0.78 (0.52–1.18)
Both trauma and discrimination	1.76 (1.28–2.44)	1.78 (1.27–2.49)	1.74 (1.24–2.45)	1.35 (0.94–1.93)	1.34 (0.93–1.92)
No. of experiences of trauma or discrimination	1.17 (1.11–1.24)	1.18 (1.11–1.26)	1.18 (1.11–1.25)	1.11 (1.04–1.19)	1.11 (1.04–1.19)
Regression analysis using the MIDAS as a continuous variable					
	Coef	Coef	Coef	Coef	Coef
Any trauma/discrimination	7.31 (–1.98–16.60)	8.25 (–1.36–17.86)	7.30 (–2.33–16.93)	3.13 (–6.31–12.57)	2.63 (–6.83–12.10)
No. of experiences of trauma or discrimination	2.37 (1.55–3.18)	2.33 (1.47–3.18)	2.23 (1.36–3.09)	1.34 (0.41–2.27)	1.28 (0.34–2.21)

Bold font indicates statistical significance.

^a Adjusted for age, sex assigned at birth, race/ethnicity, education, and use of gender-affirming hormones.

^b Adjusted for age, sex assigned at birth, gender identity, race/ethnicity, education, and use of gender-affirming hormones.

^c Adjusted for the variables in model 1a + self-reported history of depression, anxiety, and/or posttraumatic stress disorder.

^d Adjusted for the variables in model 1b + self-reported history of depression, anxiety, and/or posttraumatic stress disorder.

0.45–0.87). This association again lost significance after adjusting for psychiatric comorbidities (Table 3). These results did not change when performing the analysis with SAAB and gender identity compared with SAAB alone (Table 3).

In the exploratory analysis, the number of experiences of trauma or discrimination was associated with higher odds of moderate-severe migraine disability as a dichotomous variable after adjustment for sociodemographic and clinical factors and psychiatric comorbidities (aOR 1.11, 95% CI 1.05–1.18); however, it was not associated with migraine disability after adjustment for sociodemographic and clinical factors and psychiatric comorbidities when using the MIDAS as a continuous variable (coef 1.34, 95% CI 0.56–2.12) (Table 3).

Discussion

In this sample of SGM individuals, approximately half of the respondents with a history of headache screened positive for migrainous headache by the ID-Migraine criterion, with most reporting moderate-to-severe intensity headache. Despite that finding, only a quarter of those with migrainous headache reported use of preventive medications, and a third of those who were interested in seeing a neurologist for headache experienced barriers to accessing specialized care. The frequency of preventive medication use in this sample mirrors that found in a prior study, although comprehensive sexual orientation and gender identity information was not collected, which limits comparison.³¹ The reasons underlying the low prevalence of preventive care remain uncertain, although may

be related to known disparities in health care access experienced by SGM individuals, such as disparate rates of insurance coverage and differences in socioeconomic status.^{32,33} Barriers to equitable preventive care for SGM individuals with headache will be important to explore in future research.

In those with migraine, a history of both trauma and discrimination was associated with moderate-severe migraine disability after adjusting for sociodemographic and clinical factors; this association lost significance after adjusting for a history of depression, anxiety, or PTSD. This analysis suggests that psychiatric comorbidities may mediate the relationship between a history of trauma/discrimination and migraine disability in SGM individuals, a finding that is consistent with studies in other populations.^{7,34} National Health Interview Survey data found that screening positive for a severe mental illness accounted for 9% of the additional prevalence of headache/migraine in gay and bisexual men and 6.6% of the additional prevalence in lesbian and bisexual women compared with heterosexual peers.³⁵ The nature of the relationship between mental health and migraine is complex and likely bidirectional.³⁶ Depression, anxiety, and PTSD are associated with episodic migraine evolving into chronic migraine.^{34,37} PTSD has been associated with higher migraine frequency³⁸ and disability.^{39,40} Other studies suggest a shared genetic predisposition for migraine and depression^{41–43} or a pathophysiologic link through the role of estrogen.⁴⁴ There may also be cosensitization of the sensory and affective components of pain that can lead to neurologic and psychiatric symptoms between headache episodes.⁴⁵ Regardless of the directionality, the consistent findings of the relationship

between migraine and mood disorders highlight the importance of addressing mental health in people with migraine.

In this sample, respondents with prior exposure to discrimination and not trauma had lower odds of moderate-severe migraine disability in unadjusted analyses and after controlling for sociodemographic and clinical factors, which lost statistical significance after including psychiatric comorbidities in the model. In the exploratory analysis, a greater number of types of trauma and/or discrimination experiences were associated with increased migraine disability even after adjusting for psychiatric comorbidities. Other studies have found a similar dose-response relationship between recurrent traumatic experiences and headache frequency.^{46,47} Although our analysis was not designed to assess the specific question of cumulative trauma, these findings raise an intriguing potential direction for future study, particularly considering the ubiquity of trauma exposure in US adults.⁴⁸

This study has some limitations. The use of ID-Migraine, with a sensitivity of 84% in screening for migrainous headache, may have led to misclassification.²⁵ It may also have led to underreporting individuals with migraine with aura. One of the ID-Migraine questions asks about headache limiting the respondent's ability to participate in daily activities, and the use of this tool to screen for migrainous headache may have led to our sample including those with higher levels of disability from headache. The questionnaire was advertised to The PRIDE Study participants as one investigating experiences of headache, particularly how that experience is influenced by a history of trauma, which may have led to selection bias. This sample reported a high prevalence of trauma and/or discrimination, in part because of the broad definition of these experiences, which led to reduced power when using it as a dichotomous variable. This analysis relied on the retrospective self-report of trauma and comorbidities, which may be subject to recall bias; however, this is consistent with how this history is commonly collected in a clinical setting. The complex relationship between migraine and depression means that we are yet unable to determine whether depression is a confounder or mediator between trauma and migraine-related disability, and the cross-sectional design prevents this study from evaluating this. Although other sociodemographic factors—such as race/ethnicity^{49,50} and socioeconomic status—affect migraine prevalence and severity, this nonrepresentative sample did not allow for us to explore the interaction of these factors in our analysis and limits the generalizability of our findings.

Despite these limitations, this study adds unique understanding of migraine care experiences and severity in SGM individuals and suggests future directions for investigation and intervention. It will be important to collect inclusive sexual orientation and gender identity data in future migraine studies to further understand access to care and prevalence of migraine disability, particularly in diverse cohorts that will allow for an intersectional understanding of how social and

structural factors, such as racism and poverty, affect migraine in SGM populations. This will likely require targeted outreach coupled with community engagement to ensure appropriate representation of underserved populations. The role of gender minority stress also needs to be more explicitly studied in relation to migraine frequency and severity.³⁶ This study also highlights the important role of depression, anxiety, and PTSD in migraine disability in SGM individuals, identifying a significant and potentially modifiable risk factor for migraine disability in this population that could be targeted in future intervention studies.

Further work in this area would benefit from larger and more diverse SGM samples, inclusive of a broad range of sociodemographic identities. Systematic collection of sexual orientation and gender identity in electronic health records, population health surveys, and patient registries would be an important step toward exploring the role of traumatic experiences in migraine using an intersectional framework and thereby improving neurologic health equity in this underserved community.

Acknowledgment

The authors are grateful to Dr. S. Andrew Josephson and Dr. Amy Gelfand for their guidance in the conceptualization and contextualization of this study. The authors acknowledge the courage and dedication of The PRIDE Study participants for sharing their stories; the careful attention of PRIDeNet Participant Advisory Committee (PAC) members for reviewing and improving every study application; and the enthusiastic engagement of PRIDeNet Ambassadors and Community Partners for bringing thoughtful perspectives as well as promoting enrollment and disseminating findings. For more information, please visit pridestudy.org/pridenet.

Study Funding

This study was funded by the National Institute on Drug Abuse: K23DA039800 and R01DA052016; National Institute of Diabetes and Digestive and Kidney Diseases (K12DK111028); and Patient-Centered Outcomes Research Institute (pcori.org; PPRN-1501-26848) to M.R. Lunn.

Disclosure

N. Rosendale receives funding from the American Academy of Neurology Career Development Award, previously received personal compensation for her role as an editor for *Neurology*[®] (ending 12/2021); E.L. Guterman receives funding from the National Institute of Neurological Disorders and Stroke (1K23NS116128-01), National Institute on Aging (5R01AG056715), and American Academy of Neurology; received personal fees from Marinus Pharmaceuticals; and currently receives stock from REMO Health and fees from *JAMA Neurology*, which are unrelated to the submitted work. J. Obedin-Maliver has consulted for Hims Inc (2019–present), Folx, Inc (2020–present), Ibis Reproductive Health (2017–present), and Sage Therapeutics (5/2017, 1 day Advisory Panel). A. Flentje has consulted for Hopelab. M.R.

Capriotti receives speaking fees and travel support from the Tourette Association of America for talks on behavioral treatment of tic disorders. M.R. Lunn has consulted for Hims Inc (2019–present) and Folx, Inc (2020). The other author reports no relevant disclosures. Go to [Neurology.org/N](https://www.neurology.org/N) for full disclosures.

Publication History

Received by *Neurology* February 8, 2022. Accepted in final form May 19, 2022. Submitted and externally peer reviewed. The handling editor was Rebecca Burch, MD.

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Matthew R. Capriotti, PhD	Department of Psychology, San Jose State University, San Jose, CA	Drafting/revision of the manuscript for content, including medical writing for content, and major role in the acquisition of data
Micah E. Lubensky, PhD	The PRIDE Study/PRIDENet, Stanford University School of Medicine, Palo Alto, CA; Department of Community Health Systems, School of Nursing, University of California San Francisco, San Francisco, CA	Drafting/revision of the manuscript for content, including medical writing for content

Appendix (continued)

Name	Location	Contribution
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References

- Global, regional, and national burden of neurological disorders, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol*. 2019;18:459-480.
- Wang S-J, Chen P-K, Fuh J-L. Comorbidities of migraine. *Front Neurol*. 2010;1:16. Accessed June 10, 2019. [ncbi.nlm.nih.gov/pmc/articles/PMC3008936/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3008936/).
- Cámara-Lemarroy CR, Rodríguez-Gutiérrez R, Monreal-Robles R, Marfil-Rivera A. Gastrointestinal disorders associated with migraine: a comprehensive review. *World J Gastroenterol*. 2016;22(36):8149-8160.
- Nagata JM, Ganson KT, Tabler J, Blashill AJ, Murray SB. Disparities across sexual orientation in migraine among US adults. *JAMA Neurol*. 2020;78(1):117-118. Accessed September 28, 2020. jamanetwork.com/journals/jamaneurology/full-article/2771029.
- Hammond NG, Stinchcombe A. Health behaviors and social determinants of migraine in a Canadian population-based sample of adults aged 45-85 years: findings from the CLSA. *Headache*. 2019;59(9):1547-1564.
- Peterlin BL, Ward T, Lidicker J, Levin M. A retrospective, comparative study on the frequency of abuse in migraine and chronic daily headache. *Headache*. 2007;47(3):397-401.
- Cripe SM, Sanchez SE, Gelaye B, Sanchez E, Williams MA. Association between intimate partner violence, migraine and probable migraine. *Headache*. 2011;51(2):208-219.
- Fuh J-L, Wang S-J, Juang K-D, Lu S-R, Liao Y-C, Chen S-P. Relationship between childhood physical maltreatment and migraine in adolescents. *Headache*. 2010;50(5):761-768.
- Tietjen GE, Buse DC, Fanning KM, Serrano D, Reed ML, Lipton RB. Recalled maltreatment, migraine, and tension-type headache: results of the AMPP Study. *Neurology*. 2015;84(2):132-140.
- Peterlin BL, Tietjen G, Meng S, Lidicker J, Bigal M. Post-traumatic stress disorder in episodic and chronic migraine. *Headache*. 2008;48(4):517-522.
- Smitherman TA, Kolivas ED. Trauma exposure versus posttraumatic stress disorder: relative associations with migraine. *Headache*. 2013;53(5):775-786.
- Valentine SE, Shipherd JC. A systematic review of social stress and mental health among transgender and gender non-conforming people in the United States. *Clin Psychol Rev*. 2018;66:24-38.
- Ard KL, Makadon HJ. Addressing intimate partner violence in lesbian, gay, bisexual, and transgender patients. *J Gen Intern Med*. 2011;26(8):930-933.
- Kosciw JG, Greytak EA, Zongrone AD, Clark CM, Truong NL, Gay L, SEN (GLSEN). *The 2017 National School Climate Survey: The Experiences of Lesbian, Gay, Bisexual, Transgender, and Queer Youth in Our Nation's Schools*. Gay, Lesbian and Straight Education Network (GLSEN). 2018. [glsen.org](https://www.glsen.org).
- Flores AR, Langton L, Meyer IH, Romero AP. Victimization rates and traits of sexual and gender minorities in the United States: results from the national crime victimization survey, 2017. *Sci Adv*. 2020;6(40):eaba6910.
- Fredriksen-Goldsen KI, Kim H-J, Barkan SE, Muraco A, Hoy-Ellis CP. Health disparities among lesbian, gay, and bisexual older adults: results from a population-based study. *Am J Public Health*. 2013;103(10):1802-1809.
- Dragon CN, Guerino P, Ewald E, Laffan AM. Transgender Medicare beneficiaries and chronic conditions: exploring fee-for-service claims data. *LGBT Health*. 2017;4(6):404-411.
- Fredriksen-Goldsen KI, Emlen CA, Kim H-J, et al. The physical and mental health of lesbian, gay male, and bisexual (LGB) older adults: the role of key health indicators and protective factors. *Gerontologist*. 2013;53(4):664-675.
- Gonzales G, Henning-Smith C. Health disparities by sexual orientation: results and implications from the behavioral risk factor surveillance system. *J Community Health*. 2017;42(6):1163-1172.
- Wongsirirroj S, Grillo E, Levi S, et al. Management of migraine and the accessibility of specialist care: findings from an extended multinational survey (my migraine center survey). *Neural Ther*. 2020;9(2):551-565.
- Lipton RB, Serrano D, Holland S, Fanning KM, Reed ML, Buse DC. Barriers to the diagnosis and treatment of migraine: effects of sex, income, and headache features. *Headache*. 2013;53(1):81-92.

22. Buse DC, Armand CE, Charleston L IV, et al. Barriers to care in episodic and chronic migraine: results from the chronic migraine epidemiology and outcomes study. *Headache*. 2021;61(4):628-641.
23. Lunn MR, Lubensky M, Hunt C, et al. A digital health research platform for community engagement, recruitment, and retention of sexual and gender minority adults in a national longitudinal cohort study—the PRIDE Study. *J Am Med Inform Assoc*. 2019;26(8-9):737-748. Accessed June 10, 2019. academic.oup.com/jamia/advance-article/doi/10.1093/jamia/ocz082/5509461.
24. Stewart WF, Lipton RB, Kolodner KB, Sawyer J, Lee C, Liberman JN. Validity of the Migraine Disability Assessment (MIDAS) score in comparison to a diary-based measure in a population sample of migraine sufferers. *Pain*. 2000;88(1):41-52.
25. Cousins G, Hijazze S, Van de Laar FA, Fahey T. Diagnostic accuracy of the ID migraine: a systematic review and meta-analysis. *Headache*. 2011;51(7):1140-1148.
26. Lipton RB, Stewart WF, Sawyer J, Edmeads JG. Clinical utility of an instrument assessing migraine disability: the Migraine Disability Assessment (MIDAS) questionnaire. *Headache*. 2001;41(9):854-861.
27. Lipton RB, Dodick D, Sadosky R, et al, ID Migraine validation study. A self-administered screener for migraine in primary care: the ID Migraine™ validation study. *Neurology*. 2003;61(3):375-382.
28. Deutsch MB, Green J, Keatley J, Mayer G, Hastings J, Hall AM, World Professional Association for Transgender Health EMR Working Group. Electronic medical records and the transgender patient: recommendations from the World Professional Association for Transgender Health EMR Working Group. *J Am Med Inform Assoc*. 2013;20(4):700-703.
29. Aloisi AM, Bachiocco V, Costantino A, et al. Cross-sex hormone administration changes pain in transsexual women and men. *Pain*. 2007;132(suppl 1):S60-S67.
30. McGeough BL, Aguilera A, Capriotti MR, et al. Understanding co-occurring depression symptoms and alcohol use symptoms among cisgender sexual minority women. *J Gay Lesbian Soc Serv*. 2021;33:427-450.
31. Diamond S, Bigal ME, Silberstein S, Loder E, Reed M, Lipton RB. Patterns of diagnosis and acute and preventive treatment for migraine in the United States: results from the American migraine prevalence and prevention study. *Headache*. 2007;47(3):355-363.
32. James SandyE, Herman JodyL, Rankin Susan, et al. *The Report of the 2015 U.S. Transgender Survey [online]*. The National Center for Transgender Equality; 2016. Accessed November 19, 2019. ustranssurvey.org/.
33. Carpenter CS, Lee MJ, Nettuno L. *Economic Outcomes for Transgender People and Other Gender Minorities in the United States: First Estimates from a Nationally Representative Sample*. IZA-Institute of Labor Economics; 2022:51. Report No.: IZA DP No. 15116.
34. Buse DC, Silberstein SD, Manack AN, Papapetropoulos S, Lipton RB. Psychiatric comorbidities of episodic and chronic migraine. *J Neurol*. 2013;260(8):1960-1969.
35. Heslin KC. Explaining disparities in severe headache and migraine among sexual minority adults in the United States, 2013-2018. *J Nerv Ment Dis*. 2020;208(11):876-883.
36. Pace A, Barber M, Ziplow J, Hranilovich JA, Kaiser EA. Gender minority stress, psychiatric comorbidities, and the experience of migraine in transgender and gender-diverse individuals: a narrative review. *Curr Pain Headache Rep*. 2021;25(12):82.
37. Minen MT, Begasse De Dhaem O, Kroon Van Diest A, et al. Migraine and its psychiatric comorbidities. *J Neurol Neurosurg Psychiatry*. 2016;87(7):741-749.
38. Arcaya MC, Lowe SR, Asad AL, Subramanian SV, Waters MC, Rhodes J. Association of posttraumatic stress disorder symptoms with migraine and headache after a natural disaster. *Health Psychol*. 2017;36(5):411-418.
39. McDermott MJ, Fulwiler JC, Smitherman TA, Gratz KL, Connolly KM, Tull MT. The relation of PTSD symptoms to migraine and headache-related disability among substance dependent inpatients. *J Behav Med*. 2016;39(2):300-309.
40. Ifergane G, Buskila D, Simishvely N, Jotkowitz A, Kaplan Z, Cohen H. Post-traumatic stress disorder is not over-represented in a sample population of migraine patients. *Eur J Intern Med*. 2009;20(2):182-185.
41. Stam AH, de Vries B, Janssens ACJW, et al. Shared genetic factors in migraine and depression: evidence from a genetic isolate. *Neurology*. 2010;74(4):288-294.
42. Shur EA, Noonan C, Buchwald D, Goldberg J, Afari N. A twin study of depression and migraine: evidence for a shared genetic vulnerability. *Headache*. 2009;49:1493-1502.
43. Silberstein SD. Shared mechanisms and comorbidities in neurologic and psychiatric disorders. *Headache*. 2001;41(suppl 1):11-S17.
44. Peterlin BL, Katsnelson MJ, Calhoun AH. The associations between migraine, unipolar psychiatric comorbidities, and stress-related disorders and the role of estrogen. *Curr Pain Headache Rep*. 2009;13(5):404-412.
45. Cady R, Farmer K, Dexter JK, Schreiber C. Cosensitization of pain and psychiatric comorbidity in chronic daily headache. *Curr pain headache Rep*. 2005;9(1):47-52.
46. Anda R, Tietjen G, Schulman E, Felitti V, Croft J. Adverse childhood experiences and frequent headaches in adults. *Headache*. 2010;50(9):1473-1481.
47. Stensland SØ, Dyb G, Thoresen S, Wentzel-Larsen T, Zwart J-A. Potentially traumatic interpersonal events, psychological distress and recurrent headache in a population-based cohort of adolescents: the HUNT study. *BMJ Open*. 2013;3(9):e002997. Accessed August 24, 2020. ncbi.nlm.nih.gov/pmc/articles/PMC3731723/.
48. Kilpatrick DG, Resnick HS, Milanak ME, Miller MW, Keyes KM, Friedman MJ. National estimates of exposure to traumatic events and PTSD prevalence using DSM-IV and DSM-5 criteria. *J Trauma Stress*. 2013;26(5):537-547.
49. Befus DR, Irby MB, Coeytaux RR, Penzien DB. A critical exploration of migraine as a health disparity: the imperative of an equity-oriented, intersectional approach. *Curr Pain Headache Rep*. 2018;22(12):79.
50. Loder S, Sheikh HU, Loder E. The prevalence, burden, and treatment of severe, frequent, and migraine headaches in US minority populations: statistics from National Survey studies. *Headache*. 2015;55(2):214-228.