Episodic migraine and obesity and the influence of age, race, and sex

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ABSTRACT

Objective: To evaluate the episodic migraine (EM)-obesity association and the influence of age, race, and sex on this relationship.

Methods: We examined the EM-obesity association and the influence of age, race, and sex in 3,862 adult participants of both black and white race interviewed in the National Comorbidity Survey Replication. EM diagnostic criteria were based on the International Classification of Headache Disorders. Body mass index was classified as underweight (<18.5 kg/m²), normal (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), or obese (≥ 30 kg/m²). Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for EM were estimated using logistic regression. Models were stratified by age ($<50/\geq 50$ years), race (white/black), and sex (male/female).

Results: A total of 188 participants fulfilled criteria for EM. In all participants, the adjusted odds of EM were 81% greater in individuals who were obese compared with those of normal weight (OR 1.81; 95% CI: 1.27–2.57; $p = 0.001$), with a significant trend of increasing odds of EM with increasing obesity status from normal weight to overweight to obese ($p = 0.001$). In addition, stratified analyses demonstrated that the odds of EM were greater in obese as compared with normal-weight individuals who were 1) younger than 50 years of age (OR 1.86; 95% CI: 1.20–2.89; p for trend = 0.008), 2) white (OR 2.06; 95% CI: 1.41–3.01; p for trend ≤ 0.001), or 3) female (OR 1.95; 95% CI: 1.38–2.76; p for trend ≤ 0.001).

Conclusion: The odds of EM are increased in those with obesity, with the strongest relationships among those younger than 50 years, white individuals, and women. *Neurology*® 2013;81:1314–1321

GLOSSARY

BMI = body mass index; **CI** = confidence interval; **DSM-IV** = *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition; **EM** = episodic migraine; **ICHD-II** = International Classification of Headache Disorders, 2nd edition; **LF-EM** = lower-frequency episodic migraine; **NCS-R** = National Comorbidity Survey Replication; **OR** = odds ratio; **VAT** = visceral adipose tissue; **VLF-EM** = very low-frequency episodic migraine.

Migraine prevalence estimates are greater in women than men,¹ white compared with black populations,² and reproductive-aged (18–49 years) individuals compared with prepubescent or older individuals.³ Likewise, substantial data support age, sex, and racial differences in overall adiposity (generally estimated using the body mass index [BMI] in epidemiologic studies) as well as the distribution of adipose tissue as superficial or deep depots.^{4–6}

Because obesity is a potentially modifiable risk factor, the migraine-obesity relationship has been a focus of recent research interest. However, there is considerable controversy as to whether this relationship extends to those with episodic migraine (EM) (≤ 14 headache days/month) in general or is limited to only those with chronic or high-frequency migraine.^{7–9}

Several factors may contribute to conflicting reports on the EM-obesity association, including sample differences across studies. For example, studies failing to demonstrate EM-obesity associations included adults of all ages, had study populations limited to only peri- or postreproductive-aged

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individuals, and/or had a nonrepresentative ethnic sample.^{10–13} In contrast, studies limited to reproductive-aged individuals have identified positive associations between migraine and obesity.^{14–17} None of these studies, however, specifically evaluated potential racial differences in the EM-obesity association. Thus, our primary aim was to evaluate the EM-obesity association and the influence of age, race, and sex on this relationship. We hypothesized that the odds of EM would be increased in individuals who are obese as compared with individuals of normal weight, and that this relationship would be strongest in 1) those younger than 50 years, 2) white individuals, 3) and women.

METHODS **Study population.** The National Comorbidity Survey Replication (NCS-R) is a nationally representative face-to-face household survey of English-speaking household residents aged 18 years and older in the United States, conducted from February 2001 through April 2003. Participants were selected from a multistage area probability sample of noninstitutionalized, civilian population in the contiguous United States. The response rate was 70.9%. Recruitment to the initial interview began with a letter and study fact brochure mailed to sample households followed by an in-person visit by trained interviewers.^{18,19}

The survey was administered in 2 parts. The part I interview included sociodemographics, body composition, and mental disorders, and was administered to all respondents ($n = 9,282$). All participants who screened positive for any disorder in part I, plus approximately a 1-in-3 random probability subsample of other participants, received the part II interview ($n = 5,692$). Part II interviews included questions about physical disorders including migraine, other impairments, and correlates.

The sample was weighted to adjust for differential probability of selection, differential sampling into part II, and residual discrepancies between sample and census population sociodemographic and geographic distributions. All weighted analyses are rounded to the nearest person. A more detailed discussion of NCS-R sampling methods and weighting has been previously provided.^{18,19}

Standard protocol approvals and patient consents. The NCS-R protocol, including recruitment and consent procedures, was approved by the human subjects committees of Harvard Medical School and the University of Michigan.

Body mass index. Participants were asked to self-report their height in inches and weight in pounds. Based on this information, BMI values were calculated using the standard formula: $(\text{weight}/\text{height}^2) \times 703$. BMI was characterized based on the World Health Organization standards for BMI: <18.5 (underweight), 18.5–24.9 (normal weight), 25.0–29.9 (overweight), and ≥ 30.0 kg/m² (obese).

Migraine assessment. Participants were asked whether they ever experienced “frequent or severe headaches.” Participants reporting headaches in the past but not within the prior 12 months were categorized as nonactive headache and excluded. Those who reported never experiencing headaches in the past, including the prior 12 months, were categorized as nonheadache controls (hereinafter referred to as controls). Those who answered affirmatively were asked whether such headaches occurred in the prior 12 months. Participants responding affirmatively were asked more detailed

questions regarding headache duration, location, severity, quality, frequency, presence of nausea and/or vomiting, and presence of photophobia or phonophobia. Aggravation of pain by activity was not assessed. Additionally, participants were asked whether they experienced a visual aura (“spots, lines, or heat waves”) before their headaches began.

Participants reporting ≤ 168 headache days per year were categorized as episodic headache participants. Participants with episodic headache fulfilling the International Classification of Headache Disorders, 2nd edition (ICHD-II) criteria for EM were included. A detailed comparison of the NCS-R headache questions with the ICHD-II criteria has been previously described.^{20,21} According to the ICHD-II criteria for EM, those participants with >168 headache days per year were not included. Additional analyses were conducted for the subgroup of EM participants with lower headache frequencies (i.e., excluding participants with high-frequency EM) as well as for the subgroup of EM participants with and without aura. EM participants reporting headaches ≤ 108 days/year were categorized as lower-frequency EM (LF-EM), and those with ≤ 60 headache days/year as very low-frequency EM (VLF-EM). Participants with EM responding affirmatively to experiencing a visual aura were categorized as EM with aura and those responding negatively as EM without aura.

Covariates Sociodemographic characteristics included age, sex, race, marital status, education in years, poverty index, and smoking. Race was self-reported as white, black or African American, Asian, or other. Given the limited sample size of individuals of nonwhite/nonblack races in the NCS-R, Asian and other races were excluded from further analyses. Poverty index was characterized based on the participant’s reported income level being above or below the sample median (400% of the federal poverty level). Smoking was self-reported as never, former, or current. Hypertension and diabetes were assessed by self-report of a physician diagnosis. Finally, given the association between depression and both migraine and obesity,^{22,23} DSM-IV major depressive disorders in the past 12 months were assessed with the World Health Organization’s Composite International Diagnostic Interview version 3.0, a fully structured, lay-administered, diagnostic interview. A previous clinical reappraisal study using the DSM-IV Axis I Disorders, Research Version, Non-patient Edition of the Structured Clinical Interview for DSM-IV found generally good concordance with Composite International Diagnostic Interview diagnoses.²⁴

Statistical analysis. Statistical analyses were performed using SAS 9.3 (SAS Institute, Cary, NC). Demographic and health characteristics were compared between controls and episodic migraineurs by linear regression for normally distributed continuous variables and by χ^2 test for categorical variables. Putative confounding variables (including age, race, sex, poverty index, smoking, depression, and diabetes) were included in multivariable logistic regression models. Logistic regression models were used to estimate odds ratios (ORs) of EM according to BMI categories (underweight, overweight, normal weight [reference], and obese). Additional regression models were stratified by age (<50/ ≥ 50 years of age), race (white/black), and sex (male/female). Tests for trend were conducted to assess linear increases in odds of migraine across the normal, overweight, and obese categories. All analyses were repeated for lower-frequency (LF-EM and VLF-EM) and aura subgroups.

RESULTS **Participants.** A total of 4,709 adult participants of both black and white race had complete headache, BMI, and covariate data. Of these, 492 participants without active headache, 121 with

chronic daily headache, and 234 participants with nonmigraine episodic headache were excluded. Thus, a total of 3,862 participants of both black and white race with an average age of 46.6 ± 0.63 years (range 18–98 years) were included in the analyses. Sociodemographic characteristics are presented in table 1.

A total of 188 participants fulfilled criteria for EM and the mean headache frequency was 40.8 ± 3.1 headache days per year; $43.3\% \pm 3.9\%$ reported a visual aura. The mean yearly headache frequencies in the lower-frequency EM subgroups were 33.5 ± 2.3 (LF-EM) and 22.3 ± 1.3 (VLF-EM) headache days/year; $42.5\% \pm 4.2\%$ of the LF-EM subgroup and

Table 1 Demographics and covariates of black and white controls and participants with episodic migraine in the National Comorbidity Survey Replication, 2001–2003

	Total (N = 3,862)		Controls (n = 3,674)		Episodic migraine (n = 188)		p Value
	No.	% (SE)	No.	% (SE)	No.	% (SE)	
Age, y, mean (SE)	46.6 (0.63)		47.0 (0.64)		38.9 (0.65)		<0.001
Age <50 y	2,265	58.6 (1.5)	2,116	57.6 (1.6)	149	79.1 (2.5)	<0.001
Age ≥50 y	1,598	41.4 (1.5)	1,559	42.4 (1.6)	39	20.9 (2.5)	
Sex							
Men	1,921	49.7 (1.1)	1,883	51.2 (1.1)	38	20.3 (1.7)	<0.001
Women	1,941	50.3 (1.1)	1,791	48.8 (1.1)	150	79.7 (1.7)	
Race							
White	3,303	85.5 (1.4)	3,126	85.1 (1.4)	176	93.7 (1.6)	<0.001
Black	559	14.5 (1.4)	548	14.9 (1.4)	12	6.3 (1.6)	
Marital status							
Married/cohabitating	2,174	56.3 (1.5)	2,068	56.3 (1.6)	106	56.3 (3.8)	0.49
Never married	826	21.4 (1.0)	780	21.2 (1.1)	45	24.2 (3.2)	
Divorced/separated/widow	863	22.3 (1.4)	826	22.5 (1.4)	37	19.5 (2.4)	
Education, y							
<12	544	14.1 (0.9)	509	13.9 (0.9)	34	18.4 (2.7)	0.13
12	1,242	32.1 (1.3)	1,180	32.1 (1.3)	62	32.8 (2.4)	
13–15	1,115	28.9 (0.9)	1,061	28.9 (0.9)	54	28.7 (2.7)	
≥16	962	24.9 (1.2)	924	25.1 (1.2)	38	20.1 (2.2)	
Poverty status							
Below median	1,806	46.7 (1.4)	1,698	46.2 (1.4)	108	57.2 (4.2)	0.011
Above median	2,057	53.3 (1.4)	1,977	53.8 (1.4)	81	42.8 (4.2)	
Smoking							
Never	1,948	50.5 (1.2)	1,868	50.8 (1.2)	80	42.6 (3.0)	0.001
Former	986	25.5 (1.3)	944	26.7 (1.3)	42	22.3 (3.3)	
Current	928	24.0 (0.8)	862	23.5 (0.8)	66	35.1 (3.3)	
Hypertension	971	25.1 (0.9)	919	25.0 (0.9)	52	27.5 (3.0)	0.47
Diabetes	298	7.7 (0.6)	292	7.9 (0.6)	6	3.2 (0.8)	<0.001
MDD, 12 mo	208	5.4 (0.4)	168	4.6 (0.4)	40	21.4 (2.3)	<0.001
BMI, kg/m ² , mean (SE)	27.1 (0.16)		27.1 (0.64)		27.8 (0.30)		0.05
BMI categories							
Underweight (BMI <18.5)	129	3.3 (0.4)	125	3.4 (0.4)	4	2.1 (1.0)	0.076
Normal (BMI 18.5–24.9)	1,424	36.9 (0.9)	1,352	36.8 (0.9)	71	38.0 (2.8)	
Overweight (BMI 25–29.9)	1,306	33.8 (0.8)	1,254	34.1 (0.9)	52	27.7 (3.0)	
Obese (BMI ≥30)	1,004	26.0 (1.1)	943	25.7 (1.1)	61	32.2 (2.5)	

Abbreviations: BMI = body mass index; MDD = major depressive disorders; SE = standard error.

43.1% $\pm$ 5.2% of the VLF-EM subgroup reported a visual aura.

Participants with EM were younger and more likely to be female and white than controls (table 1). Participants with EM were less likely to be above the median poverty index and to have diabetes, and were more

likely to have depression and to be current smokers compared with controls (table 1). There were similar findings in both lower-frequency EM subgroups (table e-1 on the *Neurology*[®] Web site at www.neurology.org).

Obesity. The mean BMI was greater in those with EM (27.8 $\pm$ 0.30 kg/m²) compared with controls (27.1 $\pm$ 0.4 kg/m²; p = 0.05). The unadjusted prevalence estimate of obesity was 32.2% among those with EM and 26.0% among controls (p = 0.18). After multivariable adjustments for demographics including age, sex, and race as well as covariates (poverty index, smoking, diabetes, and depression), the odds of EM were 81% greater in participants who were obese (OR 1.81; 95% confidence interval [CI]: 1.27–2.57) compared with those of normal weight (p = 0.001; figure). In addition, a significant trend of increasing odds of EM with increasing obesity status from normal weight to overweight to obese was found (p = 0.001; table 2). Similar findings were demonstrated for each of the lower-frequency EM subgroups of total EM participants (table 2). There were no significant increases in the mean headache frequency (normal 43.8 $\pm$ 42.3, overweight 39.2 $\pm$ 35.6, obese 42.3 $\pm$ 45 headache days/year; p = 0.37) in participants with EM based on obesity status from normal to overweight to obese (p = 0.37), or between participants of normal weight and those with EM who were obese (p = 0.67). Similarly, there was no significant change in the presence of visual aura (normal 37.5% $\pm$ 3.8%, overweight 40.1% $\pm$ 6.5%, obese 50.8% $\pm$ 5.9%) based on obesity status from normal to overweight to obese (p = 0.27), or between participants of normal weight and those with EM who were obese (p = 0.08). Similar findings were demonstrated for the lower-frequency EM subgroups of total EM participants.

Age, race, and sex influence on the EM-obesity association. Age-, race-, and sex-stratified, multivariable-adjusted results demonstrated increased odds of EM in participants who were obese as compared with participants of normal weight among those who were 1) younger than 50 years (OR 1.86; 95% CI: 1.20–2.89; p = 0.006), 2) white (OR 2.06; 95% CI: 1.41–3.01; p = 0.0002), and 3) female (OR 1.95; 95% CI: 1.38–2.76; p = 0.0002; figure). A significant trend of increasing odds of EM with increasing obesity status from normal to overweight to obese was identified in those who were younger than 50 years (p for trend = 0.008), white (p for trend $\leq$ 0.001), and female (p for trend $\leq$ 0.001; table 3). Similar results were found in both lower-frequency EM subgroups (table e-2).

The odds of EM were not increased in obese participants 50 years and older or men (table 3). Because of the small number of black participants with EM, reliable interpretation of the odds of EM in black participants

Figure Adjusted total and stratified ORs and 95% CIs of episodic migraine in NCS-R participants who were overweight and obese

ORs are shown on a log scale; boxes represent the ORs and the horizontal bars the 95% CIs. Total = all NCS-R participants adjusted for age, race, sex, smoking, poverty index, depression, and diabetes; all other models are adjusted for smoking, poverty index, depression, and diabetes, as well as for age, race, and sex when not stratified on the variable. Older = 50 years and older; obese = BMI $\geq$ 30 kg/m²; over = overweight (BMI 25–29.9 kg/m²); younger = younger than 50 years. BMI = body mass index; CI = confidence interval; EM = episodic migraine; NCS-R = National Comorbidity Survey Replication; OR = odds ratio.

Table 2 Multivariable-adjusted odds of episodic migraine and lower-frequency EM subgroups by obesity status in the National Comorbidity Survey Replication

	EM			Only LF-EM			Only VLF-EM		
	No. (%)	OR (95% CI)	p Value	No. (%)	OR (95% CI)	p Value	No. (%)	OR (95% CI)	p Value
Underweight	4 (3.0)	0.50 (0.17–1.50)	0.22	4 (2.7)	0.49 (0.16–1.50)	0.21	4 (2.7)	0.61 (0.19–1.90)	0.39
Normal weight	72 (5.0)	Ref.		66 (4.7)	Ref.		54 (3.8)	Ref.	
Overweight	52 (4.0)	1.28 (0.86–1.91)	0.22	51 (3.9)	1.36 (0.89–2.06)	0.15	45 (3.4)	1.50 (0.98–2.31)	0.06
Obese	61 (6.1)	1.81 (1.27–2.57)	0.001	56 (5.6)	1.83 (1.26–2.65)	0.002	47 (4.8)	1.89 (1.29–2.78)	0.001
P _{trend}		0.001			0.002			<0.001	

Abbreviations: BMI = body mass index; CI = confidence interval; EM = episodic migraine; LF-EM = lower-frequency EM; OR = odds ratio; Ref. = reference; VLF-EM = very low-frequency EM.

All regression results are adjusted for age, race, sex, smoking, poverty index, depression and diabetes. Underweight = BMI <18.5; normal weight = BMI 18.5–24.9; overweight = BMI 25–29.9; obese = BMI ≥30 kg/m². EM included EM participants of all frequencies (i.e., ≤168 headache days/year). LF-EM included only the subgroup of total EM participants with ≤108 headache days/year, and VLF-EM included only the subgroup of total EM participants with ≤60 headache days/year. The *p*_{trend} is the effect of increasing obesity status on odds of EM as the BMI category increases from normal weight to obese.

alone with obesity was not possible (table 3). Similar results were found in both lower-frequency EM subgroups (table e-2).

DISCUSSION We conducted an in-depth, cross-sectional, multivariable analysis of general population data from the NCS-R to further investigate the association between EM and obesity status by BMI, while simultaneously considering the influences of age, race, and sex on observed associations. Our study has 4 main findings. First, we found that the odds of EM in general are increased in those with obesity, and that this increased odds is significant even in those with lower headache frequencies. After adjustments for confounders, the odds of EM in general were increased by 81%, and the odds of lower-frequency EM increased by 83% to 89% in those with obesity as compared with individuals of normal weight.

Second, our stratified results corroborate the previous evidence suggesting that the EM-obesity association is among reproductive-aged individuals but not older individuals.^{14–16} We found that the odds of migraine were increased by 86% in those younger than 50 years with obesity and were not increased in individuals 50 years and older with obesity. Although poorly acknowledged in the current literature, no study of individuals of postreproductive age has found a positive association between migraine and obesity.^{11–13,16} Taken together with our current findings, this suggests that the lack of association observed in migraine-obesity studies limited to individuals of peri- and postreproductive age are not generalizable to the population at greatest risk of migraine—those of predominantly reproductive age (18–49 years).

Third, while the odds of EM in participants with obesity including both black and white participants was increased by 81%, the odds of EM were 2-fold higher when analyses were limited to only white participants

with obesity. Thus, excluding the black participants from analyses (in whom the prevalence of migraine is lower than in white participants) does not change the significance of the odds of EM in white individuals as compared with the complete sample.

Finally, our findings suggest that the odds of EM are increased in obese women but not in obese men. While this finding may indicate that the association between EM and obesity is absent in men, more likely, this suggests that the relationship is merely stronger in women than men. Corroborating research is needed to determine whether this is the case.

Mechanisms for the association of migraine and obesity are not known. However, to some extent, the sex, age, and race differences in the distribution and volume of body fat and the different metabolic function of adipocytes from different fat depots may explain our findings.

After puberty, both black and white females develop more total body fat as well as more subcutaneous adipose tissue and less visceral adipose tissue (VAT) than males.⁴ Additionally, VAT volumes may be greater in obese white women as compared with obese black women.^{25,26} Furthermore, around 50 years of age, women of both races have an increase in VAT and develop a fat pattern more similar to men.^{16,27} The secretion of several inflammatory-related proteins from adipocytes (e.g., interleukin-6, adiponectin), several of which have been implicated in migraine, differ based on obesity status (i.e., obese/nonobese) and the depot location of the adipocyte.^{4,28} Thus, it is possible that in states of obesity, the age, sex, and race differences in adipose tissue volume and distribution modulate the secretion and production of these inflammatory-related proteins from adipocytes in such a manner as to promote or inhibit migraine.

It is also possible that having migraine predisposes individuals to developing obesity. Specifically, migraine

Table 3 Age-, sex-, and race-stratified ORs of EM by obesity status in the National Comorbidity Survey Replication

	Age			Sex			Race		
	<50 y (n = 2,326)			≥50 y (n = 1,356)			Men (n = 1,921)		
	No. (%)	OR (95% CI)		No. (%)	OR (95% CI)		No. (%)	OR (95% CI)	
Underweight	4 (4.7)	0.50 (0.15–1.69)		0 (0)			4 (3.4)	0.56 (0.19–1.70)	
Normal weight	58 (6.3)	Ref.		14 (2.7)	Ref.		57 (7.1)	Ref.	
Overweight	39 (5.5)	1.21 (0.77–1.91)		13 (2.2)	0.92 (0.52–1.63)		41 (7.9)	1.58 (1.10–2.27)	
Obese	49 (8.7)	1.86 (1.20–2.89)		12 (2.7)	1.15 (0.61–2.18)		48 (9.7)	1.95 (1.38–2.76)	
P _{trend}		0.008			0.71			<0.001	
								0.45	
								<0.001	

Abbreviations: BMI = body mass index; CI = confidence interval; EM = episodic migraine; OR = odds ratio; Ref. = reference. All models are adjusted for smoking, poverty index, depression, and diabetes, as well as for age, sex, and race when not stratified on the variable. Underweight = BMI <18.5; normal weight = BMI 18.5–24.9; overweight = BMI 25–29.9; obese = BMI ≥30 kg/m². The P_{trend} is the effect of increasing obesity status on odds of EM as BMI category increases from normal weight to obese.

could drive the development of obesity as a result of migraine-related pathophysiologic changes (e.g., serotonin decreases the drive to feed, and serotonin may be low in migraineurs interictally) or as a consequence of medications and/or lifestyle choices, such as decreased activity, associated with weight gain.^{29,30}

This study has several strengths. First, the NCS-R permitted the assessment of the association between migraine and obesity, and the influence of sex, race, and age on this relationship, in a large population-based sample that is not subject to the biases inherent in clinical samples. Second, migraine diagnoses were based on standardized diagnostic criteria. Third, the NCS-R permitted the exclusion of both those with nonmigraine headache and nonactive migraine from the control group. This may have increased the ability to detect an association between migraine and obesity, in contrast to previous studies that included nonmigraine headache and/or nonactive migraine participants in control groups.

However, there are several limitations of the current study to be considered when interpreting our results. First, BMI was calculated based on self-reported height and weight. This could result in nondifferential errors. For example, previous research has demonstrated that participants underestimate their weight (and thus their BMI) when self-reported.^{31,32} Misclassification of BMI, unrelated to migraine status, would thus have biased ORs toward no association. It is also possible that differential errors may occur with the use of self-reported BMI. For example, migraineurs may receive more medical care and be more likely to be aware of recent accurate weight measurements, thus biasing ORs toward stronger associations. However, one previous clinical trial demonstrated that even migraineurs under medical care underreported their weight and BMI when self-reported as compared with when measured.³¹ Furthermore, given that all but 2 of the previous epidemiologic general population studies evaluating the migraine-obesity association also utilized self-reported BMI, this methodologic feature is unlikely to explain cross-study differences.

Second, although we were able to examine the ORs of EM in obese white and black participants combined and in white participants alone, given the limited numbers of black EM participants in the NCS-R, we are unable to draw reliable conclusions about the EM-obesity association in the black population. Additionally, given the initial headache screening question used in the NCS-R, these results may not be generalizable to episodic migraineurs with less severe headaches. Additionally, although the headache questions in the NCS-R are based on the ICHD-II criteria, these questions have not been validated in comparison to a physician diagnosis of ICHD-II migraine. Finally, as with previous general population studies examining this association, our results may

not be generalizable to patterns in other countries because of differences in obesity prevalence estimates across countries.

Taken together, our findings indicate that the risk of episodic migraine (of all frequencies) is increased in those with obesity, with the strongest association among those younger than 50 years, those who are white, and women. These findings suggest that clinicians treating patients with EM should promote healthy lifestyle choices regarding diet and exercise routines, as well as take particular care in their choices of medications prescribed to their patients with EM given that many can affect weight positively or negatively.^{7,9} Further research evaluating the impact and efficacy of weight-loss programs in episodic migraineurs who are overweight or obese is warranted.

AUTHOR CONTRIBUTIONS

B. Lee Peterlin, DO: study conception and design, data interpretation, primary authorship of manuscript, approval of final manuscript. Andrea L. Rosso, PhD: study design, data analysis, data interpretation, revision of manuscript for intellectual content, approval of final manuscript. Michelle A. Williams, ScD: study conception, data interpretation, revision of manuscript for intellectual content, approval of final manuscript. Jason R. Rosenberg, MD, and Jennifer A. Haythornthwaite, PhD: data interpretation, revision of manuscript for intellectual content, approval of final manuscript. Kathleen R. Merikangas, PhD: acquisition of data, data interpretation, revision of manuscript for intellectual content, approval of final manuscript. Rebecca F. Gottesman, MD, PhD: data analysis and interpretation, revision of manuscript for intellectual content, approval of final manuscript. Dale S. Bond, PhD, and Jian-Ping He, MD: data interpretation, revision of manuscript for intellectual content, approval of final manuscript. Alan B. Zonderman, PhD: study design, data analysis and interpretation, revision of manuscript for intellectual content, approval of final manuscript.

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The views and opinions expressed in this report are those of the authors and should not be construed to represent the views of any of the sponsoring organizations, agencies, or US Government.

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