Published in final edited form as:

Headache. 2011 February ; 51(2): 208–219. doi:10.1111/j.1526-4610.2010.01777.x.

Association Between Intimate Partner Violence, Migraine and Probable Migraine

Swee May Cripe, Sixto E. Sanchez, Bizu Gelaye, Elena Sanchez, and Michelle A. Williams

University of Washington School of Public Health, Seattle; Instituto Nacional de Salud, Lima, Peru,; Proyectos Salud & Consultores E.I.R.L., Lima, Peru

Abstract

Objective—Intimate partner violence (IPV) among women is a global public health problem. The association between childhood maltreatment and migraine is well established, but not the association between IPV and migraine. The aim of this cross-sectional study was to evaluate the relationship between type and severity of IPV and migraine in a large cohort of Peruvian women.

Methods—Women who delivered singleton infants (N=2,066) at the Instituto Nacional Materno Perinatal, Lima, Peru were interviewed during their post-partum hospital stay. Participants were queried about their lifetime experiences with headaches and migraine, and with physical and sexual violence. The International Classification of Headache Disorders (ICHD-2) diagnostic criteria were used to classify participants according to their migraine status. Questions on physical and sexual violence were adapted from the protocol of Demographic Health Survey Questionnaires and Modules: Domestic Violence Module and the World Health Organization (WHO) Multi-Country Study on Violence against Women. Depressive symptoms were assessed using the nine-item Patient Health Questionnaire Depression Subset. Logistic regression was used to estimate multivariate adjusted odds ratios (aOR) and 95% confidence intervals (CI).

Results—Compared with women without a history of violence, women with experiences of lifetime physical or sexual violence (aOR=1.44, 95% CI 1.19–1.75), physical violence only (aOR=1.36, 95% CI 1.10–1.68), sexual violence only (aOR=1.76, 95% CI 0.97–3.21) and both physical and sexual violence (aOR=1.61, 95% CI 1.12–2.31) had increased odds of any migraine after adjusting for maternal age, parity and access to basic foods. There was no gradient of increased odds of any migraine with severity of physical violence. The relationship between IPV and any migraine was strongest among women with depressive symptoms. The odds of any migraine was increased 2.25-fold (95% CI 1.75–2.28) among abused women who also had depressive symptoms compared with non-abused and non-depressed women. Associations from sensitivity analyses that segregated women according to probable migraine (ICHD-2 category 1.6.1) and migraine (ICHD-2 category 1.1) diagnoses were of similar magnitudes as those reported here for women with any migraine diagnoses. IPV, particularly sexual violence, appears to be a risk factor for migraine.

Conclusion—Our findings suggest the potential importance of considering a history of violence among migraineurs.

INTRODUCTION

Intimate partner violence (IPV) includes physical violence, sexual violence, threats of physical or sexual violence and emotional abuse. The term “intimate partner” includes current and former spouses and dating partners. The global prevalence of IPV among

women is well established.^{1–4} In the recent World Health Organization (WHO) multi-country study on domestic violence, the lifetime prevalence of any physical or sexual partner violence varied from 15% to 71%.^{1, 5} Peru is one of the countries surveyed with a high prevalence of IPV. A recent cross-sectional violence survey among post-partum women in Lima, Peru, found that the lifetime experience of any IPV (physical, psychological, or sexual violence) was 45%.⁶ In this study,⁶ prevalence estimates of intimate partner lifetime physical, psychological, and sexual violence were 34%, 28% and 8%, respectively. Notably, 21% of women surveyed reported experiencing any IPV during the current pregnancy, including 11% reporting any physical violence, 16% reporting any psychological violence, and 4% reporting any sexual violence.⁶ Prevalence of violence during pregnancy in both developing and developed countries has been reported to be between 1% and 40%.^{7–10}

Migraine, a recurrent primary headache disorder is particularly common among women of childbearing age.¹¹ Studies of migraine during pregnancy have reported that preexisting migraine may diminish or disappear in majority of pregnant women, or remain unchanged, worsen or appear for the first time during pregnancy.^{12, 13} A prior study¹⁴ reported the lifetime prevalence of migraine in a sample of pregnant Peruvian women to be 29% (95% confidence interval (CI) 22%–36%), as defined by modified International Classification of Headache Disorders (ICHD-2) diagnostic criteria.

Women who have experienced violence often suffer long-term physical and mental health problems that are not always obvious or identified as consequences of violence.^{15–18} Migraine has been reported to be associated with childhood violence and intimate IPV.^{19–25} Results from these studies^{19–25} suggest that physical and sexual violence, and emotional abuse may be risk factors for migraine and headaches. However, one limitation of these studies is the lack of a general population control without migraine. In addition, to the best of our knowledge, no study has investigated the relationship between IPV and migraine among women, especially in countries with high prevalence of IPV, such as Peru.^{5, 6} Therefore, we examined the associations between lifetime experiences of IPV (physical or sexual violence, physical violence only, sexual violence only, and both physical and sexual violence) and migraine in a cohort of Peruvian women. We hypothesized that women with a history of IPV were more likely than women without a history of IPV to have migraine and that this relationship may be modified by depressive symptoms.

METHODS

Subjects

This cross-sectional investigation is part of a larger study that included 2,392 women who delivered at the Instituto Nacional Materno Perinatal (INMP) in Lima between August 11, 2005 and June 30, 2006. The INMP is a government hospital that provides services to low-income women, and women with high-risk pregnancies residing in Lima. Women were recruited and interviewed during their post-partum hospital stay. The participation rate was 99%. Only women between the ages of 15–49 years, and who spoke and understood Spanish were included in the study. Written consents were obtained from all participants. The institutional review boards of INMP, Lima and the University of Washington, Seattle approved this study.

Data collection

Women were interviewed in private using a structured Spanish-language questionnaire that collected information on sociodemographic factors, lifetime experience with IPV, characteristics of headache, and depressive symptoms. Participants' age were categorized as

follows: <20, 20–29, 30–34, and 35 years. Educational attainment was categorized as 6, 7–12, and >12 years of education. Other sociodemographic variables were categorized as follows: marital status (married and living with husband vs. others); parity (first live birth vs. multiparous); race (Mestizo vs. others); housing status (home owner vs. others); access to basic foods (limited [i.e., great difficulty or difficulty in accessing basic foods] vs. somewhat limited or no limitations [i.e., somewhat difficult or no difficulty in accessing basic foods]); employment (yes vs. no), prenatal care (yes vs. no), first prenatal care visit (first trimester vs. others), consumption of prenatal care vitamins (yes vs. no), and unplanned index pregnancy (most recent pregnancy or pregnancy during study period) (yes vs. no).

Measures

Intimate partner violence—Questions on IPV were adapted from the protocol of Demographic Health Survey Questionnaires and Modules: Domestic Violence Module²⁶ and the World Health Organization (WHO) Multi-Country Study on Violence against Women.¹ Women were assessed for a range of physical and/or sexual coercive acts used against them by a current or former husband or intimate partner without their consent. Women who reported experiencing any of the following were classified as having experienced moderately severe physical violence: slapping, arm twisting, throwing things, pushing or shoving. Women who reported experiencing any of the following acts were classified as having experienced severe physical violence: hitting, kicking, dragging or beating, choking or burnt on purpose, or threatening to use or actually use a weapon (such as, gun, knife, or other object). Sexual violence was assessed by two items: use of physical force to have sexual intercourse and forced to perform other sexual acts that the respondent did not want to. In this study, women were categorized as having experienced one or more acts of physical or sexual violence, physical violence only, sexual violence only, or both physical and sexual violence at any time from a current or former male partner. All study personnel were trained on interviewing skills, contents of the questionnaire, and ethical conduct of violence research (including issues of safety and confidentiality). Interviewers were trained to refer women who are in physically dangerous situations and/or need counseling to psychologists at local women's organizations, hospital psychiatrists, and battered women's shelters.

Migraine—All women were queried if they suffered headaches repeatedly the past four to five years, and if yes, whether they suffered from headache everyday. Headache classification was determined using the modified ICHD-2 criteria for migraine without aura.²⁷ “Migraine” (ICHD-2 category 1.1) was defined by at least five lifetime headache attacks lasting 4–72 hours, with at least two of the qualifying pain characteristics (unilateral location, pulsating quality, moderate or severe pain intensity, aggravation by routine physical exertion), at least one of the associated symptoms (nausea and/or vomiting, photo/phonophobia), and not readily attributable to another central nervous system disorder or head trauma (according to subject self-report). “Probable migraine” (ICHD-2 category 1.6.1) was designated if all but one of the migraine without aura criteria were fulfilled, excluding headaches attributable to another disorder. Women with “any migraine” refers to the combination of both women with migraine and probable migraine.

Depressive symptoms—Depressive symptomatology during pregnancy was evaluated using the Patient Health Questionnaire-9 (PHQ-9).²⁸ The PHQ-9 has been demonstrated to be a reliable tool for assessing psychosocial stressors among obstetrics-gynecology patients^{29, 30} and in Spanish-speaking women.³¹ We used a modified Spanish version of the PHQ-9 used by Wulsin et al.³¹ To evaluate depressive symptoms over the pregnancy period, we used response options of a) never; b) several weeks, over the pregnancy; c) more than

half the pregnancy; or d) nearly the whole pregnancy. This modified version of the PHQ-9 has not been validated. Data were imputed for participants (n=58) with missing information for one or two items, by calculating the average score of all the items that the participant had responded to. Participants with missing information for more than two of the nine PHQ-9 items were excluded from the analysis (n=1). The PHQ-9 total score is the sum of scores for the nine items for each woman, and ranged from 0–27. Women were assigned to one of five depressive symptom categories based on total PHQ-9 score, (a) no depressive symptoms (0–4), (b) mild (5–9), (b) moderate (10–14), (c) moderately severe (15–19) and (d) severe (20–27) depressive symptoms. For the purpose of this study, we assigned women to one of two categories of depressive symptoms based on total PHQ-9 score, (a) no depressive symptoms (0–9) and (b) moderate to severe depressive symptoms (10–27).^{28, 32} Interviewers were trained to identify women at high risk of immediate danger of self-harm or injury at the hands of an intimate partner. In this study, 41% of all participants endorsed the suicide item. The headache and migraine questions and PHQ-9 have been used successfully in other studies of pregnant Peruvian women.^{14, 33}

Statistical analyses

Data were entered into EPI INFO (Version 3.3.2), and analyzed using SPSS (version 14.0, SPSS Inc., Chicago, IL, USA). Frequency distributions of maternal sociodemographic characteristics were examined. Multivariate adjusted logistic regression procedures were used to calculate maximum likelihood estimates of odds ratios (ORs) and 95% confidence intervals³⁴ of any migraine with exposure to any lifetime physical or sexual violence, physical violence only, sexual violence only, and both physical and sexual violence. We included covariates of *a priori* interest (i.e., maternal age, parity and access to basic foods) in the final multivariate adjusted logistic regression models. We conducted sensitivity analyses by segregating the migraineurs to women with probable migraine and women with migraine, and repeated the analysis using similar violence categories. We also looked for evidence of interaction between depressive symptoms and IPV. The interaction term was evaluated by a likelihood ratio test for adding the interaction parameter to the fully adjusted models. Women without exposure to any lifetime IPV and no depressive symptoms were the reference group in this analysis. All reported p-values are 2-tailed with statistical significance set at 0.05.

RESULTS

Of 2,392 participants, 2,339 delivered live born singleton infants. Women with hypertension (n=30) and those who delivered infants with gross malformation (n=43) were excluded as a means to control confounding by rare and unevenly distributed characteristics that are not amenable to control using multivariate modeling methods. Women reporting experience with emotional abuse only (n=197) were excluded because of well documented concerns about the limitations inherent in measuring emotional abuse.^{35–37} Finally, we excluded three women with missing information on key variables such as migraine status or depressive symptoms. Consequently, a total of 2,066 (86.4 %) women remained for analyses.

The prevalence of any migraine in this sample of women was 31.8%, with about one third of these classified as having migraine. The majority (>50%) of the women were between 20 and 29 years of age, had low levels of education (6 years), unmarried, Mestizo, with limited access to basic foods, and had an unplanned pregnancy. There were more migraineurs (39.1%) who were 30 years and older compared with non-migraineurs (28.7%) (Table 1).

Overall, the prevalence of IPV including any lifetime physical or sexual violence (47.0% vs. 36.2%), isolated physical violence (34.8% vs. 28.2%), isolated sexual violence (2.9% vs.

2.1%), and both physical and sexual violence (9.3% vs. 6.0%) were greater in migraineurs compared with non-migraineurs. Table 2 presents the results from adjusted logistic regression models for the associations between migraine and IPV categories. All models were adjusted for maternal age, parity and access to basic foods. Compared with non-abused women, those who experienced any lifetime violence (physical or sexual) had a 1.44-fold (95% CI 1.19–1.75) increased odds for any migraine, 1.38-fold increased odds for probable migraine (95% CI 1.12–1.69) and 1.46-fold (95% CI 1.19–1.75) increased odds for migraine. Both physical (OR=1.36; 95% CI 1.10–1.68) and sexual (OR=1.76; 95% CI 0.97–3.21) violence were associated with increased odds for any migraine. However, the association between sexual violence and any migraine was not statistically significant. Sexual violence was associated with a 2.5-fold increased odds (95% CI 1.11–5.68) for migraine. There was no gradient of increased odds in the severity of physical violence. The odds for any migraine was 1.61-fold higher among women who experienced both lifetime physical and sexual violence compared with non-abused women. Both lifetime physical and sexual violence was associated with increased odds for probable migraine (OR=1.71, 95% CI 1.14–2.55) and migraine (OR=1.37, 95% CI 0.75–2.50) (Table 2).

From previous findings among pregnant Peruvian women,³² depressive symptoms were associated with migraine. We, therefore, evaluated the extent to which IPV and maternal depressive symptoms were associated with migraine (Table 3). Compared with non-abused and non-depressed women, women with depressive symptoms only (AOR=1.38, 95% CI 1.06–1.79) were associated with increased odds for any migraine (AOR=2.25, 95% CI 1.75–2.88) and migraine (OR=1.78, 95% CI 1.17–2.71). Abused women with depressive symptoms had increased odds for any migraine (OR=2.25, 95% CI 1.75–2.28), probable migraine (OR=2.07, 95% CI 1.57–2.74) and migraine (OR=2.72, 95% CI 1.83–4.04) compared with non-abused and non-depressed women. There was no clear evidence of an increased odds for any migraine with experience of any physical or sexual violence when compared with the referent group. These findings suggest that the relationship between IPV and migraine was somewhat modified by the occurrence of maternal depressive symptoms.

DISCUSSION

Our study extends the literature by adding evidence of increased odds of any migraine, probable migraine and migraine in women with a history of violence by an intimate partner. This relationship was somewhat modified by the presence of maternal depressive symptoms as we had hypothesized *a priori*. We further observed that there was no gradient of increased risks of migraine in the severity of physical violence. Strength of this study includes having a control group of women without migraine and the use of ICHD-2 criteria for migraine classification.

Several limitations should be considered when interpreting our study results. First, experience with IPV, maternal depressive symptoms and migraine were assessed after delivery and based on self-reporting in this cross-sectional study. Therefore, these measures may be subjected to non-systematic errors in recall, as well as systematic non-disclosure leading to misclassification. Individuals in the United States or Peru are more likely to minimize experiences of past violence rather than suggest that they had experienced violence in their lifetime.^{6, 10, 38} Such errors in recall may have led to an underestimation of odds ratios. To help mitigate the likelihood of systematic reporting errors, well-trained interviewers used a standard questionnaire to collect information from study participants. Moreover, neither the interviewers nor study participants were aware of any of the specific study hypotheses. In addition, instrument used in this study to characterize migraine has well established psychometric properties in diverse Spanish-speaking study populations.¹⁴ However, the modified PHQ-9 used in this study has not been validated. Second, we did not

have information on the temporal relationship between the onset and end of the reported violence and the onset of migraine, which precludes the determination of causality in this relationship. In addition, we did not have data on onset of depression or lifetime history of depression. Prospective cohort studies that include clinical confirmation of participants' migraine status are needed to confirm causal inferences concerning the association between IPV and migraine. Third, the longer period of recall time (the pregnancy period) used in this study may lead to non-differential errors in the report of depressive symptomatology. However, the effect of this non-differential measurement error would most likely lead to an attenuation of the true association towards the null value.³⁹ As a result, the magnitude of associations reported in our study tend to be conservative estimates. Finally, despite controlling for potential confounders, residual confounding by factors not measured in our study (e.g., smoking, alcohol and illicit drug use by the women, and childhood maltreatment) may have influenced reported estimation of associations. However, the prevalence of smoking, alcohol and illicit drug use among pregnant women who access medical care at INMP has been found to be low.⁴⁰ Nevertheless, we cannot rule out residual confounding by these and other unmeasured covariates. We did not specifically ask women about childhood maltreatment, which has been reported to be associated with migraine and comorbid migraine and depression.^{22, 23, 41} Several studies have suggested that violence during childhood has a significant impact on adult health,^{21, 42} with greater effect if the violence is of long duration and continues into adulthood.^{18, 23, 43} Results from our hospital-based study may not be applicable to the general population of women because women seeking care at INMP are primarily from a low socioeconomic background and may have high-risk pregnancies. However, our study provides data on an important population in Peru.

The prevalence of lifetime physical or sexual violence in our sample of women with migraine at 47% is consistent with that reported in the literature for the general population.^{1, 5} Our findings of the violence-migraine relationship corroborate those from a number of studies that were based on clinic-based retrospective interviews.^{18, 24, 44, 45} Women (n=464) who had ever experienced physical and/or sexual violence had a 40% increased odds (95% CI 1.14–1.69) for migraine compared with women who never experienced any IPV.¹⁸ A small (n=30) pilot study⁴⁴ that examined physical and/or sexual violence history and chronic headache, reported headache pain developed in all the abused women after trauma began. Data from a community-based survey⁴⁵ of women (n=3,000) found that women who experienced adult physical violence had increased odds (OR=1.62, 95% CI 1.07–2.70) of headaches/migraine. Our findings suggest that women who experienced sexual violence only were more likely to have any migraine, probable migraine and migraine than women who experienced physical violence only. In addition, we found that women who experienced any lifetime physical or sexual violence and reported depressive symptoms were statistically significantly more likely to have migraine than their counterparts with any lifetime experiences of physical or sexual violence, or with depressive symptoms alone. Depressive symptoms are strongly associated with both IPV⁴⁶ and migraine.³² None of the published studies^{43, 47, 48} present data on the effect of depression on the violence-migraine relationship. However, studies of the relationship between childhood maltreatment and adult migraine have provided evidence for the effect of depression on this relationship. For example, Tietjen and collaborators found that the relationship of childhood maltreatment and chronic migraine frequency was dependent on depression.⁴¹ In other studies, these same authors reported that all types of childhood violence and neglect were strongly associated with current depression²³ and childhood physical violence-chronic migraine remained significant even after controlling for depression.²² It is unclear as to whether depressive symptoms are the result of experience with any lifetime physical or sexual violence or whether it is the result of comorbid disorder with migraine. Prospective cohort studies are needed to clarify these relationships.

Our findings together with those of other studies^{44, 49–51} lend support to a model of life stress as etiology factor involved in the development of migraine or headaches. Violence-related stress, for example, may act via one or both of two physiological pathways to affect maternal health outcomes, a neuroendocrine and an immune/inflammatory pathway. In the neuroendocrine pathway, violence-related stress leads to increases in hypothalamic-pituitary-adrenal (HPA) activity, one of the most robust pathophysiological findings associated with depressive disorders,^{52, 53} and increases the probability of developing chronic pain.^{54, 55} Whereas in the immune/inflammatory pathway, chronic systemic inflammation and related endothelial dysfunction (reflected by elevated plasma C-reactive protein, platelet hyperactivity, and other pro-inflammatory markers) have been observed among both individuals with depressive disorders^{56–58} and migraine.^{59–65} Findings from the few studies that have evaluated such hypotheses suggest that chronic systemic inflammation^{66, 67} and dysregulation of the HPA axis^{68–71} may help to explain adverse sequelae of violence.

We did not examine the association of isolated emotional abuse with migraine because the two-question measure (humiliation and threat) used in this study provided only a crude measure of this type of violence. There is no universal definition for emotional abuse.^{35, 72} Moreover, definitions and measures of emotional abuse that have been developed and validated in western cultures may not be applicable across all cultures.⁷³ What constitutes emotional abuse varies greatly from one culture to another. While we did not examine the association of isolated emotional abuse with migraine, an analysis of any lifetime violence that included physical, sexual or emotional abuse resulted in estimates of association similar in magnitude to that reported here for any lifetime physical or sexual violence. In addition, associations between emotional abuse in childhood and both chronic (OR=1.77, 95% CI 1.19–2.62) and transformed migraine (OR=1.89, 95% CI 1.25–2.85) has been reported,²² but not adult emotional abuse.

For women with migraine, screening for past and current IPV during medical consultation is of great value. If the violence is ongoing, treatment for migraine needs to be provided. Furthermore, women need to be offered appropriate interventions that can help mitigate the occurrence and consequences of violence. If the violence has ended, then screening for past IPV is still important to investigate its possible etiologic role in migraine, and for integral treatment of neurologic and psychiatric disorders.^{24, 74}

Acknowledgments

This research was supported by awards from the National Institutes of Health (NIH), National Institute of Minority Health and Health Disparities (T37-MD-001449) and the *Eunice Kennedy Shriver* Institute of Child Health and Human Development (R01-HD-055566). The NIH had no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

References

1. Garcia-Moreno, C.; Jansen, HAFM.; Ellsberg, M.; Heise, L.; Watts, C. WHO Multi-country Study on Women's Health and Domestic Violence against Women. Initial results on prevalence, health outcomes, and women's responses. Geneva: World Health Organization; 2005.
2. Tjaden, P.; Thoennes, N. Full report of the prevalence, incidence, and consequences of violence against women. Washington, DC: U.S. Department of Justice; Nov. 2000 (Report No. NCJ 183781). 2000
3. Heise, L.; Ellsberg, M.; Gottemoeller, M. Ending violence against women. Baltimore, MD: Johns Hopkins University Press; 1999.
4. Krug EG, Mercy JA, Dahlberg LL, Zwi AB. The world report on violence and health. *Lancet*. 2002; 360:1083–1088. [PubMed: 12384003]

5. Garcia-Moreno C, Jansen HA, Ellsberg M, Heise L, Watts CH. Prevalence of intimate partner violence: findings from the WHO multi-country study on women's health and domestic violence. *Lancet*. 2006; 368:1260–1269. [PubMed: 17027732]
6. Perales MT, Cripe SM, Lam N, Sanchez SE, Sanchez E, Williams MA. Prevalence, types, and pattern of intimate partner violence among pregnant women in lima, peru. *Violence Against Women*. 2009; 15:224–250. [PubMed: 19126836]
7. Castro R, Peek-Asa C, Ruiz A. Violence against women in Mexico: a study of abuse before and during pregnancy. *Am J Public Health*. 2003; 93:1110–1116. [PubMed: 12835194]
8. Valladares E, Pena R, Persson LA, Hogberg U. Violence against pregnant women: prevalence and characteristics. A population-based study in Nicaragua. *Br J Obstet Gynaecol*. 2005; 112:1243–1248.
9. Johnson JK, Haider F, Ellis K, Hay DM, Lindow SW. The prevalence of domestic violence in pregnant women. *BJOG*. 2003; 110:272–275. [PubMed: 12628266]
10. Gazmararian JA, Lazorick S, Spitz AM, Ballard TJ, Saltzman LE, Marks JS. Prevalence of violence against pregnant women. *JAMA*. 1996; 275:1915–1920. [PubMed: 8648873]
11. Lipton RB, Bigal ME, Diamond M, Freitag F, Reed ML, Stewart WF. Migraine prevalence, disease burden, and the need for preventive therapy. *Neurology*. 2007; 68:343–349. [PubMed: 17261680]
12. Adeney KL, Williams MA. Migraine headaches and preeclampsia: an epidemiologic review. *Headache*. 2006; 46:794–803. [PubMed: 16643583]
13. Menon R, Bushnell CD. Headache and pregnancy. *Neurologist*. 2008; 14:108–119. [PubMed: 18332840]
14. Adeney KL, Flores JL, Perez JC, Sanchez SE, Williams MA. Prevalence and correlates of migraine among women attending a prenatal care clinic in Lima, Peru. *Cephalalgia*. 2006; 26:1089–1096. [PubMed: 16919059]
15. Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntyre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *Lancet*. 2004; 363:1415–1421. [PubMed: 15121402]
16. Sutherland C, Bybee D, Sullivan C. The long-term effects of battering on women's health. *Womens Health: Research on Gender, Behavior, and Policy*. 1998; 4:41–70.
17. Campbell J, Jones AS, Dienemann J, et al. Intimate partner violence and physical health consequences. *Arch Intern Med*. 2002; 162:1157–1163. [PubMed: 12020187]
18. Coker AL, Smith PH, Bethea L, King MR, McKeown RE. Physical health consequences of physical and psychological intimate partner violence. *Arch Fam Med*. 2000; 9:451–457. [PubMed: 10810951]
19. Peterlin BL, Tietjen G, Meng S, Lidicker J, Bigal M. Post-traumatic stress disorder in episodic and chronic migraine. *Headache*. 2008; 48:517–522. [PubMed: 18377377]
20. Tietjen GE, Brandes JL, Digre KB, et al. The influence of abuse on headache, mood, and somatic symptoms in women. *Headache*. 2005; 45:772.
21. Tietjen GE, Brandes JL, Peterlin BL, et al. Childhood Maltreatment and Migraine (Part III). Association With Comorbid Pain Conditions. *Headache*. 2009
22. Tietjen GE, Brandes JL, Peterlin BL, et al. Childhood Maltreatment and Migraine (Part II). Emotional Abuse as a Risk Factor for Headache Chronification. *Headache*. 2009
23. Tietjen GE, Brandes JL, Peterlin BL, et al. Childhood Maltreatment and Migraine (Part I). Prevalence and Adult Revictimization: A Multicenter Headache Clinic Survey. *Headache*. 2009
24. Diaz-Olavarrieta C, Campbell J, Garcia de la Cadena C, Paz F, Villa AR. Domestic violence against patients with chronic neurologic disorders. *Arch Neurol*. 1999; 56:681–685. [PubMed: 10369306]
25. Shuper A, Zeharia Z, Mimouni M. Migraine headaches induced by sexual abuse. *Headache*. 1994; 34:237. [PubMed: 8014043]
26. DHS. Demographic Health Survey Questionnaires and Modules: Domestic Violence Module. Maryland, USA: Available at: http://www.measuredhs.com/aboutsurveys/dhs/modules_archive.cfm [Accessed on February 1, 2007. 2005.]

27. IHS. The international classification of headache disorders, 2nd Edition. Headache Classification Subcommittee of the International Headache Society. *Cephalgia*. 2004; 44:23–136.
28. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001; 16:606–613. [PubMed: 11556941]
29. Spitzer RL, Williams JB, Kroenke K, Hornyak R, McMurray J. Validity and utility of the PRIME-MD patient health questionnaire in assessment of 3000 obstetric-gynecologic patients: the PRIME-MD Patient Health Questionnaire Obstetrics-Gynecology Study. *Am J Obstet Gynecol*. 2000; 183:759–769. [PubMed: 10992206]
30. Harrison PA, Sidebottom AC. Systematic prenatal screening for psychosocial risks. *J Health Care Poor Underserved*. 2008; 19:258–276. [PubMed: 18264001]
31. Wulsin L, Somoza E, Heck J. The Feasibility of Using the Spanish PHQ-9 to Screen for Depression in Primary Care in Honduras. *Prim Care Companion J Clin Psychiatry*. 2002; 4:191–195. [PubMed: 15014707]
32. Cripe SM, Sanchez S, Lam N, et al. Depressive symptoms and migraine comorbidity among pregnant Peruvian women. *J Affect Disord*. 2009
33. Sanchez SE, Qiu C, Williams MA, Lam N, Sorensen TK. Headaches and migraines are associated with an increased risk of preeclampsia in Peruvian women. *Am J Hypertens*. 2008; 21:360–364. [PubMed: 18202669]
34. Rothman, KJ.; Greenland, S. *Modern Epidemiology*. 2. Philadelphia, PA: Lippincott-Raven; 1998.
35. Tjaden P. What is violence against women? Defining and measuring the problem: a response to Dean Kilpatrick. *J Interpers Violence*. 2004; 19:1244–1251. [PubMed: 15534328]
36. Fernandopulle S, Fernando D. Development and initial validation of a scale to measure emotional abuse among school children aged 13–15 years in Sri Lanka. *Child Abuse and Neglect*. 2003; 27:1087–1099. [PubMed: 14602093]
37. Ruiz-Perez I, Plazaola-Castano J, Vives-Cases C. Methodological issues in the study of violence against women. *Journal of Epidemiology and Community Health*. 2007; 61(Suppl 2):ii26–31. [PubMed: 18000113]
38. Ellsberg M, Heise L, Pena R, Agurto S, Winkvist A. Researching domestic violence against women: methodological and ethical considerations. *Stud Fam Plann*. 2001; 32:1–16. [PubMed: 11326453]
39. Armstrong, BK.; White, E.; Saracci, R. *Principles of exposure measurement in epidemiology*. New York: Oxford University Press; 1992.
40. Sanchez SE, Pacora PN, Farfan JH, et al. Risk factors of abruptio placentae among Peruvian women. *Am J Obstet Gynecol*. 2006; 194:225–230. [PubMed: 16389036]
41. Tietjen GE, Brandes JL, Digre KB, et al. History of childhood maltreatment is associated with comorbid depression in women with migraine. *Neurology*. 2007; 69:959–968. [PubMed: 17785664]
42. Goodwin RD, Hoven CW, Murison R, Hotopf M. Association between childhood physical abuse and gastrointestinal disorders and migraine in adulthood. *Am J Public Health*. 2003; 93:1065–1067. [PubMed: 12835180]
43. McCauley J, Kern DE, Kolodner K, et al. Clinical characteristics of women with a history of childhood abuse: unhealed wounds. *JAMA*. 1997; 277:1362–1368. [PubMed: 9134941]
44. Domino JV, Haber JD. Prior physical and sexual abuse in women with chronic headache: clinical correlates. *Headache*. 1987; 27:310–314. [PubMed: 3654185]
45. Romans S, Belaise C, Martin J, Morris E, Raffi A. Childhood abuse and later medical disorders in women. An epidemiological study. *Psychother Psychosom*. 2002; 71:141–150. [PubMed: 12021556]
46. Gomez-Beloz A, Williams MA, Sanchez SE, Lam N. Intimate partner violence and risk for depression among postpartum women in Lima, Peru. *Violence and Victims*. 2009; 24:380–398. [PubMed: 19634363]
47. Golding JM. Sexual assault history and headache: five general population studies. *J Nerv Ment Dis*. 1999; 187:624–629. [PubMed: 10535656]
48. Felitti VJ. Long-term medical consequences of incest, rape, and molestation. *South Med J*. 1991; 84:328–331. [PubMed: 2000519]

49. Teicher MH, Samson JA, Polcari A, McGreenery CE. Sticks, stones, and hurtful words: relative effects of various forms of childhood maltreatment. *Am J Psychiatry*. 2006; 163:993–1000. [PubMed: 16741199]
50. Scher AI, Midgette LA, Lipton RB. Risk factors for headache chronification. *Headache*. 2008; 48:16–25. [PubMed: 18184281]
51. Scher AI, Stewart WF, Buse D, Krantz DS, Lipton RB. Major life changes before and after the onset of chronic daily headache: a population-based study. *Cephalalgia*. 2008; 28:868–876. [PubMed: 18557980]
52. Chrousos GP, Gold PW. The concepts of stress and stress system disorders. Overview of physical and behavioral homeostasis. *JAMA*. 1992; 267:1244–1252. [PubMed: 1538563]
53. Tsigos C, Chrousos GP. Hypothalamic-pituitary-adrenal axis, neuroendocrine factors and stress. *J Psychosom Res*. 2002; 53:865–871. [PubMed: 12377295]
54. Catley D, Kaell AT, Kirschbaum C, Stone AA. A naturalistic evaluation of cortisol secretion in persons with fibromyalgia and rheumatoid arthritis. *Arthritis Care Res*. 2000; 13:51–61. [PubMed: 11094926]
55. Raison CL, Miller AH. When not enough is too much: the role of insufficient glucocorticoid signaling in the pathophysiology of stress-related disorders. *Am J Psychiatry*. 2003; 160:1554–1565. [PubMed: 12944327]
56. Agarwal SK, Marshall GD Jr. Glucocorticoid-induced type 1/type 2 cytokine alterations in humans: a model for stress-related immune dysfunction. *J Interferon Cytokine Res*. 1998; 18:1059–1068. [PubMed: 9877450]
57. Lesperance F, Frasare-Smith N, Theroux P, Irwin M. The association between major depression and levels of soluble intercellular adhesion molecule 1, interleukin-6, and C-reactive protein in patients with recent acute coronary syndromes. *Am J Psychiatry*. 2004; 161:271–277. [PubMed: 14754776]
58. von Kanel R. Platelet hyperactivity in clinical depression and the beneficial effect of antidepressant drug treatment: how strong is the evidence? *Acta Psychiatr Scand*. 2004; 110:163–177. [PubMed: 15283736]
59. Kurth T, Schurks M, Logroscino G, Gaziano JM, Buring JE. Migraine, vascular risk, and cardiovascular events in women: prospective cohort study. *BMJ*. 2008; 337:a636. [PubMed: 18687721]
60. Welch KM, Brandes AW, Salerno L, Brandes JL. C-reactive protein may be increased in migraine patients who present with complex clinical features. *Headache*. 2006; 46:197–199. [PubMed: 16492227]
61. Welch KM. Contemporary concepts of migraine pathogenesis. *Neurology*. 2003; 61:S2–8. [PubMed: 14581652]
62. Tietjen GE, Herial NA, White L, Utley C, Kosmyna JM, Khuder SA. Migraine and biomarkers of endothelial activation in young women. *Stroke*. 2009; 40:2977–2982. [PubMed: 19608996]
63. Vanmolkot FH, de Hoon JN. Increased C-reactive protein in young adult patients with migraine. *Cephalalgia*. 2007; 27:843–846. [PubMed: 17668468]
64. Gudmundsson LS, Aspelund T, Scher AI, et al. C-reactive protein in migraine sufferers similar to that of non-migraineurs: the Reykjavik Study. *Cephalalgia*. 2009; 29:1301–1310. [PubMed: 19438929]
65. Kurth T, Ridker PM, Buring JE. Migraine and biomarkers of cardiovascular disease in women. *Cephalalgia*. 2008; 28:49–56. [PubMed: 17986270]
66. Kendall-Tackett KA. Inflammation, cardiovascular disease, and metabolic syndrome as sequelae of violence against women: the role of depression, hostility, and sleep disturbance. *Trauma Violence Abuse*. 2007; 8:117–126. [PubMed: 17545569]
67. Lemieux A, Coe CL, Carnes M. Symptom severity predicts degree of T cell activation in adult women following childhood maltreatment. *Brain Behav Immun*. 2008; 22:994–1003. [PubMed: 18396007]
68. Melamed S, Shirom A, Toker S, Berliner S, Shapira I. Association of fear of terror with low-grade inflammation among apparently healthy employed adults. *Psychosom Med*. 2004; 66:484–491. [PubMed: 15272092]

69. Lemieux AM, Coe CL. Abuse-related posttraumatic stress disorder: evidence for chronic neuroendocrine activation in women. *Psychosom Med*. 1995; 57:105–115. [PubMed: 7792368]
70. De Bellis MD, Chrousos GP, Dorn LD, et al. Hypothalamic-pituitary-adrenal axis dysregulation in sexually abused girls. *J Clin Endocrinol Metab*. 1994; 78:249–255. [PubMed: 8106608]
71. Horan DL, Hill LD, Schulkin J. Childhood sexual abuse and preterm labor in adulthood: an endocrinological hypothesis. *Womens Health Issues*. 2000; 10:27–33. [PubMed: 10697466]
72. Fernandopulle S, Fernando D. Development and initial validation of a scale to measure emotional abuse among school children aged 13–15 years in Sri Lanka. *Child Abuse Negl*. 2003; 27:1087–1099. [PubMed: 14602093]
73. Ruiz-Perez I, Plazaola-Castano J, Vives-Cases C. Methodological issues in the study of violence against women. *J Epidemiol Community Health*. 2007; 61(Suppl 2):ii26–31. [PubMed: 18000113]
74. Tietjen GE, Herial NA, Hardgrove J, Utley C, White L. Migraine comorbidity constellations. *Headache*. 2007; 47:857–865. [PubMed: 17578536]

Table 1

Characteristics of the study population (percentages)

Characteristic	Entire cohort (N=2066)	No migraine (N=1410)	Any migraine (N=656)	Probable migraine (N=464)	Migraine (N=192)
Maternal age (year $\pm$ SD; continuous)	26.9 $\pm$ 6.0	26.6 $\pm$ 6.0	27.5 $\pm$ 6.2	27.4 $\pm$ 6.1	28.0 $\pm$ 6.3
Maternal age (years)					
< 20	7.2	7.6	6.9	5.8	7.8
20–29	62.0	63.7	63.9	61.2	51.6
30–34	17.4	16.3	21.6	18.5	22.4
35 and older	13.4	12.4	17.5	14.4	18.2
Education (years)					
> 12	12.8	14.3	9.8	9.9	9.4
7–12	12.4	12.6	11.9	11.2	13.5
6	74.6	73.0	78.0	78.4	77.1
Marital status					
Married, living with husband	14.8	15.0	14.3	14.7	13.5
Other	85.2	85.0	85.7	85.3	86.5
Parity					
First live birth	42.6	45.7	36.1	36.2	35.9
Multiparous	57.4	54.3	63.9	63.8	64.1
Ethnicity					
Mestizo	89.7	89.6	89.9	90.9	87.5
Others	9.4	9.4	9.5	8.8	10.9
Employment					
Yes	44.2	44.7	43.1	43.5	42.2
No	55.8	55.3	56.9	56.5	57.8
Housing status					
Home owner	13.2	12.3	15.1	14.4	16.7
Other	86.6	87.4	84.8	85.3	83.3
Access to basic foods					
Somewhat limited or no limitations	30.2	34.0	21.8	22.4	20.3
Limited	69.7	65.8	78.0	77.4	79.7
Prenatal care					

Characteristic	Entire cohort (N=2066)	No migraine (N=1410)	Any migraine (N=656)	Probable migraine (N=464)	Migraine (N=192)
Yes	97.3	97.2	97.6	97.2	98.4
No	2.7	2.8	2.4	2.8	1.6
First prenatal care visit					
First trimester	60.7	61.0	60.2	59.1	63.0
Other trimesters	36.6	36.2	37.3	38.1	35.4
Prenatal vitamin consumption					
Yes	87.4	87.9	86.3	86.0	87.0
No	12.4	11.8	13.7	14.0	13.0
Unplanned index pregnancy					
Yes	34.7	35.5	32.9	30.6	38.5
No	64.7	63.8	66.6	69.2	60.4

Note: "Probable migraine" reflects ICHD-2 category 1.6.1, "Migraine" reflects ICHD-2 category 1.1, and "Any migraine" refers to the aggregate of women with probable migraine and migraine.

Table 2

Associations between type and severity of intimate partner violence and migraine

	No migraine (N=1410)	Any migraine (N=656)	Adjusted OR* (95% CI)	Probable migraine (N=464)	Adjusted OR* (95% CI)	Migraine (N=192)	Adjusted OR* (95% CI)
Any lifetime physical or sexual violence							
No	63.8	53.0	1.00 (Reference)	53.2	1.00 (Reference)	52.6	1.00 (Reference)
Yes	36.2	47.0	1.44 (1.19–1.75)	46.8	1.38 (1.12–1.69)	47.4	1.46 (1.07–1.99)
Physical violence only	28.2	34.8	1.36 (1.10–1.68)	34.5	1.37 (1.08–1.73)	35.4	1.37 (0.97–1.92)
Moderately severe	21.0	25.9	1.38 (0.91–1.85)	25.4	1.34 (1.05–1.70)	27.1	1.42 (0.98–2.05)
Severe	7.2	8.8	1.30 (0.99–1.02)	9.1	1.51 (1.10–2.06)	8.3	1.02 (0.99–1.05)
Sexual violence only	2.1	2.9	1.76 (0.97–3.21)	2.4	1.45 (0.71–2.96)	4.2	2.51 (1.11–5.68)
Both physical and sexual violence	6.0	9.3	1.61 (1.12–2.31)	9.9	1.71 (1.14–2.55)	7.8	1.37 (0.75–2.50)

Note: “Probable migraine” reflects ICHD-2 category 1.6.1, “Migraine” reflects ICHD-2 category 1.1, and “Any migraine” refers to the aggregate of women with probable migraine and migraine.

* Odds ratios (OR) and 95% CI (95% confidence interval) are adjusted for maternal age, parity and access to basic foods.

Table 3

Associations between intimate partner violence and migraine as modified by depressive symptoms.

	No migraine (N=1410)	Any migraine (N=656)	Adjusted OR* (95% CI)	Probable migraine (N=464)	Adjusted OR* (95% CI)	Migraine (N=192)	Adjusted OR* (95% CI)
No violence and no depressive symptoms	44.7	33.1	1.00 (Reference)	34.7	1.00 (Reference)	29.2	1.00 (Reference)
Any lifetime physical or sexual violence	19.4	16.0	1.05 (0.79–1.38)	17.0	1.06 (0.78–1.45)	13.5	0.99 (0.61–1.62)
Depressive symptoms only	19.1	20.0	1.38 (1.06–1.79)	18.5	1.22 (0.90–1.64)	23.4	1.78 (1.17–2.71)
Any lifetime physical or sexual violence and depressive symptoms	16.8	30.9	2.25 (1.75–2.88)	29.7	2.07 (1.57–2.74)	33.9	2.72 (1.83–4.04)

Note: “Probable migraine” reflects ICHD-2 category 1.6.1, “Migraine” reflects ICHD-2 category 1.1, and “Any migraine” refers to the aggregate of women with probable migraine and migraine.

* Odds ratios (OR) and 95% CI (95% confidence interval) are adjusted for maternal age, parity and access to basic foods.

** Test for interaction between IPV and depressive symptoms: Likelihood ratio test statistic = 4.86; p-value = 0.027