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Work Impact of Migraine Headaches

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Learning Objectives

- Estimate, in this population of employees with migraine, how much of overall lost productive time (LPT, hours per week absent from work plus reduced productivity hour equivalents) is due to migraine, and whether headache-related LPT reflects mainly absenteeism or presenteeism.
- State whether and to what degree the frequency and intensity of migraine headaches account for a disproportionate share of overall LPT.
- Predict the degree of symptomatic relief needed to reduce migraine-related LPT.

Abstract

Objective: *To estimate work impact of headache among migraineurs.* ***Methods:*** *Data were from a U.S. nationwide mailed questionnaire of 193,477 participants in the American Migraine Prevalence and Prevention study. Lost Productive Time (LPT) was the sum of missed hours plus reduced productivity hour equivalents. The cause of LPT was self-reported.* ***Results:*** *The mean LPT per week was 1.8 hours for headache and 2.8 for all health related causes; 76.5% of the headache-related LPT was explained by reduced performance (ie, presenteeism). The 29% of migraine cases with 11+ headaches-d/mo accounted for 49% of overall LPT; the 19% of those with pain score of 9 to 10 on a 0 to 10 scale accounted for 33% of the overall LPT.* ***Conclusions:*** *Individuals with frequent and severe headaches account for a disproportionate share of the headache-related LPT.* (J Occup Environ Med. *2008;50:736–745*)

Migraine is a common pain disorder associated with substantial impact on work role.[1] However, previous studies have largely focused on measuring absence time only[2–16]; few population-based studies provide estimates of both work absence and reduced performance while at work (presenteeism). Increasingly, evidence indicates that presenteeism, not absenteeism, is the dominant cause of lost productive time (LPT) for symptomatic conditions including pain disorders.[1,17,18] Four of nine studies that have measured LPT as a composite of absence time and reduced performance time at work[19–27] are population based.[24–27] The average estimate of total LPT (ie, sum of absence time and reduced performance time) ranges from a low of 47.4 to 96.0 hr/yr. These large differences in LPT for those with migraine translate into substantially different ratios of indirect versus direct costs. Moreover, relatively little is known about the subgroups in the population that account for significant shares of migraine related LPT and the related treatment and care management implications.

We used data from the American Migraine Prevalence and Prevention (AMPP) study, a mailed questionnaire survey initially sent to 120,000 U.S. households, to estimate work loss from migraine. The Work and Health Questionnaire (WHQ), a self-administered version of the Work and Health Interview,[16–18] was used to capture work loss data in the previous 2 weeks. The questionnaire captures data on absenteeism and presenteeism due to headache and other conditions. We estimate LPT attributed to headache as well as other conditions and provide a comparative assessment of estimates

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from four other studies. We identify the subgroup that accounts for the majority of LPT from headaches and recommend interventions that are likely to yield meaningful reductions in headache related LPT.

Methods

Population Survey

Data for estimating LPT were obtained from a U.S. nationwide mailed questionnaire of individuals 12 years of age and older participating in the AMPP study.[28] The AMPP was modeled on the methods of the American Migraine Studies one and two, described in detail elsewhere.[29,30] In brief, a self-administered headache questionnaire was mailed during the summer of 2004 to a stratified random sample of 120,000 U.S. households, drawn from a 400,000-household nationwide panel maintained by the TNS/National Family Opinion, Inc. The panel is constructed to match the US Census on age, gender, household income, household size and census region. A screening questionnaire was completed by the head of the household, who reported the total number of household members and the number of household members suffering from at least occasional self-defined severe headache. Each household member with severe headaches was asked to complete the survey. A total of 257,329 household members were contacted (132,674 females, 124,655 males) and data were obtained for 162,576 individuals including 85,284 females (64% response rate) and 77,292 males (62% response rate). Response rates were similar by gender (men = 62%; women = 64%), and did not differ by geographical region, population density, or household income. However, response rates were higher in whites versus blacks (65% vs 56%, $P < 0.001$) and in those aged 50+ years ($P < 0.01$).[28]

The screening questionnaire consisted of 21 questions assessing all headache features important to the detection of migraine and has been validated (ie, taking the first edition of the International Classification of Headache Disorders as a reference [52 Anonymous 1988]) in a population sample of migraineurs and controls with other types of headache. The sensitivity of the survey for this sample was 100%; the specificity was 82.3%.[31]

During the summer of 2005 a second survey was mailed to a random sample of headache sufferers aged 18 and older identified in the screening survey who reported suffering a severe headache in the past year. This survey included 24,000 household members (16,923 females, 7077 males). Survey data were returned for a total of 18,500 adults including 13,512 females (80% response rate) and 4988 males (70% response rate). Response rates were lower among males, non-Caucasians and individuals from, low-income households. In addition there was a slight variation in response rates across geographic regions with respondents from the Northwest region somewhat less likely to return surveys.

Migraine Case Definition

Identification of active (ie, at least one attack in the previous year) migraine cases was based on the criteria for migraine with or without aura based on those of the International Classification of Headache Disorders, second edition.[32] Diagnoses were assigned to respondents with at least one severe headache in the previous 12 months, but fewer than 15 severe headaches in the prior month, with unilateral or pulsatile pain, and either nausea, vomiting, phonophobia with photophobia, or visual or sensory aura before the headache. If these criteria were not met, respondents with severe headache were classified as having "other severe headaches."

Work and Health Questionnaire. The WHQ (available upon request) was patterned, to some degree, after the Work and Health Interview, a phone-administered questionnaire described in detail elsewhere.[33] The WHQ comprises 17 questions designed to assess: usual number of work hours per week; missed workdays in the past 2 weeks; days at work not feeling well; and six questions used to assess reduced performance at work when not feeling well. The respondent self-reported the reason for absence time and days at work not feeling well from a list of 17 illness options, other possible conditions, or four reasons unrelated to personal health.

LPT was calculated as the sum of absence time (ie, question 4) and reduced performance while at work (ie, questions 8, 12 to 17). Absence time was limited to missed days, as previous studies indicated that missed hours of work comprise a very small proportion of the overall LPT.[33,34] Questions about days at work not feeling well and reduced performance on days at work not feeling well, were used to estimate LPT from reduced performance. The specific questions used to quantify LPT are described below and validation of the LPT metric have been described in detail elsewhere.[33,34]

Analysis. Analysis was restricted to the 5997 individuals with migraine who were employed full-time or part-time and who completed the WHQ portion of the AMPP questionnaire. The follow-up survey had 18,500 adult responses, of which 11,398 (61%) were classified as current migraine sufferers. Of the 11,398 respondents, 6364 (56%) indicated that they are employed full-time or part-time. Of the 6364 employed, current migraine suffers, 5997 (95%) completed the WHQ portion of the survey.

Analyses were first completed to describe variation in health-related LPT among workers by selected characteristics. LPT for a personal health reason was the sum of hours per week absent from work for a health-related reason ("absenteeism") and the hour-equivalent of health-related reduced performance on days at work ("presenteeism"). Absenteeism included missed work-

days during the recall period. Presenteeism was quantified based on responses to six questions. For five of the six questions (ie, questions 13 to 17), respondents were asked how often, on average during the recall period, they do no work, repeated a task or job, lost concentration, worked more slowly than usual, and felt fatigued at work. To some degree, the responses were specific to the questions and formatted with the following categories: . . . all of the time, most of the time, about half of the time, some of the time, and none of the time. A sixth question (ie, question 12) asked respondents about the average amount of time it took them to start working after arriving at work on days not feeling well during the recall period. LPT was derived by first converting the categorical response options for five of the six questions into percentages (ie, all of the time = 100%; most of the time = 75%; half of the time = 50%; some of the time = 25%; and none of the time = 0%). The average of the responses to the five questions (ie, average percent of lost productive work time) was multiplied by the number of hours worked per day to yield an hour equivalent of LPT which was added to the reported average amount of time it took to start working after arriving at work on days not feeling well; this was then divided by two to estimate hours lost per week.

As noted, respondents attributed the cause of their health-related LPT to specific conditions. For this study, we defined LPT overall, for headache, and for all conditions.

Data were first summarized to describe the percent of workers with LPT (ie, absenteeism and presenteeism) due to headache and to all conditions in the previous 2 weeks. The percent of all workers with >0 headache-related LPT in the previous 2 weeks, and the percent with ≥2 hr/wk of headache-related LPT in the previous 2 weeks were also estimated.

We describe variation in the proportion of all individuals in a defined subgroup who reported 2 or more hours of LPT/wk from all illness related causes and specifically from headache. Two or more hours was selected as the lower bound of a meaningful threshold for LPT. SAS Proc GENMOD was used to estimate variation in 2+ hours of health related LPT/wk by demographic and other covariates. The log of the expectation of each binary response variable (ie, 2+ hr/wk of health related LPT vs not) was modeled as linear functions of the selected covariates. Log-link was used so that parameters could be interpreted as prevalence ratios (PR) (ie, proportion with 2+ hr/wk of health-related LPT in one group divided by the same measure in the reference group) rather than as odds ratios. We also restricted analysis to those who reported an episode of any LPT in the previous 2 weeks and described variation in mean LPT by covariates among these individuals. Variation in LPT was modeled using linear regression (SAS Proc GLM). Covariates evaluated in regression models included sex, age (18 to 29, 30 to 39, 40 to 49, 50 to 65 years of age), race (White, Black, Other), education (no high school diploma, high school diploma or General Educational Development (GED), some college or associates degree, bachelors degree, graduate degree), annual salary (<$10,000, $10,000 to $19,999, $20,000 to $29,999, $30,000 to $39,999, $40,000 to $49,999, ≥$50,000), and health insurance (insured, not insured).

SAS version 9.1 was used for all analysis (SAS Institute Inc., Cary, NC).

Results

Among the 5997 occupationally eligible participants, 78% were women. As expected (ie, because of work status), eligible respondents were older than migraine sufferers in the general population (ie, 62% were 40 to 64). A majority was Caucasian (88%), 78% were formally educated beyond high school; 81% were working 35+ hr/wk, and 34% earned less than $40,000/yr.

Overall, 58% of the occupational eligible group lost some productive time in a 2-week recall period for any health reason (Table 1); 38% had LPT due to headache. A total of 34% had 2+ hours of LPT per week for any illness and 22% for headache. Twelve percent of workers missed a workday in the previous 2 weeks; half of the missed workdays were attributable to headache; 5% of the working population missed 2+ days of work for all health problems and 3% missed 2+ days of work for headache. Among those who had any LPT, the mean hours lost per week was 4.8 for all health-related causes. Among those who had LPT due to headache, the mean hours lost per week was 4.7 for headache specifically (Table 1, sum of absenteeism and presenteeism). Among those with migraine, headache accounts for 60.7% of overall LPT (ie, [0.4 + 1.3]/[0.9 + 1.9]); 76.5% (ie, 1.3/[0.4 + 1.3]) of the headache-related LPT is explained by presenteeism or reduced performance while at work.

Variation in LPT

We estimated crude and adjusted LPT due to headache by covariates. Estimates were derived as a proportion of those who lost 2+ hr/wk (Table 2) and as the mean number of hours per week (Table 3) among those who had LPT (ie, >0 headache-related LPT). In this section, we primarily focus on the adjusted estimates, expressed as PR, comparing each group to a defined reference group.

Adjusted PR for 2+ hr/wk of LPT were significantly different by age (Table 2). Males were slightly less likely to lose 2+ hr/wk than females, although the difference was not significant (PR = 0.9 [95% CI: 0.79 to 1.03]). The youngest age group (<30 years) was more likely to have 2+

TABLE 1
Summary of Lost Productive Time Estimates in a Two-Week Recall Period Among Occupationally Employed Individuals With Migraine ($N = 5997$), AMPP Study

	Due to Headache	Due to Any Reason
Proportion with lost productive time (LPT)		
Any LPT (ie, >0 hr in the past 2 wk)	38%	58%
≥2 hr/wk in the past 2 wk	22%	34%
≥1 d absent/wk in the past 2 wk	6%	12%
≥2 d absent/wk in the past 2 wk	3%	5%
Mean LPT for the Entire Sample*	**Hours**	**Hours**
Absence time	0.4 (2.2)	0.9 (3.3)
Presenteeism	1.3 (3.3)	1.9 (3.8)
Total time	1.8 (4.3)	2.8 (5.5)
LPT Among Those Who Lost Work Time (ie, 38% of the Sample)†	**Hours $N = 2251$**	**Hours $N = 3488$**
Absence time	1.2 (3.5)	1.5 (4.3)
Presenteeism	3.5 (4.7)	3.3 (4.4)
Total time	4.7 (6.1)	4.8 (6.5)

*The denominator for these estimates comprises all study participants, regardless of whether they had any lost productive time ($n = 5997$).

†The denominator for these estimates is limited to study participants with >0 hr per week of total a productive time ($n = 2251$) due to headache and ($n = 3488$) due to any reason.

hours of LPT/wk; the likelihood of 2+ hours LPT/wk declined with increasing age, and was significantly lower for all age groups 40+, compared to those aged less than 30. Those with lower education were more likely to lose 2+ hours of LPT, but significant differences were confined to a single subgroup (ie, <12 grade). A similar pattern of higher prevalence was observed for low household income versus higher income levels. While differences were borderline significant among the subgroups, a post hoc test of trend (ie, when income level is included in the model as an ordinal value) by income level was significant. (test of trend, $P = 0.0014$, data not shown).

Table 3 summarizes mean estimates of LPT among individuals who experience some LPT in the previous 2 weeks. Again, focusing on the adjusted mean differences, a significant difference in LPT per week was observed by age and race. No group differences were observed by sex. Mean LPT was significantly higher for Blacks (difference in the means = 2.97 hours; $P < 0.001$) compared to Whites (Table 3). A significant gradient ($P < 0.01$) of decreasing mean LPT was observed in relation to increasing age. In general, mean duration of LPT was lower with increasing education ($P = 0.018$). The post hoc test of trend (ie, education defined as an ordinal value) was similarly significant ($P = 0.026$, data not shown). In contrast, after adjustment for education, a more modest, and not completely consistent inverse relation was observed for LPT and household income ($P = 0.23$); but a stronger inverse relation was observed with income defined as an ordinal value (trend test $P = 0.035$, data not shown).

Headache Days and Average Pain Intensity

LPT was strongly related to frequency of headache and reported average pain intensity (Table 4). Specifically, the adjusted PR increases directly in relation to number of headache days in the past 3 months. The PR was similar for 16 to 20 and 21 to 49 headache days; those with 21 or more days with headache in the past 3 months were more than five times as likely to lose more than 2 hours of LPT per week. A similar pattern was observed for average pain intensity, with the PR increasing monotonically from 0.43 (0 to 3 average pain score) to 1.85 (9 to 10 average pain score).

To model trends by amount of LPT, analysis was restricted to those for whom LPT >0 (Table 4). No difference in mean LPT was observed among those with 1 to 10 headache days in the past 3 months. However, the adjusted mean LPT increased thereafter. The adjusted mean LPT was similar for those with lower average pain,[4–8] but differed substantially for those in the highest pain category (ie, average pain score of 9 to 10). While relatively strong patterns were observed for total LPT, no trend was observed for missed days in relation to headache days and a very modest trend was observed for average pain intensity.

Discussion

The results of this study indicate that individuals with migraine lose substantial amounts of work time. Of those with migraine who work for pay, 38% lost some time due to headache in the preceding 2 weeks; this group lost an average of 4.7 hr/wk indicating very substantial work impact. Approximately 75% of the headache-related LPT is explained by presenteeism, a finding consistent with previous reports for headache and other pain related disorders.[1,17,18] As expected, LPT increased with both attack frequency and average pain intensity. Higher levels of LPT were associated with female sex, younger age, African American race, lower income, and lower education, although, not uniformly for all LPT related measures.

Estimates of illness-induced LPT are influenced by a number of factors that can lead to over- or underestimation bias. Estimates are substantially lower if only absenteeism is measured and presenteeism is ignored.[19–27] Estimates may also vary with the source population (eg, gen-

TABLE 2
Percent Distribution of Occupation Eligible Migraine Cases and Prevalence of Headache Related Lost Productive Time in the Previous 2 wk by Demographics (n = 5997)

	Outcome = ≥2 hr/wk Total Lost Productive Time				
			Adjusted PR*		
Demographic	Percent of Participants	Crude Prevalence (%)	PR	95% CI	*P*
Sex					0.11
Men	22.5	20.6	0.90	(0.79, 1.03)	
Women	77.5	22.7	Reference		
Age (yr)					<0.0001†
<30	12.0	28.6	1.27	(1.08, 1.51)	
30–39	23.7	25.6	1.19	(1.04, 1.37)	
40–49	32.7	21.5	Reference		
50–64	29.4	18.0	0.84	(0.72, 0.97)	
65+	2.1	18.1	0.80	(0.53, 1.23)	
Race					0.019
White	88.3	21.4	Reference		
Black	6.4	28.3	1.26	(1.04, 1.53)	
Other	3.2	29.9	1.33	(1.02, 1.74)	
Unknown	2.0	NA	NA		
Education					0.024†
<12 Grade, no diploma	2.5	33.6	1.35	(1.01, 1.82)	
High school graduate or GED‡	19.3	23.0	0.95	(0.82, 1.10)	
Some college/technical school	38.5	23.7	Reference		
Bachelor degree	25.3	19.3	0.84	(0.72, 0.97)	
Graduate degree	14.2	20.4	0.95	(0.79, 1.13)	
Unknown	0.2	NA	NA		
Household income ($)					0.007†
<22,500	14.6	26.2	1.23	(1.01, 1.50)	
22,500–39,999	19.1	27.2	1.31	(1.10, 1.56)	
40,000–59,999	20.9	21.5	1.07	(0.90, 1.28)	
60,000–89,999	22.2	19.4	1.00	(0.84, 1.19)	
90,000+	23.2	18.9	Reference		
Health insurance					0.97
Yes	87.1	21.6	Reference		
No	12.7	26.5	1.00	(0.85, 1.18)	
Unknown	0.2	NA	NA		

*The prevalence ratios are adjusted for all other covariates included in this table.
†Post hoc ordinal test for trend was significant for age ($P < 0.0001$), and income ($P = 0.0014$), but not for education ($P = 0.095$).
‡General Educational Development (high school equivalency) Tests.

eral population vs a single employer) or the length of the recall period (ie, longer recall periods result in underestimation presumably due to forgetting). For example, previous work indicates that weekly estimates of LPT for illnesses based on a 4-week recall period were 20% (ie, using a bounded recall period) to 44% (using an unbounded recall period) lower, on average, than estimates of LPT that used a 1-week recall period.[34]

Although work impact of headache has been reported in 30 previous population based studies, relatively few population based studies have measured missed work and presenteeism.[2–27,35–38] Of these, 15 studies reported on work absence only[2–16]; nine reported on both absence time and reduced performance while at work.[19–27] Among the nine studies, two were confined to workers employed by a single hospital[20] or health care facility[19]; three used patients from clinical trials[21–23] and, as such, estimates were based on a highly select sample. Four studies in general population samples[24–27] are profiled in Table 5. Several key differences among these studies, including the current data reported from the AMPP, are worth noting.

Among the five studies, recall periods vary from 1 day[27] (ie, daily diary for 3 months) to 1 year.[24,25] Methods for estimating presenteeism varied. In three studies,[24,26,27] presenteeism hours estimates were based on a single question (ie, percent effectiveness). The study by Von Korff et al[27] is unique in that the percent effectiveness question was asked in reference to individual headaches using a diary (ie, data collected daily for 3 months). Two studies,[26] including the AMPP, used questionnaires based on prior validation work to assess presenteeism. Other than the work by Von Korff, the other studies used mailed questionnaires.[24–26] Because different recall periods were used in the five studies, we standardized the LPT

TABLE 3
Estimated Number of Work Hour Lost in the Previous 2 wk Due to Headache by Demographics Among Occupationally Eligible Migraine Cases Who Reported LPT ($n = 2251$)

Demographic	No. of Participants With >0 hr Lost	Crude Mean (SE)	Adjusted Mean*		
			Parameter Estimate	95% CI	*P*
Total	2251	4.67 (0.13)			
Sex					0.25
Men	460	4.89 (0.29)	0.36	(−0.26, 0.98)	
Women	1791	4.62 (0.14)	Reference		
Age (yr)					0.0003†
<30	291	6.21 (0.54)	1.67	(0.85, 2.48)	
30–39	577	4.82 (0.25)	0.31	(−0.34, 0.97)	
40–49	744	4.39 (0.20)	Reference		
50–64	595	4.19 (0.20)	−0.21	(−0.85, 0.44)	
65+	44	3.93 (0.73)	−0.64	(−2.48, 1.20)	
Race					<0.0001
White	1980	4.35 (0.13)	Reference		
Black	150	7.43 (0.63)	2.97	(1.97, 3.97)	
Other	75	6.73 (0.97)	2.06	(0.68, 3.44)	
Unknown	46	NA	NA		
Education					0.018†
<12 Grade, no diploma	69	6.28 (0.82)	0.68	(−0.83, 2.18)	
High school graduate or GED	426	4.86 (0.31)	−0.44	(−1.13, 0.26)	
Some college or technical school	909	5.13 (0.23)	Reference		
Bachelor degree	536	4.07 (0.21)	−0.86	(−1.51, −0.22)	
Graduate degree	308	3.77 (0.22)	−0.92	(−1.72, −0.12)	
Unknown	3	NA	NA		
Household income ($)					0.23†
<22,500	356	5.53 (0.33)	1.02	(0.11, 1.93)	
22,500–39,999	485	4.91 (0.28)	0.56	(−0.23, 1.34)	
40,000–59,999	443	4.98 (0.29)	0.72	(−0.07, 1.51)	
60,000–89,999	476	4.44 (0.31)	0.39	(−0.37, 1.15)	
90,000+	491	3.76 (0.21)	Reference		
Health insurance					0.50
Yes	1922	4.57 (0.13)	Reference		
No	325	5.19 (0.38)	−0.26	(−1.03, 0.51)	
Unknown	4	NA	NA		

*The adjusted mean differences are the parameter estimates after adjusting for all other covariates included in this table.
†Post hoc ordinal test for trend was significant for age ($P < 0.0001$), education ($P = 0.026$), and income ($P = 0.035$).

across studies, using a 1-year time period.

Estimates are summarized as the average across all individuals with migraine, regardless of whether they lost work time from migraine. Moreover, two studies[24–26] estimated LPT for migraine headache only, whereas two other studies,[24] including the current one, reported LPT for all headaches in persons with migraine (ie, migraine, probable migraine, other). Von Korff et al, offer estimates for migraine only and for all headaches. Von Korff et al and van Roijen used short recall periods (ie, 1 day and 2 weeks) and yield similar estimates of average lost hours per year for migraine headache (ie, 46 to 47 hr/yr) and similar ratios of presenteeism hours and absence hours. Although the absence hour estimate of Schwartz et al[25] is consistent with the above two studies, the estimate of presenteeism hours is substantially higher. The latter may be explained by the method used to estimate reduced effectiveness from migraine while at work. Response options for questions about number of days affected at work and about reduced effectiveness were categorical and arbitrarily converted to point values (eg, subjects reported: never/rarely, less than half the time, or more than half the time, and their responses were converted to percentage values).

In persons with migraine, attacks that do not meet criteria for migraine often appear to have migraine pathophysiology and respond to migraine treatment.[39] In addition, if migraine sufferers treat early in the attack while pain is mild, following current recommendations the diagnostic threshold for migraine may not be crossed due to treatment effects.[40] We therefore elected to estimate the work burden from all headaches in persons with migraine. Although substantially different methods were used in three studies, the overall estimates of LPT are similar. Esti-

TABLE 4
Prevalence of Headache-Related Lost Productive Time in the Previous 2 wk by Headache Characteristics (n = 5997) Among Migraine Cases

		Outcome: ≥2 hr/wk Total Lost Productive Time			Outcome: LPT Lost in the Previous 2 wk Among Those With LPT >0				
						Number of Work Hours Lost		Proportion With Missed Work Days	
Variable	**Category**	***N***	**Crude Prevalence**	**Adjusted PR (95% CI)***	***N***	**Crude Mean (SE)**	**Adjusted Mean (SE)**	**Crude Prevalence**	**Adjusted PR (95% CI)**
Days with headache in last 3 mo	0–1	472	5.9%	0.48 (0.32–0.71)	54	3.77 (0.63)	0.06 (0.80)	14.8%	1.10 (0.53–2.26)
	2–5	2083	13.9%	Reference	527	4.10 (0.22)	Reference	15.2%	Reference
	6–10	1717	23.5%	1.64 (1.41–1.90)	699	4.28 (0.20)	0.06 (0.34)	14.9%	0.94 (0.70–1.26)
	11–15	824	30.7%	2.13 (1.80–2.52)	424	4.66 (0.29)	0.59 (0.38)	13.0%	0.85 (0.60–1.20)
	16–20	374	38.4%	2.57 (2.10–3.14)	234	5.25 (0.50)	1.04 (0.46)	17.1%	1.07 (0.73–1.56)
	21–49	527	40.8%	2.66 (2.23–3.18)	313	6.25 (0.42)	1.81 (0.42)	21.4%	1.27 (0.92–1.77)
				$P < 0.0001$			$P = 0.0001$		$P = 0.33$
Average pain Intensity (pain scale from 0 to 10)	0–3	85	3.5%	0.43 (0.41–1.34)	9	2.07 (0.77)	−0.93 (1.99)	00.0%	NA
	4–6	1545	13.8%	Reference	422	3.71 (0.23)	Reference	13.0%	Reference
	7–8	3226	23.1%	1.44 (1.23–1.68)	1290	4.25 (0.15)	0.28 (0.33)	13.6%	0.97 (0.71–1.32)
	9–10	1141	32.5%	1.85 (1.56–2.21)	530	6.53 (0.34)	2.22 (0.40)	23.2%	1.48 (1.06–1.25)
				$P < 0.0001$			$P < 0.0001$		$P = 0.0025$
Total		5997			2251				

*The prevalence ratios are adjusted for other covariates included in this table, symptom score and aura score.

mates range from a low of 74 hr/yr[24] where a 1-year recall period was used to a high of 96 hr/yr where a daily diary was used.[27] The AMPP estimate of 88.4 hr/yr is similar to that of Von Korff et al,[27] the two studies differ in the ratio of presenteeism hours per absence hours (ie, 1.73 vs 3.25). The difference in these ratios is largely explained by a difference in estimates of absence days attributable to headache. Differences in attribution of cause of LPT may be important.

In the AMPP study, respondents first identified days that they were absent from work in the previous 2 weeks and then assigned a cause for the absence. In the diary study of Von Korff et al[27] and the other three studies, absence days were assigned to days that an individual had headache. It is not known if the respondent would have made the same attribution. The latter method may be prone to overestimation bias as all LPT occurring during the time with headache is attributed to headache. In contrast, our method may be prone to underestimation bias, as individuals had the option of choosing from a list of numerous possible causes. Error in attribution may be a function, in part, of the number of items in the list.

Not surprisingly, LPT from headache is more likely to occur among those with more headache-days. Data from Table 4 indicates that those with more than 10 headaches-d/mo (ie, 29% of migraine cases) account for 49% of the overall LPT. The substantial work loss in this subgroup suggests that there may be a substantial return on investment in health care for use of preventative agents.

Those with very severe headaches (ie, pain score of 9 to 10 on a 0 to 10 pain scale) comprise 19% of migraine cases but account for 33% of the overall LPT. Both presenteeism and work absence were elevated in this subgroup. These data suggest that complete elimination of headaches may not be necessary to ob-

TABLE 5
Profile of Previous Population Based Studies That Have Collected Data on Both Work Absence Time and Reduced Performance Time at Work Among Individuals With Migraine Headache (All Participants With Migraine in the Studies Were Classified According to IHS Criteria)

Author	Size of Migraine Sample	Recall Period	Inclusion Criteria	Attacks Included	Data Collection Method	Measure of Reduced Performance	Lost Time Estimate in hr/yr Assuming 8-hr Workday					
							Migraine Headaches Only			All Headaches		
							Absence	Presenteeism	Total	Absence	Presenteeism	Total
Von Korff et al.[27]	122	1 d	1+ migraine in previous year; paid employment; 18–65 yr	All headaches	Daily diary for 3-mo	Reduced effectiveness (REWE) = time worked with headache × Reduced effectiveness (%)	22.4	24.0	46.4	35.2	60.8	96.0
van Roijen et al.[26]	208	2 wk	1+ migraine in previous year; paid workers (for current analysis); age ≥12 yr	Only migraine attacks	Mailed questionnaire	I & L Questionnaire	25.6	21.8	47.4	—	—	—
Schwartz et al.[25]	7970	1 yr	1+ headache in previous year; having headache while employed; ages 18–65	Migraines only	Mailed questionnaire	REWE = reported number of headaches × Proportion of headaches that caused a decreased work level × Average proportion reduction in work level × Average duration of headache	25.6	39.2	64.8	—	—	—
Stewart et al.[31]	1663	1 yr	1+ migraine in previous year; paid worker or homemaker; age ≥18 yr (“working age”)	Most severe type of headache	Mailed questionnaire	REWE = days at work with most severe type of headache × Effectiveness at work (%)	—	—	—	32.3	41.7	74.0
Current AMPP study	5997	2 wk	1+ severe headache in previous year, but less than 15 severe headaches in the prior month; paid workers; greater than 12 yr	All headaches	Mailed questionnaire	Validated measure using 6* questions × number of hr worked per day + average amount of time it took to start working after arriving at work on days not feeling well	—	—	—	20.8	67.6	88.4

*Avg % of time not worked, repeated a task or job, lost concentration, worked more slowly than usual, felt fatigued at work.

serve a reduction in migraine related LPT. For example, if the average pain score for those with severe to very severe (ie, pain score of 7 to10) headaches were reduced to mild pain (ie, pain score of 1 to 3), data from Table 4 suggests that there would be a substantial reduction in LPT, assuming that all other factors were the same.

The average estimate of headache-related LPT from this study is very similar to estimates from two previous studies that used somewhat different estimates. Intervention with acute and preventative agents are likely to yield meaningful reductions in LPT, as a disproportionate share of the headache-related LPT is explained by those with more frequent and severe headaches.

Several limitations may influence the interpretation of results from this study. First, all data are self-reported, including headache symptoms, severity, and frequency, as well as, responses to the WHQ. Errors in self-report are possible and could lead to biased estimates. However, we believe that errors in reporting are likely to result in bias toward the null, versus over-estimating the strength of associations. Moreover, migraine diagnosis using questions in the AMPP II survey are valid[31] and population level estimates of migraine work impact using a 2-week recall are reasonably valid.[33,34] Second, the AMPP study population is a volunteer cohort, selected to represent the U.S. population with regard to selected demographics. Although bias from selective participation is possible, estimates of migraine prevalence and other migraine features are similar to estimates from previous studies using more rigorous sampling methods.

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