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Disability and Economic Loss Caused by Headache Among Information Technology Workers in Korea

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Background and Purpose Headache disorders are a leading cause of disability globally. However, there is inadequate information available about these disorders and the related economic loss in the workplace in Asian countries. Information technology (IT) jobs are intellectually and cognitively challenging, and hence IT workers are a suitable population for assessing headache disorders and related economic loss.

Methods We sent invitation emails to all employees of selected IT companies. A comprehensive Web-based questionnaire regarding headache characteristics, disability, quality of life, and economic loss was completed by 522 participants from 8 companies.

Results The participants included 450 (86.2%) who had experienced headache more than once during the previous year. The frequencies of migraine, probable migraine (PM), and tension-type headache (TTH) were 18.2%, 21.1%, and 37.0%, respectively. The Migraine Disability Assessment score was higher for participants with migraine [median and interquartile range, 3.0 (0.0–6.0)] than for those with PM [0.0 (0.0–2.0), $p<0.001$] and TTH [0.0 (0.0–1.0), $p<0.001$]. The estimated annual economic losses caused by migraine per person associated with absenteeism and presenteeism were USD 197.5±686.1 and USD 837.7±22.04 (mean±standard deviation), respectively. The total annual economic loss per person caused by migraine (USD 1,023.3±1,972.7) was higher than those caused by PM (USD 424.8±1,209.1, $p<0.001$) and TTH (USD 197.6±636.4, $p<0.001$).

Conclusions Migraine, PM, and TTH were found to be prevalent among IT workers in Korea. Disability and economic loss were significantly greater in participants with migraine than in those with PM or TTH;

Keywords migraine; tension-type headache; disability; quality of life; cost of illness; work performance.

INTRODUCTION

Headache disorders are prevalent among the general population and result in substantial disability and economic losses for the affected individuals and also society as a whole.[1] The Global Burden of Disease study in 2019 identified that headache disorders were the third leading cause of disability (quantified as the number of years lived with a disability) among 369 diseases and injuries.[2] However, headache disorders are the leading cause of disability among those aged <50 years who actively participate in economic activities.[3] The World Health Organization (WHO) has reported that headache disorders are the most common disorders of the nervous system. Moreover, migraine, tension-type headache (TTH), and medication-overuse headache are responsible for high levels of disability and poor health.[4] Headache disorders are, therefore, an important health concern worldwide.

Headache disorders were recently recognized as an important public health issue in

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Asian and Oceanian countries. They were also recognized as causing substantial personal and social burdens due to the resulting disability, decrease in the quality of life (QOL), and economic loss.[5] Despite the high prevalence and burden of headache disorders, information on their related disability, QOL, and economic loss is currently scarce in these countries.[6,7]

Information technology (IT) is a rapidly developing field, and the number of people working in the IT industry is increasing rapidly.[8] Most IT workers are aged 25–55 years and are expected to exhibit a high migraine prevalence and migraine-related disability.[3,9] IT workers in Asia engage in intellectually and cognitively challenging work,[10] which makes work-related aggravation of headache common in this population.[11,12] Due to IT workers' ease of using the Internet and the availability of online assessments on work-related disability and economic loss, we selected IT workers as the subjects of the present study. This study aimed to use a comprehensive Web-based questionnaire to determine the frequency of headache and the disability and economic loss caused by headache disorders among IT workers. The results of the study are expected to 1) improve awareness of headache disorders and related disability, 2) be useful for estimating the economic loss caused by headache disorders in the workplace, and 3) provide data to inform the design of effective intervention strategies for reducing the disability of individuals with headache.

METHODS

Three substudies

Three cross-sectional substudies were conducted with IT workers in Korea, Japan, and the Philippines, with support from the WHO Regional Office for the Western Pacific (WHO-WPRO) and the International Headache Society. All three substudies followed the same protocol accredited by the WHO-WPRO. This study summarizes the findings of the substudy performed in Korea.

Participants

We contacted IT companies with more than half of their sales from the Internet or computer-related businesses and enquired about their interest in participating in the present study. After the companies confirmed their willingness to participate, an invitation email to participate in our study was sent to all employees who regularly used computers in the workplace. The invitation email included information on the purpose, objectives, methods, scope of data collection, analysis processes, and ethical considerations related to the study. A link to the questionnaire was subsequently sent to all individuals who opted to participate.

Questionnaire

The questionnaire comprised three sections: 1) questions about general demographics and employment status, 2) questions about lifestyle and QOL,[13] and 3) questions regarding the headache diagnosis, disability associated with headache, and the impact of headache on work.

Headache diagnosis

Migraine, probable migraine (PM), and TTH were diagnosed based on the third edition of the beta version of the International Classification of Headache Disorders (ICHD-3 beta).[14] If the characteristics and accompanying symptoms of a participant's headache fulfilled criteria A–E for migraine without aura, a diagnosis of migraine was established. We did not separately analyze participants according to the presence of aura, and so the group with migraine included both those with migraine with aura (ICHD-3 beta code 1.2) and migraine without aura (ICHD-3 beta code 1.1). If a participant's headache characteristics and accompanying symptoms fulfilled all but one criterion of migraine, the participant was classified as having PM. If a participant's headache characteristics and accompanying symptoms met criteria A–E for TTH, the participant was classified as having TTH. However, if a participant's headache did not meet the criteria either for migraine, PM or TTH, they were categorized as having an unclassified headache.

Disability related to headache

Disability related to headache was assessed using a modified version of the Migraine Disability Assessment (MIDAS).[15] Our modified version comprised four questions about the number of missed workdays, the number of half missed workdays, the number of days with activities reduced by half, and the number of days in which family, social, or leisure engagements were missed due to headache during the previous 3 months. The sum of the scores for the four questions was the total MIDAS score. We classified the level of disability according to our modified MIDAS score based on the original MIDAS: 0–5, little to no disability; 6–10, mild disability; 11–20, moderate disability; and ≥21, severe disability.[16]

QOL

QOL was evaluated using the Korean version of the second edition of the 12-item Short-Form Health Survey (SF-12 v2).[13] SF-12 v2 is a self-reporting survey that measures QOL. It is a shortened version of the 36-item SF-36, and has a high degree of acceptability and data quality.[17] SF-12 v2 can be used to evaluate various domains of QOL, including physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health. It also

includes a physical-component summary and a mental-component summary. The scoring of SF-12 v2 was carried out in accordance with the SF-12 v2 scoring manual.[18]

Economic loss caused by headache

Productivity loss associated with a health condition is caused by absenteeism and presenteeism. Absenteeism refers to a pattern of absence from work without a good reason and is generally unplanned, while presenteeism or working while sick can cause productivity loss and poor health.[19] The economic loss caused by headache associated with absenteeism and presenteeism was calculated using the average daily wage in the IT industry according to survey data obtained by Statistics Korea in 2017.[20] The numbers of absenteeism days and presenteeism days were based on MIDAS results. To determine the economic loss caused by absenteeism, the number of full days off was multiplied by the daily wage, while the number of half days missed was multiplied by half the daily wage. The economic loss caused by presenteeism was calculated by multiplying the number of days with work productivity reduced by at least half by half the daily wage. Since the economic loss caused by presenteeism and absenteeism based on MIDAS related to a 3-month period, the annual economic losses were obtained by multiplication by four. We used the currency exchange rate for September 19, 2019, which is when the survey was completed (USD 1.194=KRW 1,000).

Work-related headache triggering factors

We selected and evaluated work-related headache triggering factors based on previous studies, including insufficient sleep time, overtime work, prolonged computer use, heavy workload, completing projects, clearing quota, skipping meals, insufficient water intake, and alcohol intake before workdays using questions with "yes" and "no" answers.[11,21-23] If a participant responded "yes" to a question, they were considered to have experienced that triggering factor. We additionally evaluated whether menstruation was a triggering factor of headache among the female participants.

Effects of headache on personal burden and stigma

The evaluated effects of headache on personal burden and stigma included not being understood by one's boss or fellow workers, experiencing difficulties in workplace relationships, being a burden to others, lacking energy, and experiencing difficulty in concentration. Answers of "always," "often," "sometimes," "rarely," and "never" were scored as 5, 4, 3, 2, and 1, respectively, with higher scores indicating greater effects of headache in the work environment. The results were analyzed based on the scores for each item.

Ethical considerations

This study was approved by the Institutional Review Board/ethics committee of Nowon Eulji Medical Center, Eulji University (IRB No. 2017-11-007-001), and written informed consent was obtained from each participant. All procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee as well as the tenets of the 1964 Declaration of Helsinki and its later amendments, or comparable ethical standards.

Statistical analyses

Scores on binary and ordinal scales were represented as numbers and percentages. Scores on interval scales were represented as mean±standard-deviation values or median and interquartile-range values, as appropriate. Normality of the ratio of variables was tested using the Kolmogorov-Smirnov test. When normality was confirmed, independent two-tailed *t*-tests or one-way analyses of variance (as appropriate) were used to compare variables between the groups. A two-tailed Mann-Whitney U test or Kruskal-Wallis test was applied for comparisons of variables that did not conform to a normal distribution. A two-tailed chi-square test was used to compare binary and ordinal scales. No statistical power calculation was conducted before commencing the study, with the sample size instead being based on the available data.

Multiple linear regression analyses were used to evaluate the factors contributing to MIDAS scores. Headache frequency per month, headache intensity (mild, moderate, and severe), and work-related factors were analyzed. Work-related factors included hours of computer use for work per day (<2, 2–4, 4–6, 6–8, and >8 h), overtime work hours per month (<15, 15–25, 25–35, 35–45, 45–60, 60–80, and >80 h), sleep time on workdays per day (<4, 4–5, 5–6, 6–7, 7–8, and >8 h), and exercise days per week (<1, 1–3, 4–6, and every day).

The Statistical Package for the Social Sciences (version 24.0, IBM, Armonk, NY, USA) was used to perform statistical analyses. Statistical significance was set as a two-tailed probability value of $p<0.05$. Post-hoc comparisons were performed using Bonferroni correction [$p=0.017$ (0.05/3)] to adjust for multiple testing among the three groups. The results presented here constituted those from the primary analysis of our data.

RESULTS

Survey

We approached 850 individuals from 8 IT companies with 50–200 employees by sending invitation emails to participate in our study, of which 604 individuals opted to participate.

Among these, 522 (cooperation rate, 61.4%) completed the survey and 450 (86.2%) responded that they had experienced at least one headache during the previous year. The frequencies of migraine, PM, TTH, and unclassified headache were 18.2% (n=95), 21.1% (n=110), 37.0% (n=193), and 10.0% (n=52), respectively. The frequencies of headache [93.9% (154/164) vs. 82.7% (296/358), p=0.001] and migraine [29.9% (49/164) vs. 12.8% (46/358), p<0.001] were significantly higher among females than males. The frequencies of PM [21.3% (35/164) vs. 20.9% (75/358), p=0.919] and unclassified headache [12.1% (20/164) vs. 8.9% (32/358), p=0.250] did not differ significantly between females and males, while TTH was more prevalent in males than females [39.9% (143/358) vs. 30.5% (50/164), p=0.038]. The flow of participation and headache types are summarized in Fig. 1. Data collection was performed over a 15-month period from May 2018 to August 2019.

Demographic and headache characteristics of participants

Females comprised 164 (31.4%) of the 522 participants in this study. The age of all participants was 36.4±7.4 years, and did not differ significantly between participants with headache and those without headache (36.8±7.8 years vs. 36.3±7.3 years, p=0.624). The proportion of females was higher among participants with headache than those without headache [34.2% (154/450) vs. 13.9% (10/72), p<0.001]. The frequencies of permanent employees [94.4% (68/72) vs. 92.9% (418/450), p=0.629] and administrators [19.4% (14/72) vs. 23.1% (104/450), p=0.490] did not differ significantly between these two groups. There were significantly more days with headache and severe headache in participants with migraine than in those with PM or TTH. Moderate-to-severe headache intensity was more prevalent in participants with migraine than in those with PM or TTH (Table 1).

Disability by headache type

The MIDAS scores [median (interquartile range)] differed significantly between participants with migraine [3.0 (0.0–6.0)], PM [0.0 (0.0–2.0)], and TTH [0.0 (0.0–1.0)] (p<0.001). Post-hoc analyses revealed that MIDAS scores were significantly higher in participants with migraine than in those with PM (p<0.001) and TTH (p<0.001), and higher in participants with PM than in those with TTH (p<0.001). The distribution of MIDAS scores is summarized in Fig. 2.

Multiple linear regression analyses of the factors contributing to MIDAS score in individuals with migraine, PM, and TTH

Multiple linear regression analyses revealed that headache frequency was a significant factor for MIDAS scores in individuals with migraine (β=0.493, p<0.001), PM (β=0.779, p<0.001), and TTH (β=0.569, p<0.001). However, headache intensity and work-related factors were not significantly associated with MIDAS scores in individuals with migraine, PM, and TTH (Supplementary Table 1 in the online-only Data Supplement).

QOL

The SF-12 v2 scores in seven of the domains were significantly lower in participants with headache than in those without headache, while the score in the social functioning domain did not differ significantly between the two groups. All domain scores except physical functioning differed significantly among participants with migraine, PM, and TTH. Post-hoc analyses revealed that domain scores for role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health, as well as the scores for the physical-component summary and mental-component summary were significantly higher in participants with migraine than in those with TTH (Table 2).

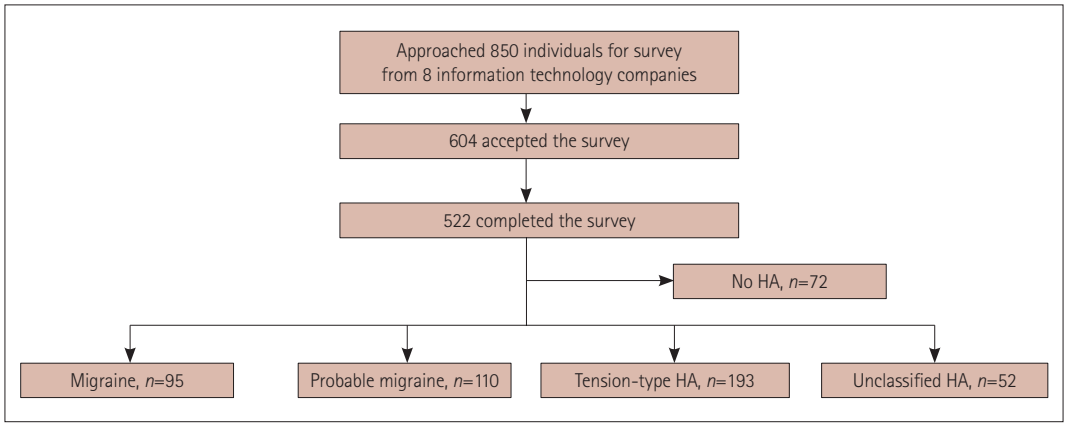

Fig. 1. Flow of participation and HA types. HA: headache.

Table 1. Demographic and clinical characteristics of the study participants (*n*=522)

	Participants without headache (*n*=72)	Participants with headache (*n*=450)	Migraine (*n*=95)	PM (*n*=110)	TTH (*n*=194)	*p**
Age, years	36.8±7.8	36.3±7.3	35.6±7.6	36.7±7.8	36.4±6.7	0.441
Sex, female	10 (13.9)	154 (34.2)	49 (51.6)	35 (31.8)	50 (25.9)	0.001 Migraine vs. PM, *p*=0.021 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Administrators	14 (19.4)	104 (23.1)	19 (20.0)	23 (20.9)	52 (26.9)	0.314
Permanent employees	68 (94.4)	418 (92.9)	91 (95.8)	96 (87.3)	184 (95.3)	0.014 Migraine vs. PM, *p*=0.054 Migraine vs. TTH, *p*=0.862 PM vs. TTH, *p*=0.253
Headache days per month		0.7 [0.3–1.7]	1.7 [0.7–3.3]	1.0 [0.3–1.7]	0.7 [0.3–1.0]	<0.001 Migraine vs. PM, *p*=0.001 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*=0.001
Severe headache days per month		0.3 [0.0–1.7]	1.0 [0.0–1.7]	0.3 [1.0–1.7]	0.0 [0.0–0.3]	<0.001 Migraine vs. PM, *p*<0.001 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Crystal-clear days per month		28.0 [25.0–29.0]	27.0 [20.0–29.0]	28.0 [25.0–29.0]	29.0 [25.0–29.0]	<0.001 Migraine vs. PM, *p*=0.209 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*=0.010
Moderate-to-severe headache intensity		274 (60.9)	90 (94.7)	77 (70.0)	70 (36.3)	<0.001 Migraine vs. PM, *p*<0.001 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Unilateral pain		362 (80.4)	77 (81.1)	93 (84.5)	150 (77.7)	0.349
Pulsating quality		294 (65.3)	81 (85.3)	83 (75.5)	89 (46.1)	<0.001 Migraine vs. PM, *p*=0.048 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Nausea and/or vomiting		124 (27.6)	70 (73.7)	50 (45.5)	0 (0.0)	<0.001 Migraine vs. PM, *p*=0.109 Migraine vs. TTH, *p*<0.001 PM vs. TTH *p*<0.001
Aggravation by movement		176 (39.1)	68 (71.6)	64 (58.2)	20 (10.4)	<0.001 Migraine vs. PM, *p*=0.098 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Photophobia or phonophobia		109 (24.2)	55 (57.9)	48 (43.6)	0 (0.0)	<0.001 Migraine vs. PM, *p*=0.459 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Chronic daily headache		17 (3.8)	9 (9.5)	2 (1.8)	5 (2.6)	0.008 Migraine vs. PM, *p*=0.015 Migraine vs. TTH, *p*=0.671 PM vs. TTH, *p*=0.010

Data are mean±standard deviation, *n* (%), or median [interquartile range] values.
*Compared among participants with migraine, PM, and TTH.
PM: probable migraine, TTH: tension-type headache.

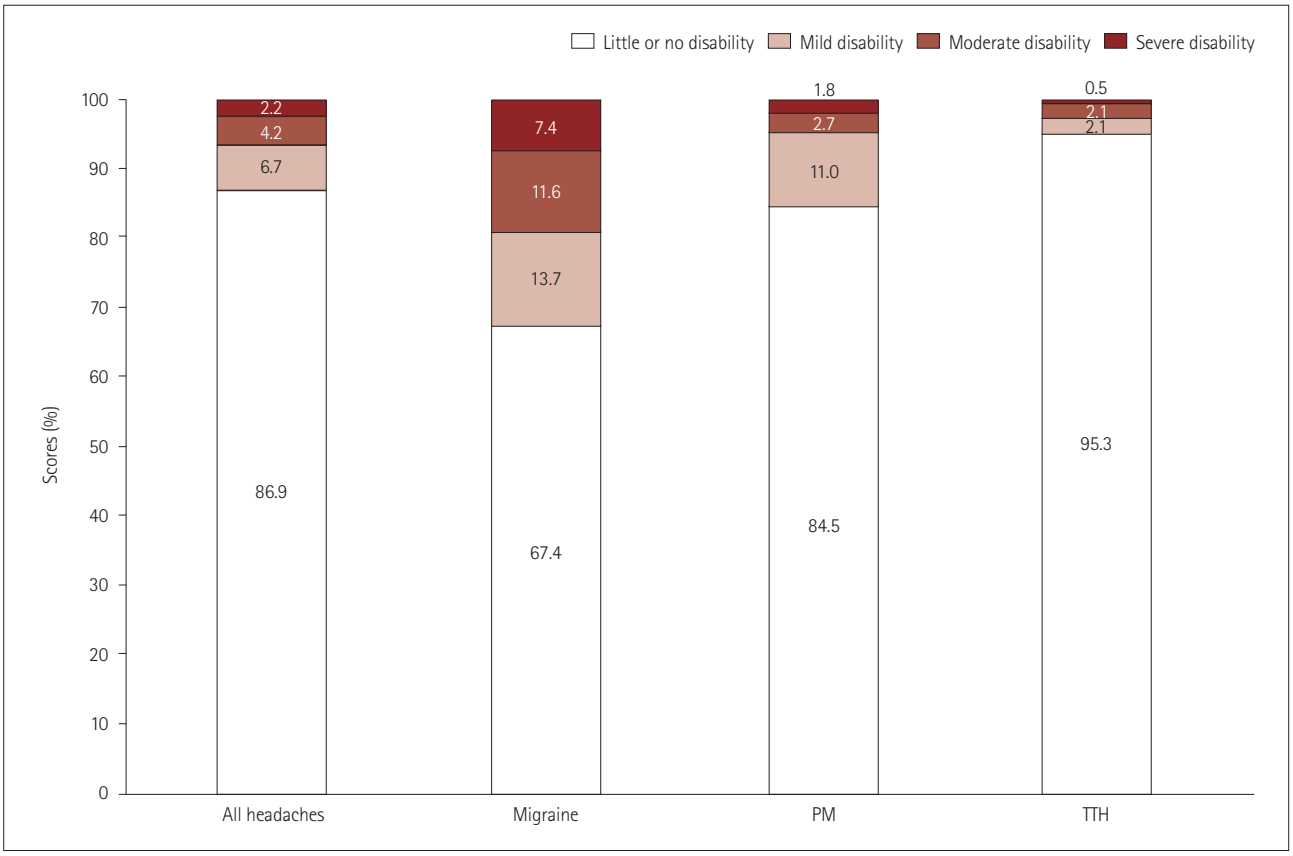

Fig. 2. Distribution of Migraine Disability Assessment scores of participants with headache, migraine, PM, and TTH. PM: probable migraine, TTH: tension-type headache.

Economic loss caused by headache

Among the 450 participants with headache, the estimated annual economic losses per person caused by headache for absenteeism and presenteeism were USD 63.1±354.6 and USD 364.5±1079.9, respectively; the corresponding losses among the 95 participants with migraine were USD 197.5±686.1 and USD 837.7±220.4. The sum of the estimated annual losses caused by absenteeism and presenteeism was significantly higher in participants with migraine than in those with PM or TTH (Table 3).

Work-related headache triggering factors

Insufficient sleep time was the most common triggering factor in participants with migraine and TTH, followed by heavy workload. Furthermore, in participants with PM, heavy workload was the most common triggering factor, followed by insufficient sleep time. Menstruation acted as a triggering factor in 73.5% of the female participants with migraine, which was significantly higher than the proportions in those with PM or TTH (Table 4).

Effects of headache on personal burden and stigma

Results for the effects of headache on personal burden and stigma are summarized in Supplementary Table 2 (in the online-only Data Supplement). Participants with migraine reported significantly higher frequencies of experiencing difficulties in workplace relationships, being a burden to others, lacking energy, and experiencing difficulty in concentration due to headache compared with participants with PM or TTH.

Medical consultations and treatment of headache

While the proportion of participants who reported having consulted a physician for headache was higher for those with migraine (25.3%) than for those with PM (6.4%, p=0.001) and TTH (6.8%, p<0.001), approximately three-fourths of all participants had never consulted a physician for headache. In contrast, 80.0% participants with migraine had treated their headaches using over-the-counter (OTC) medications (Table 5).

DISCUSSION

The main findings of the present study were as follows: 1) headache was a common complaint among IT workers, with approximately one-fifth, one-fifth, and one-third of them having

Table 2. Scores for the 12-item Short-Form Health Survey in eight domains and for the physical-component summary and mental-component summary for participants with migraine, PM, and TTH

	Participants without headache	Participants with headache	p^*	Migraine	PM	TTH	$p^\dagger$
Physical functioning	100.0 [75.0–100.0]	100.0 [75.0–100.0]	0.044	100.0 [75.0–100.0]	100.0 [75.0–100.0]	100.0 [75.0–100.0]	0.384
Role physical	100.0 [75.0–100.0]	75.0 [75.0–100.0]	0.004	75.0 [62.5–100.0]	75.0 [75.0–100.0]	87.5 [75.0–100.0]	0.004 Migraine vs. PM, p=0.351 Migraine vs. TTH, p=0.002 PM vs. TTH, p=0.024
Bodily pain	100.0 [75.0–100.0]	75.0 [75.0–100.0]	<0.001	75.0 [50.0–100.0]	75.0 [50.0–100.0]	75.0 [75.0–100.0]	0.001 Migraine vs. PM, p=0.575 Migraine vs. TTH, p=0.001 PM vs. TTH, p=0.008
General health	60.0 [33.8–85.0]	60.0 [25.0–60.0]	0.001	25.0 [25.0–60.0]	60.0 [25.0–60.0]	75.0 [75.0–75.0]	<0.001 Migraine vs. PM, p=0.217 Migraine vs. TTH, p<0.001 PM vs. TTH, p=0.003
Vitality	50.0 [50.0–75.0]	25.0 [25.0–50.0]	0.005	50.0 [25.0–50.0]	50.0 [25.0–50.0]	50.0 [25.0–50.0]	0.002 Migraine vs. PM, p=0.892 Migraine vs. TTH, p=0.003 PM vs. TTH, p=0.005
Social functioning	75.0 [50.0–100.0]	75.0 [50.0–100.0]	0.259	50.0 [25.0–50.0]	75.0 [50.0–75.0]	75.0 [75.0–100.0]	<0.001 Migraine vs. PM, p=0.121 Migraine vs. TTH, p<0.001 PM vs. TTH, p=0.003
Role emotional	93.8 [75.0–100.0]	75.0 [62.5–100.0]	0.002	75.0 [62.5–87.5]	75.0 [62.5–87.5]	87.5 [75.0–100.0]	<0.001 Migraine vs. PM, p=0.551 Migraine vs. TTH, p=0.003 PM vs. TTH, p<0.001
Mental health	62.5 [50.0–75.0]	62.5 [50.0–75.0]	0.114	50.0 [37.5–62.5]	50.0 [37.5–62.5]	62.5 [50.0–75.0]	<0.001 Migraine vs. PM, p=0.344 Migraine vs. TTH, p<0.001 PM vs. TTH, p<0.001
Physical-component summary	83.8 [69.4–93.6]	74.38 [62.5–83.8]	<0.001	68.8 [56.3–77.5]	71.3 [58.8–81.3]	77.5 [65.63–90.0]	<0.001 Migraine vs. PM, p=0.391 Migraine vs. TTH, p<0.001 PM vs. TTH, p=0.001
Mental-component summary	68.8 [56.3–81.3]	62.5 [53.1–75.0]	0.015	59.4 [46.9–68.8]	59.4 [46.1–71.9]	68.8 [53.1–78.1]	<0.001 Migraine vs. PM, p=0.420 Migraine vs. TTH, p<0.001 PM vs. TTH, p<0.001

Data are median [interquartile range] values.
*Compared between participants with headache and participants without headache, †Compared among participants with migraines, PM, and TTH.
PM: probable migraine, TTH: tension-type headache.

Table 3. Annual economic losses per person caused by headache, migraine, PM, and TTH based on Migraine Disability Assessment scores

Annual economic loss in the workplace	Participants with headache (*n*=450)	Migraine (*n*=95)	PM (*n*=110)	TTH (*n*=193)	*p**
No loss caused by absenteeism or presenteeism	292 (64.9)	39 (41.1)	63 (57.3)	150 (77.7)	<0.001 Migraine vs. PM, *p*=0.012 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001
Economic loss caused by absenteeism, USD	63.1±354.6	197.5±686.1	25.6±124.4	32.8±206.7	0.013 Migraine vs. PM, *p*=0.090 Migraine vs. TTH, *p*=0.004 PM vs. TTH, *p*=0.339
Economic loss caused by presenteeism, USD	364.5±1079.9	837.7±220.4	400.8±1,203.0	166.8±517.8	<0.001 Migraine vs. PM, *p*=0.002 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*=0.001
Total economic loss, USD	423.7±1,215.8	1,023.3±1,972.7	424.8±1,209.1	197.6±636.4	<0.001 Migraine vs. PM, *p*=0.003 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*<0.001

Data are mean±standard deviation or *n* (%) values.
*Compared among participants with migraine, PM, and TTH.
PM: probable migraine, TTH: tension-type headache.

Table 4. Work-related headache triggering factors (*n*=522)

	Participants with headache (n=450)	Migraine (n=95)	PM (n=110)	TTH (n=193)	*p**
Sex, female	154	49	35	50	
Triggering factor					
Insufficient sleep time	267 (59.3)	64 (67.4)	66 (60.0)	111 (57.5)	0.271
Overtime work	237 (52.7)	55 (57.9)	61 (55.5)	96 (49.7)	0.369
Prolonged computer use	217 (48.2)	49 (51.6)	61 (55.5)	85 (44.0)	0.136
Heavy workload	276 (61.3)	58 (61.1)	78 (70.9)	105 (54.4)	0.018 Migraine vs. PM, *p*=0.136 Migraine vs. TTH, *p*=0.286 PM vs. TTH, *p*=0.005
After completion of project	267 (59.3)	64 (67.4)	66 (60.0)	111 (57.5)	0.408
Clearance of quota	237 (52.7)	55 (57.9)	61 (55.5)	96 (49.7)	0.427
Skipping meals	217 (48.2)	49 (51.6)	61 (55.5)	85 (44.0)	0.084
Alcohol intake	298 (66.2)	64 (67.4)	73 (66.4)	126 (65.3)	0.938
Menstruation	84 (54.5)	36 (73.5)	16 (45.7)	23 (46.0)	0.002 Migraine vs. PM, *p*=0.010 Migraine vs. TTH, *p*=0.005 PM vs. TTH, *p*=0.979

Data are *n* (%) values.
*Compared among participants with migraine, PM, and TTH. Post-hoc analyses were conducted only in cases of significant differences among migraine, PM, and TTH groups.
PM: probable migraine, TTH: tension-type headache.

had experienced migraine, PM, and TTH during the previous year, respectively; 2) a significant proportion of participants with headache had headache-related disability, which were more severe in participants with migraine than in those with PM and TTH; and 3) economic loss caused by presenteeism was four times more common than that caused by absenteeism in participants with migraine, while economic loss in participants with migraine was significantly greater than that

Table 5. Medical consultations and treatment patterns of participants with migraine, PM, and TTH (*n*=522)

	Participants with headache (*n*=450)	Migraine (*n*=95)	PM (*n*=110)	TTH (*n*=193)	*p**
Currently visiting a clinic or hospital for headache	9 (2.0)	4 (4.2)	1 (0.9)	3 (1.6)	0.197
Previously visited a clinic or hospital for headache	37 (8.2)	20 (21.1)	6 (5.5)	10 (5.2)	<0.001 Migraine vs. PM, *p*<0.001 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*=0.919
Never consulted a physician	404 (89.8)	71 (74.7)	103 (93.6)	180 (93.3)	<0.001 Migraine vs. PM, *p*<0.001 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*=0.691
Treated headache using over-the-counter medications	230 (48.9)	76 (80.0)	49 (44.5)	73 (37.8)	<0.001 Migraine vs. PM, *p*<0.001 Migraine vs. TTH, *p*<0.001 PM vs. TTH, *p*=0.267

Data are *n* (%) values.
*Compared among participants with migraine, PM, and TTH.
PM: probable migraine, TTH: tension-type headache.

in those with PM and TTH.

The present study found that the frequencies of migraine and PM were higher than in previous reports. Recent epidemiological studies in Korea found that the prevalence rates of migraine and PM were 5.3% and 14.1%, respectively.[24,25] Epidemiological studies in Japan, Taiwan, and Malaysia found that the prevalence rates of migraine during 1-year periods were 8.4%, 9.1%, and 9.0%, respectively.[26-28] An epidemiological study in Singapore found that the 1-year prevalence of PM was 6.2%.[29] One possible reason for the frequencies of migraine and PM being higher in IT workers than in the participants in previous epidemiological studies is the differences in age distribution. The mean age of our participants was 36.4 years, which is lower than the mean age (42.1 years) of the general population in Korea.[30] Considering that migraine and PM are most common in people aged 20–50 years,[31,32] the younger age distribution in our study may have resulted in higher prevalence rates of migraine and PM. Another possible reason is work-related triggering of migraine and PM among IT workers. Individuals with migraine often experience their headache being provoked by triggering factors,[11,12] and the present study found that a significant proportion of participants with migraine and PM experienced work-related triggering factors.

We also found that 19.0% of participants with migraine had moderate-to-severe disability caused by headache. This proportion is comparable to those found in previous European and American epidemiological studies: a French nationwide survey found that 12.0% of individuals with migraine had moderate-to-severe disability,[33] and two US population-based studies found that 27.4% and 32.3% of individuals with migraine had moderate-to-severe disability.[34] Meanwhile, a Brazilian epidemiological study found that 22.0% of individuals with migraine had moderate-to-severe disability.[35]

Disability caused by migraine could be reduced through support programs along with medical treatment. A recent study performed in Switzerland assessed the effect of a support program in reducing disability caused by migraine.[36] That support program applied six sessions of monthly individualized telecoaching with a specialized nurse through a specially developed module on the Migraine Buddy smartphone application to the employees of a Swiss-based company and their family members. The total MIDAS score improved by 57.0% (from 15.2 to 6.5) after the employees participated in the support program. Patient activation including individual knowledge, skill, and confidence to manage their health and health care were also improved after the support program.

PM is a subtype of migraine that fulfills all but one of the standard criteria of migraine.[14] PM reportedly affects 5–15% of the general population annually, and its symptoms are less severe than those of migraine.[31] The present study confirmed the previous findings that PM caused less disability than did migraine but more than did TTH. However, to the best of our knowledge, our study is the first to produce findings for the economic loss caused by PM.

Low QOL has been consistently reported in individuals with migraine.[37,38] The severity of the low QOL in migraine has been reported to be greater than that in other chronic diseases such as hypertension and diabetes.[39] The present study found that participants with headache suffered significantly

lower QOL compared with participants without headache. Furthermore, the QOL was profoundly lower in participants with migraine and PM than in those with TTH. The severity of low QOL in migraine is strongly affected by headache frequency and intensity.[40,41] Therefore, more efforts to mitigate migraine, such as by applying treatments that reduce the frequency and intensity of attacks, are required to improve the QOL of individuals with headache.

Economic losses associated with migraine are caused by productivity loss and direct medical costs. Most studies have found that the productivity loss far outweighs the direct medical costs.[42,43] Productivity loss caused by migraine is common, with one study finding that approximately one-third of individuals with migraine had experienced loss of time at work caused by absenteeism and presenteeism during the previous 2 weeks.[44] Presenteeism is the main source of productivity loss among people with chronic pain disorders.[45] A study conducted in US found that productivity loss (i.e., lost productive time) caused by presenteeism was three times greater than that caused by absenteeism.[45] Similar results were obtained in the present study, which found that the economic loss caused by presenteeism was approximately fourfold greater than that caused by absenteeism. Productivity loss caused by absenteeism and presenteeism has been shown to be closely related to the frequency and intensity of headaches.[45] Interventions involving acute and preventive treatment could yield meaningful reductions in productivity loss caused by migraine.

The present study found that only one-quarter of the participants with migraine had consulted a physician about their headaches. In contrast, 80% participants used only OTC medications for their headaches. Considering that one-third of participants with migraine had headache-related disability in our study, most of the participants with migraine were underdiagnosed and undertreated. A lack of medical consultations and underdiagnosis are major reasons for undertreatment.[46] Medical consultation rates are generally low in Korea, and a population-based study found that the medical consultation rate for Koreans with migraine was 34.2% in 2018.[7] The rate of medical consultations associated with migraine could be increased by providing education programs on headache diagnosis and treatment to the medical community and consumers.[47] In the US, the medical consultation rate tripled from 16% in 1984 to 47% in 1999 thanks to intense efforts to educate the medical community and consumers about headache diagnosis and treatment,[48,49] while by 2016 this had increased to 79.8%. Recent advances in acute and preventive treatments for migraine, including triptans, lasmiditan, botulinum toxin, anti-calcitonin-gene-related peptide (CGRP) monoclonal antibodies, oral CGRP receptor antagonists (called gepants), and neuromodulation therapies, have resulted in more-effective treatments for migraine.[50-52] Effective treatments can improve QOL and decrease migraine-related disability.[53] Thus, more-vigorous efforts are required to improve medical consultation rates in Korea.

The present study also found that headache exerted significant effects on personal burden and stigma (Supplementary Table 1 in the online-only Data Supplement). There are previous reports of associations of the personal burden and stigma of individuals with migraine and their inability to work and impairments in various aspects of life, including family relationships, career/financial achievement, and stability.[54,55] We similarly found the presence of personal burden and stigma in the workplace among participants with PM, TTH, and migraine.

The present study had some limitations. First, individuals were only enrolled from participating IT companies, and so our sample did not reflect the overall IT working population in Korea. Nevertheless, participants were recruited from eight companies rather than only a single company, and all eligible participants in each company were enrolled. Such an approach facilitated effective evaluations of the prevalence and impact of migraine on IT workers in Korea. Second, we used a modified version of the MIDAS. The original MIDAS has two extra questions related to the number of days with missed household work and the number of days with reduced activity in the household, and does not include a question on the number of half workdays missed.[15] Therefore, while the modified MIDAS instrument that we adopted more accurately reflected disability caused by headache at work compared with the original MIDAS, direct comparisons with other studies investigating headache-related disability requires the use of the original MIDAS. Third, because participation in this study was voluntary, there was a risk of ascertainment bias, since only those with an interest in headache (and especially those affected by headache) might have participated. For this reason, questions regarding daily QOL were included to stimulate the interest of people without headache to participate. Finally, we did not determine the total sales of companies or the incomes of participants. Previous studies have found that the incomes of participants can affect their stress level and sleep quality.[56] Moreover, the sales of a company were previously found to be associated with mood problems and stress level in employees,[57] and stress, mood problems, and sleep quality may influence the headache status.[25,58] Therefore, not evaluating the total sales of companies or the incomes of participants could have been another limitation of our study.

Notwithstanding these limitations, our study had several strengths. First, we evaluated disability and economic loss caused by migraine, PM, and TTH, which have rarely been re-

ported previously.[31,59] The present study verified that the severity of disability and economic loss caused by PM and TTH were significant, but less significant than for migraine. Second, we evaluated work-related headache triggering factors along with disability and economic loss of participants with headache. We found that more than two-thirds of participants with migraine had work-related triggering factors. This finding highlights the potential for workplace modifications to reduce migraine-related disability and ameliorate the loss of workplace productivity. If a participant's headache is triggered by insufficient sleep, modifying work schedules and providing education on sleep hygiene could reduce migraine attacks and migraine-related disability.

In conclusion, approximately one-fifth, one-fifth, and one-third of the IT workers included in this study had migraine, PM, and TTH, respectively. Approximately one-third of the participants with migraine had headache-related disability, and economic loss caused by presenteeism was approximately fourfold greater than that caused by absenteeism. Disability and economic loss were significantly greater in participants with migraine than in those with PM or TTH. The present findings are expected to not only increase the understanding of disability and economic loss caused by headache in IT workers, but also ultimately help in reducing the burden of headache.

Supplementary Materials

The online-only Data Supplement is available with this article at https://doi.org/10.3988/jcn.2021.17.4.546.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

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Conflicts of Interest

Byung-Kun Kim and Min Kyung Chu, contributing editors of the *Journal of Clinical Neurology*, were not involved in the editorial evaluation or decision to publish this article. All remaining authors have declared no conflicts of interest.

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