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Daytime Hypersomnolence in Migraine : Prevalence , Clinical Correlates and Independent Predictors in Malaysia

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DAYTIME HYPERSOMNOLENCE IN MIGRAINE : PREVALENCE , CLINICAL CORRELATES AND INDEPENDENT PREDICTORS IN MALAYSIA

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ABSTRACT

Background and objectives: Sleep disturbances, including daytime hypersomnolence, are increasingly recognized as clinically significant comorbidities of migraine that adversely affect quality of life. However, data on the prevalence and determinants of daytime hypersomnolence among migraine patients in Malaysia and the broader Southeast Asian region remain limited. This study aimed to determine the prevalence of daytime hypersomnolence and to identify the clinical and sociodemographic factors associated with excessive daytime sleepiness in adult patients with migraine.

Methods: A single-center, cross-sectional study was conducted between April 2024 and April 2026 at the Neurology Clinic, Hospital Canselor Tuanku Muhriz (HCTM), Universiti Kebangsaan Malaysia (UKM). Eligible participants were adults aged 18 years and above with an established diagnosis of migraine for at least one year, confirmed by a neurologist according to the International Classification of Headache Disorders, Third Edition (ICHD-3) criteria. Baseline sociodemographic and clinical migraine data were systematically collected. Daytime hypersomnolence was assessed using the validated Epworth Sleepiness Scale (ESS), with a score exceeding 10 defining the outcome. Migraine-related disability was assessed using the Migraine Disability Assessment (MIDAS) questionnaire. Data were analyzed using IBM SPSS Statistics Version 29, with binary logistic regression performed to identify independent predictors.

Results: A total of 278 participants were recruited (mean age 46.4 ± 15.75 years; **85.6% female**). Twenty-five participants (9.0%) met the ESS threshold for daytime hypersomnolence. On univariate analysis, factors significantly associated with daytime hypersomnolence included coffee consumption, higher MIDAS score, comorbid gastroesophageal reflux disease (GERD), higher migraine attack frequency, greater pain severity, multiple migraine-associated symptoms, and use of sumatriptan, topiramate, and propranolol (all $p < 0.05$). On multivariable logistic regression, independent predictors were migraine onset at age 25–54 years (OR 0.137, 95% CI: 0.039–0.479, $p = 0.002$), higher educational attainment (OR 9.956, 95% CI: 1.334–74.292, $p = 0.025$), severe migraine-related disability (MIDAS Grade IV; OR 26.182, 95% CI: 6.763–101.359, $p < 0.001$), and sumatriptan use (OR 4.538, 95% CI: 1.404–14.669, $p = 0.012$).

Conclusion: Daytime hypersomnolence affects approximately one in ten adult migraine patients attending a tertiary neurology clinic in Malaysia. Higher migraine-related disability, sumatriptan use, higher educational attainment, and earlier age of migraine onset are independent predictors. Routine screening for daytime hypersomnolence using ESS is practical, non-invasive, and clinically warranted as part of the holistic assessment and management of patients with migraine.

Keywords: migraine; daytime hypersomnolence; Epworth Sleepiness Scale; sleep disorders; migraine disability; quality of life

1. INTRODUCTION

Migraine is a leading cause of neurological disability worldwide, consistently ranked among the foremost conditions contributing to years lived with disability (YLD) across successive iterations of the Global Burden of Disease (GBD) Study[1]. The burden of migraine extends well beyond headache pain itself; it is increasingly recognised as a complex neurological disorder driven by a constellation of associated symptoms — including fatigue, cognitive dysfunction, and sleep disturbances — that collectively contribute to substantial impairment of quality of life [2, 3, 4]. Sleep disturbances are particularly prevalent among individuals with migraine, with studies reporting impaired sleep quality — encompassing insomnia, snoring, and daytime sleepiness — in 30–50% of patients [5]. Crucially, these disruptions do not merely coexist with migraine but may actively precipitate attacks, establishing a bidirectional relationship that perpetuates both sleep disturbance and overall migraine burden.

Prior research has predominantly focused on nocturnal sleep quality as the primary dimension of sleep dysfunction in migraine. In a multicentre cohort of elderly migraine patients, poor sleep quality as measured by the Pittsburgh Sleep Quality Index (PSQI) was independently associated with migraine, whereas chronotype and obstructive sleep apnoea (OSA) risk were not — suggesting that sleep disturbance per se, rather than circadian timing or sleep-disordered breathing, may represent the most clinically relevant dimension of sleep dysfunction in this population [2]. Despite the breadth of literature on nocturnal sleep in migraine, considerably less attention has been directed towards daytime hypersomnolence as a distinct and clinically meaningful manifestation of sleep–wake dysregulation in migraine.

Daytime hypersomnolence in migraine likely reflects dysfunction of central arousal systems. Emerging evidence implicates the hypothalamic orexinergic system — which regulates sleep–wake transitions, nociceptive thresholds, and autonomic function — as a common neurobiological substrate linking sleep dysregulation and migraine pathophysiology. Perturbations in orexin signalling may contribute to both reduced wakefulness drive and increased migraine susceptibility, offering a mechanistic basis for the co-occurrence of excessive daytime sleepiness and recurrent headache. Daytime hypersomnolence is most practically assessed using the Epworth Sleepiness Scale (ESS), a validated, self-administered eight-item instrument that has been applied across large migraine cohorts. Polysomnography (PSG) remains

the gold standard for objective sleep architecture assessment [6]; however, its limited availability and high resource requirements in routine clinical settings make validated questionnaire-based tools such as the ESS a practical and well-accepted alternative.

Despite growing recognition of the bidirectional interaction between migraine and sleep, data on daytime hypersomnolence in adult migraine populations remain sparse — particularly in Southeast Asian and Malaysian clinical settings, where ethnic, lifestyle, and socioeconomic factors may shape both migraine burden and sleep patterns in distinctive ways. Furthermore, it remains unclear whether the factors associated with poor nocturnal sleep quality mirror those underlying excessive daytime sleepiness in migraine patients.

This study therefore aimed to determine the prevalence of daytime hypersomnolence among adult patients with migraine attending a tertiary neurology clinic in Malaysia, and to identify the clinical and sociodemographic factors independently associated with excessive daytime sleepiness in this population.

2. MATERIALS AND METHODS

2.1 Study Design and Study Population

This was a single-center, cross-sectional study conducted at the Neurology Clinic, Hospital Canselor Tuanku Muhriz (HCTM), Universiti Kebangsaan Malaysia (UKM), Kuala Lumpur, Malaysia. The study was conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from all participants prior to enrolment. Ethical approval was obtained from the Universiti Kebangsaan Malaysia Research Ethics Committee (UKM REC), Faculty of Medicine (reference code: FF-2024-132), covering the period from 4 April 2024 to 3 April 2026.

Participants were recruited through consecutive convenience sampling from patients with an established diagnosis of migraine attending follow-up at the Neurology Clinic, HCTM. Eligible participants were adults aged 18 years and above with a confirmed diagnosis of migraine for a minimum duration of one year, established by a neurologist according to the International Classification of Headache Disorders, Third Edition (ICHD-3) criteria. Migraine subtype was further classified as episodic migraine (fewer than 15 headache days per month) or chronic migraine (15 or more headache days per month) based on the ICHD-3 classification.

Patients were excluded if they had any of the following: secondary headache disorders attributed to structural brain abnormalities (including cerebral neoplasm or stroke), severe or disabling psychiatric illness, neurodegenerative disorders, learning disabilities, or cognitive impairment. Additional exclusion criteria included night shift work schedules, substance use disorder, a known diagnosis of obstructive sleep apnea (OSA), or comorbid chronic pain disorders including trigeminal neuralgia or active malignancy. Patients with OSA were specifically excluded given that this condition independently causes daytime hypersomnolence and would confound the primary outcome measure.

2.2 Recruitment and Data Collection

Eligible participants were identified and recruited from those attending the Neurology Clinic based on the predefined inclusion and exclusion criteria. Following written informed consent, baseline demographic and clinical data were systematically collected via structured interviewer-assisted documentation.

Demographic data recorded included age, sex, marital status, body mass index (BMI; calculated from measured height and weight), smoking status, alcohol and coffee consumption, highest education level attained, occupation type, and monthly household income. Comorbid medical conditions were also documented.

Clinical migraine-related data included the type of migraine, age at migraine onset, total duration of migraine (in years), frequency of attacks per month, associated migraine symptoms, and pharmacological and non-pharmacological treatment history. Migraine subtype was classified according to the International Classification of Headache Disorders, Third Edition (ICHD-3). Peak migraine pain severity was assessed using the Visual Analogue Scale (VAS), a 100-mm continuous scale where 0 indicates no pain and 10 indicates the most severe pain imaginable.

Daytime hypersomnolence was evaluated using the Epworth Sleepiness Scale (ESS), a validated, self-administered questionnaire available in both English and Malay. Written permission was obtained from the respective copyright holders prior to use. Migraine-related disability was assessed using the Migraine Disability Assessment (MIDAS) questionnaire, as detailed in Section 2.3.1 and 2.3.2. All data were entered and stored in IBM SPSS Statistics Version 29 (IBM Corp., Armonk, NY, USA) for subsequent analysis.

No funding is required for this research.

2.3 Assessment Instruments

2.3.1 Epworth Sleepiness Scale (ESS)

The Epworth Sleepiness Scale (ESS) is a validated, eight-item self-administered questionnaire designed to assess an individual's general level of daytime sleepiness across routine daily activities[7]. Each item is rated on a four-point Likert scale from 0 (would never doze) to 3 (high chance of dozing), yielding a cumulative score ranging from 0 to 24. A total score exceeding 10 is indicative of daytime hypersomnolence[8] and was used as the primary outcome threshold in this study. The ESS demonstrates robust psychometric properties, with a reported sensitivity of 93.5–97% and specificity of 100%[7]. The questionnaire has been validated in both English and Malay, and written permission from the respective copyright holders was obtained prior to administration.

2.2.2 Migraine Disability Assessment questionnaire (MIDAS)

The Migraine Disability Assessment (MIDAS) questionnaire is a five-item, validated instrument developed to quantify migraine-related disability across three functional domains: paid employment or schoolwork, household work, and social or leisure activities, over the preceding three months. Scores are calculated as the total number of days lost or with significantly reduced productivity. Disability is graded on a four-tier scale (Grade I: minimal, score 0–5; Grade II: mild, 6–10; Grade III: moderate, 11–20; Grade IV: severe, >20)[9]. The MIDAS questionnaire demonstrates good construct validity (Pearson correlation coefficient 0.80–0.83) and satisfactory inter-rater reliability (Cronbach's α 0.73–0.76)[10].

2.3 Statistical Analysis

The minimum required sample size was calculated using the standard single-proportion formula:

$$N = \frac{Z^2\, p\,(1-p)}{d^2}$$

Z= degree of confidence 1.96 (95%)

p: 0.796

d: max error: 0.05

where Z = 1.96 (corresponding to a 95% confidence level), p = 0.796 (based on the prevalence of poor sleep quality [PSQI >5] of 79.6% among 624 migraine patients reported by Cho et al.[11]), and d = 0.05 (maximum allowable margin of error). Accounting for an anticipated attrition rate of 10%, the final estimated sample size was 278 participants.

All data entry and statistical analyses were performed using IBM SPSS Statistics, Version 29 (IBM Corp., Armonk, NY, USA). A two-tailed significance threshold of $p < 0.05$ was applied throughout, and 95% confidence intervals (CIs) were reported where applicable.

Categorical variables are reported as frequencies and percentages. The normality of continuous variables was assessed using skewness and kurtosis. Normally distributed continuous variables are expressed as mean ± standard deviation (SD), while non-normally distributed variables are presented as median with interquartile range (25th–75th percentile). Group comparisons were performed using the independent samples t-test for normally distributed variables, the Mann–Whitney U test for non-normally distributed continuous variables, and the Kruskal–Wallis test for comparisons across three or more groups. Binary logistic regression analysis was conducted to identify independent predictors of daytime hypersomnolence.

3 RESULTS

A total of 278 participants were recruited and included in the final analysis. The cohort had a mean age of 46.4 ± 15.75 years (95% CI: 44.54–48.26), and the majority were female (85.6%) and married (79.5%). Most participants were overweight (47.5%), with a median BMI of 25.3 kg/m² (IQR: 23.4–28.4). Less than half (41.7%) had attained tertiary-level education, and 43.9% reported a monthly household income below RM1,500. Most were non-coffee drinkers (74.1%) and non-smokers (96.4%). The most prevalent comorbidities were hypertension (28.4%), gastroesophageal reflux disease (GERD; 23.7%), asthma or chronic obstructive pulmonary disease (11.9%), and diabetes mellitus (11.5%). Ischaemic heart disease, stroke, and epilepsy were each present in fewer than 10% of participants. Full sociodemographic data are presented in Table 1.

The mean age of migraine onset was 33.5 ± 14.5 years (95% CI: 31.81–35.23), with a median disease duration of 10.0 years (IQR: 5–20). Majority of participants had migraine without aura (217, 78.1%). The median frequency of migraine attacks was three per month (IQR: 2–5), and the mean peak pain score on the VAS was 4.33 ± 2.65 (95% CI: 4.02–4.64). The most frequently reported associated migraine symptoms were dizziness (52.5%), lethargy (52.2%), nausea (32.0%), mood changes (31.3%), neck pain (30.9%), and blurring of vision (26.3%). Less common symptoms included vertigo (18.7%), vomiting (16.2%), tinnitus (14.0%), confusion (10.8%), facial numbness (9.4%), and slurred speech (4.3%). Thirty-one participants (11.2%) had severe migraine-related disability as defined by a MIDAS Grade IV score.

Regarding pharmacological management, the most commonly used acute medications were paracetamol (48.6%), NSAIDs (30.6%), and sumatriptan (24.5%). For prophylaxis, amitriptyline (23.0%), propranolol (19.8%), and flunarizine (14.4%) were the most frequently prescribed agents. Among non-pharmacological approaches, massage was most commonly utilised (15.1%).

Twenty-five participants (9%) reported daytime hypersomnolence based on the ESS score, as depicted in Table 2. Most were female (76.0%), had completed tertiary education (80.0%), were married (76.0%), overweight (40.0%) or obese (48.0%), and had gastroesophageal reflux disease (48.0%). In this group, neck pain (88.0%), mood changes (84.0%), nausea (72.0%), and blurring of vision (68.0%) were common migraine symptoms. Fourteen patients (56.0%) had severe disability on the MIDAS.

Table 1: Sociodemographic characteristics and factors associated with daytime hypersomnolence among study participants with migraine

Risk Factor		N (%)	ESS	
			Yes (N , %)	No (N , %)
Gender	Male	40 (14.4)	6 (2.2)	34 (12.2)
	Female	238 (85.6)	19 (6.8)	219 (78.8)
Race	Malay	209 (75.2)	20 (7.2)	189 (68.0)
	Chinese	45 (16.2)	3 (1.1)	42 (15.1)
	Indian	18 (6.5)	0 (0.0)	18 (6.5)
	Others	6 (2.2)	2 (0.7)	4 (1.4)
Education level	No formal education	1 (0.4)	0 (0.0)	1 (0.4)
	Primary school	2 (0.7)	0 (0.0)	2 (0.7)
	Secondary school	159 (57.2)	5 (1.8)	154 (55.4)
	Tertiary education	116 (41.7)	20 (7.2)	96 (34.5)
Types of occupation	Blue collar	11 (4.0)	1 (0.4)	10 (3.6)
	Pink collar	49 (17.6)	6 (2.2)	43 (15.5)
	White collar	88 (31.7)	14 (5.0)	74 (26.6)
	Student	15 (5.4)	1 (0.4)	14 (5.0)
	Retired	12 (4.3)	1 (0.4)	11 (4.0)
	Unemployed	103 (37.1)	2 (0.7)	101 (36.3)
Household income	< RM 1500	122 (43.9)	4 (1.4)	118 (42.4)
	RM 1500 - RM 3000	30 (10.8)	4 (1.4)	26 (9.4)
	RM 3001 - RM 6000	91 (32.7)	12 (4.3)	79 (28.4)
	> RM 6000	35 (12.6)	5 (1.8)	30 (10.8)

Marital status	Single	45 (16.2)	5 (1.8)	40 (14.4)
	Married	221 (79.5)	19 (6.8)	202 (72.7)
	Divorced	9 (3.2)	1 (0.4)	8 (2.9)
	Widowed	3 (1.1)	0 (0.0)	3 (1.1)
Coffee drinker	No	206 (74.1)	10 (3.6)	196 (70.5)
	Yes	72 (25.9)	15 (5.4)	57 (20.5)
Smoker	No	268 (96.4)	23 (8.3)	245 (88.1)
	Yes	7 (2.5)	1 (0.4)	6 (2.2)
	Ex smoker	3 (1.1)	1 (0.4)	2 (0.7)
Hypertension	No	199 (71.6)	16 (5.8)	183 (65.8)
	Yes	79 (28.4)	9 (3.2)	70 (25.2)
Diabetes mellitus	No	246 (88.5)	23 (8.3)	223 (80.2)
	Yes	32 (11.5)	2 (0.7)	30 (10.8)
Asthma / COPD	No	245 (88.1)	23 (8.3)	222 (79.9)
	Yes	33 (11.9)	2 (0.7)	31 (11.2)
Stroke	No	265 (95.3)	23 (8.3)	242 (87.1)
	Yes	13 (4.7)	2 (0.7)	11 (4.0)
Epilepsy	No	275 (98.9)	24 (8.6)	251 (90.3)
	Yes	3 (1.1)	1 (0.4)	2 (0.7)
Ischemic Heart Disease	No	257 (92.4)	22 (7.9)	235 (84.5)
	Yes	21 (7.6)	3 (1.1)	18 (6.5)
Peptic ulcer disease / GERD	No	212 (76.3)	13 (4.7)	199 (71.6)
	Yes	66 (23.7)	12 (4.3)	54 (19.4)
Body Mass Index Category	Underweight	2 (0.7)	0 (0.0)	2 (0.7)
	Normal	57 (20.5)	3 (1.1)	54 (19.4)

	Overweight	132 (47.5)	10 (3.6)	122 (43.9)
	Obese	87 (31.3)	12 (4.3)	75 (27.0)
Types of migraine	Migraine with aura	61 (21.9)	14 (5.0)	47 (16.9)
	Migraine without aura	217 (78.1)	11 (4.0)	206 (74.1)
Nausea	No	189 (68.0)	7 (2.5)	182 (65.5)
	Yes	89 (32.0)	18 (6.5)	71 (25.5)
Vomiting	No	233 (83.8)	16 (5.8)	217 (78.1)
	Yes	45 (16.2)	9 (3.2)	36 (12.9)
Lethargy	No	133 (47.8)	4 (1.4)	129 (46.4)
	Yes	145 (52.2)	21 (7.6)	124 (44.6)
Blurring of vision	No	205 (73.7)	8 (2.9)	197 (70.9)
	Yes	73 (26.3)	17 (6.1)	56 (20.1)
Mood changes	No	191 (68.7)	4 (1.4)	187 (67.3)
	Yes	87 (31.3)	21 (7.6)	66 (23.7)
Confusion	No	248 (89.2)	13 (4.7)	235 (84.5)
	Yes	30 (10.8)	12 (4.3)	18 (6.5)
Numbness of face	No	252 (90.6)	18 (6.5)	234 (84.2)
	Yes	26 (9.4)	7 (2.5)	19 (6.8)
Tinnitus	No	239 (86.0)	17 (6.1)	222 (79.9)
	Yes	39 (14.0)	8 (2.9)	31 (11.2)
Vertigo	No	226 (81.3)	14 (5.0)	212 (76.3)
	Yes	52 (18.7)	11 (4.0)	41 (14.7)
Dizziness	No	132 (47.5)	4 (1.4)	128 (46.0)
	Yes	146 (52.5)	21 (7.6)	125 (45.0)
Slurred speech	No	266 (95.7)	22 (7.9)	244 (87.8)

	Yes	12 (4.3)	3 (1.1)	9 (3.2)
Neck pain	No	192 (69.1)	3 (1.1)	189 (68.0)
	Yes	86 (30.9)	22 (7.9)	64 (23.0)
Sumatriptan	No	210 (75.5)	12 (4.3)	198 (71.2)
	Yes	68 (24.5)	13 (4.7)	55 (19.8)
Paracetamol	No	143 (51.4)	9 (3.2)	134 (48.2)
	Yes	135 (48.6)	16 (5.8)	119 (42.8)
NSAIDS	No	193 (69.4)	17 (6.1)	176 (63.3)
	Yes	85 (30.6)	8 (2.9)	77 (27.7)
Ergots	No	276 (99.3)	25 (9.0)	251 (90.3)
	Yes	2 (0.7)	0 (0.0)	2 (0.7)
Propranolol	No	223 (80.2)	25 (9.0)	198 (71.2)
	Yes	55 (19.8)	0 (0.0)	55 (19.8)
Amitriptyline	No	214 (77.0)	21 (7.6)	193 (69.4)
	Yes	64 (23.0)	4 (1.4)	60 (21.6)
Flunarizine	No	238 (85.6)	22 (7.9)	216 (77.7)
	Yes	40 (14.4)	3 (1.1)	37 (13.3)
Topiramate	No	255 (91.7)	20 (7.2)	235 (84.5)
	Yes	23 (8.3)	5 (1.8)	18 (6.5)
Sodium valproate	No	277 (99.6)	25 (9.0)	252 (90.6)
	Yes	1 (0.4)	0 (0.0)	1 (0.4)
Pizotifen	No	270 (97.1)	24 (8.6)	246 (88.5)
	Yes	8 (2.9)	1 (0.4)	7 (2.5)
Erenumab	No	273 (98.2)	24 (8.6)	249 (89.6)
	Yes	5 (1.8)	1 (0.4)	4 (1.4)

Botulinum toxin	No	273 (98.2)	25 (9.0)	248 (89.2)
	Yes	5 (1.8)	0 (0.0)	5 (1.8)
Cold therapy	No	261 (93.9)	19 (6.8)	242 (87.1)
	Yes	17 (6.1)	6 (2.2)	11 (4.0)
Massage	No	236 (84.9)	12 (4.3)	224 (80.6)
	Yes	42 (15.1)	13 (4.7)	29 (10.4)
Acupuncture	No	267 (96.0)	21 (7.6)	246 (88.5)
	Yes	11 (4.0)	4 (1.4)	7 (2.5)
MIDAS	No	247 (88.8)	11 (4.0)	236 (84.9)
	Yes	31 (11.2)	14 (5.0)	17 (6.1)

	Mean, SD (95% CI)
Age (years old)	46.4 ± 15.75 (44.54 - 48.26)
Age of onset (years old)	33.5 ± 14.5 (31.81 - 35.23)
Pain score	4.33 ± 2.65 (4.02 - 4.64)
	Median (Percentile 25th, 75th)
BMI (kg/m^2)	25.3 (23.4 , 28.4)
Duration of migraine (years)	10 (5 , 20)
Frequency of migraine (per month)	3 (1 , 4)

Table 2: Demographic and Clinical Characteristics of Migraine Patients with Daytime Hypersomnolence (n = 25)

Risk Factor		ESS (%)
Gender	Male	6 (24.0)
	Female	19 (76.0)
Education level	No formal education	0 (0.0)
	Primary school	0 (0.0)

	Secondary school	5 (20.0)
	Tertiary education	20 (80.0)
Marital status	Single	5 (20.0)
	Married	19 (76.0)
	Divorced	1 (4.0)
	Widowed	0 (0.0)
Coffee drinker	No	10 (40.0)
	Yes	15 (60.0)
Peptic ulcer disease / GERD	No	13 (52.0)
	Yes	12 (48.0)
Body Mass Index Category	Underweight	0 (0.0)
	Normal	3 (12.0)
	Overweight	10 (40.0)
	Obese	12 (48.0)
Types of migraine	Migraine with aura	14 (56.0)
	Migraine without aura	11 (44.0)
Nausea	No	7 (28.0)
	Yes	18 (72.0)
Blurring of vision	No	8 (32.0)
	Yes	17 (68.0)
Mood changes	No	4 (16.0)
	Yes	21 (84.0)
Neck pain	No	3 (12.0)
	Yes	22 (88.0)
MIDAS	No	11 (44.0)

	Yes	14 (56.0)

An independent-samples t-test was conducted to examine associations between patient age, age at migraine onset, pain score, and daytime hypersomnolence as measured by the Epworth Sleepiness Scale (ESS). Age (M=46.4, SD=15.75; t (36) = 2.687, p= 0.011) and age of migraine onset (M=33.5, SD=14.5; t (276) = 3.849, p= <0.001) were both significantly associated with daytime hypersomnolence. Migraine pain score (M=4.33, SD=2.65) was also significantly associated with daytime hypersomnolence (t (41) = -8.641, p= <0.001).

The Mann-Whitney U test was used to analyse the relationship between several variables and daytime hypersomnolence. These variables included patient education level, coffee drinker status, GERD, migraine type, migraine frequency, nausea, vomiting, blurring of vision, mood changes, tinnitus, vertigo, neck pain, sumatriptan, propranolol, topiramate, and MIDAS. Several factors were significantly associated with daytime hypersomnolence. These included education level (U=1832.500, z = -4.061, p <0.001), coffee drinker (U = 1977.500, z = -4.072, p <0.001), GERD (U= 2319.500, z = -2.983, p = 0.003), migraine type (U =1979.000, z = - 4.305, p <0.001), migraine frequency (U = 2705.000, z = -2.730, p = 0.006), nausea (U = 1773.000, z = -4.484, p <0.001), vomiting (U = 1773.000, z = -4.484, p <0.001), blurring of vision (U = 1712.000, z = -4.963, p <0.001), mood changes (U = 1331.000, z = -5.947, p <0.001), tinnitus (U = 2538.000, z = -2.707, p = 0.007), vertigo (U = 2283.500, z = -3.394, p <0.001), neck pain (U = 1179.000, z = -6.459, p <0.001), sumatriptan (U = 2205.500, z = -3.352, p <0.001), propranolol (U = 2475.000, z = -2.598, p = 0.009), topiramate (U = 2755.000, z = -2.227, p = 0.026), and MIDAS (U = 1604.000, z = -7.454, p <0.001), as shown in Table 3. However, there was no statistically significant association observed between gender, race, marital status, BMI, or smoking history and daytime hypersomnolence among our study participants.

Table 3: Associations of sociodemographic factors with daytime hypersomnolence in migraine patients

Independent t test (ESS)			t	df	p value
Age			2.687	36.838	**0.011**
Age of onset			3.849	276.000	**<0.001**
Pain score			-8.641	41.168	**<0.001**
Mann–Whitney U test	ESS	Mean Rank	U	Z	p value
Gender	Negative	140.82	2828.5	-1.433	0.152
	Positive	126.14			
Race	Negative	140.16	2995.0	-0.584	0.559
	Positive	132.80			
Education level	Negative	134.24	1832.5	-4.061	**<0.001**
	Positive	192.70			
Coffee drinker	Negative	134.82	1977.5	-4.072	**<0.001**
	Positive	186.90			
Hypertension	Negative	138.46	2899.0	-0.880	0.379
	Positive	150.04			
Diabetes Mellitus	Negative	139.98	3040.5	-0.576	0.565
	Positive	134.62			
Bronchial Asthma / COPD	Negative	140.03	3028.0	-0.626	0.531
	Positive	134.12			
Stroke	Negative	139.04	3047.0	-0.824	0.410
	Positive	144.12			
Epilepsy	Negative	139.10	3061.0	-1.479	0.139
	Positive	143.56			
Ischemic Heart Disease	Negative	138.89	3008.0	-0.880	0.379
	Positive	145.68			
Peptic Ulcer Disease / GERD	Negative	136.17	2319.5	-2.983	**0.003**
	Positive	173.22			
Types of Migraine	Negative	134.82	1979.0	-4.305	**<0.001**
	Positive	186.84			
Frequency of migraine per month	Negative	137.69	2705.0	-2.730	**0.006**
	Positive	157.80			
Nausea	Negative	134.01	1773.0	-4.484	**<0.001**

	Positive	195.08			
Vomiting	Negative	136.78	2474.0	-2.814	**0.005**
	Positive	167.04			
Blurring of Vision	Negative	133.77	1712.0	-4.963	**<0.001**
	Positive	197.52			
Mood Changes	Negative	132.26	1331.0	-5.947	**<0.001**
	Positive	212.76			
Tinnitus	Negative	137.03	2538.0	-2.707	**0.007**
	Positive	164.48			
Vertigo	Negative	136.03	2283.5	-3.394	**<0.001**
	Positive	174.66			
Neck Pain	Negative	131.66	1179.5	-6.459	**<0.001**
	Positive	218.82			
Sumatriptan	Negative	135.72	2205.5	-3.352	**<0.001**
	Positive	177.78			
Paracetamol	Negative	137.38	2626.0	-1.616	0.106
	Positive	160.96			
NSAIDS	Negative	139.30	3113.0	-0.162	0.871
	Positive	141.48			
Propranolol	Negative	142.22	2475.0	-2.598	**0.009**
	Positive	112.00			
Amitriptyline	Negative	140.46	2918.5	-0.873	0.383
	Positive	129.74			
Flunarizine	Negative	139.83	3079.5	-0.356	0.722
	Positive	136.18			
Topiramate	Negative	137.89	2755.0	-2.227	**0.026**
	Positive	155.80			
Sodium valproate	Negative	139.55	3150.0	-0.314	0.753
	Positive	139.00			
Pizotifen	Negative	139.35	3123.5	-0.351	0.725
	Positive	141.06			
Erenumab	Negative	139.20	3086.0	-0.867	0.386
	Positive	142.56			
Ergots	Negative	139.60	3137.5	-0.445	0.656
	Positive	138.50			
Botulinum toxin	Negative	139.75	3100.0	-0.708	0.479

	Positive	137.00			
MIDAS	Negative	133.34	1604.0	-7.454	**<0.001**
	Positive	201.84			
Kruskal–Wallis test with ESS	N	Mean Rank	H	df	p value
BMI					
Normal	59	134.07	3.861	2	0.145
Overweight	132	137.53			
Obese	87	146.17			
Occupation					
Blue collar	11	139.64	12.096	5	**0.033**
Pink collar	49	144.02			
White collar	88	149.11			
Student	15	136.27			
Retired	12	138.58			
Unemployed	103	129.70			
Household income					
< RM1500	122	131.56	8.680	3	**0.034**
RM1500–RM3000	30	145.53			
RM3001-RM6000	91	145.33			
>RM6000	35	146.86			
Marital status					
Single	45	142.44	0.632	3	0.889
Married	221	138.95			
Divorced	9	142.44			
Widowed	3	127.00			
Smoker					
Yes	268	138.93	2.458	2	0.293
No	3	173.33			
Ex-smoker	7	146.86			
Pain Score					
1 to 3	141	127.00	30.907	2	**<0.001**
4 to 6	70	146.86			
7 to 10	67	158.12			

p value significant at <0.05

U – Mann-Whitney test

Z – Z value

t - t statistics

df- Degree of freedom

A Binary Logistic Regression analysis was conducted to examine the effects of sociodemographic factors such as age, age of migraine onset, education level, occupation type, household income, body mass index (BMI), marital status, and MIDAS on daytime hypersomnolence. The model was statistically significant, $\chi 2$ (18, N = 278) = 78.173, $p < 0.001$, suggesting that the model can distinguish between those with daytime hypersomnolence in our study population. The model explained between 24.5% (Cox & Snell R-squared) and 54.0% (Nagelkerke R-squared) of the variance in the dependent variable and correctly classified 89.9% of cases. The Hosmer-Lemeshow test indicated a good fit to the data ($\chi 2$ [7] = 4.978, p = 0.663). Age group between 25 and 54 years old (OR 0.137, C.I. 0.039 - 0.479, p 0.002), education level (OR 9.956, C.I. 1.334 - 74.292, p 0.025) and MIDAS (OR 26.182, C.I. 6.763 - 101.359, p 0.000) were significant contributors to the model, as shown in Table 4.

Table 4: Logistic regression predicting daytime hypersomnolence in migraine patients in term of sociodemographic factors

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							LL	UL
Age (years old)								
24 and less			0.570	3	0.903			
25 – 54	1.703	2.255	0.570	1	0.450	5.488	0.066	455.687
55 – 64	-38.151	5859.561	0.000	1	0.995	0.000	0.000	
65 and more	-35.265	8423.689	0.000	1	0.997	0.000	0.000	
Age of onset (years old)								
24 and less			9.710	3	**0.021**			
25 – 54	-1.985	0.637	9.710	1	**0.002**	0.137	0.039	0.479
55 – 64	18.351	7559.674	0.000	1	0.998	93281653.251	0.000	
65 and more	-0.155	19893.471	0.000	1	1.000	0.857	0.000	
Education level	2.298	1.025	5.023	1	**0.025**	9.956	1.334	74.292

Types of occupation								
Blue collar			1.274	5	0.938			
Pink collar	-1.239	1.412	0.770	1	0.380	0.290	0.018	4.612
White collar	-1.289	1.390	0.860	1	0.354	0.276	0.018	4.201
Student	-2.872	3.390	0.718	1	0.397	0.057	0.000	43.455
Retired	19.239	3678.935	0.000	1	0.996	226716539.426	0.000	
Unemployed	-1.446	3.085	0.220	1	0.639	0.236	0.001	99.557
Household income								
Less than RM1500			5.067	3	0.167			
RM1500 – RM3000	-0.397	3.065	0.017	1	0.897	0.672	0.002	273.443
RM3001 – RM6000	-2.131	3.059	0.485	1	0.486	0.119	0.000	47.668
More than RM6000	-2.652	3.056	0.753	1	0.386	0.071	0.000	28.183
BMI								
Normal			3.874	2	0.144			
Overweight	1.134	0.914	1.539	1	0.215	3.109	0.518	18.664
Obese	1.723	0.886	3.784	1	0.052	5.603	0.987	31.798
MIDAS	3.265	0.691	22.352	1	**0.000**	26.182	6.763	101.359
Constant	-3.459	3.682	0.883	1	0.348	0.031		

df − degree of freedom

OR - odds ratio

C.I. − confidence interval

LL − lower limit

UL - upper limit

A Binary Logistic Regression analysis was conducted to examine the effects of clinical factors such as type of migraine, frequency of migraine per month, pain score, migraine symptoms and migraine medications on daytime hypersomnolence. The model was statistically significant, $\chi 2$ (15, N = 278) = 68.922, $p < 0.001$, suggesting that the model can distinguish between those with daytime hypersomnolence in our study population. The model explained between 22.0% (Cox & Snell R-squared) and 48.4% (Nagelkerke R-squared) of the variance in the dependent variable and correctly classified 99.1% of cases. The Hosmer-Lemeshow test indicated a good fit to the data ($\chi 2$ [7] = 1.279, p = 0.989). Sumatriptan (OR 4.538, C.I. 1.404 - 14.669, p 0.012) was a significant contributor to the model, as shown in Table 5.

Table 5: Logistic regression predicting daytime hypersomnolence in migraine patients in term of clinical factors

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							LL	UL
Types of migraine	0.553	0.565	0.958	1	0.328	1.739	0.574	5.265
Frequency of migraine per month	-0.014	0.738	0.000	1	0.985	0.986	0.232	4.186
Peptic Ulcer Disease	-0.171	0.578	0.088	1	0.767	0.843	0.272	2.615
Nausea	-0.264	0.674	0.153	1	0.696	0.768	0.205	2.881
Vomiting	0.057	0.584	0.010	1	0.922	1.059	0.337	3.327
Blurring of Vision	0.664	0.617	1.158	1	0.282	1.942	0.580	6.508
Mood Changes	0.972	0.751	1.672	1	0.196	2.642	0.606	11.521
Tinnitus	-0.193	0.654	0.088	1	0.767	0.824	0.229	2.969
Vertigo	0.385	0.624	0.380	1	0.537	1.469	0.432	4.993
Neck Pain	1.504	0.827	3.306	1	0.069	4.498	0.889	22.754
Sumatriptan	1.512	0.599	6.384	1	**0.012**	4.538	1.404	14.669
Beta blocker	-18.463	4411.862	0.000	1	0.997	0.000	0.000	
Topiramate	0.570	0.764	0.557	1	0.455	1.768	0.396	7.901
Pain score								
1-3			0.720	2	0.698			
4-6	-16.908	3094.906	0.000	1	0.996	0.000	0.000	
7-10	0.508	0.598	0.720	1	0.396	1.662	0.514	5.370
Constant	-4.551	1.348	11.389	1	0.01	0.011		

df − degree of freedom

OR - odds ratio

C.I. − confidence interval

LL − lower limit

UL - upper limit

Spearman's correlation analysis was performed to examine the relationships regarding age, education level, coffee drinker, gastroesophageal reflux disease, age of migraine onset, type of migraine, frequency of migraine per month, pain score, symptom of migraine, migraine medications such as sumatriptan, propranolol, and topiramate or MIDAS score with daytime

hypersomnolence. As shown in Table 6 , the results of the Spearman correlation indicated a statistically significant positive relationship regarding patient education level (r(278): 0.237, p<0.01) , coffee drinker (r(278): 0.245, p<0.01) , gastroesophageal reflux disease (r(278): 0.179, p<0.01) , type of migraine (r(278): 0.259, p<0.01) , migraine pain score (r(278): 0.331, p<0.01) , frequency of migraine per month (r(278): 0.164, p<0.01) , migraine symptoms such as nausea (r(278): 0.269, p<0.01) , vomiting (r(278): 0.169, p<0.01) , blurring of vision (r(278): 0.298, p<0.01) , mood changes (r(278): 0.357, p<0.01) , tinnitus (r(278): 0.163, p<0.01) , vertigo (r(278): 0.204, p<0.01) and neck pain (r(278): 0.388, p<0.01) , and medications such as sumatriptan (r(278): 0.201, p<0.01) and topiramate (r(278): 0.134, p<0.05) and MIDAS (r(278): 0.448, p<0.01) with daytime hypersomnolence. Additionally, negative relationships were observed between the age of migraine onset and daytime hypersomnolence (r(278): -0.226, p < 0.01) and between propranolol and daytime hypersomnolence (r(278): 0.156, p < 0.01).

Table 6 : Spearman's correlation between sociodemographic factors with excessive daytime hypersomnolence in migraine patients

Relationship between sociodemographic factors with excessive daytime hypersomnolence in migraine patients

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. ESS																			
2. Age	**-0.112**																		
3. Age of Onset	**-0.226****	0.730**																	
4. Pain Score	**0.331****	-0.200**	-0.360**																
5. Education Level	**0.237****	-0.266**	-0.372**	0.406**															
6. Coffee drinker	**0.245****	-0.145*	-0.320**	0.341**	0.234**														
7. PUD / GERD	**0.179****	0.086	-0.015	0.283**	0.248**	0.172**													
8. Migraine Type	**0.259****	-0.122*	-0.232**	0.393**	0.271**	0.262**	0.194**												
9. Migraine Frequency	**0.164****	-0.055	-0.125*	0.313**	0.145*	0.068	0.217**	0.166**											
10. Nausea	**0.269****	-0.218**	-0.332**	0.531**	0.251**	0.228**	0.269**	0.381**	0.334**										
11. Vomiting	**0.169****	-0.147*	-0.167**	0.391**	0.109	0.141*	0.122*	0.192**	0.191**	0.494**									
12. Blurring of Vision	**0.298****	-0.158**	-0.250**	0.521**	0.258**	0.282**	0.205**	0.414**	0.162**	0.467**	0.448**								
13. Mood Changes	**0.357****	-0.113	-0.321**	0.699**	0.353**	0.398**	0.371**	0.317**	0.278**	0.551**	0.377**	0.514**							
14. Tinnitus	**0.163****	-0.024	-0.106	0.395**	0.183**	0.400**	0.188**	0.336**	0.178**	0.344**	0.244**	0.371**	0.375**						
15. Vertigo	**0.204****	-0.122*	-0.191**	0.469**	0.246**	0.369**	0.296**	0.347**	0.345**	0.462**	0.265**	0.364**	0.512**	0.497**					
16. Neck Pain	**0.388****	-0.136*	-0.367**	0.651**	0.360**	0.457**	0.322**	0.435**	0.312**	0.625**	0.361**	0.450**	0.723**	0.424**	0.497**				
17. Sumatriptan	**0.201****	0.047	-0.003	0.194**	0.105	0.122*	0.155**	0.184**	0.178**	0.148*	0.068	0.174**	0.085	0.035	0.027	0.09			
18. Beta blocker	**-0.156****	-0.004	0.093	-0.158**	-0.071	-0.108	-0.001	-0.132*	0.009	-0.089	-0.022	-0.03	-0.121*	-0.071	-0.03	-0.157**	0.032		
19. Topiramate	**0.134***	-0.059	-0.053	0.113	0.018	-0.029	0.170**	-0.001	0.126*	0.130*	0.01	0.118	0.079	-0.121*	-0.01	0.138*	0.133*	-0.149*	
20. MIDAS	**0.448****	-0.083	-0.189**	0.434**	0.250**	0.364**	0.178**	0.309**	0.312**	0.394**	0.279**	0.360**	0.426**	0.416**	0.299**	0.455**	0.197**	-0.061	0.018

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
ESS - Epworth Sleepiness Scale
PUD - Peptic Ulcer Disease
GERD - Gastroesophageal reflux disease
MIDAS - Migraine Disability Assessment

4 DISCUSSION

This cross-sectional study of 278 adult migraine patients attending a tertiary neurology clinic in Malaysia identified a 9.0% prevalence of daytime hypersomnolence, defined by an ESS score exceeding 10. On multivariable logistic regression, three independent sociodemographic predictors were identified: migraine onset between 25 and 54 years of age (OR 0.137, 95% CI: 0.039–0.479), higher educational attainment (OR 9.956, 95% CI: 1.334–74.292), and severe migraine-related disability (MIDAS Grade IV; OR 26.182, 95% CI: 6.763–101.359). Among clinical factors, sumatriptan use was the sole independent predictor on multivariable analysis (OR 4.538, 95% CI: 1.404–14.669). A broader constellation of clinical and sociodemographic correlates — including migraine symptom burden, attack frequency, pain severity, coffee consumption, comorbid GERD, and use of topiramate and propranolol — were additionally identified on univariate and Spearman correlation analyses. These findings are discussed in the context of existing evidence on migraine-related sleep dysfunction and the clinical relevance of daytime hypersomnolence in this population.

4.1 Prevalence

Migraine constitutes a substantial global health burden. The Global Burden of Disease Study (2015) identified migraine as the fourth leading cause of years lived with disability (YLD) in women and the eighth in men[12], and the World Health Organization (WHO) ranks it as the third most prevalent medical condition and the second most disabling neurological disorder worldwide[13]. Migraine is the leading cause of YLD among individuals aged 15–49 years globally[14], a finding that is consistent with the mean age of our cohort (46.4 years) and mean age at migraine onset (33.5 years).

The female predominance in our cohort (85.6%) aligns with established epidemiological data. The American Migraine Prevalence and Prevention (AMPP) study[15] reported lifetime migraine prevalence of 43% in women and 18% in men, with incidence peaking at approximately age 35 years (25–30% in women, 8% in men) before declining with advancing age [16,17,18,19]. Hormonal fluctuations — particularly estrogen-driven perturbations in serotonergic pathways, including 5-hydroxytryptamine — are implicated in this sex-based disparity and additionally influence sleep

architecture, creating a plausible biological link between migraine and sleep disturbance [20,21]. In our cohort, 78.1% of participants had migraine without aura, consistent with the known higher prevalence of this subtype in both sexes.

A 9.0% prevalence of daytime hypersomnolence in our migraine cohort is clinically meaningful and is supported by prior literature. Esposito et al. demonstrated that migraine disrupts sleep architecture, predisposing to daytime hypersomnolence[22]. A United States case series similarly documented daytime sleepiness as a prominent complaint among migraineurs[23]. A community-based Norwegian study [24] reported significantly elevated odds of excessive daytime sleepiness among migraineurs compared to headache-free individuals (OR = 3.3, 95% CI: 1.0–10.2). Of note, our prevalence estimate is lower than that reported by Peres et al. (37%), which likely reflects differences in study setting (tertiary clinic versus broader community), outcome instrument, and migraine severity distribution.

4.2 Sociodemographic Factors

Among sociodemographic predictors, MIDAS Grade IV disability, higher educational level, and younger age at migraine onset (25–54 years) emerged as independent predictors of daytime hypersomnolence in the multivariable model. Higher education was associated with increased odds of hypersomnolence (OR 9.956), a counterintuitive finding that may reflect greater occupational demands, cognitive workload, screen time, and delayed sleep phase among this group — factors that are independently associated with sleep disturbance and may amplify the sleep-disrupting effects of migraine.

Coffee consumption was positively correlated with daytime hypersomnolence ($r = 0.245$, $p < 0.001$). Caffeine exerts its stimulant effect by competitively blocking adenosine receptors in the central nervous system[25]. Chronic caffeine use has been shown to upregulate adenosine receptor density in animal models, producing a rebound adenosine surge upon caffeine withdrawal that manifests as excessive daytime sleepiness — a phenomenon recognized by the American Migraine Foundation[26] as a clinically relevant contributor to migraine-related sleep dysfunction.

Comorbid GERD was also significantly associated with daytime hypersomnolence. Migraine and gastrointestinal disorders share a well-described bidirectional relationship, mediated in part

through the gut–brain axis[27]. Stroe et al. demonstrated that peptic ulcer disease was independently associated with greater daytime sleepiness, even after controlling for sleep disturbances and other medical comorbidities[28]. In our cohort, GERD was present in 23.7% of all participants and 48.0% of those with daytime hypersomnolence, underscoring its clinical relevance in this population.

4.3 Clinical Factors

Higher migraine attack frequency, greater pain severity, broader symptom burden, and specific medications were associated with daytime hypersomnolence on univariate analysis and Spearman correlation. Kim et al. [29] reported higher rates of daytime sleepiness in patients with 10 or more migraine attacks per month compared with those experiencing fewer than one attack monthly (OR = 1.5, 95% CI: 0.4–5.8), while Stavem et al. [30] demonstrated a dose–response relationship between headache frequency and sleepiness irrespective of migraine classification. Peres et al. [20] further showed that daytime hypersomnolence was positively correlated with both migraine frequency and fatigue in 37% of migraine patients. These findings are broadly consistent with our own, supporting the concept that higher migraine burden compounds sleep-wake dysregulation.

Sumatriptan use was the sole independent clinical predictor of daytime hypersomnolence in the multivariable model (OR 4.538, 95% CI: 1.404–14.669, p = 0.012). This may represent a direct pharmacological effect, as sumatriptan has known sedating properties mediated through central 5-HT1B/1D agonism, commonly manifesting as post-dose drowsiness or fatigue [31]. Alternatively, sumatriptan use may serve as a surrogate marker of greater migraine severity and attack frequency, since it is predominantly prescribed for moderate-to-severe acute attacks. Topiramate and propranolol, while significantly associated with univariate analysis, did not retain significance in the multivariable model, suggesting that their apparent association may be confounded by underlying disease severity rather than representing an independent drug-specific effect.

The pattern of findings in the present study — wherein sleep disturbance correlates strongly with migraine symptom burden, disability, and specific medications — echoes the results of a

previous study in an elderly Iranian migraine cohort [18], in which poor nocturnal sleep quality (measured by the PSQI) was independently associated with migraine, while chronotype and OSA risk were not. The current study extends these observations to the dimension of daytime hypersomnolence in a younger, clinic-based Malaysian adult population, providing complementary evidence that both nocturnal sleep quality and daytime sleepiness are impaired across different migraine populations and age groups. Future studies integrating both PSQI and ESS measures, alongside objective sleep assessment (polysomnography or actigraphy), would help clarify the relative contributions of nocturnal sleep disruption and daytime hypersomnolence to overall migraine-related disability.

5 LIMITATION

We acknowledge several limitations in this study. As this was a single-centre study, we cannot extrapolate the findings to the overall community. In addition, we were unable to identify individual risk factors due to the cross-sectional study design. In the future, we plan to conduct a multicentre, case-control study to strengthen research in this field.

This study has several limitations that should be considered when interpreting its findings. First, the single-center design limits the generalizability of results to the broader Malaysian migraine population or other clinical settings. Second, the cross-sectional design precludes inference of causal or temporal relationships between identified factors and daytime hypersomnolence. Third, the relatively small number of participants with daytime hypersomnolence (n = 25, 9.0%) may have reduced the statistical power of the multivariable models and contributed to wide confidence intervals and evidence of quasi-complete separation for some variables (notably pain score in Model 2). Fourth, reliance on self-reported questionnaire data introduces the possibility of recall and response bias. Fifth, no objective sleep measures (e.g., polysomnography or actigraphy) were employed to validate subjective ESS findings. Future multicenter, prospective or longitudinal studies using objective sleep assessment tools and standardized migraine severity instruments are warranted to confirm and expand upon these findings.

6 CONCLUSION

This study identified a 9.0% prevalence of daytime hypersomnolence among adult migraine patients attending a tertiary neurology clinic in Malaysia, assessed using the Epworth Sleepiness Scale. Independent sociodemographic predictors included younger age at migraine onset (25–54 years), higher educational attainment, and severe migraine-related disability (MIDAS Grade IV). Among clinical factors, sumatriptan use was the sole independent predictor on multivariable analysis. Broader univariate and correlation analyses identified a constellation of additional associated factors including coffee consumption, comorbid GERD, migraine with aura, greater attack frequency and pain severity, multiple associated migraine symptoms, and use of topiramate and propranolol. These findings are broadly consistent with data from Western and Asian literature and highlight that daytime hypersomnolence is a clinically significant, under-recognized comorbidity of migraine. Routine screening for daytime hypersomnolence using the ESS is non-invasive, validated in Malay and English, and readily applicable to clinical practice. Early identification and management of daytime hypersomnolence may improve overall migraine outcomes and quality of life.

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