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RESEARCH

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Assessment of sleep patterns in migraine sufferers using the Epworth Sleepiness Scale

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Abstract

Background Migraine, a debilitating neurological disorder, is often co-occurring with sleep disturbances. This study used the Epworth Sleepiness Scale (ESS) to explore changes in sleep quality between individuals with migraine and healthy controls. Additionally, we examined associations between ESS scores and migraine frequency, severity, and demographic factors.

Methods This cross-sectional study included 404 participants, 204 with chronic migraine (diagnosed using ICHD-3 criteria) and 200 controls without neurological disorders. Daytime sleepiness was assessed using the Epworth Sleepiness Scale. Demographic and clinical data were analyzed using Python3 and SPSS, using t-tests and ANOVA ($P < 0.05$).

Results The study analyzed demographics, clinical characteristics, and daytime sleepiness in 204 migraine participants compared with 200 controls. Individuals with chronic migraine had higher Epworth Sleepiness Scale scores, with increased sleepiness associated with higher BMI, age, and female gender. Significant differences in sleepiness levels were observed with migraine severity, highlighting the impact of migraine on sleep patterns and quality, and no significant differences were found between control and migraine groups in ESS scores, sleep duration, or physical activity. Reliability testing confirmed high ESS consistency.

Conclusion This study highlights the prevalence of daytime sleepiness among individuals with chronic. Managing sleep quality emerges as an important treatment strategy. The use of standardized tools such as the Epworth Sleep Scale can guide personalized interventions, improve patient outcomes, and emphasize the role of lifestyle and overall health management.

Keywords Migraine, Daytime sleepiness, Epworth Sleepiness Scale, Sleep disorders, Sleep quality

Introduction

Migraine is a prevalent and debilitating neurological disorder that impacts numerous individuals each year, imposing considerable physical and psychological burdens on both participants and healthcare systems [6, 23, 45]. This condition is marked by repeated instances of intense headache, frequently associated with symptoms including nausea, sensitivity to light, and sensitivity to sound [1]. Recent studies indicate a complex relationship between sleep disorders and migraine [18, 47], with poor sleep quality frequently exacerbating the frequency and severity of migraine attacks [25, 27, 43]. Migraine itself can also contribute to sleep disorders, leading to a bidirectional pattern in which sleep problems and migraine severity influence each other [49].

Excessive daytime sleepiness (EDS) is a major clinical and public health concern which is not a disorder of itself but represents symptoms of conditions including sleep disorders, depression, anxiety and obesity metabolic

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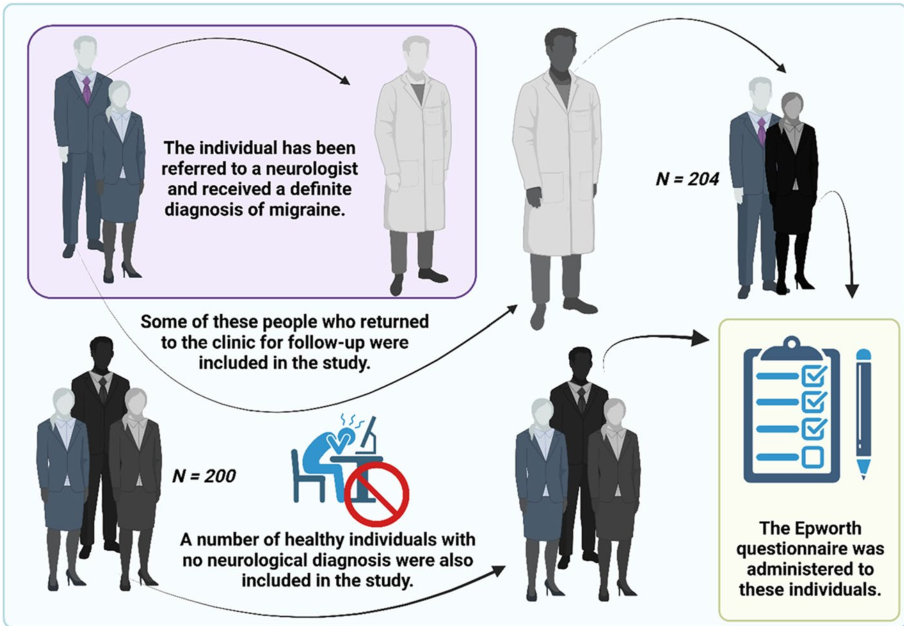

Fig. 1 Design and setting of the study

syndrome [4]. EDS can have negative effects on quality of life such as, increased cardiovascular mortality [11], car accidents [36], work related accidents [53], attention deficits and sleep attacks [3]. Despite the remarkable consequences of EDS, it is often under-reported, under-diagnosed and under-treated [22, 46].

Among the various instruments used to assess sleep disorders, the Epworth Sleepiness Scale (ESS) is widely used to assess daytime sleepiness, a common complaint of people with sleep disorders, and, consequently, to evaluate people with migraine [14]. The ESS, a subjective assessment, facilitates the measurement of sleepiness in daily contexts and offers insights into people's total sleep and waking patterns. Objective methods like polysomnography and actigraphy have examined the correlation between migraine and sleep; nevertheless, subjective evaluations such as the ESS provide a straightforward, efficient, and accessible option for extensive epidemiological research [54].

Although awareness of sleep disorders among individuals with migraine is increasing [18, 37, 47], research explicitly utilizing the ESS to evaluate daytime sleepiness and its correlation with migraine characteristics remains limited [19, 44]. This study sought to explore daytime sleepiness and disturbances in sleep quality between individuals with migraine and healthy controls through the Epworth Sleepiness Scale (ESS), moreover, to evaluate associations between excessive daytime sleepiness and migraine frequency, severity, and demographic features of individuals. Investigating this relationship may yield important insights for the clinical management of this significant issue, as enhancing sleep quality in migraine participants could alleviate migraine-related disability, lower the daytime sleepiness and improve overall quality of life.

Method and search strategies

Design and setting

This cross-sectional study was conducted on participants admitted to the Amir-Al-Momenin Hospital, an academic training hospital in Tehran, Iran, for six months in 2023 (March 3rd until September 3rd), As well as healthy individuals with no neurological diagnosis (Fig. 1).

Subjects

A total of 404 participants were recruited from the outpatient clinic of the Amir-Al-Momenin Hospital. 204 participants had been diagnosed with chronic migraine, which were diagnosed by a neurology specialist based on ICHD-3 criteria [26], and a control group of 200 individuals who did not have any neurological problems was selected through randomized sampling from the same pool of patients referred to the Amir-Al-Momenin Hospital clinic. These individuals were free of other disorders and were chosen to ensure a representative comparison group for assessing sleep patterns using the Epworth Sleepiness Scale, in conjunction with the migraine-affected group. The control group consisted of people who did not have a neurological diagnosis or a history

The Epworth Sleepiness Scale

How Sleepy Are You?

How likely are you to doze off or fall asleep in the following situations? You should rate your chances of dozing off, not just feeling tired.

Even if you have not done some of these things recently, determine how they would have affected you.

For each situation, decide whether you would have:

• No chance of dozing =0, • Slight chance of dozing =1, • Moderate chance of dozing =2, • High chance of dozing =3

Write down the number corresponding to your choice in the right-hand column. Total your score below:

situation	Chance of dosing
Sitting and reading	
Watching TV	
Sitting inactive in a public place (e.g., a theater or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in traffic	

Total Score = ________________________

Analyze Your Score

Interpretation:

• 0-7: It is unlikely that you are abnormally sleepy, • 8-9: You have an average amount of daytime sleepiness.

• 10-15: You may be excessively sleepy depending on the situation. You may want to consider seeking medical attention.

• 16-24: You are excessively sleepy and should consider seeking medical attention.

Fig. 2 The Epworth Sleepiness Scale [40]

of neurologic disease and active headache. Participants were aged between 18 and 60.

The unwillingness to participate, pregnancy (approved by a physician), a history of head or neck trauma, failure to comply with migraine diagnostic criteria, use of sleeping medications and effective psychiatric drugs, and other sleep disorders were eliminated criteria.

Measures

We have used the Epworth score scale questionnaires self-administered to evaluate daytime sleepiness because of reliability, validity, and ease of use [40]. The Epworth questionnaire surveyed the level of sleepiness by chances of dozing in the eight recent daily situations, and participants should give 0 (No chance of dozing), 1(Slight chance of dozing), 2 (Moderate chance of dozing), or 3(High chance of dozing) scores to each situation. The total score each participant gets interpreted as (Fig. 2).

The demographic and clinical characteristics of 204 participants with migraine and 200 people from the control group, such as age, sex, body mass index (BMI), cigarettes, alcohol consumption, and other complications (self-report), were also recorded.

Translation process

The Epworth Sleepiness Scale questionnaire was translated from English to Persian following a standard translation procedure. Initially, a bilingual expert conducted a forward translation from English to Persian, followed by a back translation to English by a different bilingual expert. Discrepancies between the back-translated version and the original were addressed through comparison and revision.

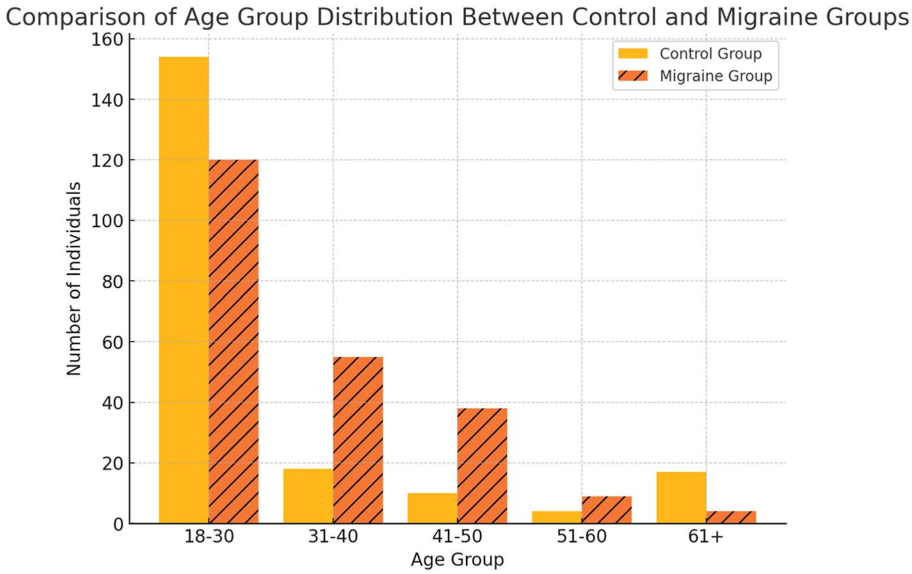

Fig. 3 Participants' number charts based on age groups

Table 1 The body mass indexes (BMI) of participants

BMI ranges	Number of participants (control group)	Number of participants (migraine group)	Total percentage (control group)	Total percentage (migraine group)
Underweight (<18.5)	17	16	8.50%	8%
Normal weight (18.5–24.9)	111	92	55.50%	45%
Overweight (>24.9)	55	61	27.50%	30%
Obese (>29.9)	17	35	8.50%	17%

Statistical analysis

The average score of each group, frequency, and relation between data were analyzed by Python3 with codes written in person and spss-26th edition.

T and ANOVA tests measured the relation between subjects (p-value $< = 0.05$).

Validity and reliability assessment

To ensure the Persian version's validity and reliability, content and construct validity were assessed. Additionally, test–retest reliability was conducted, demonstrating consistent results over time.

Results

In the current study, we evaluated demographic and clinical characteristics and also the level of daytime sleepiness of the 204 participants who had been diagnosed with migraine, based on ICHD-3 criteria [26], and were admitted to the outpatient clinic of Amir-Al-Momenin Hospital. We also compared their Epworth sleepiness scale scores [40], to the 200 participants without migraine.

Demographic and clinical characteristics

Of the 404 participants, the migraine group (204 individuals) consisted of 72 individuals (35%) males and 132 individuals (65%) females, and the control group (200 individuals) consisted of Males: 70 individuals (35%) Females: 130 individuals (65%).Participants were divided into five groups, ranging in age from 18 to 30, 31 to 40, 41 to 50, 51 to 60, and 61 or older (Fig. 3).

In the migraine group, the age group of 31 to 40 years had the most participants among other age groups, and in the control group, the age group of 18 to 30 years had the most participants among other age groups.

The body mass indexes (BMI) of participants were calculated;(1) control group: 111 (55.5%) of our participants had normal BMI, 17 (8.5%) were underweight, 55 (27.5%) and 17 (8.5%) were overweight and obese; (2) migraine group: 92 (45%) of our participants had normal BMI, 16 (8%) were underweight, 61 (30%) and 35(17%) were overweight and obese, respectively (Table 1).

The rates of smoking cigarettes and alcohol consumption for migraine group were also measured, which were 10.2% and 8.5%, respectively.

Table 2 The comorbidities of participants

Comorbidities	Number of participants (control group)	Number of participants (migraine group)	Total percentage (control group)	Total percentage (migraine group)
Hypertension	4	5	2%	2.20%
diabetes	2	1	1%	0.40%
Cardiovascular diseases	1	4	0.50%	1.80%
Chronic pulmonary diseases	2	2	1%	0.90%

Table 3 Epworth scores in control and migraine groups

Epworth scores groups	Number of participants (control group)	Number of participants (migraine group)	Total percentage (control group)	Total percentage (migraine group)
0–7 (normal)	96	96	48%	47%
8–9 (mild sleepiness)	38	49	19%	24%
10–15 (moderate sleepiness)	60	53	30%	26%
16 and higher (severe sleepiness)	6	6	3%	3%

The other comorbidities of participants were questioned, and for control group: 4(2%), 2(1%), 1(0.5%), and 2(1%), and for migrane group: 5(2.2%), 1(0.4%), 4(1.8%), and 2(0.9%) had been diagnosed with hypertension, diabetes, cardiovascular disease, and chronic pulmonary diseases, respectively (Table 2).

Epworth Sleepiness Scale scores

The Epworth Sleepiness scores of participants were categorized into four groups normal (score of 0–5), mild sleepiness (scores of 6–10), moderate sleepiness (scores of 11–12) and severe sleepiness (scores of 13 or higher). The highest percentage of members (40.1%) were dedicated.

to the mild sleepiness group. The normal, moderate, and severe sleepiness groups included 24.1%, 21.8%, and 14.0% of the participants, respectively (Table 3).

Sex differences

The mean Epworth score was 10.8 among males and 12.1 among females.

The comparison of the average Epworth score of males and females in migraine group, which the T-test did, showed a meaningful difference, and women who were diagnosed with chronic migraine showed higher levels of sleepiness than men with the same condition (Table 4).

Age groups differences

We used the ANOVA test to evaluate the differences in Epworth scores between age groups in migraine individuals.

Table 4 Sex difference Epworth score of males and females in migraine group

	Number of participants	Mean scores	T-test	*P*-value
Males	71	10.8	T=2.13	*P*=0.04
Females	132	12.1		

Table 5 Differences in Epworth scores between age groups in migraine individuals

Age groups	Mean scores	ANOVA test	*P*-value
18–30	10.5	*F*=3.45	*P*=0.02
31–40	11.2		
41–50	12		
51–60	12.5		
61+	13		

The mean scores of the 18–30, 31–40, 41–50, 51–60 and 61 or higher age groups were 10.5, 11.2, 12 and 13, respectively. The ANOVA test between the age groups demonstrated a meaningful difference, and as the age of the groups increased, the sleepiness level increased (Table 5).

Levels of sleepiness in various body mass indexes

The ANOVA test also evaluated a comparison of the Epworth scores among different BMI groups in migraine individuals. The mean scores of the underweight, normal weight, overweight, and obese groups were 10, 11, 12.5,

Table 6 Comparison of the Epworth scores among different BMI groups in migraine individuals

BMI ranges	Mean scores	ANOVA test	*P*-value
Underweight (<18.5)	10	*F*=4.12	*P*=0.01
Normal weight (18.5–24.9)	11		
Overweight (>24.9)	12.5		
Obese (>29.9)	13.2		

Table 7 Epworth Sleepiness Score for both groups

Group	Mean	Standard Deviation	Range
Control	8.21	3.94	0—22
Migraine	7.90	4.16	0—20

and 13.2, respectively. The ANOVA test between various BMI groups showed a meaningful difference. As the BMI got higher, the Epworth scores got bigger (Table 6).

Comprehensive analysis: control vs migraine groups

Data summary

This investigation contrasts healthy individuals (control group) with chronic migraine participants across many criteria, including Epworth Sleepiness Scale (ESS) ratings, sleep duration, physical activity, and demographic data.

ESS scores descriptive statistics

Descriptive statistics for the ESS scores in the control and migraine groups are as follows (Table 7): The analysis was conducted using measures such as the mean and median to summarize the data across both control and migraine groups. Specifically, the mean Epworth Sleepiness Score for the control group was 5.13, while for the migraine group, it was 5.20. The median Epworth Sleepiness Score for both groups were 5. Additionally, mean physical activity in hours for the control group was 7.25 h, while the migraine group averaged 7.33 h, with medians of 7.0 and 7.5 h, respectively (Fig. 4).

ESS scores vs sleep duration

A scatter graphic illustrates the correlation between the control and migraine groups' daily sleep duration and ESS scores. Trend lines suggest modest negative correlations, indicating that longer sleep periods are marginally linked to reduced ESS scores (Fig. 5).

ESS scores vs physical activity

A scatter plot illustrates the correlation between the length of daily physical activity and ESS scores for both

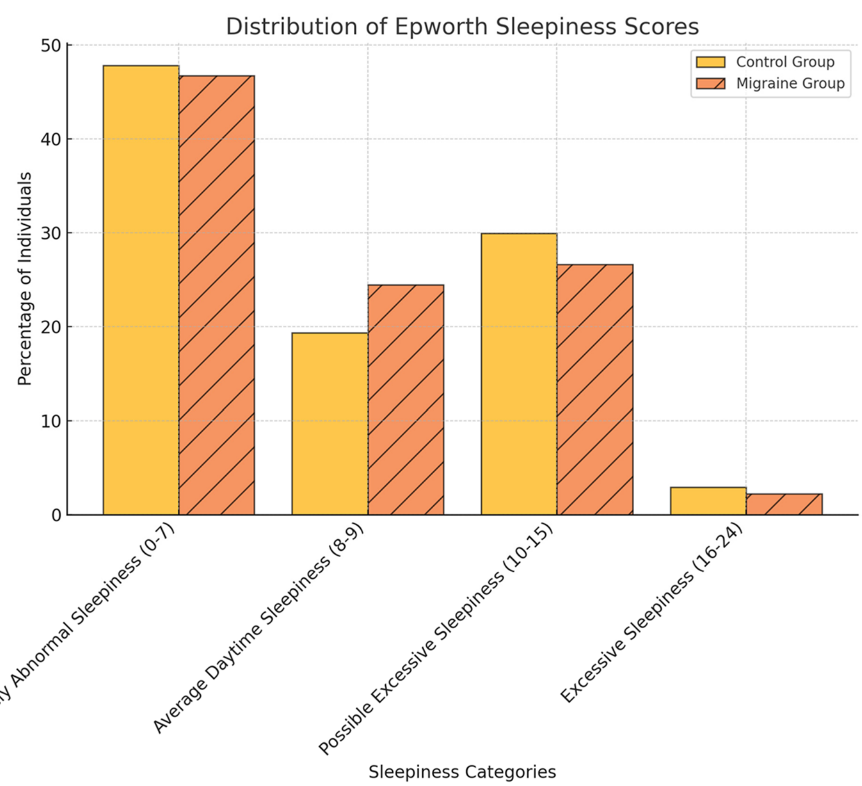

Fig. 4 Distribution Epworth Sleepiness Score for both groups

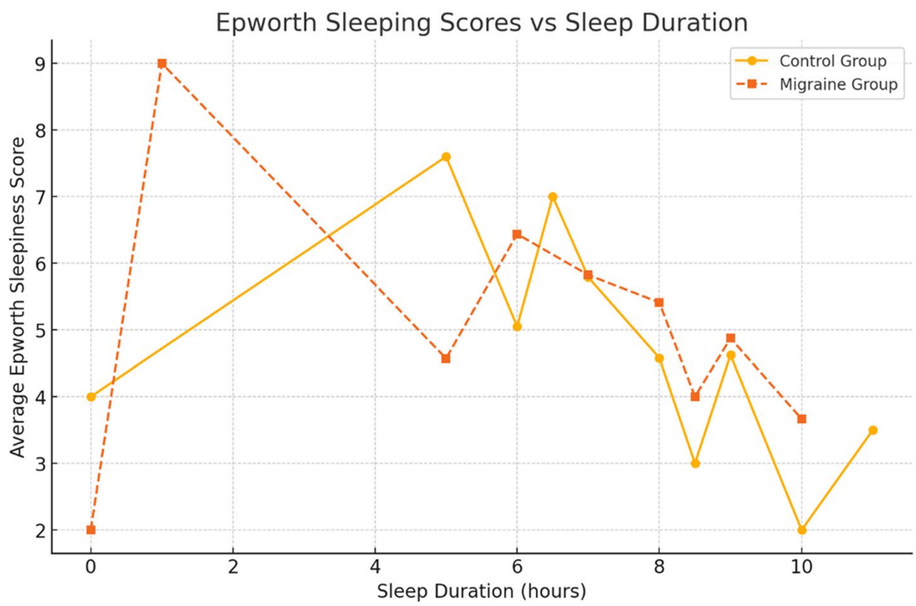

Fig. 5 ESS score chart based on daily sleep duration

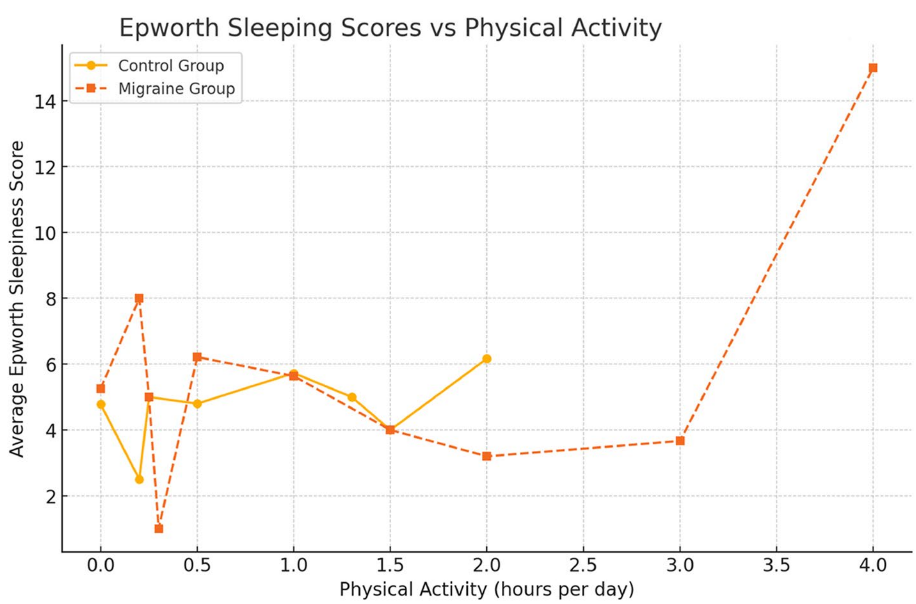

Fig. 6 ESS score chart based on daily activity duration

groups. Enhanced physical activity has a modest correlation with reduced ESS scores (Fig. 6).

Gender differences in ESS scores

The mean ESS scores for males and females were compared within the control and migraine groups. No statistically significant gender differences were found.

T-test results

T-tests were conducted to evaluate significant differences in variables between the control and migraine groups. The results indicated that while some differences were observed in mean values of certain variables, no statistically significant differences were found ($p > 0.05$) for the analyzed variables, including Epworth Sleepiness Scores across sleep duration, physical activity, and gender differences.

A t-test was performed to assess the difference between migraine and control groups; the t-test yielded a t-statistic of −0.23 and a *p*-value of 0.82. Since the *p*-value exceeds the threshold of 0.05, no significant difference was observed between the control and migraine groups in terms of Epworth sleep score.

The t-test for physical activity could not be calculated due to missing data for some participants, resulting in a t-statistic and *p*-value of NaN.

Reliability testing outcome

The test–retest reliability of the Persian version of the Epworth Sleepiness Scale indicated high reliability, with a correlation coefficient of ($r = 0.89$), confirming the consistency of the questionnaire.

Discussion

Daytime sleepiness can cause many adverse effects and noticeably lower the quality of a patient's life. Previous studies have demonstrated a complex association between migraine and sleepiness [38]. Migraine and sleepiness can both cause and worsen one another. Sleeping is key in regulating the central nervous system, and sleep disorders influence some nervous and chemical pathways in the brain. These changes can initiate or flare migraine attacks. On the other hand, participants who are diagnosed with migraine can develop sleeping disorders and daytime sleepiness [10, 30, 38, 48, 49]. The effects of insomnia and migraine form a vicious cycle that results in many complications, such as anxiety and depression [31, 51, 52], this highlights the crucial need for more investigations in this area.

In this study, our primary goal was to evaluate the level of daytime sleepiness in participants diagnosed with chronic migraine. Understanding the relation between these two conditions could improve treatment strategies and improve participants quality. The rigorous translation and validation process of the Epworth Sleepiness Scale into Persian allowed for accurate assessment of sleep patterns among the participants, facilitating meaningful comparisons with other studies using the original English version.

By comparing the level of sleepiness in the group of participants diagnosed with migraine and the group of healthy people without any medical conditions, we found significantly increased Epworth scores and level of sleepiness in the migraine group in contrast with the migraine-free group. Most of the participants with migraine had mild to severe levels of sleepiness, and a noticeable number of them showed severe levels of sleepiness. The comorbidity of both migraine and sleep disorders has been identified in previous studies [7], such as Merrill and Gibbons [28], who noticed those with a sleep disorder were 133% more likely to develop migraine. Moreover, in many studies, the higher frequency of various sleeping deprivations in migraineurs have been shown, which included higher insomnia [16], insufficient sleep duration [17], and poor sleep quality [42].

As we discussed, there is a bidirectional relationship between migraine and sleep deprivation, and they both can trigger each other [13], which can occur on several levels. First, Sleep deprivation can lead to an increased cortical spreading depression (CSD) susceptibility that promotes the occurrence of migraine [50]. Second, The changes in the concentration of certain neurotransmitters can affect sleep and migraine, which can explain our findings. Especially, 5-hydroxytryptaminergic which plays significant roles in promoting wakefulness, initiating and maintaining sleep [33, 39], and also dysregulated 5-hydroxytryptamine levels by vasodilation and contraction, altered vascular permeability, and disruption of the pain modulation system results in migraine [8, 9, 12]. As well as Neverdahl et al. [32] discovered, patients with migraine had reduced endogenous pain modulation that was induced by insufficient sleep and periods of experimental sleep restriction.

Females showed a higher average score of daytime sleepiness than males, which demonstrated that females with migraine are more likely to experience greater levels of daytime sleepiness. This can be associated with the biological and hormonal differences in males and females, as well as the role of Estrogen in increasing the sensitivity toward pain and sleep problems [29].

Our results displayed the impacts of age since the older participants got higher Epworth scores and had higher levels of sleepiness. Also, the group of participants that were 60 or older revealed the highest level of daytime sleepiness. This might be due to the changes in sleep patterns, hormonal and nervous systems, and increased comorbidities associated with higher ages [24, 34].

On the other hand, evaluating the impacts of BMI showed participants who were overweight or obese had higher levels of sleepiness. This might be associated with the role of obesity in initiating and worsening sleep deprivations such as sleep apnea, and in participants with migraine, the complications of obesity got more serious [21, 41].

Environmental factors and lifestyles also have significant effects on the levels of sleepiness in participants with migraine. The participants who consumed alcohol or smoked cigarettes had experienced higher levels of daytime sleepiness. As previous studies suggested, both alcohol and cigarettes can reduce the quality of sleep and trigger migraine attacks [5, 20, 35].

Another point that was evaluated in this study was the impacts of comorbidities such as hypertension, diabetes, cardiovascular diseases, and pulmonary diseases on the level of sleepiness in people with migraine. These conditions resulted in higher levels of sleepiness. These comorbidities directly influence the quality of sleep and daytime sleepiness [2, 15].

Limitation

A limitation of our study is the need for a more comprehensive assessment using standardized tools such as the Epworth scale to assess sleep deprivation. In addition, environmental and personal factors, as well as other health conditions, need to be further explored to develop holistic migraine management strategies. Another limitation of this study is that only individuals with chronic migraines were included in the analysis. Therefore, the findings may not be generalizable to those suffering from episodic migraines.

Conclusion

Eventually, our study demonstrated that daytime sleepiness of participants with migraine is a common problem and can be influenced by many factors, which not only affect the level of sleepiness but also affect the migraine attacks. Adequate sleeping management and improving quality can be one of the significant treatment strategies to reduce migraine symptoms. Additionally, it showed the importance of environmental and personal factors, which need to be considered more.

There is also a strong need to evaluate sleep deprivations in participants with migraine, which should be done by standard assessment tools such as the Epworth scale. Because part of the treatment for migraine sufferers depends on regulating and improving sleep. This informs physicians about the patient's condition and helps them design better treatment strategies that improve the quality of participants' lives. We also suggest evaluating the other health conditions of the participants to consider positive lifestyles and overall health alternatives.

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Authors' contributions

A.H–H. data analysis and manuscript review and editing. S.R. writing original draft, data collection, and analysis. M.S. and T.T. supervised the thesis and experimental design.

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Data availability

Data will be made available on request.

Declarations

Ethics approval and consent to participate

Human ethics have been observed, and consent to participation has been obtained from all participants in this research. The Tehran Medical Sciences, Islamic Azad University Ethics Committee confirmed this investigation (ethics code: IR.IAU.TMU.REC.1402.008).

Consent for publication

Not applicable.

Competing interest

The authors declare no competing interests.

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