# Can Dizziness Be Related to Insomnia Severity and Sleep Quality in Young Adults?

Original Investigation

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## Abstract

**Objective:** Despite the many medical problems arising from sleep disturbances, few studies have been conducted on vestibular disorders. In this study, we aimed to investigate the relationship between dizziness, sleep quality, severity of insomnia and duration of sleep, in young adults with dizziness.

**Methods:** Forty-nine individuals aged 20-40 years, with normal hearing and complaints of dizziness with an unknown origin were included. The Pittsburgh Sleep Quality Index (PSQI), the Insomnia Severity Index (ISI), and the Dizziness Handicap Inventory (DHI) were used.

**Results:** There was a very strong positive correlation between the PSQI and the ISI (r=0.838, p<0.001). Strong positive correlations were observed between PSQI and the total DHI scores (r=0.660, p<0.001), as well as between ISI and DHI scores (r=0.673, p<0.001). In addition, both PSQI and ISI showed strong positive correlations with the physical subscale of the DHI (r=0.673 and r=0.662, respectively; p<0.001 for both). A significant positive correlation was also found between the daytime dysfunction component of the PSQI and the total DHI score (r=0.640, p<0.001). Moreover, sleep duration was moderately and negatively correlated with the emotional subscale of the DHI (r=-0.454, p=0.001), indicating that shorter sleep duration was associated with greater emotional impairment related to dizziness.

**Conclusion:** Our study showed a high correlation between sleep quality, insomnia severity and dizziness in young adults with dizziness. With inventory, clinicians can contribute to improving people's quality of life by detecting dizziness associated with sleep disorders.

**Keywords:** Sleep disorders, vestibular diseases, dizziness, insomnia, sleep quality, surveys and questionnaires

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***Cite this article as:*** *Konukseven Ö, Saçlı Y, Küçük Ceyhan A. Can dizziness be related to insomnia severity and sleep quality in young adults? Turk Arch Otorhinolaryngol. 2025; 63(2): 80-87*

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**Received Date:** 10.01.2025
**Accepted Date:** 30.03.2025
**Epub:** 20.06.2025
**Publication Date:** 27.06.2025

**DOI:** 10.4274/tao.2025.2025-1-5

## Introduction

Dizziness is a common symptom seen in neurology and ear, nose and throat (ENT) clinics and generally follows a chronic course (1). In large population studies, dizziness is reported to affect approximately 15-20% of adults (2,3).

Patients with dizziness can experience both physical and mental effects. Some deterioration in the quality of life may

occur, especially with the effect of psychosocial factors (1). In a study of the social and individual impact of dizziness, 40% of the participants with dizziness indicated that the condition interrupted their daily activities, 41% took sick leave and 19% avoided leaving home (4). The severity of dizziness and its effect on quality of life can be measured using scales or questionnaires (5).

One of the complaints associated with dizziness is insomnia, and studies have shown that patients with dizziness have a high rate of sleep disturbance and sleep quality affects dizziness (6-9).

Although the meaning of sleep quality varies from person to person, it is defined as an individual's subjective assessment of their sleep experience, integrating aspects of sleep onset, sleep duration, sleep maintenance, and well-being upon awakening (10). However, the severity of insomnia is related to the degree of insomnia symptoms (11).

Sleep imbalance can affect people's quality of life by causing physical and psychological effects (12,13). Sleeping less than seven or eight hours have been associated with some diseases, traffic accidents, and work failures (14,15). Differences in sleep duration may be due to various factors such as age, socio-economic level, and general health status (12).

Human studies suggest a relationship between sleep and vestibular function. The vestibular system is responsible for the perception of head position. It has been hypothesized that the system could play a role in its onset and duration of sleep (16). In particular, it has been shown that sleep deprivation in humans can lead to changes in the posterior parietal cortex, a region that plays a crucial role in processing vestibular data regarding spatial representation (17). Animal studies indicate that the vestibular system modulates circadian rhythms, working in conjunction with input from somatosensory and visual systems (18,19).

Decreased sleep quality or sleep deprivation can affect physical functions, including postural balance, with reduced ability to adapt and selective attention (20,21). Conversely, in patients with chronic dizziness, sleep disturbances can further complicate the severity of dizziness and handicaps caused by dizziness (8).

Despite the many medical problems arising from sleep disturbances, few studies have been conducted on vestibular disorder cases (7,8).

Dizziness and sleep problems are believed to be two conditions that trigger and influence each other. This situation creates a vicious circle (22). Fewer variables can affect sleep quality or intensity in young adults than in older adults (23). Therefore, to eliminate the age effect, the study group of this study consisted of individuals aged between 20-40 years.

Accordingly, we aimed to study the relationship between the quality of sleep, the severity of insomnia, and the duration of sleep and dizziness among young adults. Furthermore, no study comparing subgroups of young people with subjective tests has been found in the literature. Therefore, sleep-related correlations of the subgroups of the Dizziness Handicap Inventory (DHI) were also examined in the study. The study is based on the hypothesis that dizziness may have an impact on sleep quality and insomnia severity in young adults, and further on the postulate that dizziness can affect sleep duration.

## Methods

This work was approved by the Non-Interventional Clinical Research Ethics Committee of İstanbul Aydın University (approval no: 2019/114, date: 19.06.2019) and all participants included in the study signed an informed consent form.

### Inclusion Criteria

Forty-nine participants (21 female and 28 male) between the ages of 20-40 years with normal hearing and complaints of dizziness of unknown origin for at least one month were included in the study.

ENT and neurological examinations, and audiovestibular assessments were done. Participants with neurological, systemic, psychiatric, and otologic diseases and regular medication use were excluded from the study.

After ENT and neurological examinations of the participants who applied to İstanbul Aydın University Audiology Laboratory between January and May 2019, pure tone audiometry evaluations were performed in a soundproof booth using a clinical audiometer (Interacoustics AC40, Interacoustics A/S, Middelfart, Denmark) with supra-aural headphones between 500-4000 Hz. Hearing thresholds ≤25 dB HL were considered normal. Acoustic immitancemetry (Interacoustics Titan Tympanometer, Interacoustics A/S, Middelfart, Denmark) was used for the middle ear and acoustic reflex evaluation of the participants. Type A tympanogram (peak is between -100 and +50 daPa; compliance from 0.3-1.6 mL) and the presence of acoustic reflexes were defined as inclusion criteria in the study.

Vestibular system examinations were performed using videonystagmography (VNG) [Otometrics International Clinical Systems (ICS) Chartr 200, Natus Medical Incorporated, Middleton, USA] and the Video Head Impulse Test (vHIT) (Otometrics ICS Impulse, Natus Medical Incorporated, Middleton, USA). Spontaneous nystagmus, gaze, saccade, smooth pursuit, and optokinetic eye movements were evaluated with VNG. The presence of pathological nystagmus in the absence of gaze fixation was defined as nystagmus with a velocity of at least 6 degrees per second. For the saccade test, accuracy of <80%, latency of

>280° ms, and peak velocity of <300° were accepted abnormal. Furthermore, a gain of less than 70% was indicative of impairment in smooth pursuit.

A minimum of 20 impulses were performed for each canal. The vHIT analysis is contingent on VOR gain and the occurrence of refixation saccades. The normal range for gain values is 0.80-1.20 for horizontal semicircular canals, 0.70-1.20 for vertical ones.

Since no pathological condition was detected in vestibular evaluation, patients with a history of dizziness of unknown cause were evaluated.

### Data Collection Tools

The following questionnaires were administered to the participants by the face-to-face method.

### Pittsburgh Sleep Quality Index

Pittsburgh Sleep Quality Index (PSQI) is a 24- item scale developed by Buysse et al. (24), to assess sleep-related disorders and sleep quality over a one-month period. Nineteen questions scored on the scale are calculated to comprise seven components, namely, sleep duration, sleep latency, use of sleeping medications, sleep disturbances, habitual sleep efficiency, daytime dysfunction, and subjective sleep quality. Every component is scored between 0 and 3, with a total score between 0 and 21. A high total score is indicative of poor sleep quality. A PSQI total score ≥5 defines poor sleep quality (24).

### Insomnia Severity Index

Insomnia Severity Index (ISI) was developed by Bastien et al. (11) to assess the severity of insomnia. Scale items consist of seven questions. Every item is evaluated within a range of 0-4, with a total score between 0 and 28. ISI comprises items designed to evaluate the sleep maintenance difficulties, severity of sleep onset, interference with daily functioning, satisfaction with current sleep patterns, degree of distress or concern resulting from sleep problems and noticeability of impairment attributed to sleep problems. With the scores obtained, the insomnia level results are: 0-7=no clinically significant insomnia, 8-14=subthreshold insomnia, 15-21=clinical insomnia (moderate severity), 22-28=clinical insomnia (severe) (11).

### Dizziness Handicap Inventory

DHI was developed in 1990 by Jacobson and Newman (5). It consists of 25 items that determine emotional and functional outcomes in vestibular system diseases, as well as factors that aggravate dizziness and impaired balance. Sub-inventories are aimed at determining the physical, emotional, and functional effects of vestibular system diseases. Each question answered either "yes" (4 points), "sometimes" (2 points), or "no" (0 points) (5). In this study, DHI scores were categorized into the following ranges: 0-30 (mild handicap), 31-60 (moderate handicap), and 61-100 (severe handicap) (25).

### Statistical Analysis

Pearson correlation analysis was performed to study the relationship between scores obtained from questionnaires and the relationship between sleep duration and DHI and its subscales. A p-value ≤0.05 was accepted as significant. SPSS v.23 software was used for statistical analysis. The correlation analysis evaluated according to Evans's classification (26).

## Results

Twenty-one female and 28 male participants between the ages of 20-40 years (mean: 30.14±6.29) were included in the study and administered the PSQI, ISI, and DHI questionnaires. The mean of all three questionnaires is shown in Table 1. The patients were asked about their average sleep duration (hours) at night in the last month in their anamnesis and added to Table 1.

As seen in Table 1, DHI is 22.2±19.52, which means the participant group has an averagely mild dizziness handicap (61.22% of the participants had a mild handicap, 38.78% a moderate handicap).

Participants' mean PSQI scores were 7.89±4.01. In our study according to PSQI normal values-22.44% of the participants

**Table 1.** Descriptive statistics for DHI, PSQI, ISI, age, and sleep duration (n=49)

| | **Mean±SD** |
|---|---|
| DHI | 22.2±19.52 |
| PSQI | 7.89±4.01 |
| ISI | 11.14±7.11 |
| Age (year) | 30.14±6.29 |
| Sleep duration (hrs) | 6.12±1.50 |
| **Components of PSQI** | |
| Subjective sleep quality | 1.38±0.99 |
| Sleep latency | 1.89±0.94 |
| Sleep duration | 1.32±1.08 |
| Habitual sleep efficiency | 0.56±0.84 |
| Sleep disturbances | 1.26±0.63 |
| Use of sleeping medications | 0.28±0.70 |
| Daytime dysfunction | 1.18±0.99 |
| **Components of DHI** | |
| Physical (P) | 8.65±7.97 |
| Emotional (E) | 5.55±5.9 |
| Functional (F) | 8±7.3 |

DHI: Dizziness Handicap Inventory, ISI: Insomnia Severity Index, PSQI: Pittsburgh Sleep Quality Index, SD: Standard deviation

had normal sleep quality, but 77.56% had poor sleep quality. That is, all participants with mild and moderate handicaps had 77.56% poor sleep quality.

The mean score obtained from the ISI scale is 11.14±7.11. These results indicate that the group was on subthreshold insomnia according to normal ISI values. Of the participants, 38.77% had no clinically significant insomnia, 26.53% had subthreshold insomnia, 26.53% had clinical insomnia (moderate severity), and 8.17% had clinical insomnia (severe).

The average sleep duration reported by participants in their anamnesis is 6.12±1.50 hours. This result is below the ideal sleep time (7 hours) (27). While 63.26% of our participants indicated to sleep less than 7 hours, the remaining 36.74% indicated to sleep more than 7 hours.

In the PSQI subgroups, the participants with dizziness complaints were most affected by sleep latency and least affected by sleeping medications. Among the DHI subgroups, physical exposure was found to be the most affected, and emotional impact the least (Table 1).

Error bars of DHI and PSQI subgroups, ISI, and sleep duration are given in Figure 1.

The correlations between the results of the questionnaires DHI, PSQI, and ISI were calculated (Table 2).

A significantly positive and strong correlation was found between DHI and PSQI (r=0.660, p<0.001) and between DHI and ISI (r=0.673, p<0.001) scores. And, as expected, a significantly positive and very strong correlation (r=0.838, p<0.001) was seen between PSQI and ISI scores (Table 2). Correlation curves are given in Figure 2.

A moderately significant negative correlation was found between DHI-Emotional (DHI-E) and sleep durations

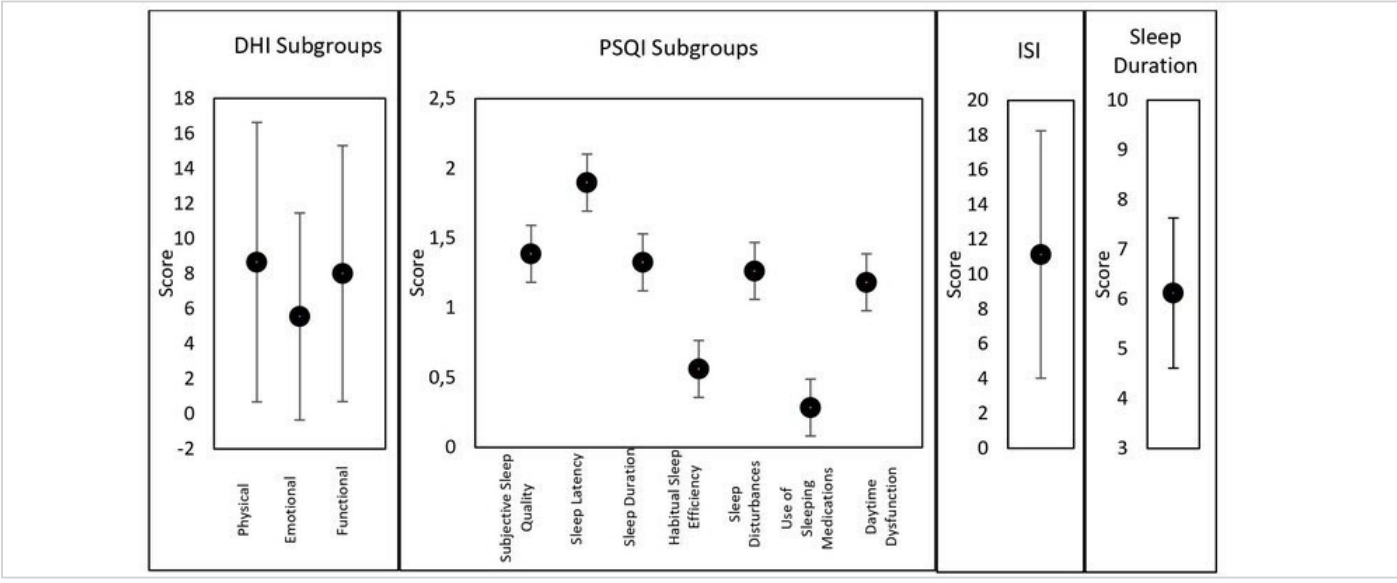


**Figure 1.** Error bars of DHI and PSQI subgroups, ISI, and sleep duration
ISI: Insomnia Severity Index, DHI: Dizziness Handicap Inventory, PSQI: Pittsburgh Sleep Quality Index

**Table 2.** Correlation and significance values of DHI, PSQI, and ISI questionnaires and DHI and sleep duration (hrs) relationship (n=49)

| | Pearson correlation (r) | p-value |
|---|---|---|
| DHI*PSQI | 0.660** | <0.001 |
| DHI*ISI | 0.673** | <0.001 |
| PSQI*ISI | 0.838** | <0.001 |
| DHI*Sleep duration (hrs) | -0.390** | 0.006 |
| DHI-P*Sleep duration (hrs) | -0.312* | 0.029 |
| DHI-E*Sleep duration (hrs) | -0.454** | 0.001 |
| DHI-F*Sleep duration (hrs) | -0.335* | 0.019 |

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed), DHI: Dizziness Handicap Inventory, DHI-P: Dizziness Handicap Inventory-Physical, DHI-E: Dizziness Handicap Inventory-Emotional, DHI-F: Dizziness Handicap Inventory-Functional, ISI: Insomnia Severity Index, PSQI: Pittsburgh Sleep Quality Index

(r=-0.454, p=0.001). A significantly weak and negative correlation was found between DHI and the sleep durations (hrs) of the participants (r=-0.390, p=0.006), between DHI-Physical (DHI-P) and sleep durations (r=-0.312, p=0.029), and between DHI-Functional (DHI-F) and sleep durations (r=-0.335, p=0.019).

Correlations between the participants' PSQI and ISI scores and the DHI subgroups were calculated and are shown in Table 3.

A significantly positive and strong correlation was found between DHI-P and PSQI scores (r=0.673, p<0.001), a significantly positive and moderate correlation between DHI-E and PSQI (r=0.562, p<0.001), and between DHI-F and PSQI (r=0.575, p<0.001) scores.

There was a positive and strong correlation between DHI-P and ISI (r=0.662, p<0.001) and between DHI-F and ISI (r=0.654, p<0.001) scores, and a significantly positive and moderate correlation between DHI-E and ISI (r=0.522, p<0.001) scores. Correlation curves are shown in Figure 3.

Correlations between the participants' DHI scores and PSQI subgroups were calculated and are shown in Table 4.

A significantly positive and strong correlation was found between DHI and daytime dysfunction subgroup scores (r=0.640, p<0.001), and a significantly positive and moderate correlation between DHI and sleep disturbances subgroup (r=0.521, p<0.001), between DHI and subjective sleep quality subgroup (r=0.514, p<0.001), and between DHI and sleep duration subgroup (r=0.440, p=0.002) scores, and a significantly positive and weak correlation between DHI and sleep latency (r=0.353, p=0.013) scores.

## Discussion

Symptoms of insomnia can range from mild to severe and even lead to mortality. Moreover, many individuals may be at risk of falling due to dizziness (28). While the relationship between sleep quality and dizziness in older adults has been widely studied-partly due to the presence of more confounding factors-fewer variables are known to affect both in young adults, and this population has been studied less. Therefore, this study focused on young adults with dizziness, investigating the relationship between sleep quality, insomnia severity, and dizziness.

Our study, inconsistent with literature, showed a significantly positive and strong correlation between the DHI and PSQI

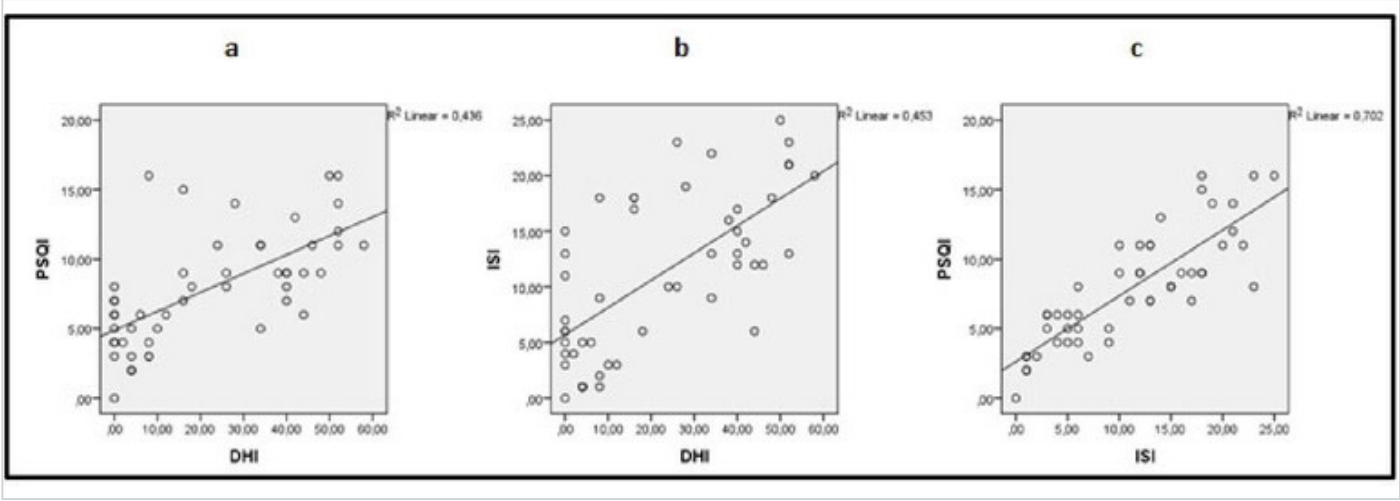


**Figure 2.** Correlation curves (a- DHI and PSQI, b- DHI and ISI, c- PSQI and ISI)
ISI: Insomnia Severity Index, DHI: Dizziness Handicap Inventory, PSQI: Pittsburgh Sleep Quality Index

**Table 3.** Correlation and significance values of PSQI and ISI questionnaires with DHI subgroups (n=49)

| | PSQI | | ISI | |
|---|---|---|---|---|
| | **Pearson correlation (r)** | **p-value** | **Pearson correlation (r)** | **p-value** |
| **DHI-P** | 0.673** | <0.001 | 0.662** | <0.001 |
| **DHI-E** | 0.562** | <0.001 | 0.522** | <0.001 |
| **DHI-F** | 0.575** | <0.001 | 0.654** | <0.001 |

**Correlation is significant at the 0.01 level (2-tailed), DHI: Dizziness Handicap Inventory, DHI-P: Dizziness Handicap Inventory-Physical, DHI-E: Dizziness Handicap Inventory-Emotional, DHI-F: Dizziness Handicap Inventory-Functional, ISI: Insomnia Severity Index, PSQI: Pittsburgh Sleep Quality Index

scores in young adults. As the sleep quality score increased, the DHI score also increased, which means increasing complaints of dizziness highly impairs sleep quality (7,9). Studies have emphasized that an increase in anxiety about insomnia should be taken into consideration as it may in turn increase the feeling of dizziness (7). Few studies have examined sleep quality in patients with dizziness. The findings of Kim et al. (9) demonstrated that these two problems are also associated with poor quality of life and emotional stress. Vestibular function and sleep quality can affect each other like a vicious circle, causing the symptoms to exacerbate (6-8).

**Table 4.** Correlation and significance values of DHI and PSQI subgroups (n=49)

| | DHI | |
|---|---|---|
| **PSQI** | **Pearson correlation (r)** | **p-value** |
| **Subjective sleep quality** | 0.514** | <0.001 |
| **Sleep latency** | 0.353* | 0.013 |
| **Sleep duration** | 0.440** | 0.002 |
| **Habitual sleep efficiency** | 0.209 | 0.154 |
| **Sleep disturbances** | 0.521** | <0.001 |
| **Use of sleeping medications** | 0.246 | 0.088 |
| **Daytime dysfunction** | 0.640** | <0.001 |

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed), DHI: Dizziness Handicap Inventory, ISI: Insomnia Severity Index, PSQI: Pittsburgh Sleep Quality Index

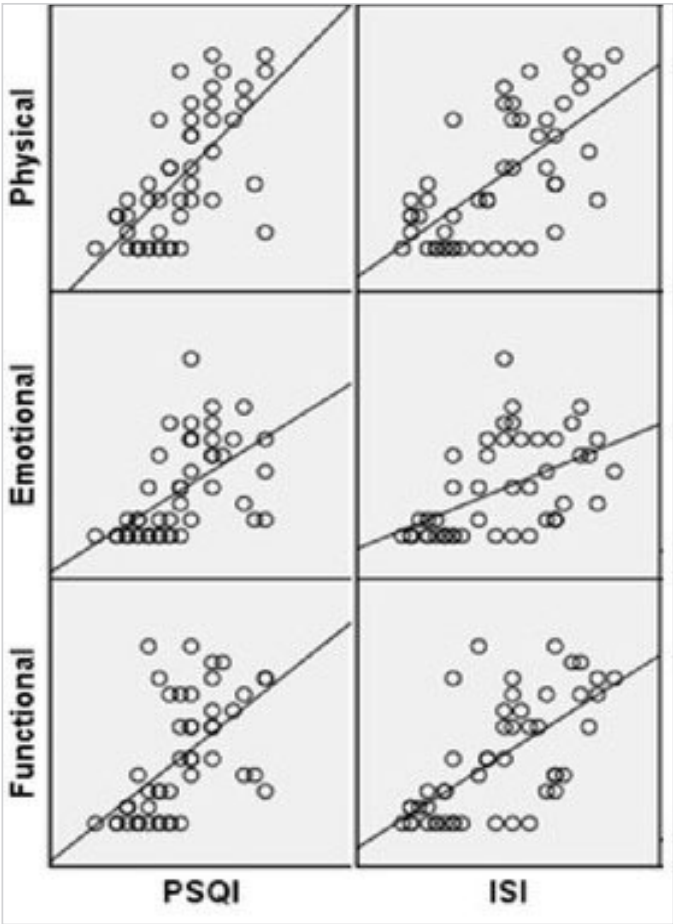


**Figure 3.** Correlation curves of PSQI and ISI with DHI subgroups ISI: Insomnia Severity Index, PSQI: Pittsburgh Sleep Quality Index

The findings of this study revealed that the ISI and DHI scores are significantly positive and strongly correlated. According to these findings, the impact of dizziness on quality of life and the severity of insomnia increase parallelly. In another study, DHI and ISI results showed a significant correlation in all evaluated vestibular diseases like vestibular migraine, benign paroxysmal positional vertigo in participants aged 11-78 years (9).

In our study, the correlations between DHI subscales and PSQI and ISI were also analyzed. The correlations of the DHI-P subscale with the other two were significantly stronger than the other DHI subscales. In one study, it was observed that only DHI-Physical scores were significantly increased in patients with more severe obstructive sleep apnea (OSA) in the 23-70-year age range (29). PSQI and ISI were thought to be more related to the physical domain, as sleep problems in patients with dizziness directly affect the essential needs in daily life (21).

All these studies have examined patients with dizziness in the elderly group or in a wide range of ages with etiology, like vestibular disorders and OSA. Our study investigated dizziness, sleep quality, and insomnia severity from two different perspectives: one is that our study group, referred to our clinic with major dizziness symptoms, includes young adults aged 20-40 years. Second is that unknown origin was seen in this group. To the best of our knowledge, there is no other study in the literature that has studied a group with unknown cause of dizziness.

The correlation between PSQI subscales and DHI was also analyzed in our study. The correlation between the daytime dysfunction subscale with DHI was significantly stronger than the other PSQI subscales. DHI was developed by Jacobson and Newman (5) to measure the effect of dizziness on daily activities, therefore, given the content of the DHI questionnaire this correlation was expected.

Albathi and Agrawal (16) studied the relationship between vertigo and sleep duration with 20,950 participants aged 18-85 years. The authors found that these two conditions were correlated with each other, and sleep durations were shorter in individuals with vertigo. Another study found that patients with bilateral vestibular loss had shorter sleep durations and abnormal sleep patterns compared to the control (30). In our study, consistent with the literature, significantly negative

and weak correlations were found between sleep durations and the DHI total score. It was observed that individuals with high DHI scores had shorter sleep durations.

However, when correlations were examined separately for the subscales of DHI, the DHI-E subscale was found to have a negative moderate correlation with sleep duration. Unlike other DHI subscales, better correlations with DHI-E indicate that short sleep duration has an emotional impact on individuals. Research has indicated a correlation between sleep duration and depression (31,32). The correlations regarding the subscales that we examined in our study were not found in the literature. Knowing which of the DHI subscales affects patients more gives us information about the need for support in that area.

In our study, PSQI and ISI scores were significantly positive and very strongly correlated with each other. Our results are consistent with the literature where PSQI and ISI scores were found to be correlated with each other, especially in studies on the validity and reliability of the tests (33,34). The comparable results of the referred studies, which evaluate sleep quality and insomnia severity, also indicate that the participants in the study responded carefully and consistently during the measurement.

In the presented study, no evaluation was conducted for mental fatigue, attention, or stress factors that could affect the test results. This constitutes a limitation of the study.

## Conclusion

To conclude, insomnia can occur as a result of dizziness or trigger dizziness in young adults. The problems brought about by dizziness affect people's quality of life. As sleep problems are not addressed in DHI, questioning sleep problems may be clinically effective in patients who present to vestibular clinics with the complaint of dizziness. It can provide a new perspective on the etiology of dizziness by helping in the diagnosis and treatment of dizziness in young adults. It can also be a guide for the rehabilitation of patients by facilitating a multidisciplinary approach. In addition, the evaluation made with DHI subscales helps to reveal the complaints of patients that are more closely related to sleep problems. Studies with larger samples and different age groups are needed to further investigate the relationship between dizziness and sleep.

### Ethics

**Ethics Committee Approval:** This work was approved by the Non-Interventional Clinical Research Ethics Committee of İstanbul Aydın University (approval no: 2019/114, date: 19.06.2019).

**Informed Consent:** All participants included in the study signed an informed consent form.

### Footnotes

### Authorship Contributions

Concept: Ö.K., Design: Ö.K., Y.S., A.K.C., Data Collection and/or Processing: Y.S., A.K.C., Analysis and/or Interpretation: Ö.K., Y.S., Literature Search: Y.S., A.K.C., Writing: Ö.K., Y.S., A.K.C.

**Conflict of Interest:** There is no conflict of interest to disclose.

**Financial Disclosure:** The authors declared that this study has received no financial support.

### Main Points

- Young adults with moderate dizziness handicaps are likely to have poor sleep quality.
- Individuals with a high dizziness handicap score may often have shorter sleep durations.
- Sleep problems can occur in young adults with dizziness of unknown origin.
- Sleep can affect the dizziness handicap subscales in different sizes.

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