Prevalence and risk factors of obstructive sleep apnea in patients with unexplained dizziness: A real-world study

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Received April 17, 2025; Accepted August 26, 2025

DOI: 10.3892/br.2025.2051

Abstract. Obstructive sleep apnea (OSA) is a globally prevalent sleep disorder linked to a wide range of systemic conditions, including cardiovascular and vestibular dysfunction. Dizziness is frequently encountered in clinical practice but underexplored on causes and relationship with OSA. The present study aimed to assess the prevalence of OSA among patients with unexplained dizziness and identify associated risk factors and potential links between these conditions. A retrospective analytical study was conducted at a tertiary care University Hospital over a two-year period, from November 2022 to November 2024. The inclusion criteria were adult patients (aged ≥18 years) who had unexplained dizziness and underwent overnight polysomnography. Those who were pregnant or had identifiable cause of dizziness such as upper respiratory tract infection, anemia, hypoglycemia, anxiety, depression, postural hypotension, or hypertensive emergency were excluded. Eligible patients were evaluated for OSA by baseline characteristics, comorbidities, STOPBang score and physical examination. The overnight home sleep apnea test was used in all eligible patients. The diagnosis of OSA was defined by an apnea-hypopnea index (AHI) of 5 or more events/h. The primary outcome was the prevalence of OSA in patients with dizziness. Risk factors of OSA were also analyzed by using the multivariable logistic regression analysis. During the study period, 81 patients met the study criteria. Of those, 76 patients (93.83%) diagnosed as OSA with a median AHI of 23 events/h (IQR of 11.5-33.5). Patients with OSA had significantly larger neck circumferences than their non-OSA counterparts (37.63 vs. 33.25 cm; P=0.042). The STOPBang score was also higher in OSA group (3.95 vs. 2.40; P=0.026). There was no significant difference among other factors between both groups including demographic variables, clinical symptoms, other anatomical variants and comorbidities. There were four factors remaining in the model by stepwise logistic regression analysis. Only STOPBang score was independently associated with OSA with an adjusted odds ratio of 2.115 (95% confidence interval of 1.048, 4.268). The cut point of STOPBang score of 3 or over had sensitivity of 82.89% and specificity of 40.00% for OSA. OSA was extremely prevalent in patients with unexplained dizziness. The STOPBang questionnaire may be used as a screening tool to detect OSA in this setting with high sensitivity.

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Key words: obstructive sleep apnea, dizziness, prevalence, polysomnography, vestibular dysfunction

Introduction

Obstructive sleep apnea (OSA) is a common disease in clinical practice. The average prevalence of OSA was 56% (1). Its prevalence may be high as 85% in adults and elderly individuals. The prevalence of OSA may be varied among countries with the highest prevalence in Mongolia (93%). Untreated or unrecognized OSA may lead to several cardiovascular diseases such as coronary artery disease or hypertension. The prevalence of OSA in patients with these cardiovascular diseases can be as high as 80% (2). Additionally, OSA may result in several neuropsychological diseases if left untreated including cognitive impairment, or depression (3,4). Patients with OSA are at risk for depression with odds ratio of 2.18 (95% confidence interval of 1.47, 2.88) by longitudinal studies (5).

Dizziness is a bothersome symptom and may cause by several diseases such as hypertensive emergency (6,7). The prevalence of dizziness in general population is ~30% (8-10). Even though there are several causes of dizziness such as upper respiratory tract infection, anemia, hypoglycemia, anxiety, depression, postural hypotension, or hypertensive emergency, up to 80% of patients with dizziness are unexplained (11). One possible cause of dizziness OSA reported by a national database from Korea (12). Patients with OSA had higher incidence rate of dizziness than the non-OSA patients (149.86 vs. 23.88 per 10,000 individuals) with the incidence rate ratio of 6.28 (95% confidence interval of 4.89, 8.08). Even though the national database study showed the positive correlation between OSA and dizziness, there is limited data

on risk factors of OSA in patients with dizziness. The national database study provided only the incidence and the correlation of both conditions. Additionally, other causes of dizziness were not adjusted in the national database study. A real-world study or pragmatic study can provide the prevalence and risk factors of OSA in patients with dizziness. Previously, two studies found that OSA was related with dizziness (13,14). Being OSA had odds ratio of 1.69 (P=0.022) to be associated with OSA. However, both studies were conducted by using the STOPBang questionnaire, not polysomnography. Therefore, the present study aimed to evaluate the prevalence and risk factors of OSA in patients with dizziness in real-world clinical practice using home sleep apnea test.

Materials and methods

This was a retrospective cohort study conducted at the outpatient department, University Hospital of Khon Kaen University, Thailand. The inclusion criteria were adult patients (aged ≥18 years) who had unexplained dizziness and underwent overnight home sleep apnea test. Those who were pregnant or had identifiable cause of dizziness such as upper respiratory tract infection, anemia, hypoglycemia, anxiety, depression, postural hypotension, or hypertensive emergency were excluded. These excluded conditions were recorded from medical charts or history taking. The study period was between November 2022 and November 2024.

Eligible patients were evaluated for OSA by baseline characteristics, comorbidities, STOPBang score (15), and physical examination. The overnight home sleep apnea test (Alice PDX®, Phillips Respironics) was performed in all eligible patients. Overnight home sleep apnea test comprised of nasal pressure transducer, pulse oximeter, and chest belt to record chest movement body position (16). The total sleep time for overnight sleep apnea test was at least 4 h. Sleep tracings were scored manually for apnea and hypopnea based on the criteria of AASM (17). The device had agreement with in-laboratory polysomnography of 96.4% (18). Diagnosis of OSA was made if an apnea-hypopnea index (AHI) was five or more events/h.

Sample size calculation. The previous study reported that the incidence of OSA in patients with dizziness by the national database study was 7.78% (12). The estimated prevalence of OSA in patients with dizziness in clinical practice was higher at 20% as previously reported (14). Based on the power of 80% and confidence of 95%, the required sample size was 50 subjects.

Statistical analyses. Prevalence of OSA in patients with dizziness was calculated. Patients were categorized into two groups: With and without OSA. Results of studied variables of both groups were reported as the mean (SD) or median (interquartile range) for numerical variables according to normal distribution of studied variables. For normally distributed variables, mean ± SD was reported, while median (interquartile range) was reported for not normally distributed variables. Number (proportion) was shown for categorical variables. The differences of each studied variable between the OSA and non-OSA group were computed by inferential statistics. For numerical variables, the student t test or Wilcoxon rank sum test was used to compare the differences between both groups for normally distributed variables and non-normally distributed variables, respectively. Fisher-Exact test was used to compare the differences between two proportions.

Predictors OSA in patients with dizziness were executed by stepwise method of multivariable logistic regression analysis. Studied variables were computed for a P-value by univariable logistic regression analysis. Those with P<0.20 or clinically significant were included in the stepwise, multivariable logistic regression analysis (19,20). The model was tested for a goodness of fit by the Hosmer-Lemeshow method. A P-value by the Hosmer-Lemeshow Chi square of more than 0.05 indicated a goodness of fit. A numerical predictor for being OSA was computed for appropriate diagnostic cut off point by a receiver operating characteristic (ROC) curve. Sensitivity and specificity for the best cut-off point for OSA diagnosis were reported. Studied variables with missing data of more than 50% were not included in the analysis (21). All statistical analyses were performed using STATA software version 10.1 (StataCorp LP).

Results

During the study period, there were 81 patients met the study criteria. Of those, 76 patients (93.83%) had OSA with a median AHI of 23 events/h (IQR of 11.5-33.5), while the non-OSA group had a median AHI of 4 events/h (IQR 3.9-4.0). Regarding baseline characteristics, comorbidities and symptoms of OSA (Table I), STOPBang score was significantly different between both groups. The OSA group had higher average of STOPBang score than the non-OSA group (3.95 vs. 2.40; P=0.026). The proportion of atrial fibrillation was significantly higher in the non-OSA group than the OSA group (20.00 vs. 0%; P=0.005). For physical signs, the OSA group had significant larger neck circumference than the non-OSA group: 37.63 vs. 33.25 cm (P=0.029) as shown in Table II.

There were seven factors included in the predictive model for OSA: Age, sex, snoring, nocturia, gastroesophageal reflux disease, diabetes and STOPBang score. There were four factors remaining in the model by stepwise logistic regression analysis (Table III). Only STOPBang score was independently associated with OSA with an adjusted odds ratio of 2.115 (95% confidence interval of 1.048, 4.268). The Hosmer-Lemeshow Chi square of the model was 3.24 (P=0.919) indicating a goodness of fit of the model. The cut point of STOPBang score of 3 or over had sensitivity of 82.89% and specificity of 40.00% for OSA. The area under ROC curve of STOPBang score on OSA was 75.39% (95% confidence interval of 57.50-93.29%) as shown in Fig. 1.

Discussion

The present study showed that the prevalence of OSA in patients with unexplained dizziness was notably high at 93.83%. This prevalence was markedly higher than the previous national study at 7.76% (12). This high prevalence of OSA in the present study may be due to the different study population from the previous study. The current study enrolled only patients with unexplained dizziness, while the national database study may enroll patients with dizziness from any causes.

Table I. Baseline characteristics, comorbidities, and symptoms of patients with unexplained dizziness categorized by presence of OSA.

Factors	Non-OSA (n=5)	OSA (n=76)	P-value
Mean (SD) age, years	59.00 (52.0-61.0)	59.00 (47.5-65.0)	0.523
Male sex	1 (20.0)	33 (44.0)	0.293
Comorbidities			
Hypertension	2 (40.0)	42 (56.8)	0.465
Diabetes	0 (0.0)	18 (25.0)	0.200
Coronary artery disease	0 (0.0)	3 (4.0)	0.646
Atrial fibrillation	1 (20.0)	0 (0.0)	0.005
Heart failure	0 (0.0)	2 (2.7)	0.710
Allergic rhinitis	0 (0.0)	11 (14.8)	0.353
Symptoms			
Snoring	2 (40.0)	57 (76.0)	0.076
Stop breathing	0 (0.0)	25 (33.3)	0.119
Fatigue	3 (60.0)	35 (46.7)	0.563
Dyspnea	2 (40.0)	13 (17.3)	0.209
GERD	2 (40.0)	34 (45.3)	0.855
Nocturia	3 (60.0)	56 (75.7)	0.435
Light sleeper	3 (60.0)	44 (58.7)	0.953
Dizziness	5 (100.0)	100 (100.0)	0.712
Sleepiness	2 (40.0)	49 (66.2)	0.507
Mean (SD) STOPBANG	2.40±1.52	3.95±1.48	0.026

Data presented as number (percentage) unless indicated otherwise; GERD: gastroesophageal reflux disease. OSA, obstructive sleep apnea.

Table II. Physical signs of patients with unexplained dizziness categorized by presence of OSA.

Factors	Non-OSA (n=5)	OSA (n=76)	P-value
Body mass index, kg/m^2	21.40 (16.80-25.65)	26.75 (23.60-30.85)	0.057
Systolic blood pressure, mmHg	124.20±8.84	130.43±1.58	0.342
Diastolic blood pressure, mmHg	73.00±4.66	74.32±1.21	0.786
Neck circumference, cm	33.25±2.18	37.63±0.48	0.042
Retrognathia	1 (20.0)	20 (27.4)	0.718
Torus palatinus	2 (40.0)	19 (25.7)	0.483
Torus mandibularis	2 (40.0)	15 (20.0)	0.029
Macroglossia	1 (20.0)	45 (60.8)	0.073
Friedman classification			0.059
1	0 (0.0)	11 (14.9)	
2	0 (0.0)	14 (18.9)	
3	4 (80.0)	18 (24.3)	
4	1 (20.0)	31 (41.9)	
Denture	0 (0.0)	12 (16.4)	0.324
Tonsillectomy	0 (0.0)	0 (0.0)	-
Thyromegaly	0 (0.0)	0 (0.0)	-

Data presented as number (percentage), mean ± SD, or median (interquartile range). OSA, obstructive sleep apnea.

These differences in study population may result in different prevalence of OSA in patients with dizziness. A previous study found that psychogenic dizziness or other causes of dizziness were closely related to poor sleep (22). Both psychogenic dizziness and other causes of dizziness had coefficients of 1.820 ($P<0.05$) and2.262 ($P<0.01$) to Pittsburg sleep quality index

Table III. Factors predictive of obstructive sleep apnea by multivariable logistic regression analysis in patients with unexplained dizziness.

Factors	Unadjusted odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
STOPBang	1.798 (0.982, 3.293)	2.115 (1.048, 4.268)
Dyspnea	0.314 (0.047, 2.074)	0.127 (0.012, 1.243)
Nocturia	2.074 (0.320, 13.408)	2.609 (0.312, 21.779)
Torus mandibularis	0.375 (0.057, 2.449)	0.383 (0.046, 3.170)

A total of seven factors included in the model including age, sex, snoring, nocturia, gastroesophageal reflux disease, diabetes and STOPBang score.

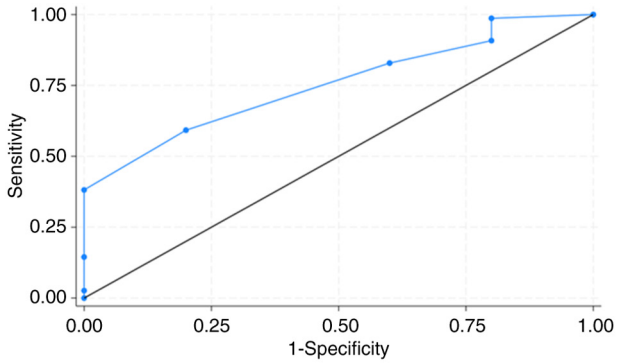

Figure 1. A ROC curve of the STOPBang score for diagnosis of obstructive sleep apnea in patients with unexplained dizziness; area under the ROC curve 75.39% (95% confidence interval of 57.50-93.29%). The cut point of STOPBang score of 3 or over had sensitivity of 82.89% and specificity of 40.00% for obstructive sleep apnea. ROC, receiver operating characteristic.

(PSQI), while only other causes of dizziness were related to insomnia severity index with a coefficient of 3.237 (P<0.05). These results showed poor sleep quality and insomnia were found in these two types of dizziness. Those with psychogenic and other causes of dizziness may be similar to those with unexplained dizziness in the present study. OSA is a condition leading to poor sleep quality and insomnia. Patients with OSA had higher global score of PSQI than those without OSA (8.62 vs. 5.36; P<0.001) as well as the C1 subscore of sleep quality (1.7 vs. 0.79; P<0.001) (23). Additionally, up to 50% of patients with OSA reported symptoms of insomnia (24,25). These data showed a close relationship between OSA and dizziness. Even though the exact mechanisms of OSA associated with dizziness remain unclear, there are several proposed mechanisms (13,26,27). These mechanisms included brainstem and cerebellar damage, imbalance of autonomic function, white matter damage, and hippocampal degeneration in the areas associated with vestibular function. These abnormalities were associated with intermittent hypoxemia from OSA.

Among several studied variables, only STOPBang score was a predictor of OSA in patients with unexplained dizziness. As previously reported, the STOPBang score was a sensitive screening tool for OSA in various settings across the world (15,28). According to the adjusted odds ratio of 2.115 in the present study, this finding may indicate moderate effect (29) of the STOPBang score as a screening tool for OSA in patients with unexplained dizziness in clinical setting of outpatient department. A systematic review showed that STOPBang score of 3 or more had sensitivity of 91.4% to detect OSA (28). Originally, the STOPBang was used to screen for OSA in patients with perioperative setting. Several studies showed that the STOPBang score can be used for OSA detection in patients underwent bariatric surgery, or obese patients (30-32). Most studies found that the STOPBang score of 3 or more associated with OSA as in the present study with patients with unexplained dizziness (13,27). The original study for STOPBang score in patients underwent surgery had sensitivity of 72%, while another study showed the sensitivity of 87.9% in OSA detection with the STOPBang questionnaire in obese patients. Similarly, the present study showed the STOPBang score of 3 for OSA detection had comparable sensitivity of 82.89% (Fig. 1). Note that low specificity of the STOPBang score of 40% may result in false positive issue.

There are certain limitations to the present study. First, the results may apply to only those without causes of dizziness. Even though STOPBang was the statistically significant factor, clinical significance was not evaluated in the present study (33). As the outcome was the diagnosis of OSA, not the effectiveness or efficacy of treatment modality, clinical significance may not be able to be evaluated. Second, no intervention such as a continuous positive airway pressure machine was applied to the patients. Further studies to evaluate CPAP treatment effects on dizziness as a treatment option. Finally, the predictive model comprised only baseline clinical parameter; no laboratory tests were included. Further cohort studies including patients with other causes of dizziness with laboratory tests may advance the knowledge provided by the current study.

In conclusion, OSA was markedly prevalent in patients with unexplained dizziness. The STOPBang questionnaire may be used as a screening tool to detect OSA in this setting with high sensitivity.

Acknowledgements

Not applicable.

Funding

No funding was received.

Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

NL, SK and KS conceived and designed the study. SS collected data and interpreted data. WB interpreted data. KS performed statistical analysis. All authors read and approved the final version of the manuscript. NL, SK and KS confirm the authenticity of all the raw data.

Ethics approval and consent to participate

The study protocol was approved (approval no. HE641504) by the ethics committee in human research of Khon Kaen University (Khon Kaen, Thailand) and all methods were conducted following the principles of the Declaration of Helsinki. The requirement for informed consent was waived due to the retrospective nature of the study.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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