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Research article

Relationship between benign paroxysmal positional vertigo (BPPV) and sleep quality

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ABSTRACT

Background: Benign paroxysmal positional vertigo (BPPV) is a common cause of vertigo precipitated mainly by changes in head position for example during sleep. The relationship between sleep quality and BPPV has not been studied sufficiently. We decided to compare sleep quality between posterior canal BPPV patients and controls.
Methods: A total of 120 patients with posterior canal BPPV and 120 controls without BPPV were included. Demographic data as well as body mass index (BMI), cigarette smoking and medical history of the subjects were documented. The sleep quality of the participants was assessed using the Pittsburgh Sleep Quality Index (PSQI).
Results: Mean scores in subjective sleep quality (0.48 vs. 0.19; P = 0.002), sleep disturbances (2.97 vs. 1.85; P = 0.007), use of sleep medications (0.6 vs. 0.25; P = 0.001), and daytime dysfunction (0.76 vs. 0.47; P = 0.07) were significantly higher in the BPPV group than in control group. Poor sleep quality (i.e., total PSQI score >5) was found in 42 patients in the BPPV group (35%) and in 16 controls (13.3%); P < 0.001. Poor sleep quality was significantly more common in those whose vertigo attacks had been started more than 12 months earlier (19 of 33 cases, 57.6%) than the patients whose symptoms had started in the past 12 months (23 of 87 cases, 26.4%); P = 0.001.
Conclusion: Patients with posterior canal BPPV have poorer sleep quality when compared to controls without this condition, especially in women and those with disease duration longer than 12 months. These finding suggest that close attention should be paid to sleep quality of patients with BPPV.

1. Introduction

Benign paroxysmal positional vertigo (BPPV), a peripheral vestibular disorder, is the most common cause of vertigo diagnosed in 14–24% of patients seen in clinics [1, 2]. BPPV is thought to be the result of calcium debris (otoconia) in the posterior semicircular canal, a condition referred to as canalithiasis [3]. BPPV is usually characterized by brief (often less than 1 min) episodes of vertigo. These episodes are usually provoked by changes in the head position (e.g., lying down, rolling over in bed, or getting out of bed) [4]. The etiology of classic presentation of BPPV is assumed to be idiopathic in about 50–70% of the patients [5], and the remaining is thought to be secondary to factors such as head trauma, Meniere disease, vestibular neuronitis, and so on [6]. Some maneuvers and exercises such as the Epley maneuver and its modified variants [7, 8] has been accepted widely as an effective intervention to alleviate dizziness and vertigo in BPPV.

Head position changes during sleep have been addressed as a potential trigger for vertigo and dizziness attacks [9]. To illustrate, in a study head positions of 50 BPPV patients were monitored using a linear acceleration sensor for three days to determine whether any association exists between positional angle of the head during sleep and recurrence of BPPV. The authors described that 22 patients experienced recurrence and they were more likely to sleep with the affected ear down and a head position of 45° [10]. The relationship between sleep and BPPV has been studied, though scarcely, from different perspectives. Most BPPV patients experience episodes of vertigo when changing their head position in bed [11]. This is expected and as stated earlier changes in the head position can precipitate vertigo episodes. This in turn can affect sleep quality of patients. The supporting evidence, for example, shows that patients who were sleeping on the affected side after repositioning maneuvers were more prone to experience recurrence of vertigo when compared to those who were sleeping in other positions [12]. On the other hand, poor sleep quality per se may result in the recurrence of BPPPV episodes [13, 14, 15]. Additionally, non-apnea sleep disturbances such as chronic insomnia are significantly associated with an increased likelihood of BPPV occurrence [16]. Considering the mentioned findings, it appears

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that a complex relationship exists between sleep quality and sleep disturbance with BPPV recurrence.

Despite the above mentioned evidence, the relationship between sleep quality and BPPV is not explained in detail and more findings are required to fully understand this complex relationship. In this study, we decided to compare sleep quality between BPPV patients and controls without BPPV. We hypothesized that sleep quality might be worse in patients with BPPV. The knowledge of this study will improve our insight about the sleep quality of BPPV patients and will provide us essential data about how much difference exists between those with and without a BPPV diagnosis.

2. Materials and methods

2.1. Study sample and design

This cross-sectional study was performed at the Ear, Nose, and Throat (ENT) clinic of our university hospital in 2019 and 2020. The BPPV group was selected from patients for whom the diagnosis of BPPV was confirmed. Sampling was performed by consecutive method. The control group consisted of subjects without a history of BPPV who were matched with the patient group in terms of age and gender and were selected from the BPPV patients' companions or patients who presented to the clinic for other reasons other than dizziness. A previous study reported the prevalence of sleep disorders in BPPV patients as 29.4%. The same report found that the prevalence of sleep disorders in subjects without BPPV was 14.7% [17]. When taking into account these figures, the minimum required sample size with an accuracy of 5% and confidence level of 95% was calculated as 120 subjects in each group.

2.2. BPPV diagnosis

Clinically, BPPV is characterized by complaints including severe postural vertigo, short duration of vertigo attacks (usually lasting about 15–30 s), history of previous vertigo attacks, lack of vertigo without change in the head position, history of head trauma before vertigo episodes, and a more severe vertigo at the beginning of the day with gradual resolution during the day. On physical examination, the disease can be easily diagnosed by provocative maneuvers. In addition, latency in the onset of vertigo after the maneuver, short period of nystagmus (3–30 s) and gradual resolution of vertigo and nystagmus after repeated maneuvers (adaptation) are all in favor of diagnosing the disease [3, 18]. In this study, patients who complained of dizziness were first evaluated by an ENT resident, and if BPPV was suspected, the diagnosis was confirmed by a board-certified otolaryngologist. He reviewed the medical history for characteristics of the vertigo and performed Dix-Hallpike maneuver. In the presence of characteristics suggestive of the condition and a positional nystagmus induced by the maneuver the diagnosis of posterior canal BPPV was made as outlined by the International Classification of Vestibular Disorders [19]. Patients for whom the diagnosis of BPPV (either idiopathic form or secondary to other causes) was made were eligible to be included. In case that vertigo was diagnosed to be secondary to the conditions in the central nervous system or because of side effects of medications, the patients were not included.

2.3. Data items

A data-gathering checklist was designed and demographic data (age and gender), background medical history, cigarettes smoking, and alcohol consumption were documented. Since some limited studies have proposed a possible association between alcohol consumption and cigarette smoking with vertigo attacks, we decided to document these factors during the visit of the patients [20, 21]. In the BPPV group, duration of vertigo episodes (in month) was also recorded. Weight and height of the participants were measured by a trained research assistant. Height was measured in upright and vertical position without shoes and with an accuracy of 0.5 cm. Weight was measured with a standard scale with an accuracy of 0.1 kg. Body mass index (BMI) was calculated by dividing weight (in kilograms) by height (in meters squared). BPPV may spontaneously resolve within the first year after onset of the symptoms, and it is unlikely to resolve in the second year [22]. Therefore, we divided the patients into two groups based on the onset of vertigo attacks (in the preceding 12 months vs. more than 12 months earlier).

2.4. Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) was used to assess the sleep quality of the participants. This self-rated questionnaire was designed and standardized by Buysse et al. [23] to assess the quality of sleep over the past month. The questionnaire consists of 19 questions. The first 4 questions include open-ended questions about the time of going to bed, the time taking for patients to fall asleep, the time patients get up in the morning, and total amount of actual sleep. In the sleep quality section of this self-report scale, it has several domains, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, taking sleep medications, and daytime dysfunction. For each question several items are offered including "never in the past month", "less than once a week", "once or twice a week", and "three or more times a week". For each question, patients receive a score of 0–3. By summing the scores of these 7 items, a total score is calculated which equals to a total score of 21. A higher PSQI score indicates worse sleep quality. A PSQI total score above five is reflective of poor sleep quality. The designers of this questionnaire reported a Cronbach's alpha of 083 for its internal consistency [23]. This questionnaire has already been used in BPPV patients [13].

2.5. Statistical analyses

The data gathered were entered into the SPSS software (ver. 22.0). The frequency of sleep disturbances were calculated and reported by frequency (percentage). In order to compare categorical variables between the study groups, the Chi-squared test was used. The Student t test was used to compare continuous data between the groups. A significance level was defined as 0.05.

2.6. Ethics

All participants provided written informed consent. The study protocol was approved by the ethical committee of Kermanshah University of Medical Sciences (Code: IR. kUMS.REC.1398.1199).

3. Results

A total of 240 participants (120 in posterior canal BPPV group and 120 in control group) participated and completed the study. Mean (SD) age of the sample was 52.08 (12.3) years (range, 25–81 years of age). There were 69 men (57.5%) and 51 women (42.5%) in BPPV group. Sixty-seven men (55.8%) and 53 women (44.2%) participated in control group. No significant difference was observed in terms of gender distribution between the two groups ($P = 0.79$). Mean (±SD) age of the patients in BPPV and control groups were respectively 51.5 (±11.6) and 52.7 (±13.1) years ($P = 0.45$). Mean (±SD) BMI values of the patients in BPPV and control groups were 25.2 (±3.2) and 24.8 (±3.4) kg/m^2, respectively ($P = 0.19$).

Table 1 presents frequency distribution of cigarette smoking, alcohol consumption, and background medical condition in the two groups. As observed, no significant difference was observed between the groups regarding the variables.

In Table 2, average scores of seven domains of the PSQI is presented. As seen, average scores in subjective sleep quality, sleep disturbances, use of sleep medications, and daytime dysfunction were significantly higher in the BPPV group than in control group. Poor sleep quality (i.e., total

Table 1. Frequency distribution of cigarette smoking, alcohol consumption, and background medical condition in benign paroxysmal positional vertigo (BPPV) and control groups.

	BPPV (N = 120)	Control (N = 120)	P value
Age, year*	51.5 (±11.6)	52.7 (±13.1)	0.45
Gender			
Male	69 (57.5%)	67 (55.8%)	0.79
Female	51 (42.5%)	53 (44.2%)	
BMI, kg/m^2*	25.2 (±3.2)	24.8 (±3.4)	0.19
Cigarette smoking	12 (10%)	14 (11.7%)	0.67
Alcohol consumption	18 (15%)	16 (13.3%)	0.71
Background medical condition	28 (23.3%)	34 (28.3%)	0.37

* Data are presented as mean (±standard deviation); BMI = body mass index.

Table 2. Average scores of seven domains of the Pittsburgh Sleep Quality Index (PSQI) and total score in benign paroxysmal positional vertigo (BPPV) and control groups.

	BPPV (N = 120)	Control (N = 120)	P value
Subjective sleep quality	0.48 (0.89)	0.19 (0.6)	0.002
Sleep latency	0.94 (0.6)	0.91 (0.7)	0.78
Sleep duration	0.9 (1)	0.8 (0.1)	0.48
Habitual sleep efficiency	88.09 (13.1)	88.28 (13.4)	0.91
Sleep disturbances	2.97 (3.7)	1.85 (2.6)	0.007
Taking sleep medications	0.6 (0.9)	0.25 (0.6)	0.001
Daytime dysfunction	0.76 (1.4)	0.47 (1.1)	0.07
Total score	4.57 (3.1)	3.49 (2.4)	0.003

Data are presented as mean (standard deviation).

PSQI score >5) was found in 42 patients in the BPPV group (35%) and in 16 controls (13.3%); P < 0.001.

Table 3 summarizes the frequency distribution of poor sleep quality between BPPV and control groups based on the variables of interest. After stratifying the frequency of poor sleep quality, it was revealed that thus difference did not remain significant for men, cigarette smokers, and those younger than 50 years of age.

Of 120 patients in the BPPV group, disease duration was less than 12 months in 87 patients. In the remaining 33 cases, BPPV had been diagnosed for more than 12 months. Poor sleep quality was significantly more common in those whose vertigo attacks had been started more than 12 months earlier (19 of 33 cases, 57.6%) than the patients whose symptoms had started in the past 12 months (23 of 87 cases, 26.4%); P = 0.001.

Table 3. Comparison of poor sleep quality (total PSQI score >5) between benign paroxysmal positional vertigo (BPPV) and control groups stratified by the variables of interest.

		BPPV	Control	P value
Age, year	<50 (N = 25)	17 (35.4%)	8 (17.8%)	0.055
	≥50 (N = 33)	25 (34.7%)	8 (10.7%)	<0.001
Gender	Male (N = 28)	18 (26.1%)	10 (14.9%)	0.1
	Female (N = 30)	24 (47.1%)	6 (11.3%)	<0.001
BMI, Kg/m^2	≤25 (N = 35)	23 (31.5%)	12 (15%)	0.01
	>25 (N = 23)	19 (40.4%)	4 (10%)	0.001
Background disease	Yes (N = 13)	10 (35.7%)	3 (8.8%)	0.01
	No (N = 45)	32 (34.8%)	13 (15.1%)	0.003
Alcohol consumption	Yes (N = 10)	8 (44.4%)	2 (12.5%)	0.06
	No (N = 48)	34 (33.3%)	14 (13.5%)	0.001
Cigarette smoking	Yes (N = 5)	3 (25%)	2 (14.3%)	0.6
	No (N = 53)	39 (36.1%)	14 (13.2%)	<0.001

The patients with poor sleep quality were referred to the Sleep Clinic of the university for further management of the sleep disturbances.

4. Discussion

The objective of this study was to compare sleep quality between a sample of patients with posterior canal BPPV and controls without this condition. The findings show that sleep quality scores were significantly lower in several domains in BPPV patients. Additionally, poor sleep quality was more prevalence in BPPV group than in control group. There is not sufficient evidence about the possible explanations that can justify worse sleep quality in BPPV patients. Some authors have proposed that poor sleep quality may result in BPPV recurrence [15]. There is also the possibility that BPPV may result in anxiety disorders or a depressed mood and these explain poor sleep quality in these patients [13]. Although several etiologic factors such as head trauma, otologic surgeries (such as stapedectomy), infectious diseases (such as viral labyrinthitis) and so on have been proposed as factors that can initiate or lead to recurrence of vertigo attacks in BPPV, it is not uncommon to visit patients who do not have any of the mentioned risk factors. Therefore, idiopathic BPPV is commonly diagnosed in otolaryngology and neurology clinics. Based on this observation, efforts have been made to discover factors in lifestyle that can be relate to recurrence of vertigo episodes. In a study on 163 idiopathic BPPV patients, poor physical activities and long recumbent position (defined as more than 10 h of lying down in a day) were discovered as independent risk factors for BPPV [24]. Since theories, regarding head position and in particular displacement of otoliths in the macula, exist in the pathogenesis of idiopathic BPPV [25, 26], studying head movements especially during sleep is important in such patient population.

This topic has not been studied widely in the literature. In an earlier study, 67 middle-aged or elderly BPPV patients were followed for 2 years and it was reported that sleep quality (assessed similarly to this study by the PSQI) was the only variable correlated with recurrence of attacks [13]. According to the findings of this study, of seven domains assessed by the PSQI, significant differences were observed in five domains between the two groups. These five domains included shorter sleep duration, prolonged sleep latency, decreased sleep efficiency, daytime dysfunction, and more frequent of sleep medications in recurrent BPPV patients compared to non-recurrent ones. We observed poorer sleep quality in four domains of the PSQI (subjective sleep quality, sleep disturbances, use of sleep medications, and daytime dysfunction). This difference could be attributed to the differences in population characteristics as we compared these domains between BPPV and healthy subjects. Furthermore, we observed that the difference in the frequency of poor sleep quality was more pronounced in women and in those older than 50 years of age. Such findings were not reported by the previous study [13].

In another study, 25 patients with posterior semicircular canal BPPV and 30 subjects without this condition were compared [15]. The results showed that the PSQI scores were significantly poorer in the BPPV group. Mean total score of the PSQI was 5.74 in BPPV group and 3 in control group (P = 0.002). The authors reported significant differences in four domains of the PSCI (subjective sleep quality, sleep latency, sleep medication use, and daytime dysfunction). These findings are in agreement with the findings we observed in our study.

4.1. Strengths and limitations

The sample size of this study was larger than previous similar studies and enabled us to perform comparisons between the groups. We used a validated and standard questionnaire to determine sleep quality. However, this was a cross-sectional study and causality cannot be inferred from the current findings. In addition, we did not assess other factors of lifestyle of these patients to find out how other variables (for example, psychological factors) can affect sleep quality. We recommend that in future

studies, these variables can be incorporated to examine a wider range of variables in an effort to examine more potentially responsible factors.

5. Conclusion

Sleep quality in patients with posterior canal BPPV is poorer than control group. Since sleep quality is an important factor for health-related quality for life and a functional lifestyle, more attention is required to sleep quality of BPPV patients. We recommend that healthcare providers pay careful attention to sleep quality when managing patients with BPPV. This recommendation may be more helpful for women, patients older than 50 years of age, and those whose BMI values are higher than 35 kg/m^2, Further research is required to explore sleep-related factors in more detail and to find out how this poor sleep quality can be managed in clinical practice.

Declarations

Author contribution statement

Khosrow Iranfar: Conceived and designed the experiments; Performed the experiments.

Samaeh Azad: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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