Investigation of the Relationship Between BPPV with Anxiety, Sleep Quality and Falls

Original Investigation

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Abstract

Objective: To investigate the effects of dizziness on sleep quality and psychological status in patients with benign paroxysmal positional vertigo (BPPV) and to evaluate its relationship with falls.

Methods: A Demographic Data Form, a Visual Vertigo Analog Scale, the Falls Efficacy Scale - International (FES-I), the Hospital Anxiety and Depression Scale (HADS), and the Pittsburgh Sleep Quality Index (PSQI) were administered in 102 individuals diagnosed with BPPV by videonystagmography test. The same scales were applied to 75 healthy volunteers as the control group, and the two groups were compared. The BPPV group was divided into two groups as posterior canal and lateral canal BPPV. These two groups were compared among themselves and with the control group.

Results: A statistically significant difference was found between the BPPV and control groups, the lateral canal BPPV and posterior canal BPPV groups, the lateral canal BPPV and control groups, and the posterior canal BPPV and control groups in terms of total scores of the PSQI, the FES-I, and the HADS ($p<0.001$). In the regression model, the FES-I score was fully explained by the PSQI and HADS scores ($p<0.001$).

Conclusion: BPPV significantly affects sleep quality, psychological state, and the risk of fall. The negative effects of BPPV restrict daily living activities, affect the prognosis of the disease, and increase the risk of falling. Considering that psychiatric issues and sleep problems increase the risk of falling in individuals with BPPV, counseling services on this issue would reduce the incidence of falls and related injuries.

Keywords: Benign paroxysmal positional vertigo, anxiety, sleep quality, falls

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Introduction

Dizziness caused by changes in head position was defined by Barany (1) as a syndrome of acute onset and short duration. It was named as benign paroxysmal positional vertigo (BPPV) by Dix and Hallpike (2). BPPV is a sudden-onset, short-term, peripheral vestibular

disease triggered by angular changes in head position relative to gravity, and it is characterized by rotational dizziness and positional nystagmus. BPPV occurs due to the movement of otoconia detached from the utricular macula into the semicircular canals (SSCs) (3). BPPV is seen as canalithiasis, cupulolithiasis, or rarely as canalithiasis jam. According to the canalithiasis theory, otoliths float in SSCs, whereas according to the cupulolithiasis theory, otoliths are attached to the cupula. Canalithiasis occurs when otoliths are rarely blocked in the canal or cupula. While nystagmus is observed in the SSC plane, which is affected by otoliths, it causes severe dizziness that limits the daily living activities of individuals (4). The separation mechanism of otoconia from the macula is usually idiopathic. In addition, head trauma, Meniere's disease, post-operative vestibular neuronitis, sudden sensorineural hearing loss, and migraine are among the secondary causes of BPPV (5).

BPPV is the most common cause of dizziness with a lifetime prevalence of 2.4%. Its prevalence is higher in women than in men, and its incidence increases with age (6). Dizziness due to BPPV is usually triggered when the patient is getting in/out of bed, turning right/left in bed, or tilting the head back or forward (3). Dizziness caused by BPPV and occurring with the angular changes of the head negatively affects the sleep quality (7), triggers anxiety and depression (8), and increases the risk of falls, especially in older individuals (9). Dizziness experienced by BPPV patients due to the angular changes of the head during sleep may awake the patient (3). Wang et al. (7) conducted a study in recurrent BPPV patients and reported that sleep quality was low, and low sleep quality was an independent factor causing BPPV. Kim et al. (10) reported that the sleep quality of individuals with vertigo was negatively affected. Ertugrul and Soylemez (11) reported that the sleep quality of BPPV patients was lower than the healthy controls. In studies evaluating the psychological state of patients with dizziness and imbalance, it has been observed that there is a significant relationship between dizziness and anxiety and depression. Ferrari et al. (8) reported that anxiety and depression are common in BPPV patients, and that psychological problems are more common in female BPPV patients. Dizziness increases the risk of falling, especially in the elderly. Fall-related accidents may cause serious injury and death (9). The aim of this study was to investigate the effects of dizziness in BPPV on sleep quality and psychological state of the patients and to evaluate its relationship with falls.

Methods

Research Design

In this study, a prospective cross-sectional analytical study design was used to obtain information about the relationship between BPPV with anxiety, sleep quality and falling.

Participants

The study was carried out prospectively between February 2021 and July 2021 at the Audiology Unit of the Department of Otorhinolaryngology, İnönü University Turgut Özal Medical Center. The sample of this study was calculated via a power analysis. According to the calculation made using the G*power 3.1 program, the sample size was determined as 176, with an effect size of 0.50, a margin of error of 0.05, a confidence level of 0.95, and a population representation of 0.95 (12). The study group consisted of 102 people who were diagnosed with BPPV by the Dix-Hallpike and Head Roll tests on the Videonystagmography device. The study also included 75 healthy controls. The study group was divided into 4 groups as lateral canal canalolithiasis (n=29), lateral canal cupulolithiasis (n=22), posterior canal canalolithiasis (n=30), and posterior canal cupulolithiasis (n=21). One hundred and two patients with a history of BPPV attack and 75 healthy individuals were included in the study. Exclusion criteria were the presence of communication barrier, chronic disease, previously diagnosed balance problems, and other otological-neurootological diseases. To exclude other vestibular system pathologies, spontaneous nystagmus, cerebellar tests, and walking tests were performed after taking a detailed anamnesis. The Visual Vertigo Analog Scale (VVAS) was used to evaluate the severity of dizziness in patients with diagnosed BPPV before the reposition maneuver. Then, the Demographic Data Form, the Falls Efficacy Scale- International (FES-I), the Hospital Anxiety and Depression Scale (HADS), and the Pittsburgh Sleep Quality Index (PSQI) were administered face-to-face.

Data Collection Tools

Falls Efficacy Scale- International

It is a self-report scale about the level of anxiety about falling during activities of daily living. The scale consists of 16 questions. The total score ranges from 16–64. The cut-off point for the Turkish version of the scale was determined as 24 (13).

Hospital Anxiety and Depression Scale

It was developed to evaluate anxiety and depression in patients. The scale is used not to diagnose, but to quickly identify anxiety and depression in patients with physical illnesses and in those presented to primary health care. The scale includes a total of 14 items: Seven items about anxiety (odd-numbered questions) and seven items about depression (even-numbered questions). Responses are scored on a four-point Likert scale between zero and three. The lowest score that patients can get from each subscale is zero, and the highest score is 21. The cut-off points of the Turkish version of the scale were determined as 10 for the anxiety subscale and seven for the depression subscale (14).

Pittsburgh Sleep Quality Index

It was developed to evaluate the sleep quality and disorder of patients in the last month. The scale consists of 24 items, of which 19 are self-report questions and five are questions that partners/roommates answer based on their observations. The total score ranges from zero to 21. A total score greater than five indicates "poor sleep quality" (15).

Statistical Analysis

Data analysis was made with the SPSS (Statistical Program in Social Sciences) 25. The Kolmogorov–Smirnov test was used to check whether the data included in the study fit the normal distribution. The significance level (p) for comparison tests was set as 0.05. Since the data showed normal distribution, a significance test (t-test) and the ANOVA test were used for the difference between two means. To determine the groups with difference as a result of the ANOVA test, the Duncan's multiple comparison (post-hoc) test was used because homogeneity of variance was established. The Cronbach α coefficient was used to conduct the reliability analysis of the scales. Multicollinearity [variance inflation values (VIF)] Analysis was performed to ensure that there was no relationship between independent variables (factor sub-dimensions). Multivariate regression analysis was used to explain the relationships between a dependent variable and two or more independent variables with a mathematical equation. Since the variables included in the study showed normal distribution, the Spearman–Pearson correlation coefficient was used.

Ethical Principles

The approval for the study was obtained from the İnönü University Health Sciences Institute's Non-Interventional Clinical Research Ethics Committee (decision number: 2021/1458, date: 05.01.2021) and consent was obtained from all patients participating in the study.

Results

A total of 177 participants were included in the study: 29 (14.4%) in the lateral canal canalithiasis group, 22 (12.4%) in the lateral canal cupulolithiasis group, 30 (16.9%) in the posterior canal canalithiasis group, and 21 (11.9%) were in the posterior canal cupulolithiasis group, and 75 (42.4%) were in the control group. There was no statistically significant difference between the groups according to age and gender of the participants (p=0.211, p=0.242). A statistically significant difference was found between the groups according to VAS scores (p=0.001) (Table 1).

A statistically significant difference was found between the patient and control groups according to the total scores of the PSQI, HADS, and FES-I scales (p<0.001, Table 2).

A statistically significant difference was found between the lateral canal BPPV, posterior canal BPPV, and control groups according to the total scores of the PSQI, HADS, and FES-I scales (p<0.001, Table 3). The Duncan Multiple Comparison test was performed, as the variance homogeneity condition was met, to determine which groups differed in all scores. As a result of the test, a significant difference was found in the total scores of the PSQI, FES-I, and depression between the lateral and posterior canal BPPV, between the lateral canal BPPV and the control group, and between the posterior canal BPPV and the control group (p<0.001). Also, a statistically significant difference was found between the lateral canal BPPV and the control group, and between the posterior canal BPPV and the control group in the total scores of the anxiety (p<0.001). However, no statistically

Table 1. Distribution of demographic variables between groups

Variables			Lateral canal canalolithiasis	Lateral canal cupulolithiasis[2]	Posterior canal canalolithiasis[3]	Posterior canal cupulolithiasis[4]	Control group[5]	Total	χ^2 value
Sex	Female	n	20	15	18	12	36	101	0.242[a]
		%	69.0%	68.2%	60.0%	57.1%	48.0%	57.1%	
	Male	n	9	7	12	9	39	76	
		%	31.0%	31.8%	40.0%	42.9%	52.0%	42.9%	
Total %		n	29	22	30	21	75	177	
		%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Variables			**Lateral canal canalolithiasis [1]**	**Lateral canal cupulolithiasis [2]**	**Posterior canal canalolithiasis [3]**	**Posterior canal cupulolithiasis [4]**	**Control group [5]**		**p-value**
Age	Mean ± SD		45.66±11.04	46.64±14.32	45.23±12.69	40.14±11.24	38.92±10.15		0.211
	M (min-max)		47 (25–71)	45.5 (23–74)	44 (25–77)	40 (20–58)	39 (19–58)		
VAS	Mean ± SD		7.86±1.53	9±1.63	8.27±1.78	8.52±1.17	0±0		0.001[b*] (1–2, 1–5, 2–5, 3–5, 4–5)
	M (min-max)		8 (5–10)	10 (5–10)	8.5 (3–10)	9 (6–10)	0 (0–0)		

n: Number, %: Percentage, SD: Standard deviation, M: Median, [a]: χ^2 test p-value, [b]: Kruskal–Wallis test p-value, *p<0.05; there is a statistically significant difference between groups
[1]Lateral canal canalolithiasis, [2]Lateral canal cupulolithiasis, [3]Posterior canal canalolithiasis, [4]Posterior canal cupulolithiasis, [5]Control group

Table 2. Comparison of patient and control groups according to total scores obtained from the scales

Scales/ dimensions	Group	Mean ± SD	Test value	p-value
PSQI	Patient	11.81±4.93	16.564	<0.001*
	Control	3.59±0.77		
Depression	Patient	8.6±4.38	19.557	<0.001*
	Control	0.09±0.29		
Anxiety	Patient	11.3±4.67	24.082	<0.001*
	Control	0.12±0.37		
FES-I	Patient	40.63±11.45	34.969	<0.001*
	Control	0.75±1.09		
VVAS	Patient	8.36±1.59	-	-
	Control	0±0	45.317[a]	<0.001*

PSQI: Pittsburgh Sleep Quality Index, Falls Efficacy Scale- International (FES-I), VVAS: Visual Vertigo Analog Scale, SD: Standard deviation, [a]Significance test (t-test) value of the difference between two means, *p<0.05 there is a statistically significant difference between groups

Table 3. Comparison of lateral, posterior, and control groups according to total scores obtained from the scales

Scales/ dimensions	Group	Mean ± SD	Test value	p-value
PSQI	Lateral	13.8±4.93	137,954	<0.001*
	Posterior	9.82±4.1		
	Control	3.59±0.77		
Depression	Lateral	9.63±4.45	153,357	<0.001*
	Posterior	7.57±4.09		
	Control	0.09±0.29		
Anxiety	Lateral	12.12±4.71	221,905	<0.001*
	Posterior	10.49±4.53		
	Control	0.12±0.37		
FES-I	Lateral	43.94±10.93	498,026	<0.001*
	Posterior	37.31±11.08		
	Control	0.75±1.09		
VVAS	Lateral	8.35±1.66	1020,97[b]	<0.001*
	Posterior	8.37±1.55		
	Control	0±0		

PSQI: Pittsburgh Sleep Quality Index, Falls Efficacy Scale- International (FES-I), VVAS: Visual Vertigo Analog Scale, SD: Standard deviation, [b]ANOVA test F-value, *p<0.05 there is a statistically significant difference between groups

significant difference was found between lateral canal BPPV and posterior canal BPPV (p>0.05).

In both patient and control groups, multiple linear regression analysis was performed in the model in which the FES-I score was the dependent variable, and the PSQI, depression, and anxiety scores were independent variables. Analysis was continued as there was no multicollinearity between independent variables (VIF <10, Table 4). Analysis results are given in Table 4.

For the patient group, the model established to test that the FES-I score, which is the dependent variable, is explained by the independent variables PSQI, Depression, and Anxiety scores was found to be significant as a whole (F=12.729, p_2<0.001, Table 4). It was calculated that 25.8% (R^2= 0.258) of the participants' FES-I scores were explained by their PSQI and anxiety scores.

In the multiple linear regression model created for the study, PSQI and anxiety scores, independent variables scores, and the coefficient were found to have a statistically significant effect on the fall scale score (p_1=0.004, p_1=0.035, p_1=0.001, Table 4). A 1-unit change in the PSQI score results in a positive 0.619-unit (β_1) change on the total FES-I score; and, a 1-unit change in the anxiety score causes a positive 0.615-unit (1) change on the total FES-I score. The effect of the PSQI score on the FES-I score is greater than the anxiety score. It was determined that the depression score did not have a statistically significant effect on the FES-I score (p_1=0.169, Table 4).

For the control group, the model established to test that the dependent variable FES-I score was explained by the independent variables PSQI, depression, and anxiety scores was not found to be significant as a whole (F=1.823, p_2=151, Table 4). In the control group, the FES-I score was not statistically explained by the PSQI, depression, and anxiety scores.

Discussion

Dizziness caused by BPPV due to the angular changes of the head negatively affects sleep quality (7, 10), triggers anxiety and depression (8), and increases the risk of falling, especially in elderly individuals (9). The aim of this study was to investigate the effects of dizziness occurring in BPPV on sleep quality and psychological status of patients and to evaluate its relationship with falls.

An analysis of the demographic data of the patient group showed that, similar to the literature, the mean age was approximately between 45 and 50 years, and female patients were more than male patients (16). Ogun et al. (17) stated that BPPV is more common in women due to hormonal fluctuations associated with menopause and low estrogen levels.

In the present study, the VVAS scores, by which dizziness was assessed, were statistically higher in the patient group. In addition, the lateral canal cupulolithiasis score of the patient group was higher than that of the lateral canal canalithiasis score, and the posterior canal cupulolithiasis score was also higher than the posterior canal canalithiasis score. The higher VVAS scores of the patients with cupulolithiasis than those with canalithiasis were attributed to the longer duration of nystagmus and dizziness (18).

Table 4. Results of multiple linear regression modeling of the relationship between FES-I and PSQI, depression, and anxiety scores

Group	Variables		β_1	t-test	p_1-value	R^2	F-test	p_2-value
Patient	Fall	Coefficient	22.651	**7.226**	**0.001***	0.258	12.729	**<0.001****
		PSQI	0.619	**2.947**	**0.004***			
		Depression	0.433	1.384	0.169			
		Anxiety	0.615	**2.138**	**0.035***			
Control	Fall	Coefficient	1.877	3.016	0.004	0.032	1.823	0.151
		PSQI	-0.299	-1.806	0.075			
		Depression	0.149	0.346	0.731			
		Anxiety	-0.592	-1.688	0.096			

PSQI: Pittsburgh Sleep Quality Index, Falls Efficacy Scale- International (FES-I), dependent variable: fall score; Independent variables: PSQI, Depression and Anxiety scores; β_1: non-standardized regression coefficients; *p_1<0.05: t-test result for the significance of the regression coefficients; VIF: Variance inflation values; R^2: Explanatory coefficient; **p_2<0.05: F-test result for the significance of the model

It is stated that vestibular dysfunction may cause many emotional disorders. It is particularly associated with particular emotional disorders such as anxiety and depression (8). Contrary to this approach, there are also opinions that emotional disorders may cause balance disorders (19). In addition, psychological factors may negatively affect the treatment of balance disorders and delay the process (20). In a study in which patients with BPPV were examined psychologically, it was stated that 40.94% of the patients had anxiety symptoms, 41.73% had depression symptoms, and 33.07% had both symptoms (21). Additionally, Ferrari et al. (8) reported mild to moderate depression in 21.7% of the BPPV patients, and Magliulo et al. (22) reported that 29.2% of the BPPV patients had clinical anxiety. In the present study, the statistically higher scores of the patient group on anxiety and depression scales compared to the control group supports the relationship between dizziness and emotional disorders. It is stated that there are important connections between neuroanatomical regions and neurotransmitters in the vestibular system and pathways associated with emotional states (23). In addition, there are functional connections between the anatomical and neurovestibular system and the structures involved in the pathogenesis of panic disorder. These links support the relationship between vestibular disorders and some psychiatric disorders (24).

Most patients with BPPV experience severe dizziness when lying down, turning in bed, and getting out of bed (25). Patients may experience stress due to vertigo attacks occurring with postural changes while lying in bed. Stress makes it difficult to fall asleep and stay asleep, causing insomnia. In the literature, it is noted that head positions during sleep are associated with BPPV and that inappropriate head positions may trigger sleep disorders. It was reported that there was a higher rate of recurrence in patients who slept in a position towards the affected side in the treated patient group after the reposition maneuver (26). Although there are many studies examining the relationship between BPPV and sleep position, there are limited studies examining the relationship between BPPV and sleep quality (11). Wang et al. (7) found that the sleep quality of patients with recurrent BPPV was worse than those with non-recurrent BPPV. Korres et al. (25) reported that there was a correlation between dizziness and sleep quality in 75.9% of the patients with BPPV. Ertugrul and Soylemez (11) also stated that the sleep quality of the patients with BPPV was significantly worse than that of healthy individuals (11). In our study, the fact that the sleep quality of the patients with BPPV was worse than that of healthy individuals and that their quality of life was negatively affected, which is similar to the literature.

Accidents and environmental factors are among the most common causes of falls, which are followed by dizziness, balance disorder, and mobility difficulties. Vestibular pathologies that may cause dizziness and balance disorders significantly increase the risk of falling (27). The unpredictability and physical symptoms of vertigo attacks significantly limit the movements of individuals during activities of daily living. BPPV patients in particular are frequently exposed to unpredictable and sudden-onset dizziness. Therefore, during symptomatic attacks, most patients avoid daily activities such as going out alone, doing housework, and driving (28). Balatsouras et al. (29) stated that BPPV increases the risk of falls and related injuries in the elderly. It is also stated that the prevalence of falls is 78% in elderly patients with BPPV, and 32%–42% of patients over the age of 70 experience fall at least once a year (30). The elderly make restrictions in their routine daily activities due to their tendency to fall (29). Choosing a sedentary lifestyle or avoiding movement as much as possible in their daily lives seriously affects the treatment process and quality of life. von Brevern et al. (6) stated that 86% of the patients with BPPV restricted their daily activities. Denkinger et al. (31) also highlighted that patients with BPPV may experience falls due to head movement or unpredictable dizziness, and injuries related to these falls. Based on the present results, the risk of falling in patients with BPPV is higher than that of healthy individuals, which is similar to the literature. In

addition, patients with vertigo had a lower walking speed than healthy individuals. The reason for this may be the fear of falling, which slows them down to prevent accidents.

In the present study, the PSQI, FES-I, and depression scale scores of the patients with lateral canal BPPV were higher than those with posterior canal BPPV and the control groups. More stimulation of the lateral SSC plane during head movements in the lying position shows that they experience vertigo attacks more frequently and their quality of life is more adversely affected. We think that these findings may be related to the worse subjective evaluations of the patients with lateral canal BPPV compared to posterior canal BPPV and control groups.

The multiple linear regression analysis model performed in our study shows that insomnia and anxiety increase the risk of falling. Examining the relationship between insomnia, psychiatric problems, and falls in patients with BPPV is important regarding the prognosis of the disease and the risk of fall. In the literature, it is noted that patients with recurrent BPPV have more psychiatric problems and that these psychiatric problems may also affect sleep (7). It is also stated that sleep disorder may cause various psychiatric and physical health problems (32). There are also studies showing that sleep disorders may cause vestibular problems (7). In addition, it is stated that the quality of life of patients with BPPV improves after treatment. Similar to our study, Sklare et al. (33) stated that when acute and episodic vertigo attacks are accompanied by emotional disorders, the fear of fall may increase and cause panic attacks. Consistent with the findings of our study, the relationship between emotional disorders and fall is highlighted. An increase in balance loss is observed as BPPV brings along psychiatric problems and insomnia. Therefore, the risk of falling increases depending on these factors.

Conclusion

Evaluation of patients with BPPV in terms of psychiatric problems, insomnia, and falls provides important information about both the immediate effect of the disease and its prognosis. Evaluation of patients in terms of psychiatric and sleep disorders is also important regarding their treatment, as it will affect the prognosis of BPPV and risk of falling. Identifying patients experiencing these problems and directing them to the psychiatry outpatient clinics will contribute to the prognosis of the disease. In addition, considering that psychiatric problems and sleep problems increase the risk of falling, we think that counseling on this subject will reduce the rates of falls and related injuries.

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Ethics Committee Approval: The approval for the study was obtained from the İnönü University Health Sciences Institute's Non-Interventional Clinical Research Ethics Committee (decision number: 2021/1458, date: 05.01.2021).

Informed Consent: Consent was obtained from all patients participating in the study.

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Authorship Contributions

Concept: D.U.C., İ.D., T.B., Design: D.U.C., İ.D., T.B., Data Collection and/or Processing: S.D., S.C.Ç., Analysis and/or Interpretation: D.U.C., İ.D., S.D., S.C.Ç., T.B., Literature Search: D.U.C., İ.D., S.D., S.C.Ç., T.E., T.B., Writing: D.U.C., İ.D., S.D., S.C.Ç., T.E., T.B.

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Main Points

- Benign paroxysmal positional vertigo (BPPV) negatively affects the sleep quality of patients.
- There is a relationship between BPPV and psychological disorders.
- BPPV increases the risk of falling.
- Variations of BPPV affect differently sleep quality, anxiety, depression, and the risk of falling.

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