PAPER DETAILS

TITLE: RELATION OF VERTIGO, DIZZINESS, AND IMBALANCE WITH PHYSICAL ACTIVITY, EXERCISE CAPACITY, ACTIVITIES OF DAILY LIVING, AND QUALITY OF LIFE IN PERIPHERAL VESTIBULAR HYPOFUNCTION

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RELATION OF VERTIGO, DIZZINESS, AND IMBALANCE WITH PHYSICAL ACTIVITY, EXERCISE CAPACITY, ACTIVITIES OF DAILY LIVING, AND QUALITY OF LIFE IN PERIPHERAL VESTIBULAR HYPOFUNCTION

ORIGINAL ARTICLE

ABSTRACT

Purpose: Vertigo (V), dizziness (D), and imbalance cause functional limitation and participation in peripheral vestibular hypofunction (PVH). The aim was to investigate the relation of V, D, imbalance, with physical activity, exercise capacity, activities of daily living (ADL), and quality of life (QoL) in patients with PVH.

Methods: Thirty-nine subjects with and 32 without PVH were included. The V and D severity and frequency using Visual Analogue Scale (VAS), balance using Modified Clinical Test of Sensory Interaction and Balance (M-CTSIB), and Activity Specific Balance Confidence Scale (ABC) were assessed. Physical activity using the International Physical Activity Questionnaire (IPAQ) and functional exercise capacity using the 6-minute walk test (6MWT) were evaluated. ADL using the Vestibular Disorders ADL Scale (VADL) and QoL using the Dizziness Handicap Inventory (DHI) were determined.

Results: M-CTSIB, ABC, IPAQ, 6MWT, VADL, and DHI were lower in patients with PVH as compared to the control group ($p<0.05$). V-severity and -frequency were related to IPAQ ($r=-0.602$ and $r=-0.321$), VADL ($r=0.626$ and $r=0.492$), and DHI ($r=0.640$ and $r=0.578$, respectively, $p<0.05$). Both D-severity and -frequency was correlated with IPAQ ($r=-0.493$ and $r=-0.487$), VADL ($r=0.565$ and $r=0.408$), and DHI ($r=0.627$ and $r=0.566$, respectively, $p<0.05$). V- and D-severity was associated with 6MWT ($r=-0.339$ and $r=-0.336$, respectively, $p<0.05$). When somatosensory and visual sensations decreased, the balance was correlated with 6MWT ($r=-0.412$), VADL ($r=0.545$), and DHI ($r=0.422$, $p<0.05$).

Conclusion: The V, D, and imbalance are associated with physical activity level, functional exercise capacity, ADL, and QoL in PVH. Further study is needed to investigate the effects of vestibular rehabilitation programs to improve physical activity and functional exercise capacity.

Key Words: Dizziness; Physical Activity Level; Postural Balance; Vertigo; Vestibular Diseases.

PERİFERAL VESTİBÜLER HİPOFONKSİYONDA VERTİGO, DİZZİNESS VE DENGE BOZUKLUĞU İLE FİZİKSEL AKTİVİTE, EGZERSİZ KAPASİTESİ, GÜNLÜK YAŞAM AKTİVİTELERİ VE YAŞAM KALİTESİ ARASINDAKİ İLİŞKİ

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Periferik vestibüler hipofonksiyon'da (PVH) vertigo (V), dizziness (D) ve denge bozukluğu çeşitli fonksiyonel limitasyonlara ve inaktiviteye neden olur. Bu çalışmanın amacı, PVH'li hastalarda V, D, denge bozukluğu, fiziksel aktivite düzeyi, fonksiyonel egzersiz kapasitesi, günlük yaşam aktiviteleri (GYA) ve yaşam kalitesi (YK) arasındaki ilişkiyi araştırmaktı.

Yöntem: Otuz dokuz PVH hastası ve PVH hastası olmayan 32 birey çalışmaya dahil edildi. V/D şiddeti ve sıklığı Vizüel Analog Skalası (VAS) ve denge Modifiye Kliniğine Uyarlanmış Denge-Duyusal Etkileşim Testi (M-CTSIB) ve Aktiviteye Spesifik Denge Güvenlik Ölçeği (ABC) ile değerlendirildi. Fiziksel aktivite düzeyi Uluslararası Fiziksel Aktivite Anketi (UFAA) ve fonksiyonel egzersiz kapasitesi altı dakika yürüme testi (6DKYT) ile ölçüldü. GYA Vestibüler Bozukluklarda Günlük Yaşam Aktiviteleri Ölçeği (VGYA) ve YK Baş Dönmesi Engellilik Envanteri (BEE) ile değerlendirildi.

Sonuçlar: PVH'li hastalarda M-CTSIB, ABC, UFAA, 6DYT, VGYA ve BEE skorlarının kontrol grubuna göre daha düşük olduğu görüldü ($p<0,05$). V şiddeti ve frekansı UFAA ($r=-0,602$, $r=-0,321$), VGYA ($r=0,626$, $r=0,492$) ve BEE ($r=0,640$, $r=0,578$) ile ilişkili bulundu ($p<0,05$). D şiddet ve frekansı UFAA ($r=-0,493$ and $r=-0,487$), VGYA ($r=0,565$ and $r=0,408$) ve BEE ($r=0,627$ and $r=0,566$) ile korele idi ($p<0,05$). V ve D şiddeti 6DYT ile ilişkili idi (sırasıyla; $r=-0,339$ ve $r=-0,336$, $p<0,05$). Somatosensör ve görsel duyular azaldığı zaman; denge 6DYT ($r=-0,412$); VGYA ($r=0,545$) ve BEE ($r=0,422$) ile ilişkili bulundu ($p<0,05$).

Tartışma: PVH'de V, D ve denge bozukluğu fiziksel aktivite düzeyi, fonksiyonel egzersiz kapasitesi, GYA ve YK ile ilişkilidir. Vestibüler rehabilitasyon programlarının, fiziksel aktivite ve fonksiyonel egzersiz kapasitesinin iyileştirilmesine etkisini araştıran ileri çalışmalara ihtiyaç bulunmaktadır.

Anahtar Kelimeler: Dizziness; Fiziksel Aktivite Düzeyi; Postural Denge; Vertigo; Vestibüler Hastalıklar.

INTRODUCTION

Peripheral vestibular hypofunction (PVH) is a heterogeneous disorder that affects one or both sides of the vestibular system resulting from a complete or partial decrease of the vestibular function (1). Patients with PVH, due to vertigo, dizziness, and imbalance are faced with many problems in daily life. Because of these symptoms, patients are afraid of falling, and they especially avoid activities that require head movement, and physical activity level decreases (2,3). Physical inactivity is accepted as the most critical risk factor for numerous diseases, primarily for cardiovascular diseases (4).

There is not yet strong evidence to determine the specific exercises for people with PVH, and vestibular rehabilitation programs instead focus on vestibular adaptation and balance development (5-7). When vertigo, dizziness, and imbalance start decreasing, the patient needs to return to an active lifestyle and take up the habit of regular exercise. Physical activity protects patients from the risks of inactivity, which are hypertension, diabetes mellitus, low exercise capacity, obesity, and high mortality risk (8). American Physical Therapy Association, in the guide published in 2016, reported that vestibular rehabilitation should consist of exercises to improve gaze stability, habituation, balance-gait training, and walking endurance (9). Two studies showed that vertigo, dizziness or imbalance decrease physical activity levels in patients with PVH, but there is no study showing their relationship with exercise capacity (10,11).

Individuals with dizziness preferred lighter exercises such as light garden work, short walks, and doing light household chores (10). Therefore, there is a relationship between dizziness and physical activity level (10,11). In addition, both mild (i.e., going for walking) and heavy (i.e., working in the garden) physical activities are associated with reduced risk of the low quality of life, risk of falls, and depression in dizziness. Mild exercise may decrease the mortality rate in dizziness.

Although some studies showed that vertigo, dizziness and balance disorders decreased the independence of daily life and quality of life in patients with PVH, there was no study which investigating the relationship between these factors and physical activity level and exercise capacity in this population (12-14). Therefore, this study aimed to investigate the relationship of vertigo, dizziness, and imbalance with physical activity level, exercise capacity, activities of daily living and quality of life in patients with PVH and to compare balance, physical activity level, exercise capacity, activities of daily living and quality of life in individuals with and without PVH.

METHODS

Subjects

This study was conducted at the Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University. Patients who were referred to the vestibular rehabilitation program with the diagnosis of PVH from the Gazi University Department of Otorhinolaryngology were included in the study. The inclusion criteria were being 18-65 years old, experiencing vertigo or dizziness for at least two months, having no additional diseases of neurological, orthopedic, circulatory system, or vision that could cause vertigo, dizziness, and imbalance. Exclusion criteria were being in the acute phase of the vestibular disease and participating in the vestibular rehabilitation program in the last one month (1). Vestibular suppressant medications, if used, were discontinued at least seven days before participating in the study. The control group consisted of subjects without PVH with similar age and gender. Before the study was started, the approval of the Ethics Committee for Non-Interventional Clinical Investigations of Gazi University was received in 2015 (Approval Date: 29.12.2015 and Approval Number: 128). All the patients and the control group were informed about the study and written informed consent was obtained. The study was conducted between December 2015 and May 2016.

Measurements

Vertigo/Dizziness severity and frequency: Vertigo severity and frequency were assessed using a numeric Visual Analog Scale (VAS) (15). The same scale was also used to evaluate dizziness. According

to the scale, the severity of vertigo/dizziness within the last seven days is rated as 1 (no vertigo/ dizziness), 2-3 (slight), 4-5 (mild), 6-7 (severe), 8-9 (extreme) and 10 (not bearable). Vertigo/dizziness frequency in the last seven days is evaluated as 1 (no vertigo/ dizziness), 2-3 (1-5 times a week), 4-5 (1-3 times a day), 6-7 (4-10 times a day), 8-9 (>10 times a day) and 10 (all the time).

Modified Clinical Test of Sensory Interaction and Balance (M-CTSIB): The test was performed using the Biodex-BioSwayTM device (SD 950-340, Biodex Medical Systems, Inc., Shirley, NY, USA). The M-CTSIB evaluates the relationship of balance with the visual, somatosensory, and vestibular systems. The tests, which were performed twice, were carried out under four different conditions for 30 seconds: Condition 1-eyes open-firm surface; Condition 2-eyes closed-firm surface; Condition 3-eyes open-foam surface, and Condition-4 eyes closed-foam surface. At the end of the tests, body oscillations of the participants were calculated by the system, and the Sway Index scores, which show the standard deviation of the average position from center, were obtained. According to the Sway Index, higher scores indicate higher postural sway of the person (16).

Activities-specific Balance Confidence Scale (ABC): The scale, which involves 16 activities of daily living associated with balance, is used to determine how much individual confidence and the risk of falling there is when individuals perform these activities. Patients are asked to grade between 0 “completely unsafe” and 100% “completely safe.” A score of close to 0 indicates that the patient has increased imbalance and risk of falling (17). The Turkish version of the scale was used in the study, and the author’s permission to use the scale was obtained (18).

Six-Minute Walk Test (6MWT): It was used to assess the exercise capacity of the patients. The subjects were allowed to rest for 10 minutes before starting the test. The measurements (heart rate, blood pressure, fatigue, and dyspnea) before and after the test was taken. Heart rate using a Polar heart rate monitor (Polar FT1, Kempele, Finland), blood pressure using a blood pressure monitor (Perfect Aneroid sphygmomanometer, ERKA, Germany), and fatigue and dyspnea were using the Modified Borg Scale were assessed. Walking as fast as possible without running through a 30-meter distance for six minutes was asked from the subjects. The total distance walked by each subject was recorded in meters and used in analyses (19).

International Physical Activity Questionnaire-Long Form (IPAQ): The level of physical activity was assessed using the IPAQ. With this questionnaire, the duration, frequency, and severity of physical activities performed in different situations such as work, transportation, housework and caring for family, recreation, sport, and leisure-time and sitting time in the last seven days are examined in detail and calculated as a metabolic equivalent of task (MET). The smallest score of the questionnaire is 0 MET min/week, and the highest score is ≥3000 MET min/week. 0-600 MET min/week is inactive, 600-3000 MET min/week is minimally active, ≥3000 MET min/week is active (health-enhancing physical activity, HEPA) (20,21). For the study, evaluations were performed using the Turkish version of the scale, and the author’s permission to use the questionnaire was obtained (21).

Vestibular Disorders Activities of Daily Living Scale (VADL): The scale measures the level of independence in a total of 28 daily life activities, 12 of which are (VADL-F), nine are (VADL-A), and seven are (VADL-I). The score of each question is between 1 and 10. Total score is between 28-280 points. If the total point is low, it means the individual is independent in daily life activities (22,23). The Turkish version of the scale was used in the study, and the author’s permission to use the scale was obtained (23).

Dizziness Handicap Inventory (DHI): The scale assesses the disability and quality of life with the effects of dizziness over the past one month. It consists of 25 questions in total, and there are three subdivisions: functional (9), physical (7), and emotional (9). The scale consists of three options, including “yes,” sometimes, and “no.” The highest total score is 100, and the lowest is 0. The level of disability according to the scale is categorized as follows: 0-30 points=mild handicap; 31-60 points=moderate handicap; 61-100 points=severe handicap (24). For the study, evaluations were

performed using the Turkish version of the scale, and the author's permission to use the scale was obtained. (25).

Statistical Analysis

Statistical analyses of the study were conducted using the program Statistical Package for Social Sciences (SPSS) Version 22.0 (SPSS Inc. Chicago, USA). A chi-square test was used to analyze the gender differences between the patients with PVH and the control group. In order to determine the difference between the two groups, Student t-Test or a Mann Whitney U Test was used considering whether the data were distributed normally or not. Histogram, coefficient of variation, kurtosis/skewness, detrended plot, and Shapiro-Wilks/Kolmogorov–Smirnov tests were used to find out whether the data were normally distributed, or not. A Spearman correlation analysis was used for the relationship between the variables. The statistical significance level was $p<0.05$. Power analysis was performed with 80%, 85%, and 90% power and 5% type I error, the number of cases was calculated at least 24, 27, and 32 for each group. The study was completed with 39 patients with PVH and 32 controls with 90% power.

RESULTS

Forty-four patients with PVH were included in the study. Five patients were excluded because four did not meet the inclusion criteria (one patient had a lower extremity prosthesis, two patients had additional neurological diseases, and one patient had a sensory loss in the diabetic foot). One patient was unable to complete the assessments. The study was completed with 39 patients (mean age=42.36±12.56 years, 21-65 years, 29 females, 10 males) and 32 controls (mean age=38.96±10.29 years, 21-56 years, 23 females, nine males) (Figure 1). Thirty-three patients had unilateral, and six patients had bilateral PVH. Benign paroxysmal positional vertigo (BPPV) was present in 11 patients with unilateral PVH and three patients with bilateral PVH. The median duration of the diagnosis was 24 months (IQR=5-36 months).

At baseline, there was no difference between the groups regarding physical characteristics, including age, height, weight, body max index, and gender ($p>0.05$, Table 1).

According to VAS scores, it was seen that the median (range) severity of vertigo was 5 (3-7), and frequency was 4 (3-6) in patients with PVH. Similarly, median of severity and frequency of dizziness was 5 (3-7). These results suggested that the severity of vertigo and dizziness changed from slight to severe, and the majority of the patients had vertigo and/or dizziness for 4-5 times a day. Two patients had only dizziness, and 37 patients had both vertigo and dizziness.

The M-CTSIB scores were higher in patients with PVH than those of the controls ($p<0.05$), indicating higher postural sway in patients with PVH compared to the controls. Additionally, the ABC scores were lower in patients with PVH compared to the controls ($p<0.05$, Table 2). The IPAQ total scores and the 6MWT distance of the patients with PVH were significantly lower than those of the control

Table 1: Characteristics of the Patients with Peripheral Vestibular Hypofunction and Controls.

Parameters		PVH Group (n=39) Mean±SD	Control Group (n=32) Mean±SD	p
Age (years)		42.36±12.56	38.96±10.29	0.225[a]
Height (cm)		163.69±9.11	166.06±7.92	0.252[a]
Weight (kg)		72.05±14.05	68.19±15.15	0.270[a]
BMI (kg/m²)		26.99±5.31	24.61±4.54	0.051[a]
Gender, n (%)	**Females**	29 (74.4)	23 (71.9)	0.814[b]
	Males	10 (25.6)	9 (28.1)	

[a]Student t Test, [b]Chi-square Test. PVH: Peripheral Vestibular Hypofunction, BMI: Body Mass Index.

Table 2: Comparison of Balance, Physical Activity Level, Functional Exercise Capacity, Activities of Daily Living and Quality of Life in Patients with Peripheral Vestibular Hypofunction and Control Group.

Variables		PVH Group Median (IQR)	Control Group Median (IQR)	p
M-CTSIB (Point)	Condition-1	0.53 (0.39-0.71)	0.30 (0.26-0.42)	**<0.001*[a]**
	Condition-2	0.75 (0.55-1.06)	0.58 (0.39-0.74)	**0.023*[a]**
	Condition-3	0.91 (0.67-1.21)	0.62 (0.56-0.70)	**<0.001***
	Condition-4	2.21(1.73-3.00)	1.73 (1.61-1.90)	**<0.001***
ABC (0-100)		58.13 (36.25-73.13)	96.25 (91.88-98.75)	**<0.001***
IPAQ Total (MET-min/week)		510 (210.00-850.50)	2417.25 (1688.25-3883.50)	**<0.001***
VADL (28-280)	Functional (12-120)	43 (26-51)	12 (12-12)	**<0.001***
	Ambulation (9-90)	31 (20-41)	9 (9-9)	**<0.001***
	Instrumental (7-70)	23 (13-31)	7 (7-7)	**<0.001***
	Total (28-280)	102 (58-119)	28 (28-28)	**<0.001***
DHI (0-100)	Functional (0-36)	22 (16-30)	0 (0-0)	**<0.001***
	Physical (0-28)	18 (12-22)	0 (0-1.5)	**<0.001***
	Emotional (0-36)	12 (4-24)	0 (0-0)	**<0.001***
	Total (0-100)	50 (36-76)	0 (0-2)	**<0.001***
6MWT (m)[ϕ]		484.01±73.33	601.70±75.93	**<0.001***

*p<0.05. [ϕ]Mean±SD. [a]Mann Whitney U Test, [b]Student's t Test. PVH: Peripheral Vestibular Hypofunction, M-CTSIB: Modified Clinical Test of Sensory Interaction and Balance, Condition-1: Eyes Open, Firm Surface; Condition-2: Eyes Closed, Firm Surface; Condition-3: Eyes Open, Foam Surface; Condition-4: Eyes Closed, Foam Surface, ABC: The Activities-Specific Balance Confidence Scale, IPAQ: International Physical Activity Questionnaire-Long Form, 6MWT: Six-Minute Walk Test, VADL: Vestibular Disorders Activities of Daily Living Scale, DHI: Dizziness Handicap Inventory.

group (p<0.05, Table 2). All the scores of the VADL and DHI were higher in patients with PVH than the control group (p<0.05, Table 2).

There were negative and strong correlations between the severity of vertigo and the IPAQ total score (p<0.05), and there were a negative and low to moderate correlation between frequency of vertigo and the IPAQ total score (p<0.05, Table 3). In addition, negative and moderate correlations found between the severity and frequency of dizziness and IPAQ total score (p<0.05, Table 3). Negative moderate to strong associations were found between vertigo/dizziness severity and 6MWT distance (p<0.05). However, the frequency was not related to walking distance in 6MWT (p>0.05, Table 3).

There were singnificant correlations between severity and frequency of vertigo/dizziness and functional (p<0.05), ambulation (p<0.05), instrumental (p<0.05), and total scores of VADL (p<0.05) and functional (p<0.05), physical (p<0.05), emotional (p<0.05) and total scores of DHI (p<0.05) were found to have positive and moderate to strong correlations with severity and frequency of vertigo/dizziness (p<0.005) in patients with PVH (Table 3).

The M-CTSIB and ABC scores were not correlated with the IPAQ total score (p>0.05, Table 3). A moderate negative association was found between the Condition-4 score in M-CTSIB and 6MWT (p=0.009, Table 3). Additionally, positive and moderate to strong correlations were found between Condition-4 in M-CTSIB and functional (p= 0.002), ambulation (p<0.001), instrumental (p=0.002) and total scores of VADL (p<0,001) and functional (p=0.009), physical (p=0.007), emotional (p=0.013) and total scores of DHI (p=0.007) (Table 3). A positive and moderate to strong correlation was found between the condition-2 score in M-CTSIB and VADL-ambulation score (p=0.026, Table 3).

DISCUSSION

The findings of this study revealed that vertigo/dizziness was related to physical activity levels, functional exercise capacity, independence of daily living activities, and quality of life in patients with PVH. Moreover, balance measurements (decreased somatosensory and visual sensations) and

Table 3: Relationship between Vertigo, Dizziness, and Balance, and Physical Activity Level, Functional Exercise Capacity, Activities of Daily Living, and Quality of Life in Patients with Peripheral Vestibular Hypofunction.

Variables	IPAQ Total		6MWT		VADL								DHI							
					Functional		Ambulation		Instrumental		Total		Functional		Physical		Emotional		Total	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
Vertigo																				
Severity	-0.602	**<0.001***	-0.339	**0.035***	0.582	**<0.001***	0.615	**<0.001***	0.592	**<0.001***	0.626	**<0.001***	0.681	**<0.001***	0.576	**<0.001***	0.494	**0.001***	0.640	**<0.001***
Frequency	-0.321	**0.046***	-0.219	0.181	0.518	**0.001***	0.482	**0.002***	0.454	**0.004***	0.492	**0.001***	0.558	**<0.001***	0.527	**0.001***	0.565	**<0.001***	0.578	**<0.001***
Dizziness																				
Severity	-0.493	**0.001***	-0.336	**0.037***	0.514	**0.001***	0.565	**<0.001***	0.545	**<0.001***	0.565	**<0.001***	0.647	**<0.001***	0.542	**<0.001***	0.453	**0.004***	0.627	**<0.001***
Frequency	-0.487	**0.002***	-0.281	0.083	0.446	**0.004***	0.448	**0.004***	0.327	**0.042***	0.408	**0.010***	0.591	**<0.001***	0.454	**0.004***	0.514	**0.001***	0.566	**<0.001***
M-CTSIB																				
Condition-1	-0.124	0.451	-0.296	0.067	0.213	0.193	0.266	0.102	0.252	0.121	0.270	0.097	0.101	0.541	0.260	0.109	0.175	0.287	0.175	0.287
Condition-2	-0.049	0.768	-0.358	**0.025***	0.197	0.229	0.356	**0.026***	0.315	0.051	0.312	0.530	0.195	0.233	0.292	0.071	0.285	0.079	0.278	0.086
Condition-3	-0.002	0.990	-0.101	0.540	0.261	0.109	0.271	0.095	0.217	0.184	0.291	0.720	0.153	0.353	0.298	0.065	0.007	0.964	0.125	0.450
Condition-4	-0.256	0.115	-0.412	**0.009***	0.491	**0.002***	0.572	**<0.001***	0.490	**0.002***	0.545	**<0.001***	0.414	**0.009***	0.427	**0.007***	0.395	**0.013***	0.422	**0.007***
ABC	0.312	0.053	0.448	**0.004***	-0.549	**<0.001***	-0.706	**<0.001***	-0.521	**0.001***	-0.601	**<0.001***	-0.704	**<0.001***	-0.596	**<0.001***	-0.698	**<0.001***	-0.706	**<0.001***
IPAQ Total	-	-	0.480	**0.002***	-0.378	**0.018***	-0.425	**0.007***	-0.276	0.089	-0.366	**0.022***	-0.407	**0.010***	-0.277	0.087	-0.345	**0.032***	-0.378	**0.018***
6MWT	0.477	**0.002***	-	-	-0.558	**<0.001***	-0.678	**<0.001***	-0.533	**<0.001***	-0.624	**<0.001***	-0.524	**0.001***	-0.415	**0.009***	-0.501	**0.001***	-0.528	**0.001***

*p<0.05. r: Spearman Correlation Coefficients PVH: Peripheral Vestibular Hypofunction, M-CTSIB: Modified Clinical Test of Sensory Interaction and Balance, Condition-1: Eyes Open, Firm Surface; Condition-2: Eyes Closed, Firm Surface; Condition-3: Eyes Open, Foam Surface; Condition-4: Eyes Closed, Foam Surface, ABC: Activities-Specific Balance Confidence Scale, IPAQ: International Physical Activity Questionnaire-Long Form, 6MWT: Six-Minute Walk Test, VADL: Vestibular Disorders Activities of Daily Living Scale, DHI: Dizziness Handicap. Inventory.

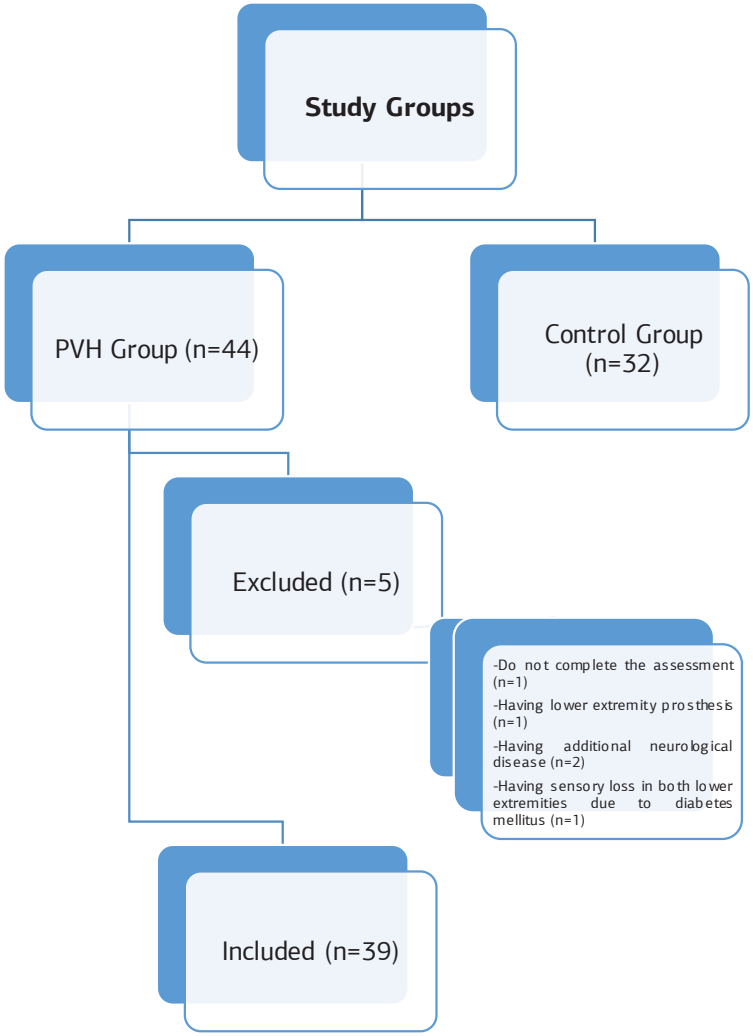

Figure 1: Flow Chart of the Participants.

balance confidence in performing daily activities were related to functional exercise capacity, independence of daily living activities, and quality of life.

Most peripheral vestibular lesions have a benign etiology and undergo spontaneous resolution due to the self-limiting nature of the condition and the process of central nervous system compensation (2). However, when this process is prolonged, or recovery is not fully achieved, patients avoid physical activities, especially these requiring head movement. Patients also move slowly, fear of falling, and restrict social life because of their handicaps. The reason for these limitations was vertigo/dizziness and imbalance symptoms that patients experience. In the literature, some studies observed that balance, physical activity level, independence of daily life activities, and quality of life have been affected in patients with vertigo or dizziness (10,26-28). Our findings were paralel in literature.

There are a limited number of studies investigating the relationship of vertigo or dizziness with physical activity levels (10,11). Ekwall et al. showed that dizziness affected the physical activity levels in older people with dizziness (10). Additionally, they observed that people with dizziness prefer lower intensity exercises, such as walking (10). Kollen et al. found that physical activity levels tend to decline as the dizziness severity increases in older people with dizziness (11). Although the participants of our study were not elderly, these studies that supported our study findings indicated a relationship between dizziness and physical activity level. Therefore, similar results were effective in the younger age group in addition to the literature.

No study investigated the relationship of vertigo or dizziness with functional exercise capacity. However, we knew that inactivity causes a decrease in functional exercise capacity (29). This issue is not generally taken into account in the rehabilitation of patients with vertigo or dizziness. Patients fear falling or losing their balance, and they believe that physical activities will increase their symptoms. Therefore, they do not prefer to do physical activity and exercise. Ekwall et al. suggested that even walking and garden activities decrease the risk of falling, and they improve the quality of life and mood in older people with dizziness (10). Although our patients were younger, and not having severe vertigo or dizziness, their physical activity level and exercise capacity were lower than the controls. We believed that these results were secondary complications of vertigo and dizziness. Therefore, we wanted to draw attention to this relationship, and we believe that aerobic exercises may be recommended to the patients.

Our study showed that objective balance test scores and perceived imbalance of PVH patients were lower compared to the control group. However, we were unable to find a relationship between balance and physical activity level, probably due to not severe vertigo or dizziness in our patients. Therefore, they had to maintain their physical activity even if they were in slow motion because minimal disability could not be an excuse for not to go to work or continue to housework in our country. Patients had to cope with vertigo or dizziness and continue their social roles. Therefore, a decrease in balance scores could not indicate a decrease in physical activity scores. The physical activity level of the controls was lower than expected, indicating that other factors may affect the level of physical activity. Although individuals in the control group had no balance disorder, they did not prefer to be physically active. It may be due to personal, cultural, and social habits. Another reason could be our assessment method because the IPAQ provides a subjective assessment of physical activity, and not specific for patients with PVH. If we had used objective assessments such as an accelerometer, we might have found a relationship.

In the current study, we reported that as vertigo/dizziness severity and frequency increased, patients became dependent on all of the dimensions of daily life activities. Neuhauser et al. showed that vigorous vertigo leads to severe disability, and a person could not perform daily living activities, and their activities were interrupted (30). Another study by Kollen et al. found that older people with dizziness feared to fall in ambulatory activities such as going up and down the stairs and talking on the phone, thus they were dependent on ambulatory daily living activities (11). Although these studies were not specific for PVH and the ages of the patients were not similar to ours, we thought that our results are parallel to their findings (11,30).

In terms of balance tests, we found that the independence of daily life activities was related to only Condition-4 test (eyes closed, foam surface) in the M-CTSIB, indicating vestibular system and its relationship with imbalance (31). Therefore, the independence of patients with PVH decreases in daily living activities when somatosensory and visual sensations decrease due to vestibular disorders. Patients' perceived imbalance could be correlated with the independence of daily life activities.

Our study showed that vertigo and dizziness severity was related to the quality of life in patients with PVH. Grigol et al. showed that vertigo severity was correlated with DHI score in patients with moderate vertigo (32). Another study showing similar results to ours reporting that vertigo was repeated in 88% of patients with vestibular vertigo, and they lived an unhealthy life and often had to go to the hospital (30).

When we investigated the relationship between balance and quality of life in patients with PVH, we found that only M-CTSIB Condition-4 and the ABC Scale were related to quality of life. These results showed that a decrease in visual and somatosensory sensations causes functional and physical limitations and emotional distress in patients with PVH. Finally, quality of life is affected. Gill-Body et al. investigated the effects of balance on functional performance and disability levels in patients with PVH (13). They found a relationship between the Sensory Organization Test with modified timed up and go test and DHI (13). Additionally, they suggested that the Sensory

Organization Test Condition-5 test was predictive for the disability level in patients who had bilateral PVH (13).

In addition to using a relatively subjective measure of physical activity level, we included both bilateral and unilateral PVH patients. Performing the study only with unilateral or only bilateral PVH patients might give different results. The other limitation of this study may be wide age range (21 to 65 years old). Although our study group is considered "young," according to the World Health Organization, it should be kept in mind that the imbalance that occurs as aging could affect all activities.

This study completed with 90% power. It is an important aspect that strengthens our study.

In conclusion, vertigo, dizziness, and balance disorders decreased physical activity levels, functional exercise capacity, independence of daily living activities, and quality of life in patients with PVH. Based on these findings, we thought that patients with PVH should get a vestibular rehabilitation. Vestibular rehabilitation should not only aim to reduce vertigo/dizziness or balance disorders, but it must also be given as training to increase the physical activity levels and functional exercise capacity. In this manner, it could prevent secondary complications of inactivity, reduce disability, and improve quality of life.

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