



Original Article

Prevalence and Associated Risk Factors of Vestibular Dysfunction in Females with Menopause

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Abstract

Background: Hormonal changes during menopause affect the vestibular system by interfering with homeostasis and by disrupting the enzyme cycles and neurotransmitter function. It has been observed that females have a higher risk of falling and this may increase after menopause. Balance in women is significantly affected by menopause. **Objective:** To find the prevalence of vestibular dysfunction in menopausal females and to find the risk factors associated with vestibular dysfunction. **Methods:** The analytical cross-sectional study was conducted from May to October 2021, the data was collected from 385 women in district Jhelum who had menopause after the age of 45 years. Non-probability convenient sampling was used to collect data. The Berg balance scale, activity-specific balance confidence scale, and a self-made questionnaire for risk factors were used in the study. **Results:** According to the activity-specific balance confidence scale, 24.4% of the population had high, 60.5% moderate, and 15.1% low physical functioning. A score of less than 67% indicated that 48.1% of patients had a risk for falls in the future. Berg balance scale showed that 6.8% of patients had a high, 22.9% medium, and 60.4% low risk of falling, a score less than 45 demonstrated that 55.8% had a higher fall risk. Diabetes, hypertension, heart disease, and smoking were all statistically significant risk factors for falls ($p \leq 0.001$). **Conclusion:** The current study concludes that there is a significant risk of developing vestibular dysfunction, with an increased risk of falls after menopause in females. Hearing loss is the most common risk factor while obesity also has a great impact on the vestibular system. But there is an increased chance of falls in participants with stroke and hypertension.

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Introduction

The vestibular system generates reflexes such as maintaining the visual axis and keeping the head and body aligned. It provides us with a sense of motion and direction in space. The vestibular sensory organs are located in the petrous part of the temporal bone, close to the cochlea. The vestibular system contains two types of sensors: the two otolith organs (the saccule and utricle), which detect linear acceleration, and the three semi-circular canals which detect angular acceleration in three planes. They send messages to the neural structures that control eye movement, posture, and equilibrium via the vestibular nerve fibers.¹

It has been observed that females have a higher risk of falling and this may increase after menopause. Balance in women is significantly affected by menopause.² The vestibular system may be influenced by hormonal changes that occur during menopause because they directly affect the enzyme cycles and neurotransmitter function, causing interference in the vestibular system's homeostasis of labyrinthine fluids.³ The Berg balance scale (BBS) was initially developed for the evaluation of equilibrium for adults with vestibular disorders.⁴ Fall is another leading cause of death in people over the age of 65 years.⁵ With ongoing vestibular dysfunctions, mental impairment is very common because of their relationship with each other.⁶

The distal part of the vestibular system is frequently affected by injury, illness, or ototoxic medications. Primary changes in the vestibular system have been observed as people get older.⁷ Mostly 80% of patients with vestibular vertigo have affected their daily life activities.⁸ Vertigo and dizziness are symptoms of vestibular dysfunction that are unexplained in 40-80% of people. Stroke,

hypertension, hearing issues, diabetes, heart problems, and smoking are all risk factors for vestibular dysfunction.⁹ Higher scores correspond to higher equilibrium certainty in the activity-specific balance confidence scale (ABC) which was originally developed for use in older people to evaluate balance.¹⁰ For each type of vestibular dysfunction, prevalence rates consistently increased with age and were higher in women than in men.¹¹ A varieties of symptoms affect women in the menopausal transition and postmenopausal periods. According to a study, 25.1% of Australian middle-aged women aged between 45 to 60 years reported "feeling dizzy or faint."¹² Vestibular dysfunction is hardly addressed in the literature.

The majority of studies are conducted on older adults including both genders. Because women experience balance problems after menopause, the current study only includes females with menopause. If women are informed, then actions can be taken to enhance their health and quality of life. Therefore, the purpose of this study was to determine the prevalence of vestibular dysfunction in menopausal females and the risk factors associated with vestibular dysfunction in females with menopause.

Methods

This was an analytical cross-sectional study conducted from May to October 2021 approval was taken from the ethical review board committee of the University of Lahore, Gujrat, Pakistan. The 385 menopausal women from District Jhelum who took part in the study gave their consent. The sample size was calculated through a formula $n = \frac{Z^2 P(1-P)}{d^2}$ where n is the sample size, Z is the statistic corresponding to the level of confidence, P means expected prevalence and had a value of 0.50,⁹ while d stands for precision (corresponding to effect size) and had a value

of 0.05, respectively. Individuals were interviewed and their demographics were collected like name, age, height and weight then body mass index (BMI) was calculated by the formula (weight in kg/height in m²). The BBS which consists of 14 questions, was then used to evaluate vestibular dysfunction. Each question's score ranges from 0-4, with 0 denoting the lowest level of function, 4 denoting the highest level of function and the maximum score was 56. All the scores were added to get a value of BBS then a score ranging from 0 to 20 means high fall risk, 21 to 40 shows medium risk, and 41 to 56 for low risk.

A score less than 45 denoted a higher risk of falls. The BBS was initially created to evaluate balance dysfunctions in daily life in older adults. The BBS presents excellent values for test-retest (ICC=0.91) and intra-evaluator reliability (ICC=0.97).¹³ To evaluate functional status in women going through menopause, a sixteen-question Activity-specific balance confidence scale was used. Each question had a percentage ranging from 0-100, with 0% denoting no confidence and 100% denoting completely confident. The total percentage of the ABC-Scale was calculated by adding all the percentages and dividing the result by the total number (16).

Physical functioning was indicated as having a high level by a score of 80%, a moderate level by a score of 50-79%, and a low level by a score of 50%. Individuals with scores less than 67% also showed a risk of falling in the future. This scale had excellent test-retest reliability (ICC=0.98, confidence interval =0.083.05), high internal consistency (Cronbach's =0.97), and good to excellent structural coherence (corrected item-total correlation: 0.77–0.92).¹⁴ The risk factors for vestibular dysfunction were evaluated using a self-made questionnaire consisting of six questions. It was found that the self-made questionnaire

had a Cronbach's Alpha value of 0.703. The menopausal women with age more than 45 years, obeying verbal commands and being able to walk were included in the study. The patients suffering from a spinal injury, or lower limb fracture in less than one year or who had poor communication were excluded from the study. A statistical package for social sciences (SPSS) version 24 was used to enter and analyze the data. For descriptive analysis, means and standard deviations were calculated for quantitative variables whereas frequency and percentages were used for qualitative variables. For inferential statistics to find significance chi-square was applied.

Results

The mean and standard deviation of different variables were given in Table I. The majority of the 385 females were obese. Among those surveyed, 42.9% had experienced a stroke, 56.5% with heart problems, 58.1% were smokers, 214.6% had hearing loss, 170.2% had high blood pressure and 80.8% had diabetes. According to ABC findings, more women had average physical functioning and less than 50% of women had a high risk for falls. However, according to BBS, more than 50% of females had a higher risk of falls (Table II).

Table I: Mean ± SD of variables (n=385)

Variables	Mean ± Std. Deviation
Age	62.62 ± 13.19
Body mass index	30.28 ± 7.08
Activity-specific confidence scale	67.72 ± 15.25
Berg balance scale	40.82 ± 10.09

Table II: Frequency and percentages of different variables (n=385)

Variables	Categories	Frequency (%)
BMI	<18.50 (Underweight)	18(4.7)
	18.50-24.99(Normal)	69(17.9)
	25.00-29.99(Overweight)	100(26.0)
	30->30(Obesity)	198(51.4)
Do you experience a stroke?	No	343(89.1)
	Yes	42(10.9)
Do you have any heart problems?	No	279(72.5)
	Yes	56(14.5)
	Unknown	50(13.0)
Do you use tobacco in any form?	No	327(84.9)
	Yes	58(15.1)
Do you experience hearing loss?	No	171(44.4)
	Yes	214(55.6)
Do you have hypertension?	No	211(54.8)
	Yes	170(44.2)
	Unknown	4(1.0)
Do you have diabetes?	No	199(51.7)
	Yes	80(20.8)
	Unknown	106(27.5)
Activity-Specific Balance Confidence Scale	80% (High physical functioning)	94(24.4)
	50-80% (Moderate physical functioning)	233(60.5)
	<50% (Low physical functioning)	58(15.1)
Risk for Fall	No Risk	200(51.9)
	<67%	185(48.1)
Berg Balance Scale	0-20	26(6.8)
	21-40	88(22.9)
	41-56	271(70.4)
Greater Risk of Fall	No Risk	170(44.2)
	<45	215(55.8)
Total		385(100.0)

Table III: Association of ABC and BBS with Risk Factors (n=385)

Association	Chi-square	p-value
BMI with ABC	14.493	0.025*
BMI with risk for falls in future	9.805	0.020*
BMI with BBS	7.650	0.265
BMI with a high risk for falls	4.683	0.197
Stroke with ABC	10.390	0.006*
Stroke with risk for falls in future	0.354	0.552
Stroke with BBS	27.649	<0.001*
Stroke with a high risk for falls	7.914	0.005*
Heart problem with ABC	5.675	0.225
Heart problem with the risk of falls in future	1.316	0.518
Heart problem with BBS	7.433	0.115
Heart problem with greater risk for falls	6.164	0.046*
Tobacco with ABC	11.002	0.004*
Tobacco with risk for falls in future	8.345	0.004*
Tobacco with BBS	46.569	11.002
Tobacco with a greater risk for falls	20.061	<0.001*
Hearing loss with ABC	15.273	<0.001*
Hearing loss with risk for falls in future	24.620	<0.001*
Hearing loss with BBS	15.355	<0.001*
Hearing loss with greater risk for falls	3.078	0.079
Hypertension with ABC	6.365	0.173
Hypertension with risk for falls in future	8.764	0.012*
Hypertension with BBS	7.847	0.097
Hypertension with greater risk for falls	12.699	0.002*
Diabetes with ABC	7.676	0.104
Diabetes with risk for falls in future	1.319	0.517
Diabetes with BBS	7.931	0.094
Diabetes with a greater risk for falls	6.705	0.035*

Tobacco use, hearing loss, BMI, and stroke all had a significant correlation with the ABC scale. Future fall risk is significantly correlated with BMI and hypertension. Women who smoked had hearing loss, cardiac disease, or previously had a stroke were more likely to fall. According to the results, hearing loss harms women's balance and is strongly correlated with BBS. All of them had statistical significance ($p \leq 0.001$) shown in Table III.

Discussion

The current study was conducted to determine the association between menopause and vestibular dysfunction and to identify different risk factors. A study conducted by Jeng YJ in 2020 showed that 21% of elderly people had diabetes mellitus.¹⁵ The most recent study showed that 20.8% of people had diabetes. According to another study finding association between smoking and peripheral vestibular disorder, there were 19 (7.3%) smokers and 241 (92.7%) non-smokers among 260 female participants.¹⁶ According to the findings of the current study, 15.1% of participants smoked and 84.9% did not and the females who smoked had a higher risk of falling ($p < 0.001$).

A study conducted by Abbas S in 2021 that determine the prevalence of balance impairments in individuals with Parkinson's disease showed only 2 (8.5%) patients complained of severe balance impairments on the BBS, while 15 (65.2%) patients had minimal to moderate balance impairments.¹⁷ According to the most recent study, 26 (6.8%) of females had severe balance problems, 88 (22.9%) of females with moderate impairments, and 271 (70.4%) of them with minimal balance impairments. The current study only involved females after menopause and used a larger sample size than those included in the prior study. According to the

findings of a cross-sectional study by Oron Y, that determine the cardiovascular risk factors among patients with vestibular neuritis, 42.2% of the population with this disease had hypertension.¹⁸ Because this included older study participants, who were more likely to develop hypertension than younger ones, the prevalence of hypertension was shown to be 44.2%. The evidence says the prevalence of hypertension increases from 12.1 to 20.1% in people over the age of 60 years.¹⁹

Khan F in 2021 showed that the prevalence of balance impairments and factors associated with it was 48.1% out of 81 stroke patients having balance disorder.²⁰ The current study showed that 10.9% of the population had a stroke and were found to be more likely to fall ($p = 0.005$). This study calculated prevalence only in females having a history of stroke. A systematic review and meta-analysis conducted by Jiam NTL in 2016 revealed that hearing loss is linked to a 69% higher risk of falls.²¹ A recent study demonstrates that 55.6% of women have hearing problems that demonstrate a correlation for the risk of a fall and was statistically significant ($p < 0.001$). A study finding association of mid-life changes in body size, body composition and obesity status with the menopausal transition revealed that 1,174 people were found to be obese, with a prevalence of 18.75%. It appears that obesity and impaired vestibular function are related to each other.²² The present study found that after menopause, 51.4% of females were obese. The evidence says that the menopause transition is linked to weight gain.

The majority of evidence points to ovarian aging as the primary cause of changes in body composition and fat distribution while chronological aging is primarily responsible for weight changes.²³ A cross-sectional study estimated musculoskeletal pain characteristics associated with lower balance confidence in

community-dwelling older adults and concluded that the 16-item ABC scale accurately measures balance confidence. Participants with low balance confidence scored 78%, 52% with moderate scores and 26% with higher scores.²⁴ The current study also uses the ABC Scale to assess the balance confidence in menopausal women.

Low balance confidence was 15.1%, moderate was 60.5%, and higher was 24.4%. However, the current study dealt with the general population, whereas the previous study included symptomatic individuals. The limitation of the study was that it was a single setting-based study so the results cannot be generalized to the whole population. The lack of specific diagnostic tests for vestibular dysfunction was the weakness of the study. It is recommended that future studies should include participant clinical history as well as specific vestibular system diagnostic tests to confirm the findings. It is necessary to investigate the underlying causes of vestibular dysfunction in menopausal females.

Conclusion

The study concludes that there is a significant risk of developing vestibular dysfunction, which increases the risk of falling after menopause. Hearing loss is the most common risk factor for vestibular dysfunction. Females with obesity, stroke, hypertension, or tobacco use are at high risk of developing a fall risk.

Declarations

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

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