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Seasonal incidence of benign paroxysmal positional vertigo

Abstract

Background: Benign paroxysmal positional vertigo (BPPV) is the most frequent type of peripheral vestibular vertigo. The risk of BPPV is increased with aging, osteoperosis and low vitamin D. The level of vitamin D in serum differs with seasons due to exposure of skin to the sunlight. Deficiency of vitamin D is frequent in winter months. Hence there may be a correlation between seasons and BPPV incidence.

Aim & objectives: To assess the seasonal influence on the incidence of BPPV in Tampa Bay region of, Florida, a local that enjoys high levels of sunlight through the year and the incidence of ear involvement during the different year.

Methods: This was a retrospective review that extracted the data from the BPPV patients'records. The source of the collected data was the American Institute of Balance (AIB) clinics in Tampa, Florida. Between 1/1/2022- 12/31/2023.

Results: A total of 1491 cases were enrolled; 28.5% were in winter, 25.3%, 23.3%, and 22.9% in spring, summer, and autumn, respectively. 49% had right-side BPPV, 37%, and 14% had left and bilateral BPPV respectively.

Conclusion: January showed a significantly higher incidence of BPPV when compared to other months. Winter showed higher incidence of BPPV when compared to other seasons with no statistical significance. This suggests that other factors in addition to vitamin D deficiency may affect the incidence of BPPV.

Keywords: impact, influence, season, BPPV, vertigo

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Introduction

Benign paroxysmal positional vertigo (BPPV) is the most frequent type of peripheral vestibular vertigo.[1] BPPV is the main reason for vertigo cases presenting to balance clinics, with a prevalence of 2.4%[2] and an incidence of 0.6% per year.[3] BPPV is defined by periods of highly debilitating vertigo spells with nausea and nystagmus stimulated by changes in head positions[4, 5]. Females are more affected compared to males with a male-to-female ratio of 1:1.5-2. The peak age of BPPV occurrence is 60-70 years despite the probability of occurrence at any age.[4] Such high incidence among the elderly is related to the macula degeneration with the increased age.[6] Additionally, individuals affected with BPPV are more predisposed to future dementia, strokes, fractures, and reduced quality of life, especially among elderly individuals.[7,8] The majority of BPPV cases are idiopathic and only 5% experience manifestations with head trauma as the major cause.[9] Despite the pathophysiology being poorly understood, the commonly acknowledged cause of BPPV is displaced otoconia that falls from the utricular macula into a semicircular canal. Head movements cause adherent deposits on the cupula (cupulolithiasis) or freely floating otoconia, which then react to head rotation or gravity to cause shearing forces on the cupula.[10] BPPV risk is increased with aging, osteoporosis and osteopenia, low vitamin D, dehydration, and fluctuations in blood pressure and blood glucose.[11,12] There is a possible association between vitamin D deficiency and BPPV; as vitamin D has a significant role in otoconial structure.[13] It regulates the metabolism of calcium in the otoconia of the inner ear.[14–17] The level of vitamin D in serum has been found to differ between seasons of the year due to the variation in seasonal insolation and exposure of skin to sunlight.[18,19] Vitamin D deficiency is very common in the winter season and as a result, a relationship between seasons and BPPV incidence has been suggested.[13] Therefore, it is necessary to determine BPPV based on seasonal variations as BPPV is affected by vitamin D levels, which in turn is influenced by seasons[3]. Hence, this research was conducted to investigate the seasonal influence on the incidence of BPPV in Tampa, Florida, and the incidence of different types of BPPV during different seasons.

Subjects and methods

Retrospective reviewed records of BPPV patients. All patients presenting as first visit to the American Institute of Balance (AIB) clinics in Tampa, Florida, in a period of 2 consecutive years, between 1/1/2022- 12/31/2023. Excluded criteria included patients presenting with follow-up visits and patients diagnosed with non-BPPV disorders. Information was collected from the AIB database system. We decided to analyze the data based on months and seasons. Seasons were classified according to the National Weather Service,[20] which defines the seasons in Tampa, Florida as follow:

I. Winter: December, January, February.

II. Spring: March, April, May.

III. Summer: June, July, August.

IV. Autumn: September, October, November.

Results

A total of 1491 patients were included in the study. Their ages ranged from 8 – 108 years old. With mean and standard deviation 70 ± 13, the distribution of age is illustrated in Figure 1.

The largest frequency of the patients had right BPPV 733(49%), followed by those who had left BPPV 552(37%). The remaining 206(14%) had bilateral BPPV Figure 2.

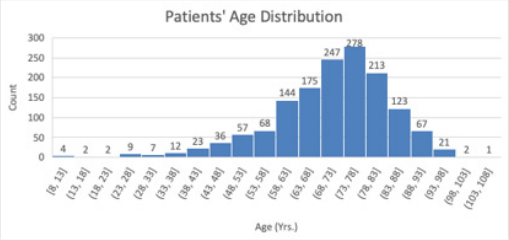

Figure 1 Age distribution for BPPV Patients from 2022 – 2023.

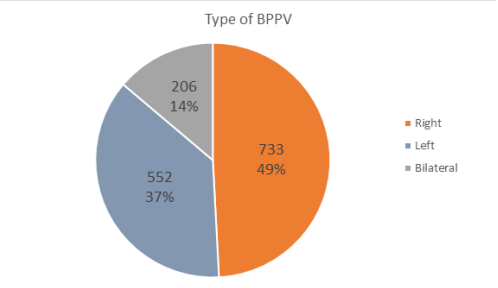

Figure 2 BPPV Type.

Number of BPPV Patients was significantly higher in January as shown in Figure 3 and Table 1.

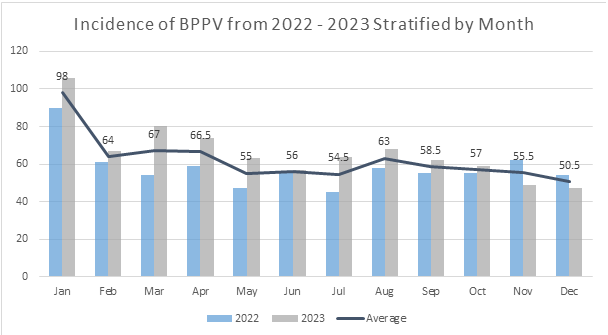

Figure 3 BPPV Incidence by Month.

Table 1 Comparison of monthly mean BPPV incidence

Month	Mean	Standard Deviation	95% CI for the mean	P-value†	Post Hoc Test‡
Jan	98	11.31	(83.26, 112.74)	0.024*	A
Feb	64	4.24	(49.26, 78.74)		B
Mar	67	18.4	(52.3, 81.7)		B
Apr	66.5	10.61	(51.76, 81.24)		B
May	55	11.31	(40.26, 69.74)		B
Jun	56	1.41	(41.26, 70.74)		B
Jul	54.5	13.44	(39.76, 69.24)		B
Aug	63	7.07	(48.26, 77.74)		B
Sep	58.5	4.95	(43.76, 73.24)		B
Oct	57	2.83	(42.26, 71.74)		B
Nov	56	9.19	(40.76, 70.24)		B
Dec	50.5	4.95	(35.76, 65.24)		B

* Significant at the 0.05 level.

† Using ANOVA [F (11, 12) = 3.37. P=0.024].

‡ Fisher's LSD Method. Means that do not share a letter are significantly different.

In winter, the frequency of the patients was 425(28.5%), whereas, in spring, summer, and autumn, the proportions were 377(25.3%), 347(23.3%), and 342(22.9%), respectively. Winter showed slightly higher rate of BPPV patients, with no statistical significance Table 2.

Table 2 Association between Season and number of BPPV Patients

Season	Total BPPV Patients	Year		P-value†
		2022	2023	
Classification from the National Weather Service				
Winter (Dec, Jan, Feb)	425 (28.5%)	205	220	0.367
Spring (Mar, Apr, May)	377 (25.3%)	160	217	
Summer (Jun, Jul, Aug)	347 (23.3%)	158	189	
Autumn (Sep, Oct, Nov)	342 (22.9%)	172	170	

†Using Kruskal Wallis to compare between seasons, H(3) = 3.17, P = 0.367. (adjusted for ties)

Throughout the two years, the distribution of BPPV types showed similar patterns for each month of around 45 – 55% Right, 30 – 40% Left, and 10 – 20% Bilateral BPPV, (X2 = 30.97; df = 22; P = 0.097) Table 3, Figure 4.

Table 3 Type of BPPV by Month (using total of 2022 and 2023)

	Right	Left	Bilateral	P-value
Jan	106 (54.1%)	68 (34.7%)	22 (11.2%)	0.097
Feb	59 (46.1%)	53 (41.4%)	16 (12.5%)	
Mar	58 (43.3%)	54 (40.3%)	22 (16.4%)	
Apr	60 (45.1%)	55 (41.4%)	18 (13.5%)	
May	63 (57.3%)	40 (36.4%)	7 (6.4%)	
Jun	47 (42.0%)	48 (42.9%)	17 (15.2%)	
Jul	53 (48.6%)	41 (37.6%)	15 (13.8%)	
Aug	58 (46.0%)	51 (40.5%)	17 (13.5%)	
Sep	61 (52.1%)	39 (33.3%)	17 (14.5%)	
Oct	58 (50.9%)	40 (35.1%)	16 (14.0%)	
Nov	57 (51.4%)	40 (36.0%)	14 (12.6%)	
Dec	53 (52.5%)	23 (22.8%)	25 (24.8%)	

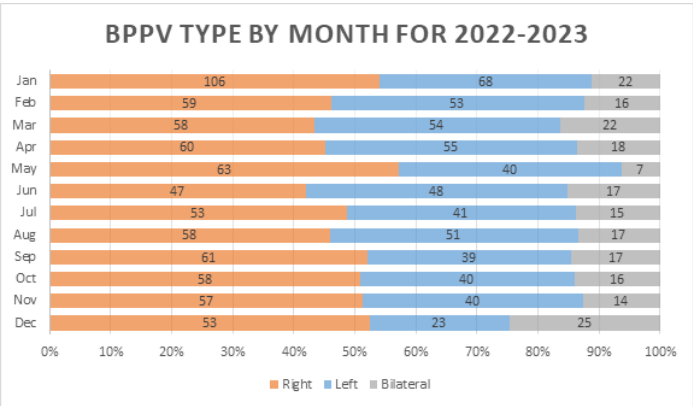

Figure 4 BPPV Type by Month for 2022-2023.

In winter, the proportion of patients who had right BPPV was the highest 218(51.3%), followed by those with left BPPV 144(33.9%), then bilateral BPPV 63(14.8%) Table 4 and Figure 5.

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Table 4 Type of BPPV by Season (using total of 2022 and 2023)

Season	Right	Left	Bilateral	P-value†
Classification from the National Weather Service				
Winter (Dec, Jan, Feb)	218 (51.3%)	144 (33.9%)	63 (14.8%)	0.436
Spring (Mar, Apr, May)	181 (48.0%)	149 (39.5%)	47 (12.5%)	
Summer (Jun, Jul, Aug)	158 (45.5%)	140 (40.3%)	49 (14.1%)	
Autumn (Sep, Oct, Nov)	176 (51.5%)	119 (34.8%)	47 (13.7%)	

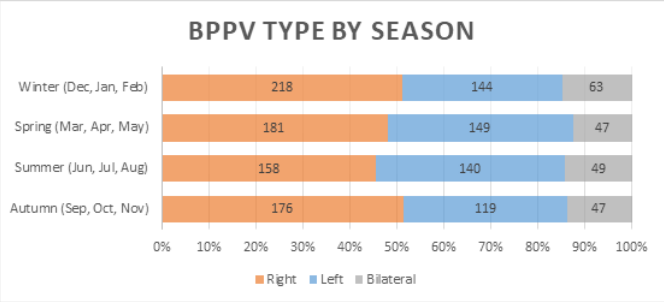

Figure 5 BPPV Type by Season for 2022-2023.

In spring, those with right BPPV represented 181(48%), whereas those with left and bilateral BPPV represented 149(39.5%) and 47(12.5%), respectively Table 4 and Figure 5.

In summer, the proportions of those with right, left, and bilateral BPPV were 158(45.5%), 140(40.3%), and 49(14.1%), respectively Table 4 and Figure 5.

In autumn, 176(51.5%) of the patients had right BPPV, whereas 119(34.8%) and 47(13.7%) of patients had left and bilateral BPPV, respectively Table 4 and Figure 5.

The comparison between the types of BPPV regarding the four seasons revealed that right BPPV was the highest in autumn 176(51.5%), whereas left type was the highest in summer 140(40.3%), and bilateral type was the highest in winter 63(14.8%) Table 4 and Figure 5.

Discussion

BPPV carries a high burden on the healthcare system, especially with the elders.[21] It is not uncommon that BPPV patients undergo multiple tests, investigations, and imaging to exclude other medical conditions presenting with the same complaints, especially at initial presentations. Significant economic costs are also associated with interruption to daily living activities including work. 60% of patients with BPPV require sick leaves and up to 38% experience falls as a direct consequence of BPPV.[22] BPPV carries a 27% recurrence rate, a third of half of cases have showed recurrence at 3 years.[1,23] BPPV has also been proven to influence negatively both the Health-Related Quality of Life (HRQol) and the Utility Measures for Audiology Application (UMAA). After recovery of BPPV symptoms, both measures showed improvements.[24]

Zhu CT et al.[25] study revealed that BPPV patients with Meniere's disease, hypertension and migraine have higher risk of recurrence rate.[25]

Chua KWD et al.,[26] investigated coexisting diseases with BPPV patients. They demonstrated that it coexisted with migraine (28%), head injury (24%), diabetes (21%) and cardiovascular problems (19%). This may be explained to a vascular or microvascular compromise to the Anterior inferior cerebellar artery (AICA) which supplies the labyrinth.[26]

Ling X et al.,[27] found that the peak age of onset of BPPV was 59.6 +/- 14.9 years old, in our study the peak age of onset was 70 +/- 13 years.[27]

Otoconia is composed of CaCO3 and glycoproteins. A study of the otoconia in animals under electron microscopy, found that the demineralization of the otoconia surface weakness the fibrils interconnecting otoconia, leading to detached otoconia into the endolymphatic space. This process is affected by the concentration of calcium in the vestibule.[28]

The mineralization process of otoconia is affected by calcium metabolism, which is a multifactorial procedure. It is controlled by several factors such as age, thyroid, estrogen and growth hormones, vitamin D, and corticosteroids. These factors alter interaction of protein and calcium binding or availability.[29] Insufficient vitamin D may be due to multiple factors including inadequate sunlight exposure, vitamin D synthesis deficiency, dietary habits, malabsorption, genetic or endocrine disorders, and post menopause.[29] Vitamin D controls calcium metabolism in the otoconia,[14–17] and its levels in serum are affected by the year seasons;[18,19] therefore, it is important to identify the correlation between BPPV and season variation as season variations and this was the objective of this study.

In the current study, the highest Incidence of BPPV was found in winter with a rate of 28.5%, followed by spring 25.3%; however, this high rate wasn't significant. Similarly, a previous study reported no remarkable difference in the seasonal or monthly distribution of cases with BPPV.[3] However, when analyzing our data based on months the incidence of BPPV patients was significantly higher in January with SD:11.31. In contrast to our findings; Cao et al.,[1] concluded that BPPV incidence increases in low temperature, low rainfall months, and high atmospheric pressure. In addition to that, the analysis showed that BPPV during cold seasons was associated with more risk factors for cardio-cerebrovascular disorders.[1] In a study done in Boston, Whitman et al. found that there is an increase in BPPV incidence in early spring months (March to May) when compared to other seasons.[30] This is in contrast to our findings, as the rate of BPPV cases in spring ranked second following winter. Such variations in BPPV regarding seasons may be mediated by vitamin D levels, where the cases in some studies may suffer from vitamin D deficiency, others may be adequately exposed to sunlight even in winter which leads to adequate levels of vitamin D which affects the incidence of BPPV.

Zuma et al.,[17] reported a considerable variation between BPPV incidence and sun radiation amount during the month of the diagnosis as well as with climate variation.[17]

In Korea, a study revealed that greater seasonal variations were seen in females with BPPV. This may be attributed to the impact of low vitamin D, similar to its effect on other diseases such as osteopenia and osteoporosis.[32] However, in the current study, we didn't assess the distribution of BPPV cases regarding gender.

Previous research revealed that there may be other causes explaining higher BPPV rates in winter and spring; it was argued that the peak of viral infections increases in winter and spring seasons, in addition to the barometric pressure, low physical activity and migraine.[31] Hence, a relationship between cold seasons and increased BPPV incidence could be attributed to other factors than low vitamin D levels.[13] Cohen et al.[33] reported an association between URTI and

BPPV, this may explain the increased frequency in winter too and may be another reason to explain our findings.[33]

Limitations

In our study, serum vitamin D level was not measured, hence, we cannot confirm that higher BPPV incidence was associated with lower serum vitamin D levels in our patients. In addition to that, it is important to pay attention to climatic variation and sunlight exposure between different regions. The annual average of possible sunshine in Tampa, Florida is about 66%.[34] This could be a limitation as exposure of sunlight is relatively higher compared to other regions and may be affecting our results in relation to seasonality. Also, other possible causes of BPPV such as migraine, low physical activity and barometric pressure were not analyzed in our study. Future studies may evaluate serum vitamin D level and evaluate other possible causes or co morbidities.

Conclusion

There was no statistically significant difference in the incidence of BPPV cases among different seasons. January had a significantly higher incidence of BPPV when compared to other months. The most affected side was the right side, followed by the left and then bilateral sides. Such findings suggest the incorporation of other factors that may affect the incidence of BPPV.

Ethical statements

Informed consent was obtained from all patients regarding the potential use of their data for research.

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Conflicts of interest

The authors confirm conducting this research in the absence of any financial or commercial relationships that could be construed as a considerable conflict of interest.

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