The relationship between Benign Paroxysmal Positional Vertigo and vitamin D deficiency

Sawsan Abuzaid MD, Wardeh alhusban MD, Wejdan elshqeirat MD, Walaa Alaqrabawi MD, Hussien Alqassem PhD.

ABSTRACT

Introduction: Benign Paroxysmal Positional Vertigo (BPPV) is considered the most common cause of Chronic vertigo (1), BPPV is most commonly primary with no secondary causes like head trauma (4), BPPV is caused by otoconia that moves freely in the semicircular canals(5), Calcium has an important role in the metabolism of these otoconia (6).

Objective: We performed our Research to study the relationship between serum Vitamin D levels and the occurrence of BPPV, it's relationship with bilateral BPPV involvement, and it's relationship with the number of repositioning maneuvers required to cure the patient with BPPV.

Methods: A case control retrospective study was done on 106 patients in the Royal Medical Services , Who were divided into two groups ; the first one was 53 patients diagnosed to have BPPV ,aged (31-81) years, the second was the control group with 53 patients with no BPPV, aged (30-82) years, BPPV was diagnosed by the presence of nystagmus with special characteristics in the positioning tests.

Results: Patients with BPPV had statistically lower serum vitamin D levels compared to the control group, patients with bilateral BPPV involvement had lower serum vitamin D levels compared to patients with unilateral BPPV that were statistically insignificant, finally patients with BPPV who needed more than one repositioning maneuver to cure had statically lower serum vitamin D levels than the patients with BPPV who needed only one repositioning maneuver to cure.

Conclusion: BPPV is associated with low serum vitamin D levels, in addition, patients with BPPV who require more than one repositioning maneuver to cure have lower serum vitamin D levels.

Keywords: Benign Paroxysmal Positional Vertigo (BPPV), otoconia, repositioning maneuvers, Nystagmus.

JRMS December 2020; 27(3): 10.12816/0057187

Introduction

Benign paroxysmal positional vertigo is considered the most common cause of chronic vertigo, in which the patient presents with recurrent attacks of vertigo that is induced by changes in position , with nausea and vomiting, it is diagnosed by dix- hall pike maneuver in which there is a nystagmus with specific characteristics (1), BPPV affects about 3.4% of the people aged above 60 years, females have double the incidence of males, with postmenopausal females being affected more than premenopausal females(2). The risk of BPPV increases with age (3).

BPPV can be idiopathic or primary in 50-70% of the cases, where there is no known etiology, or secondary, in which head trauma or vestibular neuritis are the commonest known causes(4).

*From the Department of
Correspondence should be addressed to Dr. Sawsan Abuzaid
Manuscript received . Accepted

BPPV is caused by otoconia moving freely in the semicircular canal (canalithiasis), or adherent to the cupula (cuplulothiasis) in any semicircular canal (5). Otoconia are made of Calcium Carbonate , Calcium metabolism is important for the synthesis and absorption of otoconia, Research was done to correlate between BPPV and vitamin D deficiency , and resulted in that abnormal calcium metabolism may cause BPPV(6).

Many studies were done that showed a correlation between low serum 25 hydroxy vitamin D levels and the occurrence and recurrence of BPPV(6,7, 8, 9), There are other studies that showed that low vitamin D serum levels doesn't correlate with the occurrence or recurrence of BPPV(10, 11 ,12). So there is debate about the relationship between BPPV and vitamin D deficiency.

The aim of the present study is to study serum 25 (OH) vitamin D levels in Jordanian patients with idiopathic BPPV and to investigate the possible relationship between the occurrence and recurrence of BPPV and low 25(OH) D levels , we also studied the relationship between serum vitamin D levels and the risk of bilateral BPPV involvement, in addition to that we tried to correlate a relationship between low vitamin D serum levels and the increase in the number of repositioning maneuvers required for patients' cure .

Methods

Between February 2019, and October 2019, 53 patients with 38 female patients, and 15 male patients, (31-81 years) seen with BPPV at the Department of Otolaryngology in the Royal Medical Services in Jordan, we performed the present study. All patients who visited our dizziness clinic in our department and were diagnosed to have BPPV were included in our study, so there were no favorable criteria used for including patients in this research, The BPPV diagnosis was based on a characteristic history and observation of typical nystagmus during the Dix-Hallpike maneuver and Supine Roll tests. The patients gave a history of recurrent attacks of positional vertigo and the exact etiology was unknown. All patients with secondary causes of BPPV like head trauma or vestibular neuritis were excluded from the study by history.

A control group of 53 patients with no BPPV symptoms, with 40 females and 13 males (30 - 82 years), that match the age and sex of the study group was used in this research, this study was performed in the Royal Medical Services in Jordan after being approved from the Medical Committee in the Royal Medical Services.

For each patient the age, sex, type of BPPV, (posterior, horizontal {canalithiasis, cupulothiasis}), site, and type and number of repositioning maneuvers performed for each patient were included.

The serum samples were retrospectively drawn from the antecubital vein. After centrifugation, the samples were immediately stored and Serum level of 25(OH) D was measured.

The 25(OH) D levels are therefore used to classify the vitamin D status into vitamin D deficiency (<20 ng/ml), vitamin D insufficiency (20–29 ng/ml) and vitamin D sufficiency (≥30 ng/ml) [17].

Statistics

Results were expressed as percentages for categorical variables and as medians. Univariate data on demographic and clinical features were compared by *t*-test as appropriate. Correlations among continuous variables were assessed by the Spearman rank-correlation coefficient. (Were positive)

All statistical analysis was performed with STATA for Windows, version 13.0 (STATACorp). Statistical significance was defined as $P<0.05$.

Result

In our study, 53 patients with BPPV and the same number (53) controls were included, we noticed that the average serum levels of vitamin D in our study group were lower than those controls (15.12ng/ml) vs (30.9ng/ml) the p value was (p= 0.000), which is less than (0.05) which is considered statistically significant [table I], In the study group 40 patients were diagnosed to have vitamin D deficiency , with a prevalence of 75%, on the other hand 8 patients of the control group had vitamin D deficiency, with a prevalence of 15%, which is significantly higher (figure 1).

```
. ttest VitD, by ( ControlBPPV)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	53	15.07415	1.005622	7.321036	13.05622	17.09208
2	53	30.89868	1.93586	14.09327	27.01409	34.78327
combined	106	22.98642	1.332143	13.71525	20.34502	25.62781
diff		-15.82453	2.181474		-20.15047	-11.49858

```
    diff = mean(1) - mean(2)                                      t =  -7.2541
Ho: diff = 0                                     degrees of freedom =      104

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Table I: this shows the mean and standard deviations for serum vitamin D levels in group (1) who are patient with BPPV, and group (2) which is the control group.

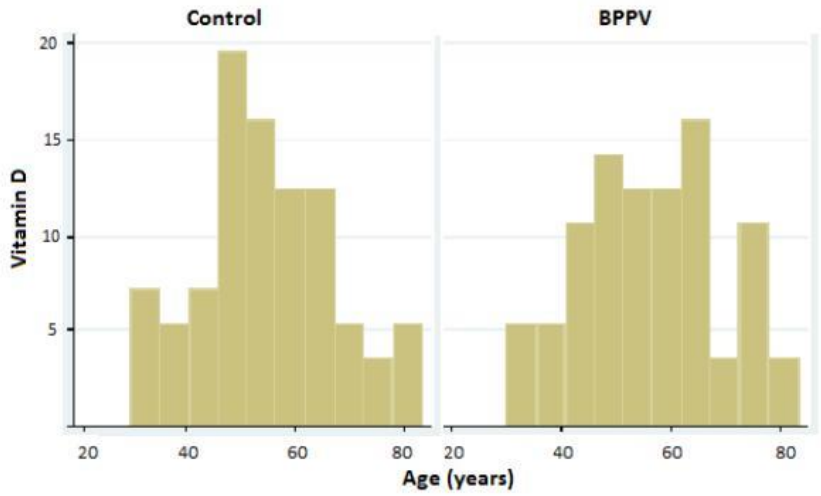

Figure 1: the chart on the left side shows the average serum vitamin D levels in different age groups in the control group, while the chart on the right side shows the average serum vitamin D levels in different age groups in patients with BPPV.

The posterior canal was the most frequently involved canal, 45 patients, with a prevalence of 84%, the horizontal canal was less frequently involved, 8 patients, with a prevalence of 15%, and there was no significant difference in serum vitamin D levels between patients with different canals.

The right side was more frequently involved than the left side, 32 versus 21 patients, there was also no significant difference in serum vitamin D levels between both sides,

We noticed that 7 patients had bilateral canal involvement with mean serum vitamin D levels of 13.69ng/ml, that was lower than the mean serum vitamin D levels in 46 patients with unilateral canal involvement which was 15.28ng/ml [table II], but the (p value) was (p=0.59), which is more than (0.05), and this was considered statistically not significant (figure 2).

```
. ttest VitD, by ( UniBilateral )

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	46	15.28174	1.083464	7.348412	13.09953	17.46395
2	7	13.69571	2.8502	7.540919	6.721527	20.6699
combined	53	15.07226	1.005507	7.320201	13.05457	17.08996
diff		1.586025	2.990579		-4.417814	7.589864

```
    diff = mean(1) - mean(2)                                      t =   0.5303
Ho: diff = 0                                     degrees of freedom =       51

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7009         Pr(|T| > |t|) = 0.5982          Pr(T > t) = 0.2991
```

Table II: this shows the mean and standard deviation for serum vitamin levels in group (1) with unilateral BPPV involvement and group (2) with bilateral BPPV involvement.

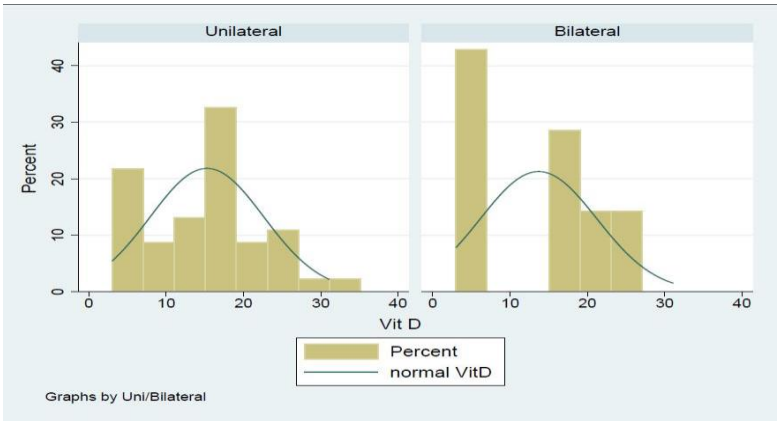

Figure 2: The chart on the left side shows the average serum vitamin D levels in different age groups in patients with unilateral BPPV, while the chart on the right side shows serum vitamin D levels in different age groups in patients with bilateral BPPV.

There were 20 patients who needed more than one repositioning maneuver ,and the mean serum vitamin D levels was 12.11ng/ml, on the other hand 33 patients required only one repositioning

maneuver ,and the mean serum vitamin D levels was higher , which was 16.7ng/ml [table III]. The p value was (p= 0.02) which is considered statistically significant (figure 3).

```
. ttest vitd , by ( A )

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	33	18.56242	2.058972	11.82789	14.36844	22.75641
2	20	11.8135	1.345628	6.017833	8.997068	14.62993
combined	53	16.01566	1.442165	10.49912	13.12174	18.90958
diff		6.748924	2.851736		1.023825	12.47402

```
    diff = mean(1) - mean(2)                                      t =   2.3666
Ho: diff = 0                                     degrees of freedom =       51

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9891         Pr(|T| > |t|) = 0.0218          Pr(T > t) = 0.0109
```

Table III: this table shows the mean and standard deviation for serum vitamin D levels in group (1) who are patients diagnosed to have BPPV and needed only one repositioning maneuver to recover, and group (2) who were diagnosed to have BPPV and needed more than one repositioning maneuver to recover.

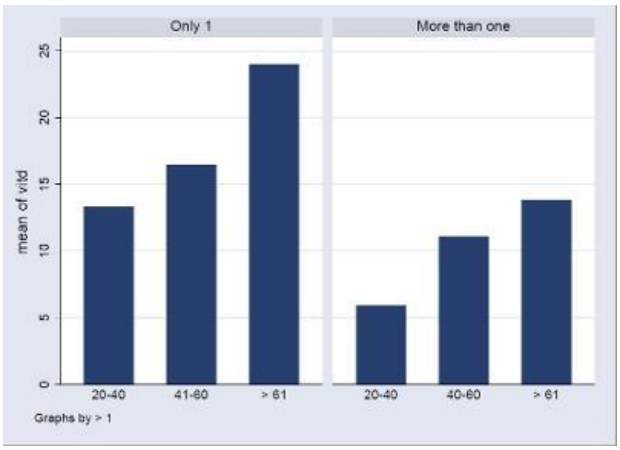

Figure 3: the chart on the left side shows the average serum vitamin D levels in different age groups in patients with BPPV who required only one repositioning maneuver to recover, while the chart on the right side shows the average vitamin D levels in different age groups with BPPV who required more than one repositioning maneuver to recover.

In our study there was no significant difference between serum vitamin D levels between the females and males in both control group and patients with BPPV, figure (4).

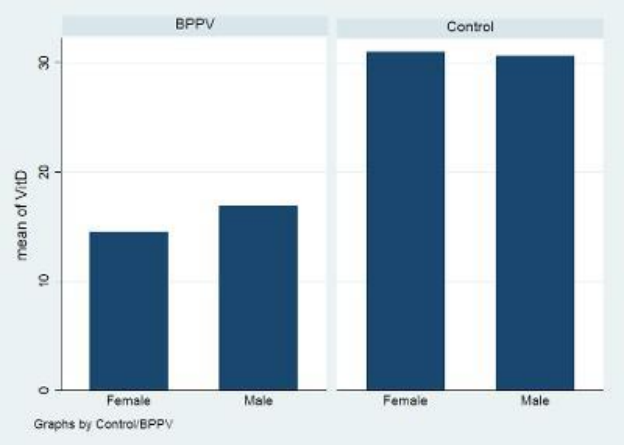

Figure 4: the graft on the left side shows the relation between serum vitamin D and the male and female groups in the patients with BPPV, on the right side shows the relation between serum vitamin D and the female and male group in the control group.

In our study only 2 patients who were diagnosed to have BPPV were diagnosed to have osteoporosis, both had low serum vitamin D levels, 3 patients were diagnosed by the neurologist to have migraine, they also had low serum vitamin D levels, one patient was diagnosed by the neurologist to have epilepsy and had low serum vitamin D levels, and two patients had otosclerosis with one with BPPV in the operated side, and both had low serum vitamin D levels.

Discussion

Many papers were done to study the relation between serum vitamin D levels and BPPV, some concluded that vitamin D deficiency is associated with BPPV and others showed no relation between both, in our study we concluded that 1) the occurrence of BPPV is associated with lower serum vitamin D levels, 2) the patients with BPPV who need more than one repositioning maneuver to recover have lower serum vitamin D levels than the patients with BPPV who recover from one repositioning maneuver, we tried to study the relationship between low serum vitamin D levels and bilateral involvement of BPPV but difference between serum vitamin D level in patients with unilateral and bilateral BPPV involvement was statistically not significant.

In our study there were no significant differences between serum levels of vitamin D in patients with posterior canal BPPV and horizontal canal BPPV, there was also no significant difference between serum vitamin D levels between males and females in both control groups and BPPV patients.

Many studies in the literature correlate with our study, some show a relationship between low serum vitamin D levels and the occurrence of BPPV, others show the relationship between vitamin D deficiency and recurrence of BPPV, others show the relation between vitamin D deficiency and BPPV in postmenopausal women (6, 7, 8), Zhang ZY and his colleagues considered vitamin D deficiency with high PTH and decreased bone mineral density risk factors for BPPV (16).

Rhim GI studied the long effect of serum vitamin D on BPPV and found that serum vitamin D levels significantly affected the recurrence of BPPV (17).

Wu Y and his colleagues tried to assess the bone metabolism in male patients with BPPV and found that decreased serum vitamin D levels is a risk factor for BPPV, in addition to that he found that the level of bone turnover among male patients with BPPV was lower than among healthy controls (18).

On the other hand other studies failed to confirm the relationship between vitamin D deficiency and the BPPV (13), , these differences may be due to differences in the clinical settings including the patients age, gender, geographic distribution, other associated medical illnesses.

In our study we added the relationship between lower serum vitamin D levels and bilateral BPPV involvement but it was statistically not significant, and the association between the numbers of repositioning maneuvers required for patients with BPPV to recover and low serum vitamin D levels.

The exact etiology of the relation between vitamin D deficiency and BPPV is not well known, but it could be contributed to the expression of some Ca2+ binding proteins regulated by vitamin D receptors in the epithelial cells of the inner ear (14), and this was also confirmed in another study that established the relationship between BPPV and abnormal calcium metabolism in the inner ear (15).

The limitation in our study include the small number of the study group (53 patients) which should be larger, the short period of follow up which was less than 1 year, and lack of studying the effect of normalization of vitamin D levels on BPPV recurrences.

The effect of vitamin D supplements on patients with BPPV was studied by Sheikhzadeh M and his colleagues who concluded in their study that normalization of serum vitamin D significantly reduces BPPV recurrences (19). Sheikhzadeh M with his colleagues performed another study that showed that correction of vitamin D deficiency in BPPV provides additional benefit to rehabilitation therapy (Epley maneuver) regarding duration of improvement. These findings suggest serum 25-OH D measurement in recurrent BPPV. (20).

So our study in correlation with other studies signifies the practical importance of measuring serum vitamin D levels in patients diagnosed to have BPPV, especially in patients with recurrence of symptoms, or in patients who need more than one repositioning maneuver to recover.

Conclusion

In our study we confirmed the relationship between low serum vitamin D levels and the presence of BPPV , and we found that patients with BPPV who need more than one repositioning maneuver to recover have lower serum vitamin D levels than the patients with BPPV who recover from the first repositioning maneuver, this signifies the importance of measuring serum vitamin D levels in patients with BPPV and treating them with vitamin D supplements, especially in patients who need more than one repositioning maneuver to recover.

References

1. **Ding J, Liu L, Kong WK, Chen XB, Liu X.Serum** levels of 25 hydroxy vitamin D correlate with idiopathic benign paroxysmal positional vertigo.Biosci Rep. 2019 Apr 30;39(4). pii: BSR20190142. doi: 10.1042/BSR20190142. Print 2019 Apr 30.
PMID: 30962270

2. **Karataş A, Acar Yüceant G, Yüce T, Hacı C, Cebi IT, Salviz M**.Association of Benign Paroxysmal Positional Vertigo with Osteoporosis and Vitamin D Deficiency: A Case Controlled Study.
J Int Adv Otol. 2017 Aug;13(2):259-265. doi: 10.5152/iao.2016.2640. Epub 2017 Mar 9.
PMID:28274898

3.**Oghalai, JS, Manolidis, S, Barth, JL, Stewart, MG, Jenkins, HA.** Unrecognized benign paroxysmal positional vertigo in elderly patients. Otolaryngol Head Neck Surg. 2000;122(5):630–634.

4.**Türk B, Akpinar M, Kaya KS, Korkut AY, Turgut S.**
Ear Nose Throat J. 2019 Oct 3:145561319871234. doi: 10.1177/0145561319871234. [Epub ahead of print]
PMID:31581827

5. **Yu S., Liu F., Cheng Z. et al.** (2014) Association between osteoporosis and benign paroxysmal positional vertigo: a systematic review. BMC Neurol. 14, 110 10.1186/1471-2377-14-110

6. **Talaat H.S., Abuhadied G., Talaat A.S. et al.** (2015) Low bone mineral density and vitamin D deficiency in patients with benign positional paroxysmal vertigo. Eur. Arch. Otorhinolaryngol. 272, 2249–2253 10.1007/s00405-014-3175-3
7. **Han W., Fan Z., Zhou M. et al.** (2018) Low 25-hydroxyvitamin D levels in postmenopausal female patients with benign paroxysmal positional vertigo. Acta Otolaryngol. 138, 443–446 10.1080/00016489.2017.1416168 [PubMed] [CrossRef] [Google Scholar]
8. **Jeong S.H., Kim J.S., Shin J.W. et al.** (2013) Decreased serum vitamin D in idiopathic benign paroxysmal positional vertigo. J. Neurol. 260, 832–838 10.1007/s00415-012-6712-2 [PubMed] [CrossRef] [Google Scholar]
9. **Talaat H.S., Kabel A.M.H., Khaliel L.H. et al.** (2016) Reduction of recurrence rate of benign paroxysmal positional vertigo by treatment of severe vitamin D deficiency. Auris Nasus Larynx 43, 237–241 10.1016/j.anl.2015.08.009 [PubMed] [CrossRef] [Google Scholar]
10. **Parham K., Leonard G., Feinn R.S. et al.** (2013) Prospective clinical investigation of the relationship between idiopathic benign paroxysmal positional vertigo and bone turnover: a pilot study. Laryngoscope 123, 2834–2839 11.**1002/lary.**24162 [PubMed] [CrossRef] [Google Scholar]
12. **Maslovara S., Butkovic Soldo S., Sestak A. et al.** (2018) 25 (OH) D3 levels, incidence and recurrence of different clinical forms of BPPV. Braz. J. Otorhinolaryngol. 84, 453–459 10.1016/j.bjorl.2017.05.007 [PubMed] [CrossRef] [Google Scholar]
13. **Karatas A., Yuceant G.A., Yuce T. et al.** (2017) Association of benign paroxysmal positional vertigo with osteoporosis and vitamin D deficiency: a case-controlled study. J. Int. Adv. Otol. 13, 259–266 10.5152/iao.2016.2640 [PubMed] [CrossRef]
14.**AlGarni M.A., Mirza A.A., Althobaiti A.A. et al.** (2018) Association of benign paroxysmal positional vertigo with vitamin D deficiency: a systematic review and meta-analysis. Eur. Arch. Otorhinolaryngol. 275, 2705–2711 10.1007/s00405-018-5146-6
15. **Yamauchi D., Raveendran N.N., Pondugula S.R. et al.** (2005) Vitamin D upregulates expression of ECaC1 mRNA in semicircular canal. Biochem. Biophys. Res. Commun. 331, 1353–1357 10.1016/j.bbrc.2005.04.053 [PubMed] [CrossRef] [Google Scholar]
16. **Yang C.J., Kim Y., Lee H.S. et al.** (2017) Bone mineral density and serum 25-hydroxyvitamin D in patients with idiopathic benign paroxysmal positional vertigo. J. Vestib. Res. 27, 287–294 10.3233/VES-170625 [PubMed] [CrossRef] [Google Scholar]
17. **Zhang ZY, Tian SF, Li H, Cao XW, Song Y.** [The correlations between serum vitamin D, parathyroid hormone, and bone mineral density with benign paroxysmal positional vertigo].Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi. 2019 Jun;33(6):504-507. doi: 10.13201/j.issn.1001-1781.2019.06.007. Chinese.
PMID: 31163522
18. Rhim GI.Serum Vitamin D and Long-term Outcomes of Benign Paroxysmal Positional Vertigo.
Clin Exp Otorhinolaryngol. 2019 Aug;12(3):273-278. doi: 10.21053/ceo.2018.00381. Epub 2019 Mar 1.
PMID: 30813712
19**. Wu Y, Fan Z, Jin H, Guan Q, Zhou M, Lu X, Li L, Yan W, Gu C, Chen C, Han W.** Assessment of Bone Metabolism in Male Patients With Benign Paroxysmal Positional Vertigo.
Front Neurol. 2018 Sep 5;9:742. doi: 10.3389/fneur.2018.00742. eCollection 2018. PMID:30233488
20. **Sheikhzadeh M, Lotfi Y, Mousavi A, Heidari B, Bakhshi E** The effect of serum vitamin D normalization in preventing recurrences of benign paroxysmal positional vertigo: A case-control study.Caspian J Intern Med. 2016 Summer;7(3):173-177.
PMID: 27757201
21. **Sheikhzadeh M, Lotfi Y, Mousavi A, Heidari B, Monadi M, Bakhshi E.**
Influence of supplemental vitamin D on intensity of benign paroxysmal positional vertigo: A longitudinal clinical study. Caspian J Intern Med. 2016 Spring;7(2):93-8.
PMID:27386060