CHAPTER - 5

DISCUSSION

Present study aimed at investigating audiovestibular profile and quality of life in individuals with BPPV. Two groups of participants were included in the study, one group involved persons with BPPV and other group had healthy control individuals. Pure tone audiometry, VNG test (Spontaneous nystagmus, Gaze test, positional test, and caloric test) and cVEMP were carried out to describe the audiovestibular profile. Quality of life (QOL) was studied using disease specific questionnaire, DHI and questionnaire assessing generic quality of life, WHOQOL-BREF

5.1 Audiovestibular findings

5.1.1. Results on Pure Tone Audiometry

Results revealed that ears with BPPV as well as ears without BPPV of the participants of Group II had significantly higher mean pure tone average than matched ears of Group I. Pathophysiology of BPPV has been attributed to migration of otoconia from the otolith organ into one of the semicircular canal (Epley, 1980). As there is no damage to cochlea in persons with BPPV, hearing sensitivity is expected to be within normal limits in these individuals. Higher PTA among the participants with BPPV in the present study could be due to associated inner ear disorders such as MD, or some unknown peripheral vestibular pathology. Such individuals with additional pathology are diagnosed as having secondary type BPPV.

Literature suggests that individuals with secondary BPPV may have abnormal results on pure tone audiometry (Pollack et al, 2002; Hughes and Proctor, 1997; Bath et al, 2000). Prevalence of abnormal results on pure tone audiometry has been reported to vary from 13 to 50% in individuals with secondary type of BPPV (Wu et al, 2006; Aguirre, Asenio, Fernadiz, Perez, 2008; Lee, Ban, Lee, Kim, 2009). In the present study19 individuals with BPPV had

bilateral hearing loss while 13 individuals had unilateral hearing loss. The data of the present study included 10 participants with BPPV secondary to MD, 15 participants with BPPV secondary to Vestibular neuritis and 37 participants with BPPV secondary to some unknown peripheral vestibular pathology. It is known that some of the pathologies such as MD affect audiovestibular system and may damage either outer hair cells (OHC) and/or inner hair cells (IHC). Consequently one may observe hearing loss in addition to vertigo in these individuals.

On the contrary, Singaretti, Moreno, Andre (2009) reported no significant difference between PTA of persons with BPPV and healthy matched control group. Discrepancy in the results of PTA in the present study could be attributed to the variations in the inclusion criteria in terms of age range of studied population and type of BPPV (primary versus secondary). Singaretti et al (2009) included participants in the age range of 60 years to 90 years for their study and it has been reported that individuals in that age range most often report primary type of BPPV (Morita, 2009; Roberts, Gans, Kastner, Lister, 2005)

On further analysis no significant difference between PTA of ears with BPPV and ears without BPPV of participants of Group II was observed. This could be explained based on the unspecific nature of associated pathology with respect to the ear of BPPV. It has been reported that BPPV can result on the same side of associated vestibular pathology or on the contralateral side. It is possible that for some participates such as Meniere's disease, hearing may be affected on both sides but BPPV may develop on either of the side thus showing no significant difference between ears with BPPV and ears without BPPV. (Balatsouras et al., 2012; song et al, 2010).

Comparison of hearing sensitivity in subgroups of BPPV

Results revealed that there was no significant difference between PTA of persons with primary BPPV and healthy control group. Similarly, there was no significant difference between

PTA of persons with BPPV secondary VN and healthy control group. However, PTA of persons with BPPV secondary to MD and those with BPPV secondary to UVP differed significantly from the PTA of healthy control group.

Present finding of no significant difference between pure tone average of persons with primary BPPV and healthy control group is in consensus with those of earlier investigators (Singaretti, Moreno, Andre, 2009; Lee N. H., Ban, Lee, Kim, 2009; Song et al, 2012). It has been reported that there is no specific etiological factor associated with primary BPPV. Primary BPPV is reported more in fifth or sixth decade of life unlike the secondary BPPV which is observed in younger clients (Lee, Ban, Lee and Kim, 2010). Possible pathogenesis proposed in the literature for generation of BPPV among older individuals is reduced vascular supply to vestibular system due to commonly found conditions such as osteoporosis, arthritis (Jeong and Kim, 2009). These conditions disturb internal structure of otoconia or their attachment to gelatinous matrix (Jeong and Kim, 2009). Dislodgement of otoconia from the otolith organ provoke abnormal deflection of cupula when they are free-floating in the semicircular canal (Jeong et al 2009; Vibert et al., 2003). As a result, these individuals report positional vertigo and positive test findings on Dix-Hallpike test. However, hearing sensitivity is not expected to be significantly affected in individuals with primary BPPV as compared to healthy control group

The results of present study showed that individuals with BPPV secondary to MD had a higher PTA than healthy control group and individuals with primary BPPV. This finding is in consensus with earlier investigators who have also reported higher PTA among the participants with BPPV secondary to MD as compared to normal healthy individuals (Gross et al., 2000; Kalberg et al., 2000; Morita, 2009; Masoud, Shadman, Rasoul and Maryam, 2015). Karlberg et al. (2000) studied 2847 clients with BPPV in a retrospective study and categorized them into

primary and secondary BPPV. Six clients with secondary BPPV due to MD had hearing loss. Similarly, Masoud, Shadman, Rasoul and Maryam (2015) reported that six out of 41 individuals with MD had developed BPPV. All these clients had significantly more hearing loss and affected EcohcG findings compared to normal healthy individuals and primary BPPV. Morita et al (2009) also reported a significant correlation between the incidence of BPPV and duration of disease in persons with bilateral MD. Similarly Gross et al (2000) reported high incidence of BPPV among the persons with MD. All the clients who reported the incidence of BPPV secondary to MD had significantly higher unilateral or bilateral hearing loss than primary type of BPPV. Furthermore, Paprella et al (2008) reported 65-70% of clients with MD experience BPPV either during or after attacks of BPPV. It has been reported that endolymphatic hydrops of inner ear not only induces hearing loss due to excessive fluid in the cochlea but it also causes destruction of maculae of the utricle and saccule through direct destruction of its surface resulting into detachment of otolith into endolymph (Riga, Bibas, Xenellis, Korres, 2011). As a result these individuals show symptoms of positional vertigo along with hearing loss.

Finding that PTA of participants with BPPV secondary to UVP differed significantly from healthy control group supports the report of Rinne, Bronstein, Rudge, Gresty et al (1998) who stated that hearing loss is a common symptoms in 80 % of persons with vestibular dysfunction due to some unspecific reason. Hearing loss was observed in 40 % of persons with BPPV-UVP in the present study. Similar to these findings, Roberts, Gans, Kastner, Lister (2005) reported 51% of individuals with canal paresis and hearing loss tend to develop BPPV. Individuals with BPPV secondary to VN probably did not show hearing loss as the nature of disorder is such that it affects vestibular nerve without affecting the cochlear physiology. Even earlier investigators

have not reported hearing loss in persons with BPPV secondary to vestibular neuritis (Karlberg, 2000; Caldas et al., 2009; Lee et al., 2010).

5.1.2 Results on VNG test

5.1.2.1 Results on spontaneous, Gaze and positional Nystagmus

Spontaneous Nystagmus

Results of the present study revealed that 8 of 92 individuals with BPPV had spontaneous nystagmus in vision denied condition while it was completely absent in normal population. Unlike the vision denied condition, no nystagmus was noted in vision enabled condition in both the groups of participants. Furthermore spontaneous nystagmus was not observed in individuals with primary BPPV in vision denied condition.

Spontaneous nystagmus was observed in five participants with BPPV secondary to VN, two participants with BPPV secondary to MD and one participants with BPPV secondary UVP. Present finding of absence of spontaneous nystagmus in participants with primary BPPV is in consensus with earlier reports by many investigators (Asprella-Libonati, 2008; Hajiabolhassan and Tavanai, 2013). However these findings are in contrast with the findings of Ko, Song, Kin and Shim (2014) who described a single case study with intractable BPPV having spontaneous nystagmus. No spontaneous nystagmus in the present study among persons with primary BPPV could be because of difference in pathophysiology of BPPV in the participants of the two studies. It might be that the participants with primary BPPV in the present study did not exhibit 'canalith jam' or 'cupilothiasis'. Ko, Song, Kin and shin (2014) reported that non fatiguing nystagmus occurs in clients with 'canalith jam', a condition in which the otoconia plugs into the narrowest portion of the canal lumen. This results into closed space between cupula and plugged portion resulting continuous nonfatiguing nystagmus. Otoconia lodged at the basal portion of the crista

can maintain the cupula in the deflected position regardless of the direction of gravity causing direction fixed nystagmus.

More number of participants with BPPV secondary to VN, MD and UVP showed spontaneous nystagmus is supported by many researchers (korres, Balatsouras, Ferekidinis et al., 2004; Yoo, Kim, Lee, Yang, Lee and park, 2015). It has been stated that secondary BPPV has specific clinical characteristics that differ from those of idiopathic BPPV. It has also been reported that spontaneous nystagmus is present in 10 % to 12 % of individuals with BPPV secondary to, vestibular neuritis (Baloh, Honubria, Jacobson, 1987; Korres, Balatsouras and Ferekidis, 2004). Similarly, Balatsouras et al (2012) reported spontaneous nystagmus in 8 % of persons with BPPV secondary to MD.

Presence of spontaneous nystagmus in these individuals with secondary BPPV is explained based on the unilateral weakness often observed in them. According to Baloh, Honubria, Jacobson (1987) unilateral weakness results into reduced electrical activity on one side of vestibular system compared to the resting potential on the unaffected side. Such asymmetry on the two sides of vestibular system ultimately causes spontaneous nystagmus. Thus, it can be concluded that spontaneous nystagmus may be observed in individuals with secondary BPPV but is most often absent in individuals with idiopathic type BPPV

Positional Nystagmus Test

Positional nystagmus was present in a total of 19 participants with BPPV. It included three participants with primary BPPV, eight participants with secondary BPPV due to VN, six participants with secondary BPPV due to MD and two participants with BPPV due to UVP. None of the participants showed positional nystagmus in vision enabled condition. Present findings are in accordance with Maria, Batista, Doriguito, Ganaca (2013) who reported no

significant abnormality on positional nystagmus test in persons with primary BPPV except in hyperextended position. Even in the present study all the 3 participants with primary BPPV had nystagmus only in hyperextended position.

Present finding of more number of participants illustrating positional nystagmus among secondary type of BPPV supports the findings of Bertholone (2002). He has reported that positional nystagmus is observed in individuals with BPPV due to associated vestibular pathology such as VN, MD or cerebro vascular diseases. No positional nystagmus in vision enabled condition echoes the reports of earlier investigators who have also reported no positional nystagmus on visual fixation condition (Steddin, 1996; Baloh, 1995; Lanska, 1997). Thus, it can be summarized that positional nystagmus is not very common finding in participants with idiopathic BPPV. Nevertheless it can be observed in participants with secondary BPPV.

Gaze Evoked Nystagmus

Gaze evoked nystagmus was present in 11 participants with secondary BPPV. None of the participants with primary BPPV demonstrated gaze evoked nystagmus. Present reports are supported by findings of earlier researchers (Chen, 2011 and Balatsouras, Ganelis, Aspris, Economou, Moukos, Koukoustsis, 2012). Chen (2011) reported importance of gaze evoked nystagmus by documenting sensitivity and specificity in differential diagnosis of acute peripheral and central vestibular disorders. It was reported that gaze evoked nystagmus has sensitivity and specificity as high as 92% in differential diagnosis when it is compared in vision enabled and vision denied condition. Balatsouras et al (2012) reported gaze evoked nystagmus in 4 of 29 persons with BPPV secondary to MD.

Difference in the occurrence of Gaze evoked nystagmus between individuals with primary BPPV and secondary BPPV has been explained by many earlier investigators (Gross et al., 2000;

Manzari, 2008) . It has been hypothesized that gaze nystagmus is present in these individuals not only due to changes in endolymphatic fluid but also due to irritated labyrinth resulting from the associated inner ear disorders. Thus the results of the present study indicate that gaze evoked nystagmus is present in only few participants with secondary BPPV.

5.1.2.2 Results on caloric test

Results on caloric test revealed a significant difference between SPV of ears with BPPV of participants of Group II and matched ears of participants of Group I for all the four irrigations of caloric tests. Comparison of canal paresis values also revealed a significant difference between the participants of Group I and Group II.

Present findings are in accordance with the earlier reports by Halmygyi et al (2000) who studied canal paresis in 39 individuals with BPPV. It was reported that 50 % of their studied clients had canal paresis. Similarly, Pollack (2002) observed that out of 58 clients with BPPV, 15 clients (26%) demonstrated canal paresis on caloric test. Likewise, Korres (2004) reported abnormal canal paresis in 22 % of the studied participants with BPPV. Masaoki, Hideaki, Koji, Akihiko and Makito (2013) studied canal paresis in 80 individuals with the diagnosis of posterior canal BPPV. The results revealed that 29% of the studied population had abnormal results on caloric test especially on the affected side of a person with BPPV. Abnormality in canal paresis is explained based on the Pendulum model or associated vestibular pathology. As per the Pendulum model given by Baloh and Honubria (1993), cupola acts as a coupler between vestibular hair cell and acceleration created by head. However due to increased cupular mass in many cases with BPPV, it results into abnormal functioning of vestibular hair cell and canal paresis.

Thus it can be concluded that abnormality on caloric test is observed in persons with BPPV but the percentage of occurrence varies from one study to another. The variability may be related to associated inner disorders seen in them.

Results of caloric test in subgroups of BPPV

Primary BPPV: It was found that SPV values of participants with primary BPPV did not differ significantly from those of Group I. This could be due to the nature of primary BPPV which affects only the otoconia of otolith organ without affecting the physiology of cupular hair cells. Similar findings have been reported by Domínguez-Durán, Gandul-Merchán, Abrante-Jiménez, Medinilla-Vallejo, and Esteban-Ortega (2010) who reported no significant difference between participants with BPPV and healthy control groups on caloric test. Similarly, Roberts, Gans, Kastner, Lister (2005) compared the canal paresis among the participants with primary and secondary BPPV and found that canal paresis is observed more often in individuals with secondary BPPV.

BPPV secondary to MD: Participants with BPPV secondary to MD did not differ significantly from the participants of Group I on SPV values of caloric test. The results of caloric test in persons with MD vary depending on the stage of MD (Curthoys, MacDougall, Halmagyi et al., 2015). It has been proposed that endolymphatic hydrops might damage the utricle, resulting in loose otoconia and BPPV secondary to MD (Karlberg et al, 2000). Numerous investigators have reported canal paresis in persons with BPPV secondary to MD (Stahle and Bergman, 1967; Thomas and Harrison, 1971; Hughes and Proctor, 1997; Bath et al, 2000). However some investigators have reported that there is no significant canal paresis in the initial stages of MD (Mateijsen et al., 2001; Chen, Zhao, Zhuang, Xie, Jin, 2015). In the present study 6 out of 10 participants had MD in their initial phase. This could have resulted in normal SPV

values for this group of participants. Difference in the results among various studies has been reported to be due to the severity of disorder and duration of disorder.

BPPV secondary to VN: Results of caloric test showed that SPV values of persons with BPPV secondary to VN differed significantly from the SPV values of Group I and those with primary BPPV. Significant difference in the SPV values of participants with BPPV secondary to VN as compared to healthy control group is in accordance with reports of earlier investigators (Harada et al., 1993; Karlberg et al., 2000; Balatsouras et al., 2006). It has been reported that 97 to 100 % of individuals with VN exhibit canal paresis with no significant auditory symptoms (Yoo, Kim, Lee, Yang, Lee, Park, 2015). In the present study, 14 participants out of 15 persons with BPPV secondary to VN had canal paresis. It is reported that high number of individuals with VN develop BPPV as vestibular neuritis affects most often superior vestibular nerve and structure such as macula of utricle (Fetter and Dichgans, 1996). The damage to utricle has been hypothesized to cause displacement of otoconia leading to posterior canal BPPV (Karlberg et al., 2000). Thus it can be concluded that caloric responses are abnormal in persons with BPPV secondary to VN

BPPV secondary to UVP: Results revealed that SPV values of persons with BPPV secondary to UVP differed significantly from those of Group I as well as persons with primary BPPV. Individuals with BBPV secondary to unspecific vestibular pathology (UVP) may have some latent vestibular pathology in the past (Pollack, 2002). These conditions are reported to affect the vestibular nerve or impair the vascular supply of vestibular system, thereby affecting the function of vestibular system resulting in low SPV values on caloric test (Nadol and Schuknecht, 1989; Gans and H gans, 2002). Grad and Baloh (1989) who studied 84 clients with

the complaint of vertigo due to cerebrovascular origin also reported that 42 % of the participants had canal paresis.

5.1.3 Results on cVEMP

Response Rate

cVEMP (Cervical evoked Myogenic potential) was absent in 22% of the participants of Group II and 5% of the participants of Group I. High response rate among the normal individuals supports the findings of earlier investigators (Akin et al., 2003; Ochi et al., 2001; Streubel et al.,2001; Sarda, Vanaja and Bhat, 2014). Significantly greater number of participants with BPPV had absence of cVEMP as compared to healthy control group. These findings are in congruence with earlier reports by many researchers who have also reported absence of cVEMP in more number of participants with BPPV than normal healthy group (Longo, onofri, Pelliccaiari and Quranta, 2012; Stravos et al., 2011; Gacek, 2003; Kim, Oh, Kin, Yang, 2015). Longo, Onofri, Pelliccaiari and Quranta (2012) reported that cVEMPs were altered in 14 ears (30.4%) and was absent in seven (15%) ears with BPPV. Similarly, Kim, Oh, Kim, Yang and Yang (2010) evaluated saccular function in 112 individuals with BPPV using cervical vestibular evoked myogenic potentials (VEMPs). They observed abnormalities of cVEMPs in 41 out of 112 individuals with BPPV. More number of participants with BPPV showing absence of cVEMP responses in the present study than the earlier literature could be due to the differences in the associated vestibular pathologies observed in the present participants with BPPV. In the present study, there were 12 ears with BPPV secondary to VN, five ears with BPPV secondary to MD, 13 ears with BPPV secondary to UVP, and 5 ears with idiopathic BPPV had absence of VEMP. This is in consensus with earlier reports by Hamalygi, (1995); Viciana and Lopez-Escamez

(2010) who reported nearly 50 % of individuals with vestibular neuritis had absent cVEMP Similarly, Waele et al (2012) reported cVEMP was absent in 54% of individuals with MD.

Furthermore, absence of response was observed in the ear with BPPV as well in the ear without BPPV among the participants of Group II though the response rate was lower in ears with BPPV. Absence of cVEMP responses on the side of BPPV as well as on contralateral side was explained by Gacek (2003) through histopathological study of temporal bones of individuals with BPPV. He has reported that, otoconial deposit in posterior semicircular canal was found in only one temporal bone, while 50% of the subjects with BPPV had loss of ganglion cells of the superior vestibular division and inferior vestibular division on both the sides of BPPV. This has been correlated with the large proportion of absence of cVEMP among the participants with BPPV in the ears with BPPV and on the contralateral ears with BPPV (Akkuzu, Akkuzu, Ozluoglu, 2006). More number of participants in the present study showing absence of cVEMP on the side of BPPV as well as on the contralateral side could be associated with neuronal degeneration of inferior vestibular nerve or maculae of saccule in persons with BPPV.

This it can be concluded that there was significantly higher number of participants with BPPV shows absence of response on cVEMP than healthy control group. Moreover, absence of cVEMP can be found on the either side of BPPV.

Latency of P13 and N23 peaks

In the present study, there was no statistically significant difference between the mean latencies of P13 and N23 peaks of Group II and Group I. These findings reiterate the reports of previous researchers (Yang, Sung, Jong and Lee, 2008; Korres, Balatsouras, Ferekidis, 2004; Akkuzu, Akkuzu, Ozluoglu, 2006; Longo, onofri, Pelliccaiari and Quranta, 2012, Singh and Apeksha, 2015) who documented no significant difference in mean latencies of P13 and N23

peaks in persons with BPPV and healthy control group. However, comparison of VEMP results in ears with BPPV secondary to VN, and UVP showed that latency of N23 peak in participants with BPPV secondary to VN and UVP differed significantly from those of healthy control group as well as participants with primary BPPV. These findings are in partial agreement with earlier investigators such Viciana, Lopez-Escamez (2014) and Manzari, Burgess, Curthoys (2012) who have reported significant difference in the latency of P13 and N23 latency between participants with BPPV secondary to inner ear disorders and healthy control group. Viciana, Lopez-Escamez (2014) evaluated the usefulness of cVEMP in fifty individuals with VN. Results revealed that 51% of the participants showed an increase in ipsilateral latencies for P13 and N23 peaks.

Present finding of prolongation of only N23 peaks in persons with BPPV has also been reported earlier by Srinivasan et al (2015). In the present study, prolongation in the peak of N23 could be attributed to the neuronal pathology associated in the persons with vestibular neuritis and persons with unspecific vestibular pathology. Pathway of cVEMP has been found to be from saccular portion to vestibular nerve and ganglion to the vestibular nucleus in the brainstem. From brainstem, impulses are sent to neck muscles via the medial vestibulospinal track and accessory nerve (Colebatch & Halmagyi, 1994). Delayed N23 latency with normal P13 latency indicates that probably pathology was more central.

Unlike the results of the present study, which showed no significant prolongation of latencies in persons with BPPV secondary to MD, Akkuzu, Ozluoglu (2006) reported prolongation of latencies as the most common findings on cVEMP in persons with MD. Rauch et al. (2004) reported that MD display alterations in cVEMP threshold and tuning, supporting the hypothesis of altered saccular motion mechanics arising from hydropic distension. In the present study, there was no prolongation of latencies observed indicating that MD could be due to

mechanical disturbance at the inner ear level without affecting the saccular afferents (Curthoys, MacDougall, Halmagyi et al., 2015). Thus it can be concluded that more number of participants with BPPV secondary to VN and UVP depict abnormal results on cVEMP than participants with BPPV secondary to MD or participants with primary BPPV.

Amplitude of P13-N23 peak

Results for the amplitude parameter revealed that participants with BPPV (Group II) showed significantly lower amplitude levels than healthy control participants (Group I). These findings echoes the earlier reports by Lee, Park, Lee, Sung and Park (2012); Bacoi et al (2015); Kim, Oh, Kim, Yang and Yang (2010); Srinivasan et al (2015) who stated that peak to peak amplitude is reduced in individuals with BPPV as compared to healthy control group. Reduction in the peak to peak amplitude of P13-N23 complex has been attributed to an existence of the vestibular pathology i.e. BPPV alone or BPPV secondary to other vestibular pathology which affect the saccular maculae (Lee, Park, Lee, Sung and Park, 2012). Furthermore, significant difference for the amplitude of P13-N23 peak between healthy normal and persons with BPPV secondary to MD, VN or UVP was also observed. It is well documented that BPPV due to secondary inner ear disorders damages vestibular system and detach the otolith from the utricular and saccular macule. (Murofushi, Halmagyi, Yavor, 1996; Gobel, O'Mera, Gianoli, 2001; Rauch, 2004). Thus associated pathology in persons with BPPV results into reduction in amplitude of P13-N23 peak of cVEMP. Nevertheless it is important to mention that, in the present study contraction of sternocleido mastoid muscle (SCM) was maintained subjectively. A reference point was maintained on the opposite shoulder in each participants and the participants were asked to touch their chin to a reference point so that maximum contraction of SCM muscle is achieved. Good test retest reliability of cVEMP has been reported using this procedure (Anoop and Singh, 2012).

Therefore present findings can be related to reports of other researchers who have used EMG monitoring.

Furthermore, in the present study, there were three individuals with augmented cVEMP among individuals with BPPV secondary to MD. This could be attributed to the hyper-reaction of labyrinth due to the resilient nature of Disorder. Hype-reaction of labyrinth in individuals with BPPV has been explained by the seo et al (2013) with help of mass-spring –damper model of utricle. They hypothesized that similar model can be applied for saccular maculae as the properties of anatomical structure is similar. As per this model otolith organ is a dynamic model with mass positioned on it in the form of carban crystal molecule (Otoconia). In individuals with BPPV, loss of these otoconia either from urticle or saccule results into reduction in overall weight of the mass floating on the saccular or utricular organ. This may result into hypermobility of the macular hair cells and thereby increase reactions from the steriocilia'a of otolith organ, this would ultimately result into increased amplitude of cVEMP.

5.2 Self-perceived handicap and general Quality of Life: Primary and Secondary BPPV

5.2.1 Self-Perceived Handicap

Self-perceived handicap of persons with DHI ranged from mild to severe among the participants of Group II. Overall score for each domain showed that participants with BPPV had physical domain to be more affected than functional and emotional domain. These findings are supported by many other investigators such as Jose, Maria, Fernandez, Manuel and Isabel (2003); Fielder et al. (1996); Grimby, Rosenhall (1995) and Handa, Kuhn, Cuhhas, Schafflein, Ganancas (2005). Fielder et al (1996) reported that DHI is affected in individuals with dizziness due to vestibular disorders. Moreover, physical domain has been found to be more affected than, emotional and functional domains. Similarly, Jose, Maria, Fernandez, Manuel and Isabel (2003)

assessed self-perceived handicap using DHI in 51 participants with BPPV. Among all the domains of DHI, physical domain was found to be affected more than functional and emotional domain. Likewise Handa et al. (2005) compared the impact of dizziness on quality of life, in individuals diagnosed as BPPV and/or MD in crisis and out of crisis. The DHI was administered to 70 participants with positional vertigo, 70 with MD and 15 with both. They reported that physical aspects were found to be more affected than functional and emotional aspect of DHI. Reason for physical domain to be more affected than other domain has been attributed to the characteristics of BPPV. In persons with BPPV, vertigo is characterized by acute short-lived, which tend to occur when the patient assumes a critical head position due to otconical displacement (Baloh, Honrubia, Jacobson, 1987). Thus, physical task such as looking up, making head movements, performing household task, bending down have direct association with otoconical dislodgement resulting into acute vertigo. Hence they show difficulty in physical domain as well as functional domain substantially. Consequences of it are emotional reactions such as fear of staying at home alone, going out alone or feeling frustrations.

Further, the results revealed that self-perceived handicap was highest among individuals with BPPV secondary to VN followed by individuals with MD and individuals with UVP. Individuals with primary BPPV reported lowest self-perceived handicap on DHI among all the groups of BPPV. These findings support the results of earlier researchers who have reported self-perceived handicap to be highest in individuals with VN followed by MD and UVP (Leon, Gutierreza, Hurtado, Ramirrez-Velezb, 2010). Self-perceived handicap was lowest in persons with primary BPPV. Nevertheless, score observed by Leon, Gutierreza, Hurtado, Ramirrez-Velezb (2010) are much higher than what is observed in the present study. These differences in the results are probably due to the variations in inclusion criteria of the participants, different

level of adaptation shown by the participants, varied associated vestibular pathologies, demand on day to day life, age, and occupation. For example, participants studied by Leon, Gutierreza, Hurtado, Ramirrez-Velezb (2010) were only female participants. This would have resulted into more self-perceived handicap than what is found in the current study. Even in the present study females reported slightly more handicap than males in psychological domain of WHOQOL-BREF.

On further analysis of each domain of DHI, it was found that in individuals with BPPV secondary to VN, functional domain was more affected followed by physical and emotional domain. This could be due to more affected activities of daily living due to severe vertigo experienced by these participants along with spontaneous nystagmus and vomiting (Voorde, Loonen, Leeuwen, 2012). These individuals demonstrated severe dizziness, spontaneous nystagmus and imbalance due to unilaterally affected vestibular afferents either shown on cVEMP or caloric test (Vicinia, Lopez-Escamez, 2012). As a result, these participants have difficulty in performing activities such as walking on narrow lane, in crowded place, in dark and performing household task. They may also face difficulty in attending social meeting or performing play activities or dance, causing functional domain to be more affected than the other domains. Physical domain has also been found to be affected significantly due to an extended impairment of vestibular system seen in individuals with BPPV secondary to vestibular neuritis. Moreover, emotional domain was also found to be more affected in these participants than participants of other associated group. Earlier investigators such as Asmumdson et al (2001) and Prevez et al (2001) have also reported several psycho affective manifestation related to vestibular disorders among the participants with higher self-perceived handicap.

Similar to Group II-VN, individuals of Group II-MD showed functional domain to be more affected followed by emotional and physical domain. It is known that individuals with dizziness due to MD show severe episodic vertigo with nausea, tinnitus and hearing loss with or without abnormal results on vestibular tests depending upon the stage of the disorder (Timmer et al., 2006; Mateijsen et al., 2001; Shin, Kim and Park, 2013). These symptoms such as fluctuating tinnitus, nausea and severe vertigo lasting for more than 3-4 hours affects the ability to perform many day to day activities affecting functional domain of the DHI. It was observed that participants with BPPV secondary to MD also demonstrated similar symptoms along with positional vertigo. Therefore functional domain would have been more affected in participants with BPPV secondary to MD.

Unlike the participants of Group II-VN and Group II-MD, participants Group II-IP reported more handicap on the physical domains of DHI when compared to functional and emotional domains. This could be due to the pathophysiology of the disorder found in these groups of participants. It is known that primary type of BPPV results into positional vertigo of short duration due to otconical displacement affecting primarily physical task such as looking up, making head movements, performing household task, bending down (Hall, 1979; Brandt and Steddin, 1993). But other than positional vertigo which lasts for few seconds to minute, there are no other associated symptoms shown by these participants unlike the participants with VN and MD. As a consequence physical domain would have been more affected by participants with primary BPPV. Thus it can be concluded that participants with idiopathic BPPV would show more affected physical domain followed by functional and emotional domain whereas in participants with BPPV secondary to VN, MD and UVP, functional domain is found to be more affected followed by physical and emotional domain.

General Quality of Life

Mean score on WHOQOL-BREF was lesser in persons with BPPV indicating poorer quality of life than healthy control group. Similar findings have been reported in the literature by many investigators such as Gopinath, Mcmohan, Rochtchina, Mitchell (2009) and Takano et al (2010). Takono et al (2010) have studied general quality of life using WHOQOL-BREF in individuals with 120 individuals with dizziness. Out of these 120 participants 41 participants had BPPV. Poorer general quality of life in individuals with dizziness has been attributed to affected integrity of vestibular systems. Similarly, Gopinath, Mcmohan, Rochtchina, Mitchell (2009) examined 2751 clients with dizziness out of which 10.8 % clients had BPPV. General QOL was assessed using SF-36 questionnaire. Domains that are reported to be most commonly affected are physical domain, social functioning and vitality on SF-36 questionnaire. Similarly, in the present study, physical and social relationships were found to be maximally affected domains on WHOQOL-BREF. This can be due to restricted movements of head and body resulting into reduced overall productivity and poorer quality of life.

Furthermore, mean score of WHOQOL- Bref was found to be most affected in participants of Group II-VN followed by participants of Group II-MD and Group II-UVP. QOL was least affected in Group II-IP. On further analysis of each domain of WHOQOL-BREF it was found that physical domain was more affected followed by social relationship, psychological and environmental in participants of Group II-VN, Group II-UVN and Group II-IP, whereas among the participants of group IIMD, physical domain was followed by psychological, social relationship and environmental. This is in consensus with earlier studies by Fielder et al, (1996); Robertson et al, (1996); Gamiz and Lopez (2004); Hsu et al, (2005). It has been reported by these researchers that physical domain is more affected than other domains in individuals with

vestibular dysfunction. It has been also reported that "Social Relationship" is affected next to the physical domain (Fielder et al, 1996; Bagger-Sjoback, Bergenius, Langius, 2002). This has been attributed to the phobias and fear of falls resulting from dizziness (Hsu, Hwa Hu, Jang Wong, Jiun Wang, Luk and Chern, 2005).

There was a significant difference among DHI scores of participants with BPPV secondary to VN, MD, UVP and participants with primary BPPV, however, the scores of WHOQOL- Bref of all the groups of participants did not differ significantly. This could be due to the difference in the nature of questionnaire. DHI is more disease specific questionnaire while WHOQOL- Bref is a general questionnaire. This fact is supported by Perez, Garmendia, Granero, Tapia (2001). Perez, Garmendia, Granero, Tapia (2001) did factor analysis to assess different structure of DHI and questionnaire assessing general quality of life , UCLA-DQ. It was reported that 7 items of each domain of DHI were categorized under handicap factor while rest of the 11 items were categorized under disability factor. On the other hand, UCLA-DQ items could be categorized into two categories i.e. frequency and severity of vertigo. Thus these two questionnaire were found to be associated with each other yet reported to provide different information

Similarly, Enloe, Shiels (1997) evaluated the relationship between the disease specific questionnaire, DHI and general outcome measure, the SF-36 and their reliability and responsiveness for persons in a vestibular rehabilitation program. DHI was reported to be more responsive to change than the SF-36. Thus it was concluded that the DHI and the SF-36 provide reliable and responsive measurements, but they appear to provide different information about the health status of individuals with vestibular disease.

5.2.2 Self perceived handicap and General Quality of life based on the results of vestibular

tests Self-Perceived handicap

Self-perceived handicap was also studied as per the extent of impairment indicated by number of abnormalities on vestibular tests. Group IIa had abnormality on only Dix-Hallpike test while Group IIb had abnormal results on cVEMP and Dix-Hallpike both. Group IIc had abnormal results on caloric, cVEMP and Dix Hallpike test. Participants of Group IIc showed maximum self-perceived handicap followed by Group IIb and Group IIa., It was observed that participants of Group IIc had severe self –perceived handicap while participants of Group IIa and IIb had mild to moderate level of self-perceived handicap. Higher level of self-perceived handicap among the participants of Group IIc and Group IIb than the participants of Group IIa supports the findings of earlier researchers who have also reported increased self-perceived handicap in individuals with BPPV who have abnormal results on vestibular tests such as cVEMP and oVEMP than individuals with BPPV having no abnormality on other vestibular test (Aneli, Abouyared, Snapp, Jethanamest, 2014; Hoseinabadi, Poubakhi, Yazdani, Kouhi, Kamali, 2016). Persons associated with larger degree of abnormal results on vestibular tests have more severe form of BPPV and greater degree of handicap. It has been also reported in the past that more the number of abnormalities on the vestibular test, higher are the chances of recurrence of BPPV (Lee, Park, Lee, Sung, Park, 2013). It can be construed that abnormalities on more number of vestibular tests indicates more extensive damage to the labyrinth which in turn can affect daily activities leading to higher self-perceived handicap.

Analysis of pattern of abnormality across the three domains of DHI showed that the physical domain was maximally affected followed by functional and emotional domains among the participants of Group IIa. This finding is in consensus with earlier literature documenting that the self-perceived handicap in individuals with BPPV is more in the physical domain (Andre, 2003;

Enloe and Shield, 1997; Lee, Kwon and Ban, 2009; Vorrde, Loonen, Leeuwen, 2012). Physical domain assesses the situations that trigger dizziness such as turning in bed, bending down, looking up, walking on sideways, making quick movements of head, or while performing ambitious activates. Temporary characteristics of BPPV and situations in which these symptoms occur justifies greater handicap on the physical domain when compared to other domains. Functional and emotional domains of DHI were found to be less affected because items of these domains get affected from activity limitations created by the disorder. As participants of Group IIa had difficulty only during changing head positions, activities of day to day life would have been less affected on functional domain and emotional domain as compared to physical domain.

Unlike the participants of Group IIa, functional domain was maximally affected, followed by physical and emotional domains in participants of Group IIb and Group IIc, Participants of Group IIb and Group IIc had abnormality on cVEMP and/or Caloric tests in addition to Dix-Hallpike test. Abnormal responses on caloric test and cVEMP imply impaired sacculocolic reflexes (VCR) and vestibulo-ocular reflexes (VOR) in addition to positional vertigo. It is known that VCR and VOR are important for maintaining the stable image on ocular fovea during head movement and maintaining the neck muscles during linear and angular acceleration of body. Canal paresis or unilateral vestibular loss results into deficit in maintaining the excitation phase of vestibular hair cells on one side and inhibition on opposite side. Consequently more impairment is experienced for maintaining stable image during head movements during activities such as driving a vehicle, turning head while crossing roads or playing sports. Thus impaired VOR and VCR would have affected functional aspect in addition to physical aspect in participants of Group IIb and Group IIc. This is in accordance with earlier investigators, McCaslin, Jacobson, Granthum, Piker and Verghese (2011) who determined

performance of clients on standard six conditions of the Sensory Organization Test (SOT) using the computerized dynamic posturography in three groups of participants. Among their three groups, Group 1 had only abnormal cVEMP response, Group 2 had only abnormal caloric response while Group 3 had abnormal responses on both cVEMP and caloric test. Results revealed that Group1 had significantly less antero-posterior sway than Group 2 and Group 3. On DHI test, Group 3 had maximum score on DHI scale than other two groups. Thus the functional ability and self-perceived handicap varies as per the abnormal results on various vestibular tests.

In addition to functional domain, emotional domain was also observed to be more affected among the participants of Group IIb and Group IIc. This could be due to the strong association between functional domain with emotional domain in depicting the self-perceived handicap in individuals with dizziness (Jacobson, Newman, Hunter, 2001). It has been reported that as functional domain which assess the ability of a person in performing day to day activities gets more affected, emotional domain also gets affected. Therefore emotional reactions such as fear of staying alone at home or frustration due to dizziness would have been observed in these groups of participants as well. Similarly, increased overall stress, affected personal relationship and overall feeling of handicap is linked with reduced ability to perform many day to day task, resulting into emotional domain to be affected (Voorde, Loonen, Leeuwen, 2012, Vereeck, 2006).

General Quality of Life

WHOQOL-BREF revealed that general quality of life in participants of Group IIc was more affected than those of Group IIb and Group IIa. However, there was no statistically significant difference in the general QOL of participants of Group IIa and Group IIb. This shows that

extent/pattern of abnormality also play a pivotal role in affecting the general QOL in persons with BPPV. Present findings are in consensus with the earlier investigators such as chinhara (2012); Jacobson et al. (2012) who have reported that abnormal responses on caloric test are indicative of extensive damage to inner ear or vestibular system which results into dislodgment of otoconia and the more incapacitating type of BPPV. Thus, the QOL would have been affected among the participants of Group IIc. This is also in partial agreement with earlier study by McCaslin, Jacobson, Granthum, Piker andVerghese (2011) who demonstrated more postural instability on SOT test in individuals with dizziness who had impairment at both superior as well as inferior vestibular nerve demonstrated by caloric test and cVEMP than individuals who had showed abnormal results on either of the one vestibular test.

No significant difference in the general QOL between the participants of Group IIa and Group IIb could be because of the general nature of WHOQOL-BREF which has not captured the subtle impairment resulting from abnormal responses on cVEMP.

Pattern of abnormality across five domains of WHOQOL-Brief revealed physical domain to be having lowest score across all the three subgroups. Social relationship was second maximally affected domain followed by environmental, general QOL and psychological domain among the participants of Group IIb and IIa whereas among the participants of Group IIc, physical domain was maximally affected followed by psychological, social relationship and environmental domain.

Similar results have been reported by Leon, Gutierrez, Hurtado and Velez (2012) who studied general QOL using SF-36. They observed that physical performance and mental performance was maximally affected in individuals with BPPV while physical function, vitality, mental health, general health and social function were less affected. Physical domain of

WHOQOL-BREF depicts extent to which activities of daily living are affected, extent to which person is dependent on medical substances, extent to which mobility is affected and amount of pain experienced by a person along with disturbance in rest or sleep. Persons with BPPV are known to have positional vertigo and disturbance while sleeping and getting up from bed because of its pathophysiology. These individuals are also quite dependent on medicine to subside the nausea and vertigo experienced by them. This will affect the scores on the physical domain of WHOQOL-BREF.

5.3 Factors affecting self-perceived handicap and quality of life (QOL)

5.3.1 Effect of age

Effect of age on DHI revealed no significant difference in self-perceived handicap of young adults and old adults with BPPV across all the three clinical groups. However general quality of life assessed using WHOQOL-BREF was found to be more affected in old adults than young adults among those with primary BPPV. These findings are in consensus with earlier reports by Handa, Kuhn, Cunha, Schaffleln, Ganança, (2005) and Voorde, Zaag-Loonen, Leeuwen (2012) who have reported increase in impairment on various balance measures with advancing age but no significant difference in self-perceived handicap across different age group. Voorde, Zaag-Loonen, Leeuwen (2012) assessed self-perceived handicap in individuals with dizziness using DHI. It was found that 70% of participants had moderate or severe self-perceived handicap. The handicap perceived by the clients was primarily caused by physical and functional factors and less by emotional factors. Moreover, older clients reported more impairment than younger ones but no significant difference was observed on self-perceived handicap. Similarly, Handa, Kuhn, Cunha, Schaffleln, Ganança (2005) assessed influence of age in individuals with vestibular disorders. The DHI was applied in seventy participants with BPPV, seventy with MD and fifteen

with both. No significant statistical differences were observed, when comparing the results across age, in individuals with BPPV as well as individuals with BPPV and MD.

Similar reports has been documented by Takano et al (2010) who evaluated the QOL in individuals with dizziness across different age groups. They observed no significant differences across different age groups on both WHOQOL-BREF and DHI. However, thy reported that elderly subjects above 80 years had poorer QOL than other population. As present study had included participants only up to 70 years, an effect of age was probably not seen on DHI. Nevertheless effect of age was observed on the 'Social Relationship' domain of WHOQOL-BREF in the present study. Social Relationship' domain depicts the information regarding 'support from friends and family', 'sexual relationship' and 'personal relationship' which are most often affected with advancing age due to many health issues, resulting into poorer quality of life in them (Nachtegaal, Festen, Kramer, 2011; Lipowski, 1988). Similarly 'Psychological' domain of WHOQOL-BREF was also found to be more affected in old adults than young adults in the present study. This domain involved questions related to self-esteem, positive and negative thoughts, learning and concentration. It has been reported in the literature that older individuals have more negative thoughts and poor learning due to psychological stress. Aachtegaal, Festen, Kramer (2012) and Lipowski (1988) reported that elderly individuals experience more psychological stress due to increased dependency, restricted mobility, physical illness and need for medical help. Thus it can be concluded that there is no effect of age on dizziness related self-perceived handicap in persons with BPPV, however general quality is affected with advancing age in individuals with BPPV

5.3.2 Effect of Gender

DHI showed no significant difference in self-perceived handicap between both the genders. Nevertheless self-perceived handicap was observed to be more in female than males. Similar results were found for the WHOQOL-BREF with significant difference being present for psychological domain between gender groups. These findings of grater self-perceived handicap on DHI and 'poorer quality of life on Psychological' domain of WHOQOL-BREF among the female participants compared to male participants is in agreement with Robertson and Ireland (1995) who reported higher score in females for all the subscales of DHI even though the difference between males and females was not significant. Similarly, Takano et al. (2010) evaluated the QOL in elderly subjects with dizziness and compared the scores of WHOQOL-BREF across the gender groups. Results of their study revealed poorer QOL and self-perceived handicap among the female participants than male. Similar findings have been documented by other investigators (Handa, Kuhn, Cunha, Schaffleln, Ganança, 2005; Kurre et al., 2012)

Handa, Kuhn, Cunha, Schaffleln, Ganança (2005) compared the impact of dizziness on quality of life in individuals diagnosed as BPPV and/or MD, in crisis and out of crisis. Additionally influence of gender was also assessed in these individuals with dizziness. No statistical significant differences was observed, when comparing the results across age, gender as a variable in individuals with BPPV. Similarly, Kurre (2012) explored whether women and men with vertigo differ significantly with regard to self-perceived disability, anxiety and depression. Both genders did not differ significantly in the mean level of self-perceived disability, anxiety, depression and symptom severity. Thus it can be summarized that there is no effect of gender on dizziness related self-perceived handicap in persons with BPPV, nevertheless females may perceive poorer quality of life than males

5.3.3 Effect of frequency of dizziness

In the present study, the frequency of dizziness showed a moderate to strong correlation with self-perceived handicap and poor yet significant correlation with general QOL. In other words, more the frequency of dizziness greater is the self-perceived handicap. Present findings of significant association between frequency of dizziness and self-perceived handicap supports the earlier studies by Agrawal (2000); Perez (2001); Hsu et al (2005) and Dross et al (2011).

Perez (2001) reported that frequent spells of vertigo results into severe negative impact on self-perceived handicap and provoke a feeling of fear of having another episode. It has been also been reported that relationship between frequency, self-perceived handicap and fear is well established in individuals with sudden and unpredicted nature of vertigo as in BPPV, Migraine, MD (Dross et al,, 2011 and Agarwal et al., 2000). Similarly Hsu et al (2005) investigated the quality of life using the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) and the Hospital Anxiety and Depression Scale (HADS) in 197 elderly individuals who has the primary complaint of dizziness. Results of the study indicated that all the individuals with dizziness had lower score in all eight domains and HADS score. Out of the three variable relating to the characteristics of dizziness (frequency of attacks, duration of illness and vertiginous sensation), only the frequency of attacks correlated with SF-36 subscale. Thus authors concluded that more the frequency of attacks, severe is the impairment of physical functioning.

Further, results have also revealed that frequency of dizziness has grater association with functional and emotional domain of DHI than physical domain. It is known that functional domain and emotional domain of DHI reflects the ‘vestibular Handicap’ part of dizziness whereas physical domain of DHI depicts the ‘Vestibular Disability’. Numerous investigators

have reported that frequency of dizziness correlates more with vestibular handicap part than vestibular disability part (Perez, 2001, Korres et al 2010).

5.3.4 Duration of dizziness

Present results revealed that poor yet significant association between duration of dizziness with self-perceived handicap and no significant association with general quality of life. These reports are in congruence with earlier studies by Dros et al (2011) who have found poor yet significant association between duration of dizziness and self-perceived handicap. It has been further reported that with increase in duration, there is an increase in somatic anxiety, disease specific disability and decreased psychosocial functioning. This would result into overall increase in self-perceived handicap with increase in duration of dizziness.

However, present findings are not in agreement with Hsu et al (2005) who have reported no significant association between duration of dizziness and self-perceived handicap. Plausible reason for not finding an association between duration and self-perceived handicap was attributed to an age of the participants and acceptance of dizziness by the participants. Most the participants of their study were geriatric in nature who would have already accepted their problem and adjusted to their problem unlike the present study which had younger as well as older age groups. Moreover present study had individuals with dizziness due to definite vestibular disorder unlike the other studies which had participants with dizziness due to vestibular as well non vestibular causes. Hence it can be summarized that frequency and duration of dizziness affect self-perceived handicap nevertheless former factor plays more important role than the later.

5.3.5 Effect of associated hearing loss

Results revealed a significant mild to moderate relationship between general quality of life assessed using WHOQOL-BREF and associated hearing loss among participants with BPPV. However there was no significant association observed between self-perceived Handicap assessed using DHI and associated hearing loss. This could be because of the differences in the nature of the questionnaire used for assessing the general QOL and dizziness related self-perceived handicap. DHI is a disease specific questionnaire which specifically collects information related to dizziness such as increase or decrease in dizziness due to certain body position or situation (Physical domain). It also assesses the functions/activities of day to day life that are dependent on vestibular integrity (Functional domain) and psychological distress or trauma associated due to dizziness (Emotional domain). As these questions are explicitly linked to only dizziness, score on this scale, may not get affected due to presence or absence of hearing loss in any individual. On the contrary, WHOQOL- Bref has been found to have a significant association with presence of hearing loss in persons with dizziness. This could be because WHOQOL-BREF depicts the general quality of life through the questions related to the psychological, physical, social relationship domains of life which are not specific to only dizziness.

Present findings are supported by earlier researchers such as Soderman, Sjoback, Bergenius and Languis (2002) and Chia, Wang, Rochtchina, Cummning, Newall, Mitchell (2007) who have reported increased score on psychological domain of a questionnaire assessing general quality of life among the dizzy participants due to vestibular pathologies with associated hearing loss. Soderman, Sjoback, Bergenius and Languis (2002) evaluated self-reported quality of life in individuals with MD. Questionnaire used were SF-12 and HAD, Sickness Impact Profile (SIP),

the Function Level Scale (FLS). Results revealed that QOL was significantly affected in individuals with MD. Moreover, tinnitus and hearing loss group were found to influence psychosocial dimensions of scale assessing QOL. Similarly, Chia, Wang, Rochtchina, Cummning, Newall, Mitchell (2007) reported that individuals with combined pathology of hearing and vertigo tend to report their hearing loss more often than who don't have comorbid problem. This was associated with more affected quality of life in individual who have both vertigo as well as hearing loss than individuals who have only either of them affected. This underlies that hearing loss among elderly individuals with vertigo worsens the general quality of life (Publica, 2013). Present reports of worsened quality of life especially in the psychological domain among the participants with Group II with associated hearing loss echoes the findings of earlier researchers like Fellinger (2007) and Chia (2007). It was reported that psychosocial aspect are mainly affected among these individuals having associated hearing loss due to lack of communication, associated loneliness and depression (Hawthrone, 2008). Nevertheless present reports are not in congruence with other studies by Gopinath, Mohan, Rochtchina, Mitchell (2009) who have reported that self-perceived handicap as well as quality of life assessed using SF-36 do not differ irrespective of presence or absence of hearing loss. This could be due to variation among the studied population across the studies such as age of the participants, associated vestibular pathology and many such other conditions. Study by Gopinath, Mohan, Rochtchina, Mitchell (2009) had involved many participants dizziness due to non-vestibular causes as well and age of clients involved all geriatric population. Thus, it can be concluded that associated hearing loss has an effect on self-perceived QOL in persons with BPPV.

Overall it can be summarized that PTA among the participants with BPPV secondary to inner ear disorder was higher than normal healthy individuals. Moreover, Participants with

secondary BPPV also depicted more abnormality on VNG and VEMP tests than primary type. This fact is supported by many earlier investigators and has been explained based on the existence of prior pathology at the level of cochlear or vestibular organ. Nevertheless occurrence of abnormal results on various vestibular tests have been reported to vary from one study to another. Possible reasons provided for the variance are characteristics of associated inner ear pathology such as duration, severity and nature of pathology.

Furthermore, in the present study self-perceived handicap and quality of life has been also found to vary based on both nature of associated pathology and results on vestibular tests in individuals with BPPV. This has been espoused by few investigators and explained based on aggravated signs and symptoms shown by participants with secondary BPPV and severely affected vestibular integrity. On analysis of domains of scales, it was further observed that physical domain is more affected in participants with primary BPPV while functional and physical both are affected in secondary type BPPV. Thus present study underlies the importance of detail vestibular tests and assessment of self-perceived handicap along with quality of life in persons with BPPV. This will further enhance clinician's understanding of a client and its need for more comprehensive rehabilitation strategies. Nevertheless, variations in self-perceived handicap as well as general QOL across the groups of participants who were divided based on the vestibular test results, would have had an additional sensory integration issues as well. Posturography was not carried out in the present study which could have tapped the sensory integration abilities among the participants with BPPV and its influence on quality of life.