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Validation of using 2-item and 5-item of the Dizziness Handicap Inventory Thai version for screening Benign Paroxysmal Positional Vertigo (BPPV) in Thai population

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Abstract

Objective: To validate the use of total score, 5-item score, and 2-item score of the Thai version of the Dizziness Handicap Inventory (DHI-TH) for screening benign paroxysmal positional vertigo (BPPV) in Thai population.

Study Design: A retrospective electronic medical chart review
Setting: Tertiary care teaching hospital

Patients: A total of 60 electronic medical records of patients who were diagnosed with BPPV at the vestibular clinic were identified during the period from January 2021 to May 2022. The electronic medical records of another 60 patients with other vestibular disorders were also reviewed.

Main Outcome Measures: The total score, 2-item score, and 5-item score of the DHI-TH were obtained.
Results: The area under the receiver operating characteristic curve (AUC) of the 2-item and 5-item score for predicting BPPV was 0.855 (95% confidence interval: 0.788-0.923) and 0.806 (95% confidence interval: 0.728-0.884), respectively. Using a cut-off value of 6 in the 2-item score had a good sensitivity of 73.33%, specificity of 80% in discriminating BPPV from those without BPPV. For the 5-item score, a cut-off value of 15 had 63.33% sensitivity and 90% specificity in separating BPPV from non-BPPV.

Conclusions: Both 5-item and 2-item scores from the DHI-TH are valid for initial BPPV screening. We recommend using 2-item score due to its time efficiency, aligning with comparable sensitivity and specificity observed in the 5-item score.

Keywords: Benign paroxysmal positional vertigo—Dizziness—Screening—Dizziness Handicap Inventory

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INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is one of the most common diagnoses among patients who visit the hospital with a presentation of vertigo.[1] In the United States, BPPV is diagnosed in approximately 5.6 million visits per year.[2-4] In our vestibular clinic at tertiary hospital in Bangkok, the prevalence of BPPV is approximately 50% of dizziness during 2020-2022. BPPV is more prevalent among women aged over 40 years, and could be associated with a history of head injury, diabetes mellitus, or vitamin D deficiency.[5-7] BPPV is mostly caused by a detached otoconia in utricle into semicircular canals, causing vertigo when the patients move their head from sides to sides. The patients mostly presented with recurring positional vertigo lasting seconds from the nystagmus which are caused by stimulation of the affected semicircular canals[8,9]. Patients with BPPV has increased chance of falling and impaired daily life activities[10]. Although BPPV can be spontaneously resolved in 1–3 months,[11,12] the canalith repositioning procedure (CRP) help patients recover in a timely fashion.[13] To accurately diagnose the condition, clinicians need to perform the diagnostic maneuver specifically for BPPV.[8,14-18] Patients with true BPPV must experience a brief spinning sensation and have typical nystagmus. [14,19-20] During the COVID-19 pandemic, diagnosing BPPV is challenging because the clinicians need to closely observe for nystagmus and some patients may feel nauseated or vomit, leading to removal of their face masks. Moreover, some patients do not provide a clear history of BPPV during the interview. As a result, clinicians may overlook BPPV and omit the BPPV diagnostic test. Initial screening of BPPV may help reduce the chance of BPPV going undiagnosed. The Dizziness Handicap Inventory (DHI), developed by Jacobson and Newman in 1990, is primarily used for evaluation of the effects of dizziness or imbalance in daily life activities.[21] The DHI consists of 25 questions and requires approximately 10–15 minutes to complete. Each question has three possible answers: yes (4 points), sometimes (2 points), and no (0 points). The total score ranges from 0 to 100. A higher score correlates with greater impact of dizziness on daily life activities. Several research studies have investigated the possibility of using the DHI score for screening BPPV. Whitney et al. reported that extracting five of the following items on the DHI questionnaire could be beneficial for BPPV prediction: Item 1: Does looking up increase your problem? Item 5: Do you have difficulty getting into or out of bed? Item 11: Do quick movements of your head increase your problem? Item 13: Does rolling over in bed increase your problem? Item 25: Does bending over increase your problem? This scale is called the 5-item BPPV subscale and was found to indicate a significant likelihood of BPPV ($\chi 2 = 8.35$; $p < 0.01$) and it could be easily computed and used to

further decide whether the patient should undergo the Dix-Hallpike examination, especially if not routinely done.[22] Chen et al. also postulated that the DHI subscale would be more accurate in predicting BPPV due to its relevance to the symptoms of BPPV compared to the Total DHI and finally reported that in the Chinese version of the DHI questionnaire, the 5-item subscale can be used to screen BPPV, with sensitivity of 74.5% and specificity of 88.7% at a cut-point value of 12 points.[23] Additionally, the 2-item subscale (Items 5 and 13) with a cut-point value of 6 points can predict BPPV, with a sensitivity of 78.2% and specificity of 88.7%. Saxena et al. stated that the likelihood of correctly diagnosing BPPV was 16 times greater if the total DHI score was greater than or equal to 50.[24] The DHI has been translated into Thai language and verified its reliability and validity in patients with vestibular disorders with excellent test–retest reliability (ICC ranged from 0.91 to 0.97, $p < 0.001$) and good discriminate ability in detecting the patients with dizziness (AUC1/40.99, 95% CI1/40.98–1.00. p<0.001)[25]. The DHI-TH has been used to compare the horizontal canal BPPV and posterior canal BPPV groups, and the results show that the horizontal canal BPPV group has higher scores. Additionally, items 7 and 23 are found to be more related to horizontal canal BPPV.[26] However, to the best of our knowledge, the 2-item and 5-item scores have never been utilized to predict BPPV in the Thai population. Thai patients with BPPV may respond to the Thai version of DHI (DHI-TH) in a different way due to Thai lifestyle and culture. The aim of this study was to validate the use of the total score, 5-item score, and 2-item score of the DHI-TH and find the optimal cut-off value for screening BPPV in Thai population.

MATERIALS AND METHODS

The design of this study was a retrospective medical chart review in a tertiary referral center. Sixty patients who were diagnosed with BPPV without any other coexisting vestibular disorders (e.g. Meniere's Disease, vestibular migraine, or concurrent vestibulopathy) at the vestibular clinic of Ramathibodi Hospital were retrospectively identified from the electronic medical records during the period from January 2021 to May 2022. The diagnosis of BPPV was confirmed with the presence of typical nystagmus provoked by the Dix-Hallpike maneuver or supine roll test. The medical records of another 60 patients of similar age who were diagnosed with other vestibular disorders were also reviewed. The exclusion criteria were individuals with age <25 or >85 years, patients with any psychiatric disorders, and patients who have been prescribed vestibular suppressant 3 days prior to the visit. All patients had to complete the DHI-TH on their first visit to be included in the analyses. The DHI-TH has demonstrated good internal consistency and excellent test–

retest reliability.[25] The total score of the DHI-TH also had good discriminating ability between patients with dizziness and healthy individuals. The 2-item score is the sum of scores on Item 5 (getting in or out of bed) and Item 13 (rolling over in bed). The 5-item score is the sum of scores on Item 1 (looking up), Item 5 (getting in or out of bed), Item 11 (quick head movements), Item 13 (rolling over in bed), and Item 25 (bending over). The total (0–100), 2-item (0–8), and 5-item (0–20) scores were used for data analysis. This study was approved by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (MURA2022/298).

Statistical analysis

All statistical analysis was conducted using IBM SPSS Statistical Software for Windows version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics was used for the demographic characteristics and DHI-TH scores of all patients. To examine the distribution of scores, the Shapiro–Wilk test of normality was used. The Mann–Whitney *U* test was used to compare the total, 2-item, and 5-item DHI-TH scores between the two groups. The level of statistical significance was set at $p < 0.05$. To evaluate the screening ability of the total, 2-item, and 5-item DHI-TH scores in discriminating BPPV and non-BPPV groups, a receiver operating characteristic (ROC) curve was used. The area under the ROC curve (AUC) and 95% confidential interval (CI), sensitivity, specificity, Youden index, positive predictive value (PPV), and negative predictive value (NPV) were calculated accordingly. The optimal cut-off value from the ROC curve was the point at which the Youden index was maximal.

RESULTS

Patient characteristics

Table 1 shows the characteristics of patients in each group. The average age of patients with BPPV was 60.25 ± 13.56 years and 76.67% out of the total of 60 patients were women. The average age of patients without BPPV was 61.78 ± 15.96 years and 86.67% were women. In approximately 70% of our patients with BPPV had involvement of the posterior canal and right ear was found more frequently than the left ear. This finding was in agreement with previous studies. [27-29]

TABLE 1. Characteristics of patients in BPPV and Non-BPPV groups

Variable	BPPV (n = 60)	Non – BPPV (n = 60)
Age (yr), mean±SD	60.25 ± 13.56	61.78 ± 15.96
Gender, n (%)		
Male	14 (23.33%)	8 (13.33%)
Female	46 (76.67%)	52 (86.67%)
Canal involvement, n (%)		
Lateral semicircular canal		
Left	4 (6.67%)	
Right	7 (11.67%)	
Posterior semicircular canal		
Left	17 (28.33%)	
Right	24 (40%)	
Multiple canals (>1 canal)	8 (13.34%)	
Diagnosis, n (%)		
Bilateral vestibulopathy		13 (21.67%)
Central vestibular lesion		3 (5%)
Cervicogenic dizziness		1 (1.67%)
Dysequilibrium		8 (13.33%)
Meniere's Disease		2 (3.33%)
Multifactorial dizziness		14 (23.33%)
Unilateral vestibulopathy		12 (20%)
Vestibular Migraine		7 (11.67%)

BPPV, Benign Paroxysmal Positional Vertigo

DHI-TH scores

TABLE 2. Mean ± standard deviation, median, and range of the DHI-TH total score, domain subscores (physical, emotional, functional), 2-item scores and 5-item scores of patients with BPPV (n=60) and non-BPPV (n=60)

Variable	BPPV (n = 60)	Non – BPPV (n = 60)	***p* value**
DHI-TH total			*p > 0.05*
Mean ± SD	47.23 ± 23.63	42.73 ± 20.81	*p > 0.05*
Median	45	46	
Range	0 – 100	4 – 86	
DHI-TH physical domain[a]			*p > 0.05*
Mean ± SD	17.23 ± 6.69	13.30 ± 6.09	*p* < 0.05

Median	18	13	
Range	0 – 28	0 – 24	
DHI-TH emotional domain			*p > 0.05*
Mean ± SD	10.67 ± 9.03	10.47 ± 7.60	*p > 0.05*
Median	8	10	
Range	0 – 36	0 – 32	
DHI-TH functional domain			*p > 0.05*
Mean ± SD	19.33 ± 10.60	17.87 ± 9.28	*p > 0.05*
Median	18	20	
Range	0 – 36	0 – 34	
DHI-TH 2–item score[b]			*p* < 0.05
Mean ± SD	6.53 ± 1.98	2.80 ± 2.58	
Median	8	2	
Range	0 – 8	0 – 8	
DHI-TH 5–item score[c]			*p* < 0.05
Mean ± SD	15.40 ± 4.76	9.70 ± 4.64	
Median	16	10	
Range	0 – 20	0 – 20	

[a]Mann – Whitney U, z = 3.15, $p < 0.05$; [b]Mann – Whitney U, z = 6.93, $p < 0.05$; [c]Mann – Whitney U, z = 5.83, $p < 0.05$

DHI-TH indicates Thai version of Dizziness Handicap Inventory, BPPV, Benign Paroxysmal Positional Vertigo

Table 2 demonstrates the DHI-TH total, domain subscores, 2-item, and 5-item scores for patients with BPPV and non-BPPV. The mean DHI-TH total scores were 47.23 ± 23.63 and 42.73 ± 20.81 for patients with BPPV and non-BPPV, respectively. The DHI-TH scores in each domain were not normally distributed according to the Shapiro–Wilk test of normality ($p < 0.05$). Using the Mann–Whitney U-test, the median DHI-TH total scores did not differ significantly between groups (45 vs. 46 for BPPV and non-BPPV groups; $p > 0.05$). Significantly higher physical domain scores (greater perceived disability) were detected in patients with BPPV. Scores of the 2-item as well as the 5-item questionnaires were significantly higher in patients with BPPV than in those without BPPV (6.53 ± 1.98 and 15.40 ± 4.76 vs. 2.8 ± 2.58 and 9.70 ± 4.64, respectively; $p < 0.05$).

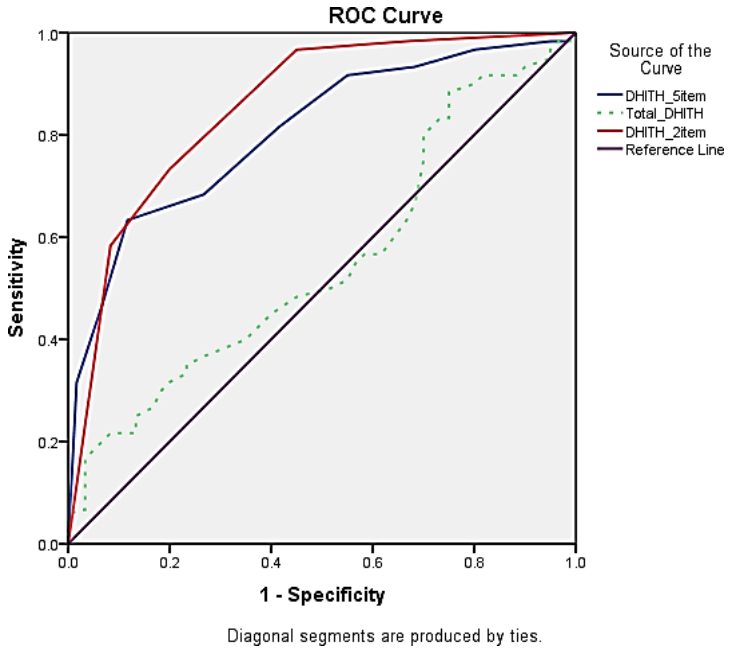

FIG. 1. Receiver operating characteristic (ROC) curves for the DHI-TH totalscore, 2-item score, and 5-item score

Figure 1 presents the ROC curves for total, 5-item, and 2-item DHI-TH scores. Based on the ROC curves, the AUC of the 2-item and 5-item scores were significantly different from 0.5. The AUC of the 2-item score was 0.855 (95% CI: 0.788 to 0.923) and the best cut-off score of at least 6 had a good sensitivity of 73.33%, specificity of 80%, PPV of 78.6%, and NPV of 75% for discriminating patients with BPPV from those without BPPV. The AUC of the 5-item score was 0.806 (95% CI: 0.728 to 0.884) and the cut-off score of at least 15 had a sensitivity of 63.33%, specificity of 90%, PPV of 86.4%, and NPV of 71.1%. as shown in Table 3

TABLE 3. Sensitivity, specificity, PPV, and NPV of 2-item and 5-item DHI score with best cut point according to ROC curves.

	Sensitivity	Specificity	PPV	NPV
2-item score with cut point 6	73.3%	80%	78.6%	75%
5-item score with cut point 15	63.33%	90%	86.4%	71.1%

DISCUSSION

This study retrospectively explored the possibility of using the total DHI-TH score or its subscores (either 2-item or 5-item questionnaire) for screening BPPV. Interestingly, the mean total DHI-TH scores did not differ between patients with and without BPPV. In our study, patients with BPPV perceived greater difficulty with physical movements than patients without BPPV. This finding could be expected because free-floating debris moves during changes in the head position related to gravity. The result is in agreement with those previous studies.[22,23] The top five "yes" responses in our patients with BPPV were quick head movements, turning over in bed, getting into or out of bed, bending over, and avoiding heights. Notably, the first four items were included in the 2-item and 5-item scores. On the contrary, most patients without BPPV reported difficulty with quick head movements, strenuous housework, bending over, feeling frustrated, and avoiding heights. Strikingly, patients in both groups were quite sensitive to heights. We hypothesized that patients with dizziness generally have fear of falling so their confidence is compromised in high places. Our results suggested that screening for BPPV using either the 2-item or 5-item DHI-TH subscale was acceptable. Chen and colleagues also reported that the subscale scores of the Chinese DHI were effective in predicting the presence of BPPV.[23] For the 2-item questions (getting into or out of bed and rolling over in bed), the best cut-off value was 6, with sensitivity of 78.2 and specificity of 88.7. We obtained the same optimal cut-off value of 6, with sensitivity 73.33% and specificity 80%. Many patients with BPPV frequently describe their symptoms being provoked when lying down in bed or turning onto their side. In this study, approximately 90% of patients with BPPV described dizziness during these activities. In contrast, Lindell et al. found that only 32 of 324 participants (10%) reported positional dizziness when lying down or turning over in bed, and 8 out of 20 participants who underwent diagnostic tests had positive results for BPPV.[30] However, their participants were aged between 70–85 years, which were older than our patients. For the 5-item questionnaire, our optimal cut-off value was 15, with sensitivity of 63.33% and specificity of 90%. Compared to Chen's study, they reported a cut-off value of 12, with sensitivity of 74.5% and specificity of 88.7.[23] We, therefore, recommend using either the 5-item or 2-item of the DHI-TH questionnaire to screen Thai patients with dizziness because it is quick to do and has good sensitivity and specificity. The 2-item DHI-TH offers higher sensitivity and lower specificity, whereas the 5-item DHI-TH provides a test with lower sensitivity and higher specificity. Since we initially identified this test for use as a screening tool, we recommend employing the 2-item DHI-TH due to its superior sensitivity,

ease of use, and comparable specificity. To simplify the process, clinicians need only ask two simple questions during the history-taking process. Based on the results of this study, performing the diagnostic maneuver for BPPV should be considered if patients feel dizzy during these two movements. The findings of this study have to be seen in light of some limitations. First, this was a small, retrospective, single-site study. The data was collected during the COVID-19 pandemic so fewer patients than usual presented to our center; thus, the generalizability of the study results was somewhat limited. Second, although most patients with BPPV had posterior canal involvement, we also included those with lateral canal and multiple canal involvement. They probably experienced different degrees of severity, which could have had an impact on their responses on the DHI-TH. We recommend recruiting more patients with BPPV and grouping them according to the involved canals, duration of onset, and severity in future studies. In addition, we did not screen out patients with a history of BPPV from the non-BPPV group. It is possible that these individuals avoid certain movements that could provoke dizziness, leading to negative answers on the DHI-TH.

CONCLUSION

Screening for BPPV using scores of the DHI-TH is a feasible solution for general physicians who are not familiar with this condition. BPPV is often underdiagnosed and undertreated. Many patients with dizziness, especially elderly individuals, are unable to describe the characteristics of their dizziness to their physicians. Using the subscores of the DHI-TH help increase awareness, ease the screening diagnosis of probable BPPV, and encourage referral to a specialist for further evaluation and management. We recommend using 2-item score due to its time efficiency, aligning with comparable sensitivity and specificity observed in the 5-item score.

Appendix 1: แบบประเมินผลกระทบอาการเวียนศีรษะต่อการดำรงชีวิตประจำวัน

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Appendix

1.แบบประเมินผลกระทบอาการเวียนศีรษะต่อการดำรงชีวิตประจำวัน

คลินิกโรคเวียนศีรษะและการทรงตัว ศูนย์การแพทย์สมเด็จพระเทพรัตน์ ชั้น 4

ชื่อ-นามสกุล.....HN.....วันที่..... P VR#.....

แบบประเมินผลกระทบอาการเวียนศีรษะต่อการดำรงชีวิตประจำวัน

แบบประเมินนี้ต้องการค้นหาความยากลำบากที่ท่านมีเนื่องจากอาการเวียนศีรษะหรือโคลงเคลง ตอบโดยการทำเครื่องหมาย ✓ ในช่อง "ใช่" "ไม่ใช่" หรือ "บางครั้ง" เฉพาะที่สัมพันธ์กับอาการเวียนศีรษะหรือโคลงเคลงในช่วง 1 สัปดาห์ที่ผ่านมาเท่านั้น และตอบทุกข้อ

ข้อ	คำถาม	ใช่	ไม่ใช่	บางครั้ง
P1	การเงยหน้ามองขึ้นด้านบน ทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			
E2	จากปัญหาที่คุณมีอยู่ ทำให้คุณรู้สึกหงุดหงิดหรือไม่?			
F3	จากปัญหาที่คุณมีอยู่ จำกัดการเดินทางเพื่อทำธุรกิจ หรือการพักผ่อนของคุณหรือไม่?			
P4	การเดินในช่องทางเดิน ของห้างสรรพสินค้าทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			
F5	จากปัญหาที่คุณมีอยู่ คุณมีความยากลำบากในการลุกขึ้นจากที่นอนหรือเอนตัวลงนอนหรือไม่?			
F6	คุณรู้สึกว่าอาการเวียนศีรษะจำกัดการเข้าร่วมกิจกรรมทางสังคม เช่น การออกไปรับประทานอาหารนอกบ้าน การออกไปโรงภาพยนตร์ เต้นรำหรืองานเลี้ยงต่างๆ อย่างมีนัยสำคัญหรือไม่?			
F7	จากปัญหาที่คุณมีอยู่ ทำให้คุณมีความยากลำบากในการอ่านหนังสือหรือไม่?			
P8	การทำกิจกรรม อาทิเช่น การเล่นกีฬา การเต้นรำ การทำงานบ้าน เช่น ปัดกวาดหรือการจัดเก็บจานชาม ทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			
E9	จากปัญหาที่คุณมีอยู่ ทำให้คุณรู้สึกกลัวที่จะออกจากบ้านคนเดียวหรือไม่?			
E10	จากปัญหาที่คุณมีอยู่ คุณเคยรู้สึกอายเมื่ออยู่ต่อหน้าผู้อื่นหรือไม่?			
P11	การเคลื่อนไหวศีรษะเร็วๆ ทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			
F12	จากปัญหาที่คุณมีอยู่ ทำให้คุณหลีกเลี่ยงการอยู่ในที่สูงหรือไม่?			
P13	การพลิกตะแคงตัวบนเตียงทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			
ข้อ	**คำถาม**	**ใช่**	**ไม่ใช่**	**บางครั้ง**

คลินิกโรคเวียนศีรษะและการทรงตัว ศูนย์การแพทย์สมเด็จพระเทพรัตน์ ชั้น 4

F14	จากปัญหาที่คุณมีอยู่ ทำให้คุณทำงานบ้านที่หนักๆ หรือการดูแลสนามหญ้ารอบบ้านยากขึ้นหรือไม่?			
E15	จากปัญหาที่คุณมีอยู่ ทำให้คุณกลัวว่าคนอื่นอาจคิดว่าคุณมีลักษณะเหมือนคนเมาเหล้าหรือไม่?			
F16	จากปัญหาที่คุณมีอยู่ การจะออกไปเดินตามลำพังเป็นเรื่องยากสำหรับคุณหรือไม่?			
P17	การเดินตามทางเท้า ทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			
E18	จากปัญหาที่คุณมีอยู่ การใช้สมาธิเป็นเรื่องยากสำหรับคุณหรือไม่?			
F19	จากปัญหาที่คุณมีอยู่ คุณมีความยากลำบากในการเดินรอบบ้านตอนกลางคืนหรือไม่?			
E20	จากปัญหาที่คุณมีอยู่ ทำให้คุณกลัวการอยู่บ้านคนเดียวหรือไม่?			
E21	จากปัญหาที่คุณมีอยู่ ทำให้คุณรู้สึกว่าตนเองพิการหรือไม่?			
E22	จากปัญหาที่คุณมีอยู่ สร้างความตึงเครียดต่อความสัมพันธ์กับสมาชิกในครอบครัว หรือเพื่อนของคุณหรือไม่?			
E23	จากปัญหาที่คุณมีอยู่ ทำให้คุณมีภาวะซึมเศร้าหรือไม่?			
F24	ปัญหาที่คุณมีอยู่รบกวนการทำงานหรือภาระหน้าที่ทางครอบครัวของคุณหรือไม่?			
P25	การก้มตัวลงทำให้คุณมีปัญหาเพิ่มขึ้นหรือไม่?			

Total = ... [16 - 34 points (mild handicap); 36 - 52 points (moderate handicap); 54+ points (severe handicap)]

P1, 4, 8, 11, 13, 17, 25 = ...; E2, 9, 10, 15, 18, 20, 21, 22, 23 = ...; F3, 5, 6, 7, 12, 14, 16, 19, 24 = ...

BPPV: 1+5+11+13+25 = .../20*100 =..... [Whitney SL. Usefulness of the DHI in screening for BPPV (2005)]

Cervicogenic dizziness screening: 1+11+9 =..... (>9 is likely to be C-dizziness)
[Reid SA et al. Utility of a brief assessment tool developed from the DHI to screen for cervicogenic dizziness (2017)]

**MCID for DHI = 18
Total DHI <20 -- unlikely to be vest