Research Article

Translation and Assessment of the Validity, Reliability, Sensitivity, and Specificity of the Persian Version of the Dizziness Symptom Profile

Hossein Soleimani[1], Devin L. McCaslin[2], Mansoureh Adel Ghahraman[1*], Shohreh Jalaie[3], Ali Kouhi[4], Pedram Borghei[4], Reza Hoseinabadi[5*]

[1.] Department of Audiology, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran

[2.] Department of Otolaryngology-Head and Neck Surgery, University of Michigan-Michigan Medicine, Ann Arbor, Michigan USA

[3.] School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran

[4.] Otorhinolaryngology Research Center, Tehran University of Medical Sciences, Tehran, Iran

[5.] Manchester Center for Audiology and Deafness, School of Health Sciences, University of Manchester, Manchester, United Kingdom

ORCID ID:
Hossein Soleimani: 0000-0002-3844-1886
Devin L. McCaslin: 0000-0001-6099-288X
Mansoureh Adel Ghahraman: 0000-0002-7118-6231
Shohreh Jalaie: 0000-0001-6044-9617
Ali Kouhi: 0000-0002-4154-8908
Pedram Borghei: 0000-0002-6506-7500
Reza Hoseinabadi: 0000-0002-5331-6696

Citation: Soleimani H, McCaslin DL, Adel Ghahraman M, Jalaie S, Kouhi A, Borghei P, et al. Translation and Assessment of the Validity, Reliability, Sensitivity, and Specificity of the Persian Version of the Dizziness Symptom Profile. Aud Vestib Res. 2025;34(4):?-?.

Article info:
Received: 28 Aug 2024
Revised: 05 Jan 2025
Accepted: 05 Jan 2025

[*] **Corresponding Authors:** Department of Audiology, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran. madel@tums.ac.ir
Manchester Center for Audiology and Deafness, School of Health Sciences, University of Manchester, Manchester, United Kingdom. reza.hoseinabadi@manchester.ac.uk

Short running title: Translation and Assessment of the Validity, …

Highlights:

- The DSP-P is a history-based diagnostic tool with high sensitivity and specificity
- The DSP-P can lead to accurate differentiation of various vestibular disorders
- The DSP-P can enhance cost efficiency and expedite vestibular disorders diagnosis

ABSTRACT

Background and Aim: Due to the annoying nature and prevalence of dizziness, vertigo, and imbalance, the need for rapid diagnosis, and challenges in the differential diagnosis of various vestibular disorders, this study aimed

to translate the Dizziness Symptom Profile (DSP), which is a self-report tool that helps clinicians differentiate the most common vestibular system disorders, into the Persian language and evaluate its validity, reliability, sensitivity, and specificity.
Methods: The profile was translated into Persian as DSP-P. Face, known-groups, and concurrent validities, internal consistency, test-retest reliability, sensitivity, and specificity were determined. 253 patients with dizziness and 59 healthy individuals completed the DSP-P before visiting the otolaryngologist, and the agreement between the proposed diagnoses of DSP-P and the final diagnosis of the otolaryngologist (our gold standard) was examined.
Results: The qualitative face validity of DSP-P was confirmed. There was a significant difference between the mean scores of the study groups ($p<0.001$). The diagnosis of DSP-P was completely in agreement with the gold standard in 53.3% of cases. Internal consistency was excellent ($\alpha\geq0.81$) for all categories except the persistent postural-perceptual dizziness, superior canal dehiscence and unspecified unsteadiness categories ($0.62\leq\alpha\leq0.69$). Generally, the test-retest reliability of the DSP-P scores and diagnoses was very good. The sensitivity of DSP-P was 94.4% for diagnosing benign paroxysmal positional vertigo, 93.5% for Meniere's disease, 100% for vestibular neuritis, 86.3% for vestibular migraine, and 84.2% for persistent postural-perceptual dizziness.
Conclusion: The DSP-P was demonstrated to be a valid and reliable history-based diagnostic tool with high sensitivity and specificity.
Keywords: Vertigo; validity; reliability; dizziness symptom profile

Introduction

Estimates indicate that dizziness and vertigo account for 10% of patients seeking medical attention [1, 2]. Dizziness is a general term that refers to imbalance, disorientation, or a false sense of motion. Vertigo results from a peripheral or central vestibular system disorder and manifests as the illusion of a person's own movement or rotation, environment, or both [3]. Studies in large populations have shown that dizziness and vertigo affect 15 to 20% of adults annually [4]. It is estimated that the vast majority (about 86%) of patients diagnosed with unspecified dizziness could have been diagnosed more accurately if they had received a special neuro-otological examination [2].

Assessments and differential diagnoses of various vestibular system disorders are difficult and require expertise, as these processes cannot be completed using objective and quantitative tests alone. Thus, a crucial step in diagnosing the cause of vertigo and choosing an appropriate treatment is considering a comprehensive history [5]. The diagnosis of vestibular disorders depends largely on the patient's description of their symptoms [6, 7]. However, history-taking can cause problems when evaluating dizzy patients because patients' descriptions of symptoms often lack sufficient clarity, consistency, and reliability. The clinician must obtain important information from the patient relatively quickly and must translate this information into scientific language. In other words, the clinician must analyze and understand the patient's description to carry out the examination according to the patient's complaints. Patients often complicate the history-taking process by giving information that helps little with differential diagnoses [2].

Given the importance and challenges of history-taking, the lack of a tool for rapid differentiation between various causes of vertigo is a serious problem. Creating a history-based tool, such as a questionnaire, could increase the accuracy and efficiency of diagnoses. Such a tool could also help clinicians choose proper treatment strategies and make appropriate referrals. Clinicians could also use this kind of tool to reduce the number of possible diagnoses, determine which tests should be performed, avoid unnecessary tests, and save time and costs [2, 5].

Several questionnaires are currently available that describe the emotional, physical, and functional impacts of vestibular disorders and dizziness (e.g. Dizziness Handicap Inventory (DHI), Vertigo Handicap Questionnaire (VHQ), and the University of California, Los Angeles Dizziness Questionnaire (UCLA-DQ)). To help differentiate the most common vestibular system disorders, Jacobson et al. developed the Dizziness Symptom Profile (DSP) [2]. The DSP is completed by the patient before visiting the otolaryngologist and can reduce the number of proposed possible diagnoses to one to three of the most common vestibular disorders. The DSP which can be combine with history taking and physical examination, comprises 31 items designed to help practitioners diagnose vestibular disorders such as Benign Paroxysmal Positional Vertigo (BPPV), vestibular migraines, Meniere's disease, vestibular neuritis/labyrinthitis, Persistent Postural-Perceptual Dizziness (PPPD), Superior Canal Dehiscence (SCD) and unspecified unsteadiness [2].

The advantages of the DSP include the straightforward nature of the patient's response format, which utilizes a Likert scale, as well as the clarity and comprehensibility of the items presented. The absence of specialized terminology enhances intelligibility, while the focus on clinical diagnostic criteria pertinent to the diagnosis of vertigo, dizziness, and imbalance is particularly noteworthy. Furthermore, the DSP is capable of identifying multiple coexisting disorders. Completing the DSP is not time-consuming, providing insights into the progression and precedence of vestibular disorders experienced by the individuals. Additionally, the DSP facilitates the documentation of changes in patient`s symptoms, as well as variations in symptom severity following medical, surgical, and nonmedical interventions.

The preliminary findings showed that the agreement of DSP with the diagnosis of otolaryngologists was very satisfactory; BPPV (82%), Meniere`s disease (100%), vestibular migraine (95.3%), PPPD (80%) and unspecified unsteadiness (59.4%). The overall accuracy of the DSP was calculated at 70.3%. The results showed that DSP might be useful in the differential diagnosis of dizzy patients. DSP has great potential for reducing the burden on clinicians and reducing delays in the diagnosis of common vestibular disorders [2].

Due to the annoying nature and prevalence of dizziness, vertigo, and imbalance, the need for rapid diagnosis, and challenges in the differential diagnosis of various vestibular disorders, the present study was designed to translate the DSP into Persian language and to evaluate its validity, reliability, sensitivity and specificity to create the first Persian diagnostic profile of vestibular disorders.

Methods

First, permission was obtained from the original author of DSP to translate it. In order to translate the original version of DSP into Persian language according to guidelines and instructions for developing, translating and validating a questionnaire [8]. Then to evaluate face validity and cross-cultural adaptation, the pre-final version of the Persian version of Dizziness Symptom Profile (DSP-P) was preliminarily tested on a sample of 30 participants with vestibular disorders.

The qualitative face validity was determined in a specialized panel consisting of 11 audiologists expert in the field of balance. The goal was to find ambiguity in phrases or lack of expressivity in the meanings of words. The comments of the expert panel were applied as subtle changes in the DSP-P. The content validity assessment was not performed as it was already confirmed by the original authors.

The DSP-P was administered on 253 patients aged 18 or older with complaints of dizziness, vertigo, and imbalance who had not received treatment formerly, were able to read and speak Persian language, had appropriate vision and physical conditions to complete the DSP-P accurately, were willing to participate in the study, and did not consume alcohol. In addition, DSP-P was given to 59 participants with no history of vertigo and imbalance while having other inclusion criteria as the healthy group. Participants were asked to use the 5-point Likert scale to respond to each of the 31 items of the DSP-P. Their score for each category was calculated, and the maximum score of each category was normalized to 100% [2]. Patients completed DSP-P just before being visited by the otolaryngologist.

A form was provided to the otolaryngologist consisting of two options (positive and negative) for each of four categories: BPPV, Meniere's disease, vestibular neuritis/labyrinthitis, and vestibular migraine. The "positive" option indicated the possibility that the patient was afflicted with the relevant vestibular disorder. The otolaryngologists were asked to select at least one of the most probable disorders based on his/her diagnosis after visiting each patient and performing necessary evaluations at his/her discretion. An "other" option was also provided and was used when the patient's disorder did not fit any of the main disorders, when dizziness and vertigo were side effects of a drug or when the otolaryngologist could not diagnose the main cause of the patient's symptoms [2].

Known-groups validity was analyzed using independent t-tests in two ways. First, the mean score of participants with each vestibular disorder was compared separately with the healthy group according to the relevant category. Then, the mean score of participants with each vestibular disorder was compared separately with the mean scores of participants with other vestibular disorders.

The sensitivity and specificity of the DSP-P were evaluated by plotting a Receiver Operating Characteristic (ROC) curve and determining cut-off points [9]. If the subject`s score on a category was higher than the cut-off point, the disease associated with that category was considered one of the probable diagnoses for that patient (positive). Also, if the patient obtained a high score (i.e., above the cut-off point) on more than three categories, the three categories with the highest scores were selected as possible diagnoses [2]. True positives, false positives,

true negatives, and false negatives were determined to assess the sensitivity and specificity of the DSP-P in diagnosing any vestibular disorders mentioned by the otolaryngologist. Finally, the sensitivity and specificity of the DSP-P in diagnosing BPPV, Meniere's disease, vestibular neuritis, vestibular migraines, and PPPD were measured by plotting the ROC curve and considering the cut-off points.
To assess the concurrent validity with our gold standard of otolaryngologist, the agreement between the final diagnoses of DSP-P and the otolaryngologist`s diagnosis was measured.
Cronbach`s alpha was employed to check the internal consistency of DSP-P items. Cronbach`s alpha values >0.6 were considered acceptable [10].
Test-retest reliability was evaluated by administering the valid version of the DSP-P twice with 48-hour interval [11] to 30 participants with vestibular disorders. Additionally, a kappa test was used to evaluate the test-retest reliability of diagnoses assigned by the DSP-P. Furthermore, Spearman's correlation coefficient was used to assess the test-retest reliability of the scores obtained for Meniere's disease, vestibular neuritis/labyrinthitis, vestibular migraine, PPPD and SCD. In addition, the test-retest reliability of the BPPV category scores was assessed by Pearson's correlation coefficient. The cut-off points determined for each category were used to check the test-retest reliability of diagnoses assigned by the DSP-P.

Results

After reviewing original and translated versions of the DSP, the expert committee rated the quality of translation, clarity of items and conceptual similarity of each item on a 100-point scale. The points given to clarity of translation and conceptual similarity ranged from 59.09 to 100 and 63.64 to 100, respectively. The expert committee assigned the lowest scores to items 5 "I am unsure of my footing when I walk outside" and 7 "I get dizzy when I am in open spaces and have nothing to hold onto". These items were discussed and revised using the most appropriate words. The expert committee suggested adding phrases to the profile instructions to describe the equivalent word of "dizziness" in Persian, thus making the instructions clearer. Experts' comments were considered as qualitative face validity and were applied. In addition, all 30 participants in the pilot study rated the DSP-P items as 100% clear, fluent, and unambiguous.
Among 253 patients (mean age 46.21±12.71 years, 180 female), 206 received one diagnosis, 37 received two diagnoses, and one received three diagnoses from the otolaryngologists. Nine did not receive any diagnosis. About 60% of participants who received only one diagnosis had BPPV and vestibular migraine disorders. The combinations of vestibular migraines and PPPD and vestibular migraines and BPPV were the most common multiple diagnoses in patients who received two diagnoses. One patient was diagnosed with vestibular migraines, PPPD, and psychogenic vertigo.
Among 59 participants (mean age 35.12±9.09 years, 34 males) in the healthy group, nine received a vestibular migraine diagnosis by the DSP-P based on the cut-off point determined for each category (cut-off point=32.5). Among them, five participants gave high scores to migraine headache items. In addition, another nine participants obtained scores between 35 to 45 on the PPPD category. All of them gave high scores to items 9 ("I am depressed much of the time") and 28 ("I am anxious much of the time") (Table 1).
Known-group analysis showed that there was a significant difference ($p<0.001$) between the mean scores of patients with BPPV and the healthy group, as well as between BPPV patients and patients with other vestibular disorders in the BPPV category. This finding also applies to Meniere's disease, vestibular neuritis, vestibular migraines, and PPPD (Table 1).
ROC curves were plotted to evaluate the sensitivity and specificity of the DSP-P in diagnosing BPPV, Meniere's disease, vestibular neuritis, vestibular migraines and PPPD, and. The results of the analysis showed the excellent sensitivity and specificity of the DSP-P in diagnosing the most common vestibular disorders (Figure 1).
Regarding concurrent validity, the agreement between the diagnoses by otolaryngologists (gold standard) and the diagnoses generated by the DSP-P based on cut-off points was evaluated for each category. In 53.3% of cases, the diagnosis of the DSP-P was completely in agreement with the diagnosis of the otolaryngologist (according to the order and accuracy of the diagnoses) (Table 2).
Cases of disagreement between the diagnoses generated by the DSP-P and otolaryngologists were also examined. In total, there were 86 cases of disagreement; the most important cases are listed in Table 3.
Cronbach's alpha values were excellent for the BPPV (0.81), Meniere's disease (0.85), vestibular neuritis/labyrinthitis (0.84) and vestibular migraines (0.87) categories. In addition, Cronbach`s alpha values were acceptable for the PPPD (0.62), SCD (0.63) and unspecified unsteadiness (0.69) categories. Spearman's

correlation coefficients between items were evaluated to explore the low internal consistency of the PPPD category items [3 ("I have spells where I get dizzy and also have irregular heartbeats (palpitations)"), 9 ("I am depressed much of the time"), 24 ("I have spells where I get dizzy and it is difficult for me to breathe"), 28 ("I am anxious much of the time"), and 31 ("I feel dizzy all of the time")]. The results indicated that the correlation coefficient of item 31 with other items and the correlation of items 9 and 24 was not desirable ($r<0.2$) though significant ($p<0.05$).

A comparative analysis of the mean and standard deviation of the test and retest administrations is shown in Table 4. The Pearson's correlation coefficient was 0.948 for the BPPV category scores obtained in the first and second administrations. Further, Spearman's correlation coefficients were 0.939, 0.785, 0.976, 0.976, 0.877 and 0.945 for scores obtained in the first and second administrations for Meniere's disease, vestibular neuritis, vestibular migraine, PPPD, SCD and unspecified unsteadiness, respectively. In addition, there was no significant difference between the scores obtained in the first and second administrations of the profile ($p<0.001$). Therefore, the DSP-P had high test-retest reliability in this regard.

The kappa coefficients in the first and second administrations for the first, second and third diagnoses were almost excellent (0.957, 0.942, and 0.844, respectively; $p<0.001$). These outcomes confirm that the DSP-P has excellent test-retest reliability.

Discussion

The data show that about 60% of participants had vestibular migraines and BPPV, with vestibular migraines being the most common diagnosis. However, in most epidemiological studies conducted in different countries, BPPV has been identified as the most common vestibular disorder [4, 12]. In addition, the current investigation did not involve any cases of SCD, labyrinthitis, or unspecified unsteadiness, making statistical analysis impossible.

According to the otolaryngologists' diagnoses, 206 patients (81.42%) had only one vestibular disorder, with vestibular migraines and BPPV being the most common (29.12% and 31.55%, respectively). Roberts et al. examined the occurrence of multiple vestibular disorders in 131 patients using the DSP and found that 52.7% of patients received only one diagnosis [13]. Meanwhile, in the present study, BPPV and vestibular migraines were more common (42% and 39.1%, respectively).

Furthermore, in the present study, 37 patients (14.62%) had multiple vestibular disorders. Vestibular migraines and PPPD was the most prevalent combination, followed by vestibular migraines and BPPV. Roberts et al. reported that 47.3% of people had more than one vestibular disorder and that vestibular migraine and BPPV was the most common combination [13]. Therefore, the possibility of multiple vestibular disorders should be considered. The simultaneous occurrence of these disorders is justified and expected due to the prevalence of migraine in patients with BPPV [14, 15], the increased risk of BPPV in patients with migraine [16], the similarity of vestibular migraine symptoms and PPPD and the occurrence of psychiatric disorders such as anxiety and depression in both groups of patients [17-19]. Accordingly, clinicians need to consider the possibility of several co-occurring disorders when determining the cause of a patient's symptoms.

By analyzing the mean and standard deviation of healthy participants' scores in the DSP-P categories and examining the responses of each healthy individual to all items, it was found that five of the nine participants who had high scores on the vestibular migraine category assigned high scores to items that dealt with migraine headaches. Moreover, nine healthy participants had unexpected scores for PPPD items. This was because they assigned high scores to items related to anxiety and depression. Therefore, reducing the number of items related to migraine headaches or replacing them with other symptoms of vestibular migraines, as well as replacing items related to anxiety and depression with other symptoms of PPPD, may improve the sensitivity and specificity of the DSP-P and help diagnose these important disorders.

In general, the results showed that the score of the expert panel on each item was high in terms of lack of ambiguity, correct translation, and inclusion of conceptual content of the DSP. This means that the expert panel considered the DSP-P as a fluent, unambiguous, and understandable instrument that contains the conceptual content of the DSP. However, the clarity and conceptual similarity of the DSP-P title, as well as items 5 "I am unsure of my gait stability when I walk outdoors" and 7 "I feel dizzy when I am in open spaces (outdoors) and have nothing to hold onto", we're not desirable, indicating a need to make changes. Accordingly, the desired changes were applied to these items, as well as to other items that required subtle changes.

According to 30 participants with a vestibular disorder, all items were fluent, unambiguous, and understandable. In addition, the patients needed little help from a clinician to complete the profile. The random arrangement of the items also prevented patients from repeating a specific pattern in their responses. The face validity of the DSP-P was confirmed based on the opinions of experts and the results of the interview.

The present study hypothesized that the mean scores of individuals with any given vestibular impairment would differ from the mean scores of healthy individuals and participants with other vestibular disorders. Statistical tests showed statistically significant differences in both cases. In other words, the scores of individuals who suffered from a vestibular impairment (e.g., BPPV) were not often high on other categories unrelated to their impairment. This shows that DSP-P is a good history-based diagnostic tool that can differentiate patients with different diseases with high accuracy based on characteristic symptoms. Moreover, the higher mean scores of BPPV, Meniere's disease and vestibular neuritis patients in the relevant categories were likely due to the more specific symptoms of these diseases. Examples of such symptoms include positional vertigo in BPPV, the occurrence of hearing loss and tinnitus in Meniere's disease, the long duration of vertigo, and the occurrence of cold and flu in vestibular neuritis.

The sensitivity of the DSP-P in diagnosing BPPV, Meniere's disease, vestibular neuritis, and PPPD was 93.4%, 93.5%, 100%, and 84.2%, respectively. Jacobson et al. reported that the diagnostic accuracy of the DSP was 82.1% in diagnosing BPPV, 100% for Meniere's disease, 20% for vestibular neuritis, and 80% for PPPD [2]. Thus, there is relatively good agreement between the results of the two studies. However, the diagnostic accuracy decreases less with each misdiagnosis as the number of samples grows. Therefore, the cause of differences could be the number of samples. Jacobson et al.'s study included 11 Meniere's disease, 38 BPPV, five vestibular neuritis, 43 vestibular migraines, and five PPPD patients [2]. The present study included two to three times as many patients with each disorder compared to Jacobson et al.'s sample. In addition, the DSP-P outperformed the 32-item version of Zhao`s questionnaire, which had 92% accuracy for vestibular migraine, 90% for BPPV, 86% for Meniere's disease, and 63% for vestibular neuritis [20].

The three-level diagnostic algorithm of Filippopoulos et al., which was designed to identify Cerebrovascular Events (CVEs) and categorize patients with non-vascular vestibular disorders (unilateral vestibulopathy, BPPV, vestibular paroxysmal, Meniere's disease, vestibular migraines and functional dizziness), had an overall diagnostic accuracy of 71%. This algorithm, which is completed by an expert based on patient symptoms and findings, identified CVE with a sensitivity of 94% and six common vestibular disorders with a specificity of over 95% [21]. In addition, the diagnostic accuracy of Suvanich et al.'s algorithm was 64.23%, and Cohen's kappa coefficient was 0.55 ($p<0.05$) [22]. Meanwhile, the overall sensitivity and specificity of the DSP-P, which is a self-report profile, were 91% and 89%, respectively. Therefore, there was good agreement between the proposed possible diagnoses of DSP-P and the diagnoses of otolaryngologists. Thus, the DSP-P can be used to reduce the number of possible diagnoses.

The sensitivity and specificity of the DSP-P in diagnosing vestibular migraines with a cut-off point of 32.5 was also good (86.3%). However, if, like with the other categories, higher cut-off points (57.5 to 67.5) were used, its sensitivity would not have been very favorable (65 to 74%). However, Jacobson et al. found that the sensitivity of the DSP in diagnosing vestibular migraines was 95.3% [2]. This could be because the DSP faces issues with differentiating between migraine headaches and vestibular migraines. Moreover, its items are not sufficiently accurate to diagnose vestibular migraines, as they focus primarily on migraine headaches and their symptoms. In addition, patients with vestibular migraines may not have a headache for years before the onset of vestibular symptoms. Further, in some patients, headaches and vestibular symptoms may never coincide.

Another weakness is that the DSP considers positional vertigo to be just one of the characteristics of BPPV. However, positional vertigo can also occur in patients with vestibular migraines. In cervical vertigo, dizziness, and vertigo become more severe with head movement, and the patient may report positional vertigo. In addition, the present study found that the diagnosis of vestibular impairments concerning the duration of vertigo was not very helpful. This is because a significant number of patients with Meniere's disease and vestibular migraines reported cases of vertigo lasting from a few seconds to five minutes, which is a symptom of BPPV.

According to the analysis, the presence of four items related to migraine headache symptoms in the vestibular migraine category and the low cut-off point (32.5) led to about 33% of all disagreement cases (29 out of 86 cases). These disagreements were related to the addition of vestibular migraines to the main diagnosis provided by the DSP-P. Occasionally, patients responded to vestibular migraine items with "not sure" and "disagree," but a score higher than 32.5 was still achieved. Therefore, as mentioned previously, it is recommended to eliminate or

substitute the items related to migraine headaches with items related to other characteristic symptoms or to use a higher cut-off point, such as 57.5 or 62.5. Taking such a step would improve diagnostic accuracy and increase the similarities and agreement between the diagnoses of otolaryngologists and the DSP-P.
In addition, BPPV was one of the misdiagnoses in 23 of 86 cases of disagreement. Given that most BPPV category items are related to positional vertigo, it does not appear that positional vertigo is a specific symptom of BPPV, while it may be present in other disorders (especially vestibular migraines). Therefore, it is recommended that some items related to positional vertigo be replaced with items related to other symptoms or that a paradigm be designed to better differentiate disorders.
Cronbach's alpha values were high (above 0.8) for BPPV, Meniere's disease, vestibular migraines, and vestibular neuritis, indicating good internal consistency and proper measurement of the construct in question. Cronbach's alpha values were also acceptable (between 0.6 and 0.7) for PPPD, SCD, and unspecified unsteadiness. The reason for the low Cronbach`s alpha value for the SCD category may be the small number of items. The correlation between items was measured to investigate why Cronbach's alpha was low in the PPPD category; item 31 appeared to be less correlated with other items in this category.
Landon-Lane et al. evaluated the test-retest reliability of the DSP on 150 adult patients with vestibular impairments, showing that Cronbach's alpha values of all DSP categories (excluding PPPD) were acceptable in both the test and retest stages. In their study, the Cronbach's alpha values for vestibular migraine, Meniere's disease, vestibular neuritis, BPPV, SCD, unspecified unsteadiness, and PPPD were 0.89, 0.84, 0.78, 0.74, 0.73, 0.78 and 0.67, respectively [23]. These outcomes suggest that although the Cronbach's alpha values in our study were higher than those in Landon-Lane et al.'s study, both studies generally have very good agreement for several disorders.
Considering people's memory, the fluctuating nature of vertigo, and the possibility of changing the patient's condition, the two tests were performed an average of 24 to 48 hours apart. Similarly, Landon-Lane applied a time interval between the test and retest of 1.58 days on average [23].
The results show no significant differences between the scores obtained in different categories during the test and retest, indicating that the DSP-P has very good repeatability. According to Landon-Lane et al., the test-retest reliability of the DSP was moderate to strong and the intraclass correlation coefficient ranged between 0.85 and 0.94 [23]. This outcome shows that the results of the two studies are in good agreement.
The reproducibility of the given diagnoses was very good (kappa coefficient >0.84). Meanwhile, the level of agreement of diagnoses in the test-retest reliability measurement of Suvanich et al.'s algorithm was 70.77%, and Cohen's kappa coefficient was 0.71 ($p<0.05$) [22]. Therefore, in general, the DSP-P may be suitable for clinical use.

Conclusion

This study aimed to prepare a Persian version of the Dizziness Symptom Profile (DSP) and determine its validity, reliability, sensitivity and specificity. The results showed that the Persian version of Dizziness Symptom Profile (DSP-P) is a valid and reliable history-based diagnostic tool with high sensitivity and specificity. The results were in good agreement with the results of other studies performed using the DSP; therefore, it can be used in clinical settings to reduce the number of proposed possible diagnoses and lead to the accurate differentiation of various vestibular disorders. Other applications include showing the chronology of vestibular disorders that a patient has, documenting changes in the symptoms that a person reports and documenting changes in the severity of symptoms after medical, surgical and non-medical interventions. The DSP-P can also encourage clinicians to consider the possibility of multiple co-occurring vestibular disorders as a source of patient complaints. Using the DSP-P may accelerate the diagnosis process and reduce costs and delays in diagnosing the most common vestibular disorders.

Ethical Considerations

Compliance with ethical guidelines

This study received approval from the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1399.1041). All participants signed informed consent prior the study.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

HS: Conceptualization, design of the study, data acquisition, data analysis and interpretation, drafting the manuscript; DLM: Conceptualization, study advisor, critical revision of the manuscript; MAG: Conceptualization, design of the study, study supervision, critical revision of manuscript; SJ: Data analysis and interpretation, critical revision of the manuscript; AK: Data acquisition, study advisor; PB: Data acquisition; RH: Conceptualization, design of the study, critical revision of the manuscript.

Conflict of interest

The authors have no conflict of interest, financial or otherwise to declare.

Acknowledgments

This article is emerged from H. Soleimani`s MSc thesis in Audiology submitted to Tehran University of Medical Sciences.

References

1. Grill E, Strupp M, Müller M, Jahn K. Health services utilization of patients with vertigo in primary care: a retrospective cohort study. J Neurol. 2014;261:1492-8. [DOI:10.1007/s00415-014-7367-y]
2. Jacobson GP, Piker EG, Hatton K, Watford KE, Trone T, McCaslin DL, et al. Development and Preliminary Findings of the Dizziness Symptom Profile. Ear Hear. 2019;40(3):568-76. [DOI:10.1097/AUD.0000000000000628]
3. Hale T, Trahan H, Parent-Buck T. Evaluation of the patient with dizziness and balance disorders. In: Katz J, editor. Handbook of clinical audiology. 7th ed. Philadelphia, PA: Wolters Kluwer; 2015. p. 399-424.
4. Neuhauser HK. The epidemiology of dizziness and vertigo. Handb Clin Neurol. 2016;137:67-82. [DOI:10.1016/B978-0-444-63437-5.00005-4]
5. Al Saif A, Alsenany S. Sensitivity and specificity of the amer dizziness diagnostic scale (adds) for patients with vestibular disorders. J Phys Ther Sci. 2015;27(1):91-6. [DOI:10.1589/jpts.27.91]
6. Karatas M. Central vertigo and dizziness: epidemiology, differential diagnosis, and common causes. Neurologist. 2008;14(6):355-64. [DOI:10.1097/NRL.0b013e31817533a3]
7. Newman-Toker DE, Cannon LM, Stofferahn ME, Rothman RE, Hsieh YH, Zee DS. Imprecision in patient reports of dizziness symptom quality: a cross-sectional study conducted in an acute care setting. Mayo Clin Proc. 2007;82(11):1329-40. [DOI:10.4065/82.11.1329]
8. Hall DA, Zaragoza Domingo S, Hamdache LZ, Manchaiah V, Thammaiah S, Evans C, et al. A good practice guide for translating and adapting hearing-related questionnaires for different languages and cultures. Int J Audiol. 2018;57(3):161-75. [DOI:10.1080/14992027.2017.1393565]
9. Powell G, Derry-Sumner H, Rajenderkumar D, Rushton SK, Sumner P. Persistent postural perceptual dizziness is on a spectrum in the general population. Neurology. 2020;94(18):e1929-38. [DOI:10.1212/WNL.0000000000009373]
10. Revicki D. Internal Consistency Reliability. In: Michalos AC, editor. Encyclopedia of Quality of Life and Well-Being Research. Dordrecht: Springer; 2014. p. 3305-6.
11. Marx RG, Menezes A, Horovitz L, Jones EC, Warren RF. A comparison of two time intervals for test-retest reliability of health status instruments. J Clin Epidemiol. 2003;56(8):730-5. [DOI:10.1016/s0895-4356(03)00084-2]
12. Chua K, Gans R, Spinks S. Demographic and clinical characteristics of BPPV patients: a retrospective large cohort study of 1599 patients. J Otolaryngol ENT Res. 2020;12(1):20-30. [DOI:10.15406/joentr.2020.12.00451]
13. Roberts RA, Jacobson GP, Hatton K. Multiple Co-Occurring Vestibular Disorders Identified Using the Dizziness Symptom Profile. Am J Audiol. 2020;29(3):410-8. [DOI:10.1044/2020_AJA-19-00119]
14. Ishiyama A, Jacobson KM, Baloh RW. Migraine and benign positional vertigo. Ann Otol Rhinol Laryngol. 2000;109(4):377-80. [DOI:10.1177/000348940010900407]
15. Lempert T, Olesen J, Furman J, Waterston J, Seemungal B, Carey J, et al. Vestibular migraine: Diagnostic criteria1. J Vestib Res. 2022;32(1):1-6. [DOI:10.3233/VES-201644]
16. Chu CH, Liu CJ, Lin LY, Chen TJ, Wang SJ. Migraine is associated with an increased risk for benign paroxysmal positional vertigo: a nationwide population-based study. J Headache Pain. 2015;16:62. [DOI:10.1186/s10194-015-0547-z]
17. Beh SC, Masrour S, Smith SV, Friedman DI. The Spectrum of Vestibular Migraine: Clinical Features, Triggers, and Examination Findings. Headache. 2019;59(5):727-40. [DOI:10.1111/head.13484]
18. Huang TC, Wang SJ, Kheradmand A. Vestibular migraine: An update on current understanding and future directions. Cephalalgia. 2020;40(1):107-21. [DOI:10.1177/0333102419869317]
19. Popkirov S, Staab JP, Stone J. Persistent postural-perceptual dizziness (PPPD): a common, characteristic and treatable cause of chronic dizziness. Pract Neurol. 2018;18(1):5-13. [DOI:10.1136/practneurol-2017-001809]
20. Zhao JG, Piccirillo JF, Spitznagel EL Jr, Kallogjeri D, Goebel JA. Predictive capability of historical data for diagnosis of dizziness. Otol Neurotol. 2011;32(2):284-90. [DOI:10.1097/MAO.0b013e318204aad3]
21. Filippopulos FM, Strobl R, Belanovic B, Dunker K, Grill E, Brandt T, et al. Validation of a comprehensive diagnostic algorithm for patients with acute vertigo and dizziness. Eur J Neurol. 2022;29(10):3092-101. [DOI:10.1111/ene.15448]
22. Suvanich R, Chatchawan U, Jariengprasert C, Yimtae K, Hunsawong T, Emasithi A. Development and validation of the dizziness symptoms questionnaire in Thai-outpatients. Braz J Otorhinolaryngol. 2022;88(5):780-6. [DOI:10.1016/j.bjorl.2021.05.007]
23. Landon-Lane RL, Piker EG, Jacobson GP, Hatton K, Roberts RA. Test-Retest Reliability of the Dizziness Symptom Profile. Ear Hear. 2021;42(1):206-13. [DOI:10.1097/AUD.0000000000000918]

Table 1. Comparison of mean (standard deviation) scores of the Persian version of dizziness symptom profile of patients in each category with other vestibular disorders and with healthy group

Category	Healthy group	Other vestibular disorders			
	Mean(SD)	Mean(SD)	Mean(SD)	p*	p†
BPPV	83.48(13.88)	4.66(8.7)	36.32(22.27)	<0.001	<0.001
Meniere`s disease	75.86(17.8)	3.22(6.68)	16.18(17.5)	<0.001	<0.001
Vestibular migraine	63.72(24.62)	17.37(17.4)	18.16(19.28)	<0.001	<0.001
Vestibular neuritis	81.87(8.56)	1.37(4.65)	8.46(16.24)	<0.001	<0.001
PPPD	73.15(14.54)	16.1(14.02)	34.48(18.75)	<0.001	<0.001
SCD	NM	4.07(8.06)	NM	-	-
Unspecified unsteadiness	NM	1.58(5.39)	NM	-	-

BPPV; benign paroxysmal positional vertigo, PPPD; persistent postural-perceptual dizziness, SCD; superior canal dehiscence, NM; not measured due to the low number of patients

* Comparison between category and healthy group, † Comparison between category and other vestibular disorders

Table 2. Complete agreement between diagnoses generated by the Persian version of dizziness symptom profile and gold standard based on the order and accuracy of diagnoses

Otolaryngologist diagnoses	Number of otolaryngologist diagnoses	Number of correct diagnoses of DSP-P	Percentage of agreement
BPPV	65	47	72.30
Meniere`s disease	41	26	63.41
Vestibular neuritis	8	8	100.00
Vestibular migraine	60	38	63.33
PPPD	2	0	0.00
Others	30	16	53.33
Not diagnosed	9	7	77.77
Vestibular migraine and BPPV	9	9	100.00
Vestibular migraine and PPPD	17	12	70.58
Vestibular migraine and Meniere`s disease	4	2	50.00
Meniere`s disease and PPPD	1	1	100.00
Vestibular neuritis and BPPV	1	1	100.00
Vestibular migraine and others	3	0	0.00
Vestibular migraine and vestibular neuritis	1	0	0.00
BPPV and others	1	0	0.00
Vestibular migraine and PPPD and psychogenic vertigo	1	0	0.00

DSP-P; the Persian version of dizziness symptom profile, BPPV; benign paroxysmal positional vertigo, PPPD; persistent postural-perceptual dizziness

Table 3. Important discrepancies between the diagnoses for the Persian version of dizziness symptom profile and the gold standard

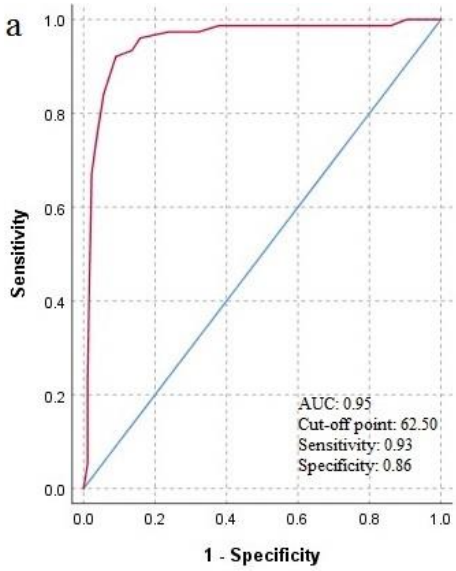
Diagnoses by otolaryngologist (gold standard)	Discrepancies between gold standard and DSP-P diagnosis (number)
BPPV	-BPPV and vestibular migraine (7)
	BPPV and PPPD (3)
	Vestibular migraine and BPPV and PPPD
Meniere`s disease	Meniere`s disease and vestibular migraine (5)
	Meniere`s disease and BPPV (3)
	Meniere`s disease and vestibular migraine and PPPD (2)
Vestibular migraine	Vestibular migraine and BPPV (5)
	Vestibular migraine and PPPD (2)
	Vestibular migraine and PPPD and BPPV (2)
Vestibular migraine and PPPD	Vestibular migraine and PPPD and BPPV (2)
	BPPV and PPPD (1)
Other vestibular disorders	Vestibular migraine (5)
	BPPV (4)
	PPPD (2)
	Vestibular migraine and PPPD (2)

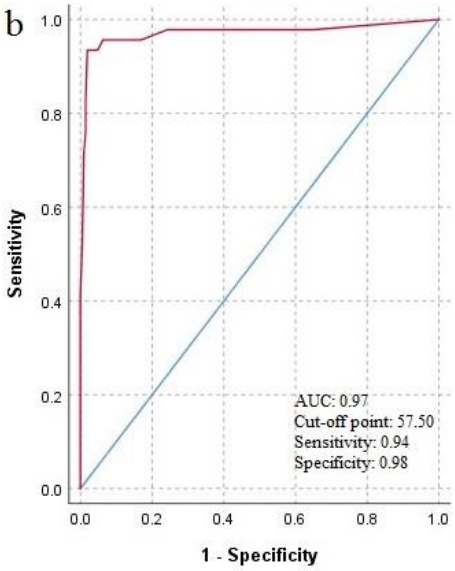
DSP-P; the Persian version of dizziness symptom profile, BPPV; benign paroxysmal positional vertigo, PPPD; persistent postural-perceptual dizziness

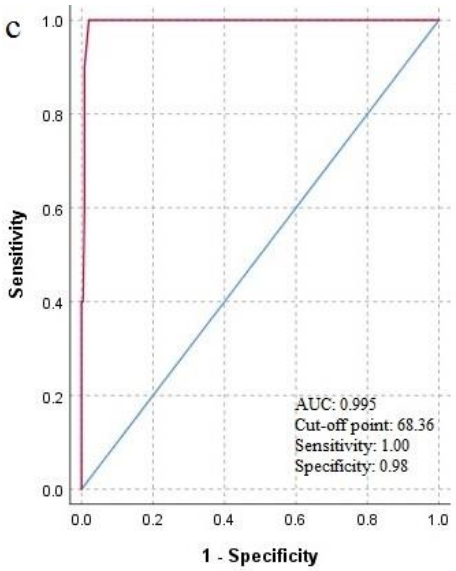
Table 4. Mean and standard deviation of scores obtained from test and restest administrations

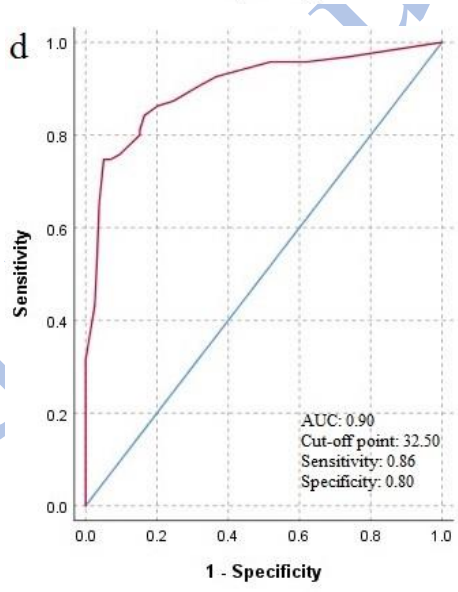
Category	Mean(SD)	
	Test administration	Retest administration
BPPV	47.16(24.90)	43.33(28.04)
Meniere`s disease	34.00(33.61)	31.50(34.11)
Vestibular migraine	38.66(31.72)	41.66(31.84)
Vestibular neuritis	12.91(22.85)	10.62(23.62)
PPPD	44.66(26.19)	46.00(24.08)
SCD	9.61(16.00)	8.29(15.44)
Unspecified unsteadiness	18.54(21.98)	16.45(17.56)

BPPV; benign paroxysmal positional vertigo, PPPD; persistent postural-perceptual dizziness, SCD; superior canal dehiscence


a
Sensitivity
1 - Specificity
AUC: 0.95
Cut-off point: 62.50
Sensitivity: 0.93
Specificity: 0.86


b
Sensitivity
1 - Specificity
AUC: 0.97
Cut-off point: 57.50
Sensitivity: 0.94
Specificity: 0.98


c
Sensitivity
1 - Specificity
AUC: 0.995
Cut-off point: 68.36
Sensitivity: 1.00
Specificity: 0.98


d
Sensitivity
1 - Specificity
AUC: 0.90
Cut-off point: 32.50
Sensitivity: 0.86
Specificity: 0.80

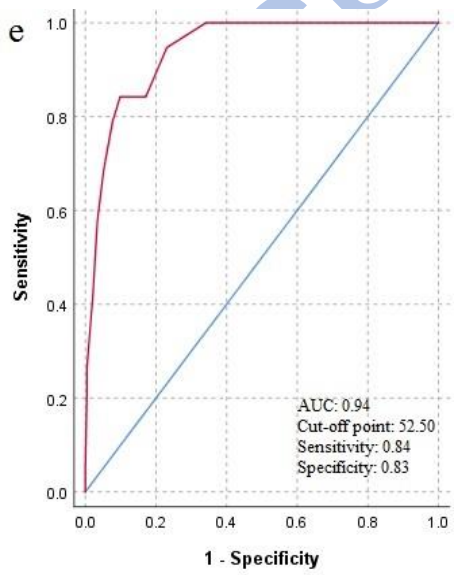

e
Sensitivity
1 - Specificity
AUC: 0.94
Cut-off point: 52.50
Sensitivity: 0.84
Specificity: 0.83

Figure 1. Receiver operating characteristic curves, area under curves, cut-off points, sensitivities, and specificities of the Persian version of dizziness symptom profile (red line) in diagnosing a) benign paroxysmal positional vertigo, b) Meniere`s disease, c) vestibular neuritis, d) vestibular migraine, and e) PPPD, and the reference line (blue). AUC; area under curve