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Original Article

Comparison of Quality of Life Between Patients with Chronic Unilateral Vestibular Hypofunction and Bilateral Vestibulopathy

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BACKGROUND: To compare symptom burden, functional impact, emotional well-being, and health-related quality of life (HRQoL) between patients with chronic unilateral vestibular hypofunction (UVH) and bilateral vestibulopathy (BVP).

METHODS: This cross-sectional study included 100 patients with chronic UVH and 148 patients with BVP from a tertiary referral center. Symptom burden and functional impact were assessed using the Bilateral Vestibulopathy Questionnaire, Dizziness Handicap Inventory, and Oscillopsia Severity Questionnaire (OSQ). Emotional well-being was evaluated with the Hospital Anxiety and Depression Scale, and HRQoL with the EuroQol 5-Dimension 5-Level and Health Utility Index Mark 3. Total scores were compared across groups. Standardized mean differences (SMDs) were calculated to quantify the differences across all patient-reported outcome measures.

RESULTS: Bilateral vestibulopathy patients reported significantly greater symptom burden and functional limitations than chronic UVH patients ($P < .05$). No significant group differences were found in emotional well-being or generic HRQoL. Both patient groups showed significantly worse outcomes than healthy controls across most domains ($P < .05$). Standardized mean difference analysis showed that when effect sizes between groups were large or moderate, the differences were statistically significant. Conversely, when effect sizes were very low or small, there were no statistically significant differences (except for the OSQ, which remained significant despite a small effect size).

CONCLUSION: Chronic UVH and BVP are associated with significantly reduced QoL. Bilateral vestibulopathy patients report a greater symptom burden and functional limitations compared to patients with chronic UVH. These findings demonstrate the need for tailored assessments and targeted rehabilitation strategies for vestibular patients.

KEYWORDS: Bilateral vestibulopathy, quality of life, questionnaire, symptom, unilateral vestibular loss, unilateral vestibular hypofunction, unilateral vestibulopathy

INTRODUCTION

Chronic unilateral vestibular hypofunction (UVH) and bilateral vestibulopathy (BVP) are heterogeneous disorders, resulting from reduced or absent vestibular function in respectively 1 or 2 vestibular end-organs, vestibular nerves, or a combination of both.[1,2]

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Patients with chronic UVH or BVP commonly experience a range of symptoms, including unsteadiness, oscillopsia, visually induced dizziness, cognitive complaints, autonomic dysfunction, tiredness, and spatial disorientation.[3-7] The severity and nature of these symptoms vary widely and are influenced by the underlying etiology, comorbid conditions, psychological factors, physical activity, and the stage of vestibular compensation.[8-10] These disorders have a wide range of etiologies, making it challenging to identify the exact cause in many cases.[1,3,4,11] The diagnosis of BVP is currently guided by the Bárány Society criteria, which rely on a combination of vestibular symptoms and objective test findings,[2] whereas no standardized diagnostic criteria exist (yet) for chronic UVH. Overall, both chronic UVH and BVP present with various clinical pictures, which often lead to misdiagnosis.[12]

Chronic UVH and BVP can both reduce quality of life (QoL) and impose substantial socioeconomic burdens, which are often underestimated.[3,4,13] To fully understand their impact on QoL, semi-structured interviews were previously conducted to explore the full spectrum of symptoms, challenges, and coping behaviors in both patient groups. These findings revealed a variety of symptoms, significant functional limitations in daily life activities, reduced social interactions, and a marked decline in overall QoL across both groups.[5,7]

In addition to qualitative insights, patient-reported outcome measures (PROMs) play a crucial role in evaluating QoL by capturing the patient's subjective experience.[14] Patient-reported outcome measures are classified into condition-specific and generic measures.[15] Condition-specific PROMs assess the impact of a particular disease or specific domains, whereas generic PROMs assess overall health and well-being, often focusing on health-related QoL.[16] These PROMs, widely used in vestibular research and clinical practice, provide valuable insights into patients' experiences. Furthermore, comparisons across different levels of symptom severity and impact on QoL are facilitated.

Previous studies using both condition-specific and generic measures showed that chronic UVH and BVP are associated with moderate-to-severe handicaps, generally normal levels of anxiety and depression, and reduced QoL in both conditions.[4,5,7] Despite the growing body of evidence on the negative impact on QoL,[3,4,13] previous studies focused on either chronic UVH or BVP. No direct comparison of QoL between the 2 conditions using a set of validated PROMs was performed. These conditions differ in pathophysiology, symptom profiles, and compensatory mechanisms.[17] This makes such a comparison clinically relevant.

MAIN POINTS

- Chronic unilateral vestibular hypofunction (UVH) and bilateral vestibulopathy patients exhibited significantly worse outcomes across multiple domains compared to healthy normative data.
- Bilateral vestibulopathy patients showed more severe impairments, but chronic UVH also led to moderate-to-severe quality of life (QoL) reduction.
- A substantial proportion of chronic UVH patients experience long-term functional and emotional limitations.
- The impact of chronic UVH on QoL is often underestimated in clinical settings.
- QoL assessment in chronic UVH requires a multidimensional approach covering physical, psychological, and social domains.

After all, understanding these differences may support more individualized, condition-specific management strategies. Therefore, the aim of this study was to investigate differences in symptom burden, functional impact, emotional well-being, and HRQoL between chronic UVH and BVP patients, using condition-specific and generic PROMs.

MATERIALS AND METHODS

Participants

This study was conducted at Maastricht University Medical Center+ during different time periods. Chronic UVH patients were included between August and December 2024. Bilateral vestibulopathy patients were included between April 2021 and January 2022. Patient-reported outcome measures were administered in the BVP group as part of another study.[18] All patients had been diagnosed prior to study inclusion, as a confirmed diagnosis was an inclusion criterion. Both patient groups had the opportunity to undergo rehabilitation prior to inclusion in this study. Patients were selected based on specific clinical and diagnostic criteria. For chronic UVH, inclusion required at least one of the following symptoms: chronic dizziness, unsteadiness, oscillopsia, or symptoms worsened by head movements. Patients with symptoms persisting for ≥3 months were considered eligible. Diagnosis was confirmed by the video head impulse test (vHIT). Video head impulse test results had to show a reduced vestibulo-ocular reflex (VOR) gain on the affected side (<0.7) with normal VOR gain on the healthy side (≥0.8-≤1.2) and a ≥18% asymmetry between ears.[7] For BVP, patients met the Bárány Society diagnostic criteria, which included unsteadiness and/or oscillopsia during walking or head movements, a reduced caloric response (sum of bithermal maximal peak SPV <6°/s), and/or a bilaterally reduced VOR gain (vHIT <0.6 or torsion swing test VOR gain <0.1).[2] Detailed descriptions of the test procedures were provided previously.[19] All patients were required to be ≥18 years old and proficient in written Dutch. Patients with a medical history of neurological disorders (such as multiple sclerosis, stroke, or Parkinson's disease) were excluded.

Patient-Reported Outcome Measures

Bilateral Vestibulopathy Questionnaire

The Bilateral Vestibulopathy Questionnaire (BVQ) assesses the full spectrum of symptoms and the impact on daily life in BVP patients. It includes 24 items across 4 subscales: imbalance, oscillopsia, cognition, and emotion. Responses are rated on a 6-point Likert scale with the following levels: always, frequently, regularly, sometimes, rarely, and never. The BVQ total score is calculated by summing the mean scores of its 4 constructs. Each construct score is the mean of its item scores, obtained by dividing the total item score by the number of items in that construct. Higher scores indicate higher symptom severity.[18]

Dizziness Handicap Inventory

The Dizziness Handicap Inventory (DHI) evaluates the impact of dizziness on QoL. It consists of 25 questions divided into 3 subscales: physical, functional, and emotional. Responses are scored using 3 options: yes (4 points), sometimes (2 points), and no (0 points). The overall DHI score is calculated by summing the scores of all items, ranging from 0 to 100. Higher scores indicate worse outcomes. Scores are categorized as follows: 0-14 indicates no handicap, 16-34 mild handicap, 36-52 moderate handicap, and 54 or higher severe handicap.[20] In this study, a score of 5 was considered representative of healthy subjects, based on the literature.[21]

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale (HADS) identifies possible anxiety and/or depression. It consists of 14 questions divided into 2 subscales: anxiety and depression. Each item is scored on a scale of 0-3. Separate subscale scores for anxiety and depression are calculated by summing the respective item scores. The total score for each subscale ranges from 0 to 21, with the following cut-offs: A score between 0 and 7 points indicates no anxiety or depression; a score between 8 and 10 points indicates possible anxiety or depression; and scores exceeding 10 points indicate probable anxiety or depression.[22] In short, the higher scores indicate worse outcomes. Based on a previous study, an anxiety score of 4 and a depression score of 2 were used as reference values in this study.[21]

Euro-QoL 5 Dimension and 5 Level

The Euro-QoL 5 Dimension and 5 Level (EQ-5D-5L) measures generic health status and health-related quality of life (HRQoL). It includes 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is rated on a 5-point scale (1 = no problems to 5 = severe problems/unable to). Scores can be converted into an EQ-5D-5L index score ranging from –0.059 to 1.0.[23,24] Additionally, the instrument includes a Visual Analog Scale (VAS) for assessing perceived health status. Low scores in both EQ-5D-5L VAS and index values reflect worse outcomes. In healthy populations, EQ-5D-5L index scores of 0.839 ± 0.179 and a VAS score of 78.8 ± 13.8 were used as reference values in this study.[24,25]

Health Utility Index 3

The Health Utility Index 3 (HUI-3) assesses general health status and HRQoL. It includes 15 questions with 8 attributes: vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain. Each attribute is rated across 5 or 6 levels of (dis)ability. Scores are transformed into HRQoL values using a population-validated utility function, yielding a range from 1 to 0. Low scores refer to worse outcomes. The HUI-3 scores are categorized as follows: No disability (1.00), mild disability (0.89-0.99), moderate disability (0.70-0.88), and severe disability (<0.70).[26] For healthy individuals, an overall health utility score of ≥0.85 is considered representative.[27]

Oscillopsia Severity Questionnaire

The Oscillopsia Severity Questionnaire (OSQ) evaluates the severity of oscillopsia in various daily activities. It consists of 9 questions. Responses are rated on a 5-point Likert scale with the following levels: 1 (never), 2 (seldom), 3 (sometimes), 4 (often), and 5 (always). The overall score is calculated as the average of all item scores, ranging from 1 (no severity) to 5 (maximum severity). A mean score of 3 or higher indicates moderate-to-extreme oscillopsia severity.[28] A mean score of ≤2 suggests minimal oscillopsia severity, which is considered normal in healthy individuals.[28]

All PROMs used in this study are validated instruments, with the exception of the OSQ, which has not been validated yet.

Normative Data of Healthy Subjects

Normative data of healthy subjects were obtained from previous studies or other sources, depending on the PROM. Regarding the DHI and HADS, normative data were obtained from 151 Dutch-speaking healthy subjects (59.6% female, mean age 50.9 ± 18.5 years).[21] For the EQ-5D-5L, the reference index scores were derived from the Dutch population (n = 1003). The index score of the 60-year-old group was used as a reference.[24] The reference EQ-5D VAS score was obtained from another study (n = 2748, 55.7% female, mean age 65.6 ± 9.6 years).[25] Regarding the HUI-3, normative data were derived from a group of 2060 subjects.[27] For the OSQ, data were collected from 57 healthy subjects (25 female, mean age 41 years, range 20-77 years).[28] For the BVQ, no normative data are yet available.[18] Therefore, no comparison with healthy subjects was made in this study.

Data Analysis

Data were analyzed using both visual methods (histogram and Q-Q plots) and statistical tests (Shapiro–Wilk test) to assess the normality of the distributions. A one-sample *t*-test was conducted to compare the QoL scores between the chronic UVH group and normative data based on healthy subjects.[29] For comparisons between the chronic UVH and BVP groups, the Mann–Whitney *U*-test was applied due to the non-normal distribution of the data. Violin plots were used for visualization, and the significance level was set at 0.05. Additionally, to quantify the difference between groups, standardized mean differences (SMD) were calculated. The SMD is a measure of effect size that quantifies the difference between 2 groups relative to their variability. In this study, the SMD between the chronic UVH group and BVP group was calculated using the formula: (mean_BVP − mean_UVH)/sd_pooled, where the pooled SD was derived from both groups). Additionally, the SMD between the chronic UVH group and the group of healthy subjects was computed using the formula: (mean_UVH – mean_healthy)/sd_UVH). Similarly, the SMD between the BVP group and the healthy control group was calculated using the formula: (mean_BVP – mean_healthy)/sd_BVP. The interpretation of the SMD values was based on Cohen's guidelines: values of 0.2 or less indicated a very low effect, 0.2-0.49 indicated a small effect, 0.5-0.79 represented a moderate effect, and values of 0.8 or higher suggested a large effect.[30]

For the comparison between chronic UVH and BVP:

- Positive SMD values indicated worse outcomes in BVP for BVQ, DHI, OSQ, and HADS.
- Negative SMD values indicated worse outcomes in BVP for HUI-3 and EQ-5D-5L compared to chronic UVH.

For the comparison between chronic UVH and normative data based on healthy subjects:

- Positive SMD values indicated worse outcomes in chronic UVH for DHI, OSQ, and HADS.
- Negative SMD values indicated worse outcomes in chronic UVH for HUI-3 and EQ-5D-5L.

For the comparison between BVP and normative data based on healthy subjects:

- Positive SMD values indicated worse outcomes in BVP for DHI, OSQ, and HADS.
- Negative SMD values indicated worse outcomes in BVP for HUI-3 and EQ-5D-5L.

A barplot was used for visualization, and all analyses were performed using R (version 4.3.1; R Foundation for Statistical Computing, Vienna, Austria).

Ethical Considerations

This study was conducted in accordance with the legislation and ethical standards on human experimentation in the Netherlands and in accordance with the Declaration of Helsinki (amended version 2013). The study protocol was classified as non-WMO (Wet medisch-wetenschappelijk onderzoek) research and received approval from the Medical Ethics Review Committee of Maastricht University and the Maastricht University Medical Center+ (UM/MUMC+) (Approval: METC 2025-0031; Date: 14.02.2025). Approval was also obtained from the Advisory Board of MUMC+. Written informed consent was obtained from all patients participating in this study.

RESULTS

Patient Characteristics

A total of 248 patients were included in this study. This comprised 100 patients with chronic UVH and 148 patients with BVP. All patients completed the disease-specific and generic PROMs. The mean age of patients at the time of diagnosis was 63.8 ± 12.0 years, with ages ranging from 20 to 90 years. Among the study population, 52% were male and 48% were female. The characteristics of chronic UVH and BVP patients are separately presented in Table 1.

For chronic UVH patients, the mean horizontal vHIT VOR gain was 0.47 ± 0.14 on the affected side and 0.93 ± 0.08 on the healthy side. In BVP patients, the mean horizontal vHIT VOR gain was 0.33 ± 0.27 for the right ear and 0.32 ± 0.23 for the left ear.[18]

Chronic Unilateral Vestibular Hypofunction Patients Versus Bilateral Vestibulopathy Patients

Significant differences were found in BVQ total scores, DHI total scores, and OSQ total scores between chronic UVH patients and BVP patients ($P < .05$). No significant differences were observed in EQ-5D-5L index, EQ-5D-5L VAS, HADS-anxiety, HADS-depression, and HUI-3 overall utility scores ($P > .05$) (Figure 1).

The SMD analysis identified moderate effects in BVQ total scores and DHI total scores, indicating significantly poorer outcomes in BVP patients compared to chronic UVH patients, with a greater impact on symptom burden and functional limitations. In contrast, all other PROMs exhibited very low to small effects, suggesting minimal differences between the 2 groups regarding these aspects (Figure 2).

Chronic Unilateral Vestibular Hypofunction Patients Versus Healthy Subjects

All PROMs demonstrated statistically significant differences between chronic UVH patients and healthy subjects ($P < .001$), except the BVQ for which normative data were unavailable. No comparison was conducted for this measure (Figure 1).

The SMD analysis identified large effects in DHI total scores and HUI-3 overall utility, indicating significantly poorer outcomes for chronic UVH patients compared to healthy subjects. Moderate effects were observed in HUI-3 Ambulation, EQ-5D-5L VAS, EQ-5D-5L index, and HADS-depression, which indicated noticeable impact on physical functioning, emotional well-being, and HRQoL. In contrast, very low to small effects were found in OSQ total scores, HADS-anxiety, HUI-3 Cognition, HUI-3 Emotion, and HUI-3 Vision. This suggested that

Table 1. Patient Characteristics of Chronic Unilateral Vestibular Hypofunction and Bilateral Vestibulopathy

	Chronic UVH Patients N = 100	BVP Patients N = 148	Total N = 248
Age (years), mean ± SD (range)	64.1 ± 10.8 (29-90 years)	63.7 ± 12.9 (20-89 years)	63.8 ± 12.0 (20-90 years)
Gender	N (%)		
Male	55 (55)	74 (50)	129 (52)
Female	45 (45)	74 (50)	119 (48)
Side of lesion			
Right	33 (33)	–	33 (13)
Left	67 (67)	–	67 (27)
Both	–	148 (100)	148 (60)
Etiologies			
Idiopathic	10 (10)	55 (37.2)	65 (26)
Infection/inflammation	33 (33)	17 (11.5)	50 (20)
Menière's disease	19 (19)	8 (5.4)	27 (11)
Genetic	–	26 (17.6)	26 (10)
Neoplasm	22 (22)	–	22 (9)
Ototoxicity	–	20 (13.5)	20 (8)
Autoimmune disorders	1 (1)	8 (5.4)	9 (4)
Vestibular migraine	5 (5)	4 (2.7)	9 (4)
Mixed etiologies	5 (5)	3 (2.0)	8 (3)
Iatrogenic	3 (3)	1 (0.7)	4 (1.5)
Neurodegenerative conditions	–	3 (2.0)	3 (1)
Congenital	–	2 (1.4)	2 (1)
Benign recurrent vertigo	1 (1)	–	1 (0.5)
Vascular	–	1 (0.7)	1 (0.5)
Metabolic	1 (1)	–	1 (0.5)

Idiopathic: Vestibular function loss with no identifiable underlying cause.
Genetic: Vestibular function loss caused by genetic mutations affecting the inner ear or vestibular neural pathways (e.g., DFNA9 due to COCH gene mutations), leading to early-onset or progressive vestibular loss.
Neoplasm: Vestibular function loss due to benign or malignant tumors involving the inner ear, vestibular nerve, or cerebellopontine angle, which can potentially cause progressive loss of function.
Iatrogenic: Vestibular function loss resulting from medical or surgical interventions, such as inner ear surgery or radiotherapy affecting vestibular structures.
Neurodegenerative conditions: Vestibular function loss associated with progressive neurodegenerative diseases affecting central or peripheral balance pathways.
Congenital: Lack of vestibular function present from birth, often associated with inner ear malformations, congenital infections, or genetic syndromes, leading to delayed motor development and long-term balance impairment.
Benign recurrent vertigo: Vestibular function loss associated with recurrent spontaneous vertigo episodes lasting minutes to hours, without hearing loss or neurological deficits.
Vascular: Vestibular function loss caused by impaired blood supply to the inner ear or central vestibular pathways, such as ischemic or microvascular disease.
Metabolic: Vestibular function loss related to metabolic disorders that affect the inner ear (e.g., diabetes or thyroid disease).
BVP, bilateral vestibulopathy; UVH, unilateral vestibular hypofunction.

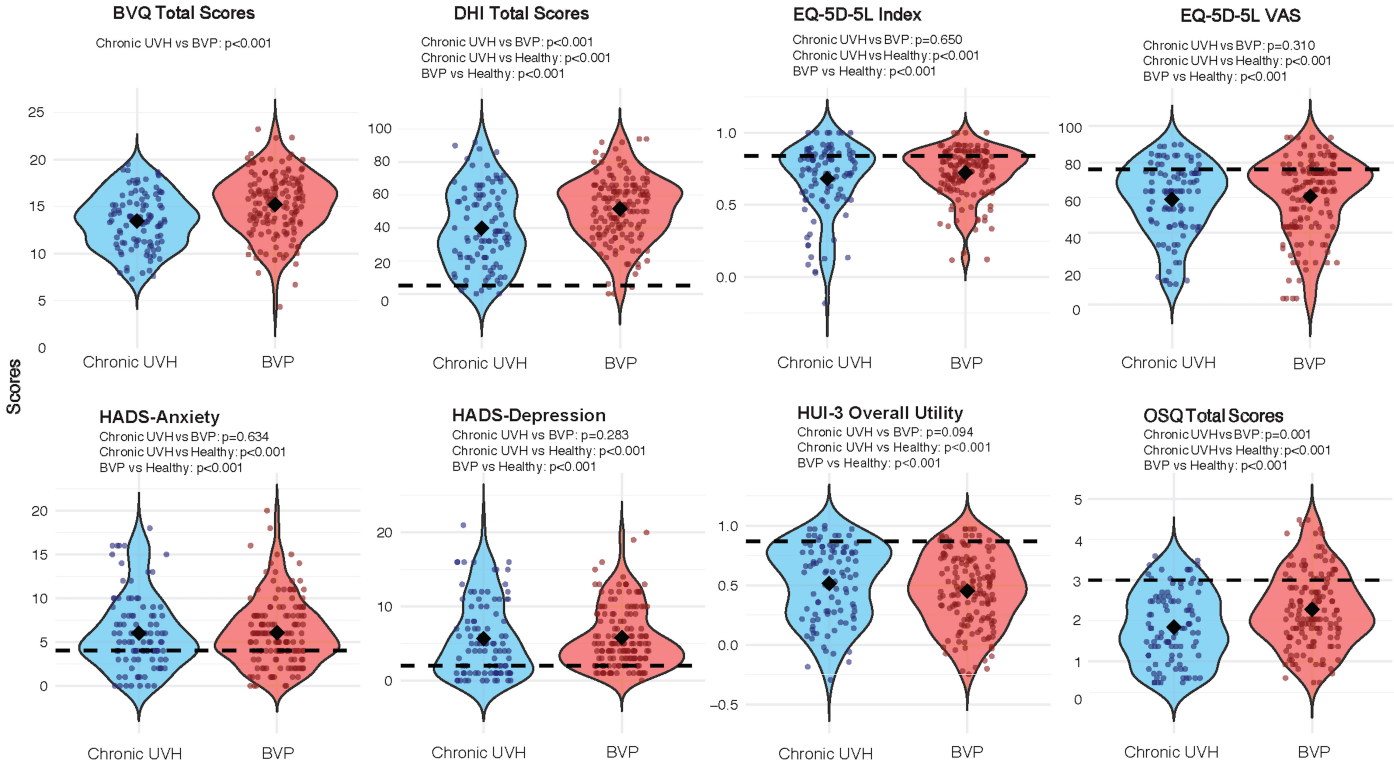


Figure 1. Violin plots illustrating the comparison of QoL across chronic UVH patients, BVP patients, and healthy subjects, using a set of PROMs. Dashed lines represent normative data of healthy subjects derived from previous studies or other sources. "Chronic UVH vs. BVP" indicates the *P*-value for the comparison between chronic UVH patients and BVP patients. "Chronic UVH vs. Healthy" shows the *P*-value for the comparison between chronic UVH patients and normative data of healthy subjects. "BVP vs. Healthy" shows the *P*-value for the comparison between BVP patients and normative data of healthy subjects. Squares within each violin plot indicate mean scores. The wider sections of violin plots indicate a higher data density, whereas narrower sections reflect lower data density.

chronic UVH patients were almost equal to healthy subjects in these domains (Figure 2).

Bilateral Vestibulopathy Patients Versus Healthy Subjects

All PROMs demonstrated statistically significant differences between BVP patients and healthy subjects ($P < .001$), except the BVQ. After all, as normative data for BVQ were unavailable, no comparison was conducted for this measure (Figure 1).

The SMD analysis identified large effects in DHI total scores, HADS-depression, and HUI-3 overall utility, indicating significantly poorer outcomes for BVP patients compared to healthy subjects. Moderate effects were observed for HUI-3 Ambulation, EQ-5D-5L VAS, EQ-5D-5L index, HADS-anxiety, and OSQ total scores. This indicated a noticeable impact on physical functioning, emotional well-being, and HRQoL. In contrast, very low to small effects were found in HUI-3 Cognition, HUI-3 Emotion, and HUI-3 Vision. This suggested that BVP patients were almost equal to healthy subjects in these domains (Figure 2).

DISCUSSION

This study demonstrated that chronic UVH and BVP patients exhibit worse outcomes across all PROMs compared to healthy subjects (only BVQ was not determined). Furthermore, BVP patients experienced a higher symptom burden and functional limitations than chronic UVH patients. This distinction was particularly evident in condition-specific PROMs: BVQ, DHI, and OSQ. However, no significant differences were observed between chronic UVH patients and BVP patients in generic PROMs and HADS.

The differences in symptom burden and functional limitations between chronic UVH patients and BVP patients could be attributed to several factors. First, the extent of vestibular hypofunction might play a role, as it can directly influence functional performance.[31] Chronic UVH patients have 1 intact vestibular organ. This improves compensatory strategies like vestibular compensation, adaptation, and sensory substitution.[32] These strategies help maintain functional independence despite occasional instability. In contrast, BVP patients lack vestibular input on both sides, which severely limits e.g., vestibular compensation.[33] Therefore, BVP patients generally report more unsteadiness (especially in dim light conditions or on uneven surfaces), oscillopsia (blurred vision during head movements), and they have a higher risk of falling.[34,35] This makes daily activities more challenging. The increased functional impairment leads to greater dependence and social isolation, which further reduces QoL.[5-7]

Secondly, vestibular hypofunction not only has physical but also psychological and emotional consequences.[36] Chronic UVH patients may develop anxiety or depression.[4,37] However, these issues are more pronounced in BVP patients.[5,13] The constant fear of falling, loss of independence, and reduced social participation can severely impact mental well-being. Difficulties in work and daily tasks may lead to a loss of self-confidence.[5] This psychological burden might further contribute to the lower QoL reported by BVP patients compared to chronic UVH patients and healthy subjects.

Beyond the severity of vestibular hypofunction, comorbidities can also influence patient outcomes and QoL. For instance, a previous

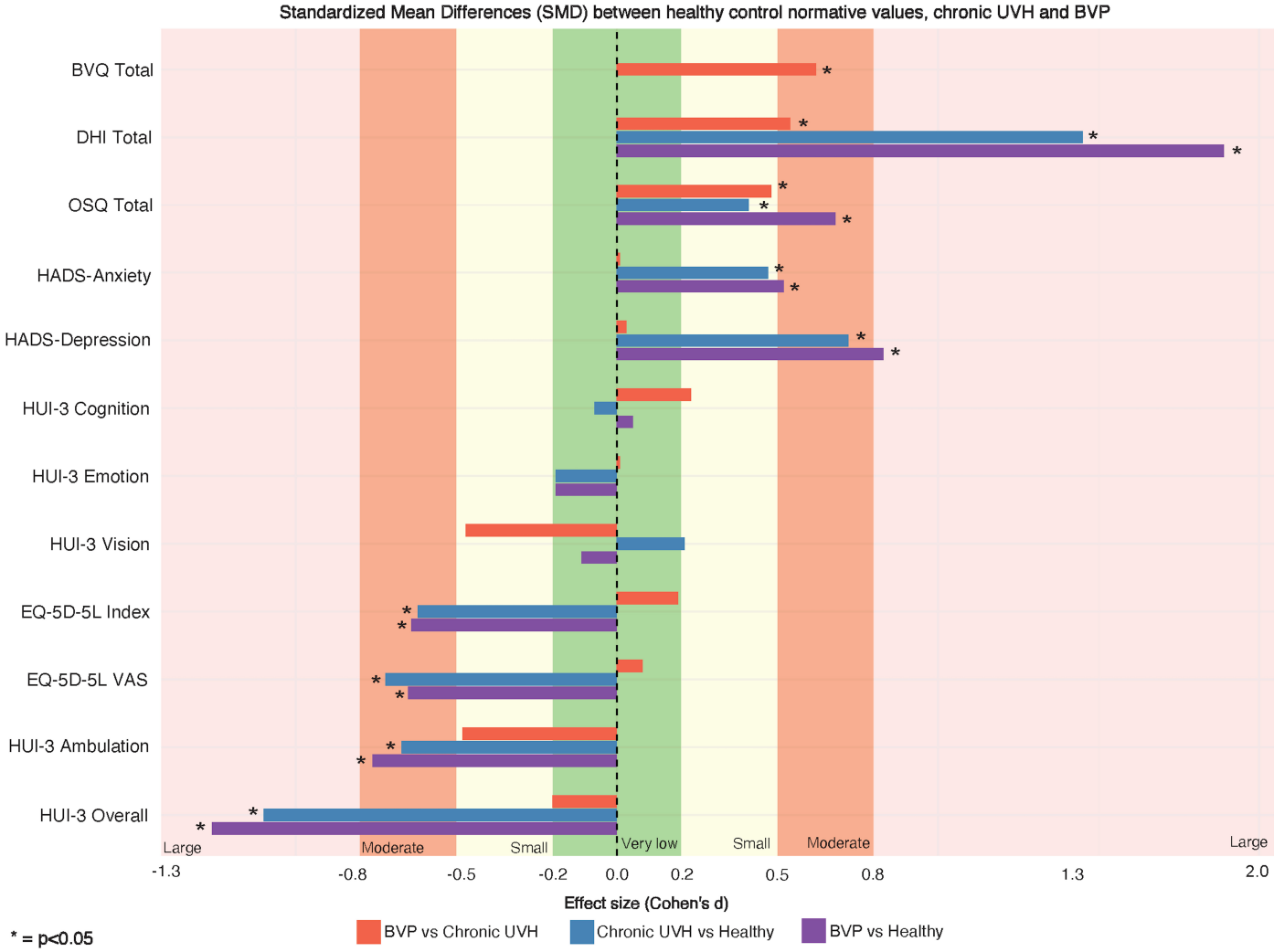


Figure 2. Bar plot of standardized mean differences (SMD) comparing chronic UVH patients, BVP patients, and healthy subjects. Standardized mean difference values are interpreted according to Cohen's guidelines: values ≤ 0.2 indicate a very low effect (green areas), values between 0.2 and 0.49 indicate a small effect (yellow areas), values between 0.5 and 0.79 represent a moderate effect (orange areas), and values ≥ 0.8 suggest a large effect (pink areas). For the comparison between BVP and chronic UVH, positive SMD values indicate worse outcomes in BVP for BVQ, DHI, OSQ, and HADS, while negative SMD values indicate worse outcomes in BVP for HUI-3 and EQ-5D-5L compared to chronic UVH. For the comparison between chronic UVH and normative data of healthy subjects, positive SMD values indicate worse outcomes in chronic UVH for DHI, OSQ, and HADS, whereas negative SMD values indicate worse outcomes in chronic UVH for HUI-3 and EQ-5D-5L. For the comparison between BVP and normative data of healthy subjects, positive SMD values indicate worse outcomes in BVP for DHI, OSQ, and HADS, whereas negative SMD values indicate worse outcomes in BVP for HUI-3 and EQ-5D-5L. Asterisks (*) indicate statistically significant differences ($P < .05$).

study found that the presence of persistent postural-perceptual dizziness (PPPD) significantly reduces QoL in chronic UVH patients.[4] Persistent postural-perceptual dizziness, characterized by persistent dizziness, motion-induced instability, and heightened anxiety, can exacerbate functional limitations and compromise adaptation.[38] While PPPD is well documented in UVH, it may also affect a subset of BVP patients, though this has been less frequently studied. This implies that clinicians should explicitly screen for comorbidities, such as PPPD, in patients with vestibular hypofunction and decreased QoL. This could facilitate appropriate management and targeted interventions.[39]

Condition-specific PROMs captured significant differences in symptom burden and functional limitations between chronic UVH patients and BVP patients. However, generic PROMs did not show significant differences between the 2 groups. This difference likely reflects the greater relevance, reliability, and sensitivity of condition-specific PROMs, which are designed to detect subtle changes in vestibular function and its impact on daily life.[40] In contrast, generic PROMs assess broad health domains, such as pain, self-care, and speech, which might not always be relevant to patients with chronic UVH or BVP. As a result, these tools may not fully capture the true burden of chronic UVH and BVP and, therefore, possibly underestimate the impact. However, it is recommended that both condition-specific and generic PROMs are used concurrently to provide a more detailed evaluation of QoL.[16] Although an extensive PROM battery was intentionally used in this study to assess symptom burden, functional impact, emotional well-being, and HRQoL across multiple domains, such an extensive assessment is not feasible for routine clinical practice. For clinical use, a more focused PROM selection is recommended. Based on the findings, the DHI provides a practical and broadly applicable measure of functional impact,[41] while the EQ-5D-5L offers a brief assessment of generic HRQoL. For patients with BVP, the BVQ is an appropriate disease-specific PROM. In contrast, a validated

disease-specific PROM for chronic UVH is currently lacking, which indicates the need for further development in this area.

In case large or moderate effect sizes were observed between groups, a statistically significant difference was found. In case very low to small effect sizes were observed, no statistically significant difference was found, except for the OSQ. This exception might be explained by 2 possible factors. First, OSQ scores may exhibit lower within-group variability, which can lead to a higher SMD and contribute to statistical significance, even when the absolute difference between groups is modest. Secondly, as a condition-specific PROM focusing on oscillopsia severity, the OSQ may be more sensitive to detect subtle differences between patient groups. At the same time, the lack of psychometric properties might also affect the reliability of the significance. These findings demonstrate the importance of interpreting both statistical significance in conjunction with effect size.

Although BVP patients exhibited the highest symptom burden in condition-specific PROMs, the present findings reveal that chronic UVH patients also experience substantial functional limitations. This is congruent with a previous study, in which approximately one-third of UVH patients reported moderate-to-severe disability, despite vestibular rehabilitation.[3] These findings indicate that chronic UVH can result in long-term impairment, which highlights the need for individualized therapy in this population. Management of chronic UVH includes treatment of the underlying cause (e.g., Menière's disease), management of secondary conditions (e.g., PPPD), and treatment of vestibular hypofunction.[42,43] Vestibular rehabilitation is regarded as the first-line therapy, although some patients show limited improvement. Regarding BVP, conventional rehabilitation often provides limited benefit, whereas emerging interventions such as vibrotactile feedback and vestibular implants have shown promising results.[44,45] While these approaches are currently applied in BVP, they may be explored in selected chronic UVH patients in the future.

Several limitations were identified in this study. First, normative data based on healthy subjects were obtained from other studies or sources. This might (partially) compromise perfect comparison with the chronic UVH and BVP patients. Nevertheless, the main goal of this study was to compare chronic UVH patients with BVP patients. Secondly, a time interval was present between diagnosis (chronic UVH or BVP) and administration of the PROMs. This interval was different for every patient. Therefore, a (partial) change in vestibular function over time cannot be excluded, although this was considered unlikely.[46] Thirdly, PROMs were administered in the BVP group as part of another study[18] and the study population included patients with a wide range of disease durations, from recently diagnosed individuals to patients with longstanding disease. Exact timing between symptom onset and questionnaire completion was not available, partly due to the gradual onset of symptoms and potential recall bias in this patient population. Fourthly, the BVQ was originally developed to assess symptom burden and functional impact in BVP patients and was not formally validated for use in chronic UVH, which might not have fully captured the symptom profile of patients with chronic UVH. Finally, there is a lack of systematic assessment of comorbidities in both the chronic UVH and BVP groups, which may have influenced symptom burden and quality of life outcomes.

CONCLUSION

Chronic UVH and BVP are associated with significantly reduced QoL. Bilateral vestibulopathy patients report a greater symptom burden and functional limitations compared to patients with chronic UVH. These findings demonstrate the need for tailored assessments and targeted rehabilitation strategies, including vestibular rehabilitation and emerging interventions such as vibrotactile feedback and vestibular implants, to address the distinct needs of vestibular patients.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of University Maastricht/Academic hospital Maastricht (UM/MUMC+)(Approval No: METC 2025-0031; Date: 14.02.2025)..

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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