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Original Article

Effect of Vestibular Rehabilitation Combined with Cervical Manual Therapy in Patients with Cervicogenic Dizziness: A Randomized Controlled Trial

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ABSTRACT

Background: Cervicogenic dizziness is associated with cervical dysfunction and disturbed integration of cervical proprioceptive, vestibular, and visual information. Evidence regarding rehabilitation programs simultaneously addressing cervical and vestibular impairments remains limited. Objective: To compare vestibular rehabilitation combined with cervical manual therapy and cervical exercises with vestibular rehabilitation alone in patients with cervicogenic dizziness. Methods: This multicenter randomized controlled trial included 60 participants allocated equally to experimental and control groups. Both groups received vestibular rehabilitation three times weekly for six weeks; the experimental group additionally received cervical manual therapy and cervical home exercises. Dizziness Handicap Inventory (DHI), Visual Analogue Scale, Neck Disability Index, Berg Balance Scale, cervical Joint Position Error, and cervical range of motion were assessed at baseline, Week 6, and Week 12. Outcomes were analyzed using mixed repeated-measures ANOVA with Bonferroni-adjusted comparisons. Results: DHI decreased from 55.4 ± 8.3 to 17.2 ± 4.4 in the experimental group and from 55.9 ± 8.5 to 32.0 ± 6.3 in controls. At Week 12, the between-group DHI difference was −14.8 points. Significant group × time interactions occurred for all outcomes (partial $\eta^2 = 0.30–0.41$; $p < 0.001$), with greater improvements in pain, disability, balance, proprioception, and cervical mobility in the experimental group. Conclusion: A multimodal cervical-plus-vestibular rehabilitation program produced greater short-term improvement than vestibular rehabilitation alone in patients with cervicogenic dizziness. Keywords: Cervicogenic dizziness; Vestibular rehabilitation; Cervical manual therapy; Dizziness Handicap Inventory; Randomized controlled trial; Physiotherapy.

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INTRODUCTION

Cervicogenic dizziness (CGD), also described as cervical dizziness, is a clinical syndrome characterized by dizziness, disequilibrium, or spatial disorientation occurring in association with neck pain, restricted cervical movement, and cervical musculoskeletal dysfunction (1,2). Unlike dizziness caused primarily by peripheral vestibular pathology, CGD is thought to involve disturbed afferent input from cervical muscles, joints, and other proprioceptive structures, resulting in incongruent information between the cervical, vestibular, and visual sensory systems (2). Patients commonly report non-rotatory dizziness, unsteadiness, neck stiffness, headache, impaired balance, and symptoms provoked or aggravated by cervical movement or sustained postures (1). Because these manifestations overlap considerably with peripheral vestibular, neurological, cardiovascular, and other causes of dizziness, CGD remains a clinical diagnosis that requires careful assessment and exclusion of alternative disorders rather than reliance on a single definitive diagnostic test (3).

Dizziness represents a substantial clinical problem because of its association with activity restriction, impaired mobility, reduced participation, and decreased quality of life. Population-based evidence indicates that dizziness and vertigo are frequently encountered symptoms across adult healthcare populations (4). When dizziness coexists with neck pain and cervical dysfunction, the resulting impairment may extend beyond subjective symptoms to postural instability, altered sensorimotor control, and difficulty performing activities requiring coordinated head, eye, and trunk movements (5). These functional consequences are particularly relevant to rehabilitation because persistent dizziness may reduce confidence during mobility and increase dependence on compensatory movement strategies, while concurrent neck pain and stiffness can further limit participation in therapeutic exercise and everyday activities.

The principal neurophysiological explanation for CGD is based on disturbed cervical proprioception and sensory mismatch. Cervical muscles and joint structures provide continuous afferent information concerning the position and movement of the head relative to the trunk. When this proprioceptive input becomes altered by pain, muscle dysfunction, restricted joint mobility, or other cervical impairments, it may conflict with information derived from vestibular and visual systems, thereby disrupting sensorimotor integration and postural control (2,6). Abnormal cervical sensorimotor function has been demonstrated in individuals with neck pain and associated disorders, supporting the clinical relevance of impaired cervical position sense and sensorimotor control (6). Consequently, assessment of patients suspected of having CGD commonly includes cervical range of motion, joint position sense, postural control, vestibulo-ocular function, and tests intended to differentiate cervical contributions to dizziness from competing vestibular or neurological causes (3,7).

Conservative rehabilitation is commonly used for CGD because treatment can address several impairments implicated in its clinical presentation. Interventions may include cervical manual therapy, vestibular rehabilitation, sensorimotor retraining, balance exercises, cervical mobility and stabilization exercises, and postural training (2,8). Manual therapy is directed primarily toward reducing cervical pain and mechanical restriction and improving movement and sensorimotor function. Techniques such as joint mobilization and sustained natural apophyseal glides have demonstrated beneficial effects on dizziness-related symptoms and cervical function in clinical trials involving patients with cervicogenic dizziness (9). Evidence syntheses have similarly reported improvements in dizziness intensity, pain, and cervical range of motion following manual therapy, although limitations in study quality, treatment heterogeneity, diagnostic criteria, and sample size continue to reduce certainty regarding the magnitude and generalizability of these effects (10,11).

Vestibular rehabilitation provides a complementary approach by targeting gaze stability, balance, habituation, sensory reweighting, and adaptation of the vestibulo-ocular and postural control systems. Programs commonly incorporate gaze-stabilization exercises, repeated exposure to symptom-provoking movements, balance retraining, head–eye coordination, and progressively challenging functional mobility activities (12). Although vestibular rehabilitation is well established in the management of peripheral vestibular hypofunction, its underlying principles of adaptation, habituation, substitution, and sensory integration are also relevant to patients whose dizziness is accompanied by disturbances in cervical sensorimotor control (8,12). Vestibular rehabilitation may therefore improve the central processing and integration of visual, vestibular, and somatosensory information, whereas cervical interventions may act more directly on the musculoskeletal and proprioceptive impairments contributing to abnormal cervical afferent input.

The potential clinical value of combining cervical manual therapy with vestibular rehabilitation arises from these complementary therapeutic mechanisms. Cervical manual therapy may reduce pain, restore mobility, and improve the quality of proprioceptive information originating from the cervical region, while vestibular rehabilitation may facilitate central compensation, sensory reweighting, gaze stabilization, and postural adaptation (8,12). Addressing both components within the same rehabilitation program may therefore provide broader improvement than treatment focused predominantly on vestibular adaptation alone. Earlier evidence reviews identified a plausible rationale for combining manual therapy and vestibular rehabilitation but concluded that direct evidence supporting the combined approach remained limited (8). More recent systematic reviews and meta-analyses have strengthened evidence for manual therapy in CGD but continue to highlight methodological heterogeneity, relatively small samples, differences in intervention dosage, variable diagnostic procedures, and inconsistent outcome assessment across trials (10,11).

An additional limitation of the existing evidence is its restricted applicability to rehabilitation settings in low- and middle-income countries. Much of the published clinical evidence concerning manual therapy and cervicogenic dizziness originates from healthcare environments outside South Asia (9-11). Differences in referral pathways, rehabilitation accessibility, clinical resources, treatment adherence, and patient characteristics may affect the implementation and effectiveness of rehabilitation interventions. Evidence evaluating a standardized program that combines structured vestibular rehabilitation with cervical manual therapy among patients with CGD in Pakistan therefore remains limited. Locally generated evidence is important for determining whether the clinical benefits observed in previous research can be reproduced within routine rehabilitation settings serving this population.

Accordingly, the present randomized controlled trial was conducted to evaluate the efficacy of vestibular rehabilitation combined with cervical manual therapy compared with vestibular rehabilitation alone in patients with cervicogenic dizziness. The primary objective was to determine whether the combined intervention produced greater reduction in dizziness-related disability, measured using the Dizziness Handicap Inventory. Secondary outcomes included neck pain intensity, neck-related disability, balance performance, cervical joint position error, and cervical range of motion. It was hypothesized that participants receiving vestibular rehabilitation combined with cervical manual therapy would demonstrate greater improvement in dizziness-related disability and associated cervical and sensorimotor outcomes following the six-week intervention and at subsequent follow-up than participants receiving vestibular rehabilitation alone.

MATERIALS AND METHODS

This multicenter, parallel-group randomized controlled trial was conducted in the outpatient physiotherapy departments of Lady Reading Hospital, Khyber Teaching Hospital, and Rehman Medical Institute, Peshawar, Pakistan, between January 2024 and December 2025. The study evaluated the effects of vestibular rehabilitation combined with cervical manual therapy compared with vestibular rehabilitation alone in patients with cervicogenic dizziness. The trial was designed in accordance with the principles of randomized controlled trial reporting. Ethical approval was obtained from the Institutional Review Board before commencement of the study, and all participants provided written informed consent before enrollment. Participant confidentiality and voluntary participation were maintained throughout the study.

Adults presenting to the participating physiotherapy departments with symptoms suggestive of cervicogenic dizziness were screened consecutively for eligibility by licensed physiotherapists with at least five years of clinical experience in musculoskeletal and vestibular rehabilitation. Cervicogenic dizziness was identified clinically on the basis of dizziness associated temporally with neck pain or cervical movement, evidence of cervical musculoskeletal dysfunction, and exclusion of alternative vestibular, neurological, cardiovascular, and other systemic causes of dizziness, consistent with the diagnostic approach described in the literature (3,7). The clinical diagnosis established by the physiotherapist was subsequently confirmed by a rehabilitation physician.

Patients were eligible if they were aged 18–65 years, had persistent symptoms for at least three months, reported dizziness associated with neck pain or neck movement, demonstrated restricted cervical range of motion or other evidence of cervical dysfunction on examination, and had a positive Cervical Neck Torsion Test or Cervical Joint Position Error test. These tests were incorporated into the broader clinical assessment because cervical torsion and sensorimotor testing may assist in identifying a cervical contribution to dizziness when interpreted together with clinical history and exclusion of competing diagnoses (3,7). Participants were also required to understand the study procedures and provide informed consent. Patients were excluded if they had a diagnosed peripheral vestibular disorder, including benign paroxysmal positional vertigo, Ménière disease, vestibular neuritis, or labyrinthitis; a central neurological disorder such as stroke, multiple sclerosis, Parkinson disease, or cerebellar pathology; vertebrobasilar insufficiency or suspected cervical arterial dysfunction; cervical fracture, tumor, inflammatory arthritis, congenital cervical abnormality, or recent cervical surgery; severe visual impairment affecting balance; uncontrolled cardiovascular disease; pregnancy; or receipt of vestibular rehabilitation or cervical manual therapy during the preceding three months. This exclusion-based diagnostic strategy was adopted because cervicogenic dizziness has no universally accepted single diagnostic gold standard and requires differentiation from disorders capable of producing similar dizziness and balance symptoms (3).

The required sample size was calculated using G*Power version 3.1.9.7 for a repeated-measures analysis involving two intervention groups and three assessment time points. The calculation assumed a medium effect size of f = 0.25, a two-sided alpha level of 0.05, statistical power of 80%, and a correlation of 0.50 among repeated observations. The minimum calculated sample was 52 participants, corresponding to 26 participants per group. Allowing approximately 15% for potential attrition, the target sample was increased to 60 participants, with 30 participants assigned to each intervention group. Eligible patients were recruited using consecutive sampling until the required sample size was achieved.

Following completion of baseline measurements, participants were randomized in a 1:1 ratio to either the experimental or control group. The allocation sequence was computer generated by an independent researcher who was not involved in participant recruitment, treatment delivery, or outcome assessment. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes prepared by an independent administrator and opened only after baseline assessment had been completed. Because of the physical nature of the intervention, neither the treating physiotherapists nor the participants could be blinded to group allocation. Outcome assessments were nevertheless performed by a physiotherapist who remained blinded to treatment allocation, and statistical analysis was undertaken without disclosure of group identity to the statistician, thereby reducing the potential for detection and analytical bias.

Participants in both groups received supervised vestibular rehabilitation three times weekly for six consecutive weeks. Each treatment session lasted approximately 45–60 minutes. The vestibular rehabilitation program incorporated gaze-stabilization, habituation, balance, postural-control, dynamic-gait, head–eye coordination, and functional-mobility exercises. These components were selected to facilitate vestibulo-ocular adaptation, habituation to symptom-provoking movements, sensory reweighting, postural control, and functional compensation, consistent with established principles of vestibular rehabilitation (8,12). Exercise difficulty and complexity were progressively modified according to symptom tolerance and clinical performance.

Gaze-stabilization training included vestibulo-ocular reflex exercises using VOR ×1 and VOR ×2 tasks performed initially in sitting and subsequently in standing, with progression achieved by increasing head-movement speed and visual or postural complexity. Habituation exercises involved repeated exposure to head and body movements that provoked symptoms within individual tolerance. Balance retraining progressed from static to dynamic activities, from firm to compliant support surfaces, and from eyes-open to eyes-closed conditions where appropriate. Postural-control activities emphasized cervical alignment and trunk stability, while dynamic-gait training incorporated walking with head movements, tandem walking, obstacle negotiation, and dual-task activities. Head–eye coordination and functional activities such as sit-to-stand transfers, turning, reaching, and stair negotiation were incorporated according to individual ability. The progressive structure was consistent with contemporary vestibular rehabilitation principles emphasizing adaptation, habituation, substitution, balance retraining, and task-specific progression (12).

In addition to the standardized vestibular rehabilitation program, participants allocated to the experimental group received cervical manual therapy directed at clinically identified cervical pain, mobility restriction, muscle dysfunction, and associated sensorimotor impairment. Manual therapy approaches are supported as conservative interventions for cervicogenic dizziness, although available studies have used heterogeneous techniques and treatment dosages (8,10,11). The intervention included Maitland cervical joint mobilization, Mulligan sustained natural apophyseal glides, soft-tissue mobilization, myofascial release, manual muscle stretching, and gentle cervical traction when clinically indicated and after exclusion of contraindications. Maitland mobilizations were applied using Grades I–IV according to pain severity, mobility restriction, and clinical examination findings, whereas sustained natural apophyseal glides were applied to restricted cervical segments during active cervical movement. Mobilization-based approaches, including Maitland techniques and sustained natural apophyseal glides, have previously been evaluated in randomized trials of cervicogenic dizziness and have demonstrated improvements in dizziness and cervical function (9).

Soft-tissue techniques in the experimental group were directed toward the cervical paraspinal, upper trapezius, levator scapulae, sternocleidomastoid, suboccipital, and related cervical or upper thoracic musculature according to examination findings. Manual stretching was applied to shortened cervical muscle groups, including the upper trapezius, levator scapulae, scalenes, sternocleidomastoid, and suboccipital muscles. Gentle manual cervical traction was used only where clinically indicated. The manual-therapy component was progressively modified according to reassessment findings over the six-week treatment period. During the initial weeks, treatment emphasized lower-grade mobilization, soft-tissue techniques, and gentle stretching; subsequent sessions progressed toward higher-grade mobilization, sustained natural apophyseal glides, myofascial techniques, and management of persisting movement restrictions. Such multimodal cervical management is consistent with the proposed therapeutic objective of improving cervical mobility, reducing pain, and normalizing cervical sensorimotor input in patients with cervicogenic dizziness (2,8,10,11).

The home-exercise prescription differed according to intervention allocation. Participants in both groups were instructed to perform vestibular exercises daily and record adherence in an exercise diary. Participants in the experimental group additionally performed prescribed cervical mobility and stretching exercises, whereas the control group performed the vestibular home program alone. Accordingly, the experimental intervention represented a multimodal cervical-plus-vestibular rehabilitation program rather than an isolated manual-therapy exposure. All supervised interventions were delivered by licensed physiotherapists with at least five years of experience in musculoskeletal and vestibular rehabilitation.

Treatment progression followed a structured six-week sequence. During Week 1, vestibular rehabilitation consisted primarily of VOR ×1 training, basic balance exercises, habituation, and postural correction, while the experimental group additionally received Grade I–II cervical mobilization, soft-tissue mobilization, and gentle stretching. During Week 2, vestibular exercise repetitions and standing-balance demands were increased, with gaze-stabilization progression, while cervical treatment progressed to Grade II–III mobilization, sustained natural apophyseal glides where clinically indicated, and myofascial techniques. Week 3 incorporated dynamic gait activities and obstacle negotiation with head movements, accompanied in the experimental group by Grade III mobilization, progression of sustained natural apophyseal glides, and cervical stretching. During Week 4, vestibular rehabilitation advanced to balance activities on unstable surfaces and dual-task exercises, while cervical techniques were continued according to reassessment. Week 5 emphasized functional mobility and advanced gaze-stabilization tasks, with manual therapy directed toward persisting cervical restrictions. Week 6 focused on functional integration, individualized progression, reinforcement of the home program, and final reassessment of cervical mobility and symptom response.

Clinical outcomes were evaluated at three predefined assessment points: baseline before randomization (Week 0), immediately after completion of the six-week supervised intervention (Week 6), and Week 12, corresponding to a further assessment six weeks after completion of supervised treatment. The same blinded physiotherapist conducted the assessments at all time points to improve measurement consistency and minimize detection bias.

The primary outcome was dizziness-related disability measured using the Dizziness Handicap Inventory (DHI). The DHI is a 25-item patient-reported measure evaluating the perceived functional, emotional, and physical consequences of dizziness, with a total score ranging from 0 to 100; higher scores represent greater dizziness-related disability. The DHI was selected as the primary outcome because dizziness-related functional limitation constitutes a central clinical manifestation of cervicogenic dizziness and has been commonly used in previous clinical studies evaluating treatment effects in this population (2,9-11).

Secondary outcomes comprised neck pain intensity, neck-related disability, balance performance, cervical proprioception, and cervical range of motion. Neck pain intensity was assessed using a 10-cm Visual Analogue Scale ranging from 0, representing no pain, to 10, representing the worst imaginable pain. Neck-related functional disability was measured using the Neck Disability Index, with scores ranging from 0 to 50 and higher scores indicating greater disability. Balance performance was assessed using the Berg Balance Scale, for which higher scores reflect better functional balance. Cervical proprioception was evaluated using the Cervical Joint Position Error test with a laser-pointer system, and absolute repositioning error was recorded in degrees; lower errors represented greater repositioning accuracy. Cervical joint-position and other sensorimotor tests have been used to characterize proprioceptive impairment associated with neck pain and related cervical disorders (6,7).

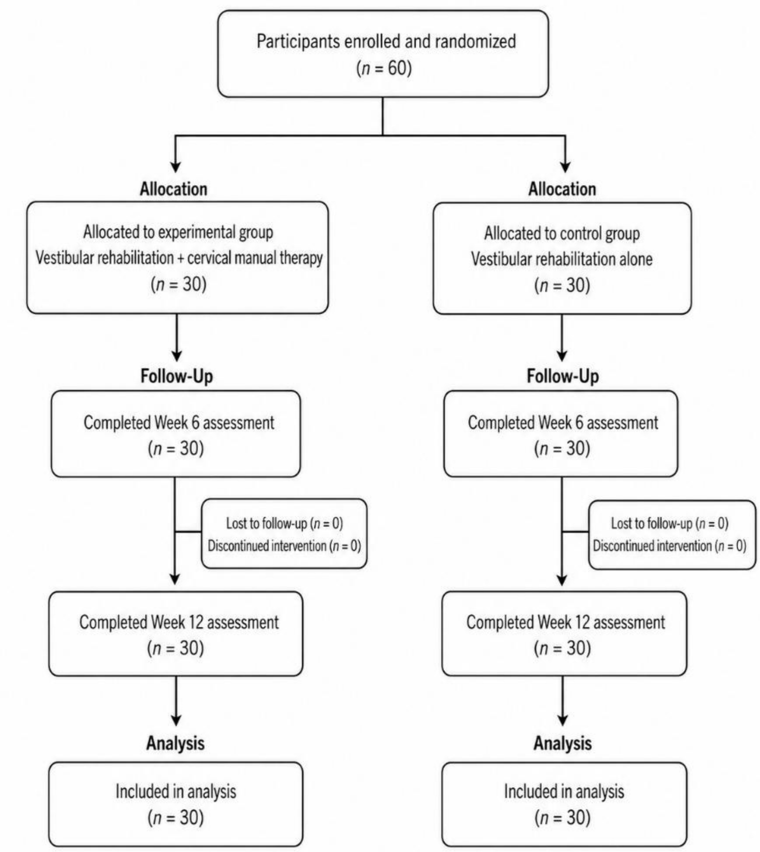

Figure 1 CONSORT Flowchart

Active cervical range of motion was assessed for flexion, extension, right and left rotation, and right and left lateral flexion using a Cervical Range of Motion device. Three measurements were obtained for each movement direction, and the mean value was used for analysis. Measuring cervical mobility alongside proprioceptive, balance, pain, and dizziness outcomes allowed the intervention to be evaluated across the principal musculoskeletal and sensorimotor domains implicated in cervicogenic dizziness (2,10,11).

Several procedures were used to enhance intervention fidelity and data quality. Before participant recruitment, treating physiotherapists underwent standardized training in the study intervention protocol, and a treatment manual was used to promote consistency across the participating centers. Treatment delivery and participant adherence were documented throughout the intervention period. Attendance was recorded at each supervised session, and participants attending fewer than 80% of scheduled treatment sessions were defined a priori as non-compliant. Home-exercise adherence was monitored using participant exercise diaries. Adverse events occurring during treatment were documented and managed according to the clinical procedures of the participating institutions. Outcome assessment and statistical analysis were blinded to treatment allocation as additional measures to limit measurement and analytical bias. Data was analyzed using IBM SPSS Statistics version 27.0. Continuous variables were summarized as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Distributional assumptions for continuous variables were evaluated using the Shapiro–Wilk test together with visual inspection of Q–Q plots. Baseline characteristics were summarized descriptively, with independent-samples t tests used for continuous variables and the chi-square test or Fisher exact test, as appropriate, for categorical variables.

Changes in clinical outcomes across the three assessment points were evaluated using a two-way mixed repeated-measures analysis of variance, with intervention group as the between-subject factor and time as the within-subject factor. The group × time interaction was used to determine whether the pattern of change over time differed between the experimental and control groups. Significant omnibus effects were explored using Bonferroni-adjusted pairwise comparisons to control inflation of type I error across repeated comparisons. Treatment effects were expressed using partial eta squared (η^2p) for repeated-measures ANOVA, and standardized between-group effects were expressed using Cohen's d where applicable. All statistical tests were two sided, and a p-value <0.05 was considered statistically significant. All 60 randomized participants completed the scheduled outcome assessments and were retained in the analysis; consequently, no outcome-data imputation was required.

RESULTS

A total of 60 participants with clinically diagnosed cervicogenic dizziness were enrolled and randomized in a 1:1 ratio to the experimental group, which received vestibular rehabilitation combined with cervical manual therapy (n = 30), or the control group, which received vestibular rehabilitation alone (n = 30). All randomized participants completed the six-week intervention and the Week 12 assessment and were retained in the final analysis.

Participant Characteristics

The baseline demographic and clinical characteristics of the participants are presented in Table 1. The mean age was 44.4 ± 8.3 years in the experimental group and 45.1 ± 8.8 years in the control group. Men represented 53.3% and 50.0% of the experimental and control groups, respectively.

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	Experimental Group (n = 30)	Control Group (n = 30)
Age, years	44.4 ± 8.3	45.1 ± 8.8
Male, n (%)	16 (53.3)	15 (50.0)
Female, n (%)	14 (46.7)	15 (50.0)
Height, cm	169.0 ± 7.3	168.4 ± 7.0
Weight, kg	72.0 ± 9.4	70.9 ± 9.8
BMI, kg/m^2	25.2 ± 3.0	24.9 ± 3.1
Symptom duration, months	8.9 ± 2.9	9.2 ± 3.1
Right-sided symptoms, n (%)	17 (56.7)	16 (53.3)
Left-sided symptoms, n (%)	11 (36.7)	12 (40.0)
Bilateral symptoms, n (%)	2 (6.7)	2 (6.7)
DHI score	55.4 ± 8.3	55.9 ± 8.5
VAS score	7.5 ± 1.0	7.6 ± 1.1
NDI score	29.4 ± 4.6	29.7 ± 4.8
BBS score	44.2 ± 4.1	43.9 ± 4.3
JPE, °	7.6 ± 1.2	7.7 ± 1.3
Cervical flexion, °	37.3 ± 5.0	37.1 ± 5.1
Cervical extension, °	43.5 ± 5.6	43.4 ± 5.8
Right rotation, °	57.5 ± 6.9	57.3 ± 7.1
Left rotation, °	57.2 ± 6.8	57.0 ± 7.0
Right lateral flexion, °	30.8 ± 4.8	30.6 ± 4.9
Left lateral flexion, °	31.0 ± 4.8	30.9 ± 5.0

Values are mean ± SD unless otherwise indicated. BMI, body mass index; DHI, Dizziness Handicap Inventory; VAS, Visual Analogue Scale; NDI, Neck Disability Index; BBS, Berg Balance Scale; JPE, Joint Position Error.

Mean body mass index was 25.2 ± 3.0 kg/m^2 in the experimental group and 24.9 ± 3.1 kg/m^2 in the control group, while mean symptom duration was 8.9 ± 2.9 and 9.2 ± 3.1 months, respectively. Right-sided symptoms were the most frequently reported pattern in both groups. Baseline values for dizziness-related disability, pain, neck disability, balance, cervical joint position error, and cervical range of motion were also closely comparable between groups.

Changes in Dizziness-Related Disability and Secondary Outcomes

Both groups demonstrated progressive improvement from baseline to Week 6 and Week 12 across all measured clinical outcomes; however, the magnitude of change was consistently greater in the experimental group. The longitudinal outcome values are summarized in Table 2. The primary outcome, DHI score, decreased in the experimental group from 55.4 ± 8.3 at baseline to 30.6 ± 6.1 at Week 6 and 17.2 ± 4.4 at Week 12. The control group improved from 55.9 ± 8.5 at baseline to 41.8 ± 6.9 at Week 6 and 32.0 ± 6.3 at Week 12. The corresponding absolute improvement from baseline to Week 12 was 38.2 points in the experimental group compared with 23.9 points in the control group. Pain intensity followed a similar pattern. Mean VAS scores decreased from 7.5 ± 1.0 to 3.5 ± 0.8 at Week 6 and 1.6 ± 0.6 at Week 12 in the experimental group, whereas the control group decreased from 7.6 ± 1.1 to 4.8 ± 0.9 and 3.4 ± 0.8, respectively. Neck-related disability also decreased progressively, with NDI scores falling from 29.4 ± 4.6 to 10.2 ± 2.6 by Week 12 in the experimental group, compared with a reduction from 29.7 ± 4.8 to 17.4 ± 3.5 in the control group.

Balance improved in both groups, but greater improvement occurred following the combined intervention. Mean BBS scores increased from 44.2 ± 4.1 at baseline to 50.2 ± 3.0 at Week 6 and 54.4 ± 2.0 at Week 12 in the experimental group. Corresponding values in the control group were 43.9 ± 4.3, 47.0 ± 3.5, and 49.8 ± 2.9. Cervical proprioception also improved over time.

Table 2. Clinical Outcomes at Baseline, Week 6, and Week 12

Outcome	Group	Baseline	Week 6	Week 12	Absolute Change
DHI	Experimental	55.4 ± 8.3	30.6 ± 6.1	17.2 ± 4.4	−38.2
	Control	55.9 ± 8.5	41.8 ± 6.9	32.0 ± 6.3	−23.9
VAS	Experimental	7.5 ± 1.0	3.5 ± 0.8	1.6 ± 0.6	−5.9
	Control	7.6 ± 1.1	4.8 ± 0.9	3.4 ± 0.8	−4.2
NDI	Experimental	29.4 ± 4.6	16.5 ± 3.6	10.2 ± 2.6	−19.2
	Control	29.7 ± 4.8	21.9 ± 3.8	17.4 ± 3.5	−12.3
BBS	Experimental	44.2 ± 4.1	50.2 ± 3.0	54.4 ± 2.0	+10.2
	Control	43.9 ± 4.3	47.0 ± 3.5	49.8 ± 2.9	+5.9
JPE, °	Experimental	7.6 ± 1.2	4.1 ± 0.8	2.4 ± 0.5	−5.2
	Control	7.7 ± 1.3	5.5 ± 0.9	4.3 ± 0.7	−3.4
Cervical flexion, °	Experimental	37.3 ± 5.0	44.2 ± 4.3	49.0 ± 3.7	+11.7
	Control	37.1 ± 5.1	40.5 ± 4.7	42.9 ± 4.4	+5.8
Cervical extension, °	Experimental	43.5 ± 5.6	50.6 ± 4.7	55.5 ± 4.1	+12.0
	Control	43.4 ± 5.8	46.7 ± 5.0	49.2 ± 4.6	+5.8
Right rotation, °	Experimental	57.5 ± 6.9	67.5 ± 5.4	73.1 ± 4.3	+15.6
	Control	57.3 ± 7.1	62.0 ± 6.0	65.4 ± 5.3	+8.1
Left rotation, °	Experimental	57.2 ± 6.8	67.8 ± 5.3	73.4 ± 4.2	+16.2
	Control	57.0 ± 7.0	62.2 ± 6.0	65.7 ± 5.2	+8.7
Right lateral flexion, °	Experimental	30.8 ± 4.8	37.5 ± 4.0	41.5 ± 3.5	+10.7
	Control	30.6 ± 4.9	34.5 ± 4.4	36.8 ± 4.0	+6.2
Left lateral flexion, °	Experimental	31.0 ± 4.8	37.9 ± 4.0	41.8 ± 3.4	+10.8
	Control	30.9 ± 5.0	34.8 ± 4.3	37.2 ± 4.0	+6.3

Negative change indicates improvement for DHI, VAS, NDI, and JPE; positive change indicates improvement for BBS and cervical range of motion.

Mean JPE decreased from 7.6 ± 1.2° to 4.1 ± 0.8° and 2.4 ± 0.5° in the experimental group at Weeks 6 and 12, respectively. In the control group, JPE decreased from 7.7 ± 1.3° to 5.5 ± 0.9° and 4.3 ± 0.7°. Improvements in cervical mobility were observed across all movement directions. By Week 12, cervical flexion increased to 49.0 ± 3.7° in the experimental group compared with 42.9 ± 4.4° in the control group, while cervical extension increased to 55.5 ± 4.1° and 49.2 ± 4.6°, respectively. Similar patterns were observed for bilateral rotation and lateral flexion.

Between-Group Effects at Week 12

Direct between-group comparisons at Week 12 demonstrated consistently larger favorable outcomes in the experimental group. For the primary outcome, mean DHI was 14.8 points lower in the experimental group than in the control group (mean difference [MD] −14.80, 95% CI −17.62 to −11.98; Cohen's d = −2.72). Pain was also lower by 1.80 VAS points (95% CI −2.17 to −1.43; d = −2.55), while NDI was lower by 7.20 points (95% CI −8.80 to −5.60; d = −2.34). The experimental group demonstrated a 4.60-point higher BBS score at Week 12 (95% CI 3.31 to 5.89; d = 1.85) and a 1.90° lower JPE (95% CI −2.22 to −1.58; d = −3.12). Between-group differences in cervical range of motion ranged from 4.60° for left lateral flexion to 7.70° for bilateral rotation, consistently favoring the combined intervention.

Table 3. Between-Group Differences at Week 12

Outcome	Experimental	Control	Mean Difference	95% CI	Cohen's d
DHI	17.2 ± 4.4	32.0 ± 6.3	−14.80	−17.62 to −11.98	−2.72
VAS	1.6 ± 0.6	3.4 ± 0.8	−1.80	−2.17 to −1.43	−2.55
NDI	10.2 ± 2.6	17.4 ± 3.5	−7.20	−8.80 to −5.60	−2.34
BBS	54.4 ± 2.0	49.8 ± 2.9	+4.60	3.31 to 5.89	+1.85
JPE, °	2.4 ± 0.5	4.3 ± 0.7	−1.90	−2.22 to −1.58	−3.12
Cervical flexion, °	49.0 ± 3.7	42.9 ± 4.4	+6.10	4.00 to 8.20	+1.50
Cervical extension, °	55.5 ± 4.1	49.2 ± 4.6	+6.30	4.05 to 8.55	+1.45
Right rotation, °	73.1 ± 4.3	65.4 ± 5.3	+7.70	5.20 to 10.20	+1.60
Left rotation, °	73.4 ± 4.2	65.7 ± 5.2	+7.70	5.25 to 10.15	+1.63
Right lateral flexion, °	41.5 ± 3.5	36.8 ± 4.0	+4.70	2.76 to 6.64	+1.25
Left lateral flexion, °	41.8 ± 3.4	37.2 ± 4.0	+4.60	2.68 to 6.52	+1.24

Mean difference calculated as experimental minus control. Negative differences favor the experimental group for DHI, VAS, NDI, and JPE because lower values represent better outcomes; positive differences favor the experimental group for BBS and cervical range of motion. Confidence intervals and Cohen's d values were derived directly from the reported Week 12 means, standard deviations, and group sizes (n = 30 per group).

Mixed Repeated-Measures Analysis

Mixed repeated-measures ANOVA demonstrated significant effects of time and significant group × time interactions for all primary and secondary outcomes. The strongest reported interaction effect was observed for DHI ($F = 36.84$, $p < 0.001$, partial $\eta^2 = 0.41$), indicating that the trajectory of dizziness-related disability differed substantially between the two treatment groups. Significant interaction effects were also observed for VAS ($F = 29.84$, $p < 0.001$, partial $\eta^2 = 0.37$), NDI ($F = 32.58$, $p < 0.001$, partial $\eta^2 = 0.39$), BBS ($F = 24.93$, $p < 0.001$, partial $\eta^2 = 0.33$), and JPE ($F = 30.85$, $p < 0.001$, partial $\eta^2 = 0.38$). All cervical range-of-motion outcomes demonstrated significant group × time interactions, with partial η^2 values ranging from 0.30 for cervical flexion to 0.35 for left rotation. These findings indicate that changes in cervical mobility over the study period differed according to treatment allocation.

Table 4. Mixed Repeated-Measures ANOVA for Clinical Outcomes

Outcome	Group Effect F (p)	Time Effect F (p)	Group × Time F (p)	Partial η^2
DHI	18.86 (<0.001)	218.42 (<0.001)	36.84 (<0.001)	0.41
VAS	15.24 (<0.001)	183.91 (<0.001)	29.84 (<0.001)	0.37
NDI	17.35 (<0.001)	199.76 (<0.001)	32.58 (<0.001)	0.39
BBS	13.02 (0.001)	166.41 (<0.001)	24.93 (<0.001)	0.33
JPE	15.41 (<0.001)	189.72 (<0.001)	30.85 (<0.001)	0.38
Cervical flexion	11.46 (0.001)	152.38 (<0.001)	22.98 (<0.001)	0.30
Cervical extension	12.09 (<0.001)	158.36 (<0.001)	24.11 (<0.001)	0.31
Right rotation	13.82 (<0.001)	172.55 (<0.001)	26.91 (<0.001)	0.34
Left rotation	14.04 (<0.001)	175.64 (<0.001)	27.26 (<0.001)	0.35
Right lateral flexion	11.75 (0.001)	159.42 (<0.001)	24.33 (<0.001)	0.31
Left lateral flexion	12.02 (0.001)	162.11 (<0.001)	24.79 (<0.001)	0.32

η^2, partial eta squared. Values are reproduced from the reported mixed repeated-measures ANOVA.

Pairwise Changes Across Assessment Periods

Bonferroni-adjusted pairwise comparisons demonstrated significant improvement from baseline to Week 6 and from baseline to Week 12 for all assessed outcomes in both groups. In the experimental group, DHI, VAS, NDI, and JPE also showed significant further improvement between Week 6 and Week 12 (all $p < 0.001$). Balance and cervical range-of-motion outcomes continued to improve during this period, with Week 6-to-Week 12 p-values ranging from 0.003 to 0.006. The control group similarly demonstrated improvement between baseline and both subsequent assessments. Changes from Week 6 to Week 12 remained statistically significant but were smaller in magnitude, with reported p-values ranging from 0.016 to 0.039.

Table 5. Bonferroni-Adjusted Within-Group Pairwise Comparisons

Group / Outcome	Baseline vs Week 6	Baseline vs Week 12	Week 6 vs Week 12
Experimental Group			
DHI	<0.001	<0.001	<0.001
VAS	<0.001	<0.001	<0.001
NDI	<0.001	<0.001	<0.001
BBS	<0.001	<0.001	0.005
JPE	<0.001	<0.001	<0.001
Cervical flexion	<0.001	<0.001	0.003
Cervical extension	<0.001	<0.001	0.004
Right rotation	<0.001	<0.001	0.006
Left rotation	<0.001	<0.001	0.005
Right lateral flexion	<0.001	<0.001	0.003
Left lateral flexion	<0.001	<0.001	0.003
Control Group			
DHI	<0.001	<0.001	0.016
VAS	<0.001	<0.001	0.021
NDI	<0.001	<0.001	0.025
BBS	0.004	<0.001	0.034
JPE	<0.001	<0.001	0.019
Cervical flexion	0.005	<0.001	0.037
Cervical extension	0.005	<0.001	0.031
Right rotation	0.003	<0.001	0.027
Left rotation	0.003	<0.001	0.028
Right lateral flexion	0.004	<0.001	0.039
Left lateral flexion	0.004	<0.001	0.038

Overall Outcome Pattern

Across the 12-week assessment period, both interventions were associated with improvement in dizziness-related disability, neck pain, neck-related disability, balance, cervical proprioception, and cervical mobility. The magnitude of improvement was consistently greater in participants receiving the combined cervical and vestibular rehabilitation program. The most pronounced between-group differences at Week 12 were observed for DHI, JPE, VAS, and NDI, while clinically favorable differences were also evident in balance performance and all cervical range-of-motion measures. The significant group × time interactions across all assessed outcomes further indicated different recovery trajectories between the two intervention groups.

DISCUSSION

The present randomized controlled trial evaluated whether a multimodal rehabilitation program combining vestibular rehabilitation with cervical manual therapy and cervical home exercises provided greater benefit than vestibular rehabilitation alone in patients with cervicogenic dizziness. Both groups improved over the 12-week assessment period; however, the experimental group demonstrated consistently greater improvement in dizziness-related disability, neck pain, neck-related disability, balance, cervical proprioception, and cervical range of motion. The primary outcome, Dizziness Handicap Inventory (DHI), showed a greater reduction in the experimental group, with mean scores decreasing from 55.4 at baseline to 17.2 at Week 12 compared with a reduction from 55.9 to 32.0 in the control group. The Week 12 between-group difference was 14.8 DHI points, while the significant group × time interaction indicated that the pattern of improvement differed between the interventions. These findings support the study hypothesis that adding a structured cervical rehabilitation component to vestibular rehabilitation can provide additional clinical benefit in appropriately selected patients with cervicogenic dizziness.

The greater reduction in dizziness-related disability observed after the combined intervention is consistent with current models of cervicogenic dizziness, in which altered cervical somatosensory information is considered capable of disrupting integration among cervical proprioceptive, visual, and vestibular inputs (2). Cervical pain, restricted movement, and impaired sensorimotor control may modify afferent information regarding head position relative to the trunk, while vestibular rehabilitation promotes adaptation, habituation, gaze stabilization, postural control, and sensory reweighting (6,12). The observed treatment effect is therefore physiologically plausible because the experimental program addressed both cervical musculoskeletal and broader sensorimotor impairments. Nevertheless, the present design does not establish that cervical manual therapy alone was responsible for the additional benefit because participants in the experimental group also received cervical mobility and stretching exercises as part of their home program. The findings should consequently be interpreted as evidence for the combined cervical-plus-vestibular rehabilitation strategy, rather than as an isolated estimate of the effect of manual therapy.

The present DHI findings are broadly consistent with previous clinical evidence supporting cervical manual therapy for cervicogenic dizziness. Reid et al. compared Mulligan sustained natural apophyseal glides with Maitland mobilization and placebo and reported improvements in dizziness-related outcomes following active manual therapy (9). Systematic evidence has similarly suggested that manual therapy can reduce dizziness impact and related cervical symptoms, although the certainty and magnitude of benefit have varied because of differences in diagnostic criteria, treatment protocols, follow-up periods, and study quality (2,10,11). The present trial extends this evidence by evaluating cervical treatment within a structured vestibular rehabilitation program rather than comparing different manual-therapy techniques alone. This distinction is clinically relevant because cervicogenic dizziness frequently presents as a multidimensional problem involving dizziness, neck symptoms, proprioceptive impairment, postural instability, and restricted cervical movement rather than as an isolated mechanical cervical disorder.

Pain intensity and neck-related disability also demonstrated greater improvement in the experimental group. By Week 12, mean VAS pain was 1.6 in the experimental group compared with 3.4 in the control group, while mean NDI scores were 10.2 and 17.4, respectively. These findings indicate that incorporating cervical treatment addressed impairments that vestibular exercises alone were less specifically designed to target. Manual mobilization, soft-tissue treatment, stretching, cervical mobility exercises, and graded movement may influence pain through improvements in movement tolerance, reduction of mechanical restriction, and changes in cervical sensorimotor function. Previous randomized evidence has demonstrated improvements in cervical symptoms following Mulligan and Maitland approaches in patients with cervicogenic dizziness (9), while more recent systematic reviews have reported favorable effects of manual therapy on pain and cervical function (10,11). The current findings are therefore directionally consistent with the existing literature, although differences in intervention composition prevent direct comparison of treatment effect magnitudes.

The improvement in neck-related disability is clinically relevant because the functional consequences of cervicogenic dizziness extend beyond dizziness itself. Patients may experience difficulty with activities requiring sustained cervical posture, head movement, visual orientation, ambulation, and coordinated head–trunk motion. Clinical studies of cervicogenic dizziness have demonstrated associations among dizziness-related disability, cervical restriction, postural abnormalities, pain, and functional impairment (5,7). In the present study, simultaneous improvements in DHI, VAS, NDI, balance, proprioception, and range of motion suggest that the treatment response involved several interconnected domains of function. However, because these outcomes changed concurrently, the present data cannot determine whether reduction in pain preceded improvement in dizziness, whether improved cervical mobility facilitated better vestibular exercise performance, or whether these changes developed in parallel.

Balance performance improved in both groups, but the magnitude of improvement was greater in participants receiving the combined intervention. Mean BBS scores increased from 44.2 to 54.4 in the experimental group and from 43.9 to 49.8 in the control group by Week 12. Vestibular rehabilitation is specifically intended to improve gaze stability, postural control, gait, and functional balance through repeated exposure to progressively challenging sensory and movement conditions (12). Improvement in the control group is therefore compatible with the expected effects of vestibular rehabilitation. The additional improvement in the experimental group may reflect the contribution of better cervical movement and proprioceptive control to postural orientation. Previous investigations have demonstrated abnormalities in postural control among individuals with cervicogenic dizziness and relationships between cervical and balance-related clinical measures (5,7). The current findings therefore support rehabilitation that considers both vestibular and cervical contributions to postural stability.

A particularly marked treatment difference was observed for cervical joint position error. Mean JPE decreased from 7.6° to 2.4° in the experimental group compared with a decrease from 7.7° to 4.3° in the control group. Joint position error provides a clinical estimate of cervical repositioning accuracy and is frequently used to investigate cervical sensorimotor function. A recent systematic review and meta-analysis found poorer joint-position sense and other sensorimotor performance in people with neck pain compared with asymptomatic individuals, with differences influenced by factors including pain and the presence of dizziness (6). The greater reduction in JPE in the experimental group is therefore consistent with improvement in cervical sensorimotor performance. Cervical mobilization, repeated active movement, stretching, and proprioceptive exposure may all have contributed to this change, while vestibular rehabilitation may have supported integration of cervical, visual, and vestibular information.

These proprioceptive findings are also compatible with earlier manual-therapy research. Randomized studies of cervical mobilization in cervicogenic dizziness have reported changes in head repositioning accuracy and related cervical outcomes following treatment (9). Evidence syntheses have further suggested that cervical manual therapy may positively influence dizziness and cervical function, although heterogeneity among trials remains substantial (2,10,11). The present results add to this evidence by demonstrating concurrent improvement in JPE and balance within a multimodal rehabilitation program. They should not, however, be interpreted as proof that normalization of cervical proprioception caused the reduction in dizziness, because mediation analysis was not performed and the temporal relationship between these outcomes was not examined.

Cervical range of motion improved in every measured direction, with consistently greater gains in the experimental group. At Week 12, between-group differences favored the experimental intervention by approximately 4.6° to 7.7° across the six cervical movement directions. Restricted cervical mobility is commonly described among patients with cervicogenic dizziness and may coexist with pain, altered movement behavior, and impaired sensorimotor control (1,7). The larger gains observed in the experimental group are expected given that this intervention directly incorporated joint mobilization, sustained natural apophyseal glides, soft-tissue techniques, stretching, and cervical mobility exercises. The findings are consistent with previous randomized manual-therapy research and systematic reviews showing improvement in cervical mobility following active cervical interventions (9-11). Importantly, greater range of motion should be interpreted as one component of the overall treatment response rather than as direct evidence that increased cervical movement itself was responsible for improvement in dizziness.

The significant group × time interactions observed across the primary and secondary outcomes further indicate that the two groups followed different trajectories during the study period. Partial η^2 values ranged from 0.30 to 0.41, suggesting substantial statistical interaction effects within the reported analysis. Direct Week 12 comparisons also produced large standardized differences for several outcomes. These effect-size estimates strengthen the evidence that the observed group differences were not limited to p-values alone. Nevertheless, statistical effect-size magnitude should not automatically be equated with clinical importance. Clinical relevance depends on the measurement properties of each instrument, the absolute magnitude of change, patient expectations, baseline severity, adverse effects, treatment burden, and established clinically important thresholds. Accordingly, the present findings provide evidence of sizeable statistical differences between the treatment strategies, while clinical interpretation should remain anchored to the absolute changes observed in DHI, pain, disability, balance, proprioception, and cervical mobility.

Both groups continued to demonstrate improvement between Week 6 and Week 12. Because supervised treatment was completed at Week 6, the Week 12 assessment represents the persistence and subsequent trajectory of outcomes during the six weeks following the supervised intervention rather than a 12-week treatment period. The continued improvement may reflect maintenance of exercise behavior, progressive sensorimotor adaptation, improved confidence with movement, or ongoing effects of the home programs. Vestibular rehabilitation relies partly on repeated movement exposure and central adaptation processes that can continue beyond supervised sessions (12). In the experimental group, continued cervical mobility and stretching exercises may also have contributed to maintenance of the observed gains. Because exercise adherence during the follow-up interval was not quantified in the reported Results, the relative contribution of continued home exercise cannot be established.

From a clinical perspective, the findings support consideration of a multimodal approach in patients with cervicogenic dizziness who present with concomitant neck pain, restricted cervical mobility, impaired cervical position sense, and balance limitations. Vestibular rehabilitation alone produced improvement across all major outcomes and remains an important component of management. The additional gains observed in the experimental group suggest that patients with identifiable cervical impairments may benefit from incorporating targeted cervical rehabilitation rather than addressing vestibular adaptation in isolation. This interpretation is compatible with reviews emphasizing the potential role of manual therapy and multimodal rehabilitation in cervicogenic dizziness while acknowledging limitations in the certainty of the available evidence (2,8,10,11).

The study also provides evidence from a Pakistani rehabilitation setting, an area comparatively underrepresented in the existing cervicogenic dizziness literature. Conducting the trial across three tertiary-care institutions increases its relevance to local clinical practice and demonstrates the feasibility of implementing a structured cervical and vestibular rehabilitation program in this context. Nevertheless, multicenter recruitment does not by itself establish broad generalizability. Differences in referral patterns, therapist expertise, patient characteristics, resource availability, and adherence across other healthcare settings may influence outcomes, and the study did not report center-specific recruitment or treatment effects.

Several methodological strengths support interpretation of the findings. Participants were randomly allocated to treatment groups using a computer-generated sequence with concealed allocation, outcome assessment was blinded, and the same principal clinical outcomes were assessed at baseline, immediately following the six-week intervention, and at Week 12. The treatment program was structured, therapist experience was specified, and intervention fidelity procedures included standardized training and treatment documentation. The study also evaluated multiple dimensions of cervicogenic dizziness, including dizziness-related disability, pain, neck disability, balance, cervical proprioception, and cervical mobility, providing a broader assessment of treatment response than reliance on symptom intensity alone.

These strengths should be considered alongside important limitations. First, the sample consisted of 60 participants. Although this met the reported a priori sample-size requirement, the modest sample restricts precision and limits subgroup analysis. Larger trials are required to determine whether treatment effects vary according to age, symptom duration, baseline disability, cervical impairment, or other clinically relevant characteristics. Second, participants and treating physiotherapists could not be blinded because of the nature of the rehabilitation interventions. Expectancy, therapist interaction, and performance effects therefore cannot be excluded despite blinded outcome assessment.

Third, the treatment contrast does not isolate cervical manual therapy. The experimental group received manual therapy together with cervical mobility and stretching exercises in addition to vestibular rehabilitation, whereas the control group received vestibular rehabilitation and its corresponding home program. The greater improvement in the experimental group must therefore be attributed to the additional cervical rehabilitation package as a whole. A future factorial or multi-arm trial including vestibular rehabilitation alone, cervical treatment alone, and the combined intervention would better distinguish individual and combined treatment contributions.

Fourth, although the trial was conducted at three clinical sites, center-specific participant numbers and therapist effects were not incorporated into the reported statistical model. Potential clustering by treatment center or therapist could therefore not be evaluated. Fifth, the analysis involved multiple secondary outcomes and repeated comparisons, increasing the potential for multiplicity despite the use of Bonferroni adjustment for reported pairwise comparisons. The primary DHI outcome should consequently carry greater inferential weight than the collection of secondary endpoints.

Sixth, the follow-up period extended only to Week 12, corresponding to six weeks after supervised treatment. The study therefore provides evidence of short-term persistence rather than long-term effectiveness. Follow-up at six or twelve months would be necessary to evaluate recurrence, continued exercise adherence, durability of functional improvement, and later healthcare use. Seventh, cervicogenic dizziness remains a clinical diagnosis without a universally accepted diagnostic gold standard (3). Despite structured clinical assessment and exclusion criteria, some diagnostic heterogeneity cannot be completely excluded.

Additional limitations concern outcomes that were not measured. The study did not evaluate health-related quality of life, falls, fear of movement, psychological status, patient satisfaction, return to work, healthcare utilization, or cost-effectiveness. These domains may be particularly important when judging the broader value of a rehabilitation program. Furthermore, the reported results do not provide detailed adherence data, adverse-event frequencies, or center-specific treatment fidelity. Such information would strengthen assessment of feasibility, safety, and implementation in future trials.

Future research should therefore prioritize adequately powered multicenter trials with clearly standardized diagnostic criteria, detailed intervention dosing, longer follow-up, explicit reporting of adherence and adverse events, and statistical approaches capable of accounting for center or therapist effects. Comparative designs that separate manual therapy, cervical exercise, vestibular rehabilitation, and combined treatment would help determine which components contribute most to clinical improvement. Future studies should also examine patient-centered outcomes such as quality of life, falls, participation, work status, satisfaction, and cost-effectiveness, while mechanistic research could investigate whether changes in cervical proprioception mediate improvements in dizziness or balance.

Overall, the findings indicate that a structured multimodal program incorporating cervical rehabilitation alongside vestibular rehabilitation produced greater short-term improvement than vestibular rehabilitation alone across dizziness-related disability and several associated cervical and sensorimotor outcomes. The results are consistent with the broader literature supporting cervical manual therapy and vestibular rehabilitation in the management of appropriately selected patients with cervicogenic dizziness (2,8-12). At the same time, the treatment package, modest sample, short follow-up, and diagnostic complexity require the magnitude and generalizability of the observed effects to be interpreted cautiously.

CONCLUSION

Vestibular rehabilitation combined with a structured cervical rehabilitation program produced greater improvement than vestibular rehabilitation alone in dizziness-related disability, neck pain, neck-related disability, balance performance, cervical joint position accuracy, and cervical range of motion in patients with cervicogenic dizziness. The between-group differences and significant group × time interactions indicate a greater short-term treatment response to the multimodal intervention, with improvements persisting at the Week 12 assessment. Because the experimental program included cervical manual therapy together with cervical mobility and stretching exercises, the findings support the combined cervical-plus-vestibular rehabilitation strategy rather than the independent effect of manual therapy alone.

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