

Effects of Combined Vojta Therapy and Vestibular Neuromuscular Training on Walking Speed and Static Balance in Individuals with Down syndrome

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Abstract

Background: Down syndrome is associated with hypotonia, ligamentous laxity, reduced muscle strength, delayed motor development, impaired coordination, and altered postural control, which may affect balance, gait, and functional mobility. Aim: To determine the effects of combined Vojta therapy and vestibular neuromuscular training on walking performance and static balance in individuals with Down syndrome. Methods: A pre-test and post-test experimental design was conducted with 15 children with Down syndrome. Participants received a combined intervention consisting of Vojta therapy, vestibular stimulation, and neuromuscular exercises for 45 minutes per session, 5 sessions per week, for 12 weeks. Static balance was assessed using the Pediatric Berg Balance Scale, and walking performance was assessed using the One-Minute Walk Test. Pre-test and post-test values were analyzed using a paired t test at $p < 0.05$. Results: The mean Pediatric Berg Balance Scale score increased from 47.13 at pre-test to 52.60 at post-test, with a mean difference of 5.47 and a paired t value of 17.83. The One-Minute Walk Test mean distance increased from 81.33 m to 94.13 m, with a mean difference of 12.80 m and a paired t value of 30.74. Both calculated t values exceeded the critical value of 2.145. Conclusion: The findings indicate statistically significant improvements in static balance and walking performance following 12 weeks of combined Vojta therapy and vestibular neuromuscular training.

Keywords: Down Syndrome, Vojta Therapy, Vestibular Neuromuscular Training, Walking Speed, Static Balance, One-Minute Walk Test, Pediatric Berg Balance Scale

1. Introduction

Down syndrome is a chromosomal disorder associated with trisomy 21 and a characteristic pattern of physical, developmental, cognitive, and functional features. Common neuromotor and musculoskeletal characteristics include hypotonia, ligamentous laxity, reduced muscle strength, altered postural control, delayed motor development, and impaired coordination. These impairments may influence functional mobility and participation in daily activities [1, 2].

Individuals with Down syndrome commonly demonstrate difficulties in postural control, balance, and gait. Hypotonia and ligamentous laxity can reduce joint stability and contribute to altered movement strategies. Gait alterations and reduced propulsive capacity may contribute to slower walking and reduced gait efficiency [3, 4].

Postural control depends on the integration of visual, vestibular, and somatosensory information. Deficits in this integration may affect equilibrium during functional activities. Walking performance is also an important indicator of functional mobility and participation; therefore, improving gait and postural stability is an important goal of physiotherapy management in individuals with Down syndrome [5, 6].

Vojta therapy is a neurodevelopmental approach based on reflex locomotion, in which specific stimulation of defined body zones in selected positions is used to facilitate coordinated postural and locomotor responses. Vestibular neuromuscular training combines vestibular stimulation with exercises intended to improve postural control, muscle activation, coordination, and functional movement [7, 8].

Previous studies have described beneficial effects of Vojta therapy on gait-related abilities and vestibular-based exercise on balance and motor performance in individuals with Down syndrome [9, 10]. A systematic review and meta-analysis has also reported beneficial effects of physical exercise on balance in children with Down syndrome [11]. However, the dissertation identifies limited evidence regarding the combined use of Vojta therapy and vestibular neuromuscular training for gait and balance. Therefore, the present study was undertaken to determine the effects of the combined intervention.

2. Aim and Objective

Aim: To determine the effectiveness of combined Vojta therapy and vestibular neuromuscular training on walking speed and static balance in children with Down syndrome.

Objective: To determine the effectiveness of combined Vojta therapy and vestibular neuromuscular training on walking speed and static balance using the Pediatric Berg Balance Scale and One-Minute Walk Test.

3. Materials and Methods

3.1 Study Design and Setting

A pre-test and post-test experimental design was used. The study was conducted at Thulir Special School and Therapy Centre, Coimbatore. The overall study duration was 8 months.

3.2 Participants and Sampling

Fifteen children with Down syndrome were selected using purposive sampling. The methodology and limitations in the dissertation specify an age range of 6–12 years. Participants included both male and female children diagnosed with Down syndrome by a paediatrician.

3.3 Inclusion Criteria

- Children diagnosed with Down syndrome by a paediatrician.
- Age group of 6–12 years.
- Both male and female children.
- Pediatric Balance Scale score indicating mild to moderate balance impairment.
- Able to walk independently with or without minimal assistance for less than one minute.
- Able to follow simple verbal instructions.

3.4 Exclusion Criteria

- Congenital heart disease contraindicating exercise.
- Uncontrolled epilepsy.
- Recent fractures or orthopaedic surgery.
- Severe visual or auditory impairments.
- Associated neurological conditions other than Down syndrome.

3.5 Outcome Measures

Static balance was assessed using the Pediatric Berg Balance Scale, a pediatric modification of the Berg Balance Scale. Walking performance was assessed using the One-Minute Walk Test, which records the distance walked in one minute [12].

3.6 Intervention Procedure

After explaining the study procedure to the participants and their parents or guardians, written informed consent was obtained. Pre-test assessment of balance and walking performance was performed.

Vojta therapy was administered for approximately 20 minutes. The intervention included reflex creeping with emphasis on body symmetry, stabilization of the elbow and foot support points, appropriate head positioning, and facilitation of abdominal and paraspinal muscle activation. Two repetitions were performed on each side, with each repetition lasting approximately 2 minutes and a 2–3-minute rest period according to participant tolerance.

Vestibular stimulation and neuromuscular exercises were administered for approximately 25 minutes. Activities included eye movements independent of head movements, controlled head movements, balance activities incorporating head movements, lower-limb strengthening, trunk stabilization, functional weight-bearing, balance, and coordination exercises, with emphasis on controlled movement and functional joint stabilization.

The complete intervention was administered for 45 minutes per session, 5 sessions per week, for 12 weeks. Exercise intensity and difficulty were progressed according to participant ability and tolerance. Post-test assessment was performed at the end of the intervention using the same outcome measures.

3.7 Statistical Analysis

Descriptive statistics were used to summarize the outcome measures. Pre-test and post-test values were compared using a paired t test. The level of statistical significance was set at $p < 0.05$. For 15 participants, the reported critical t value was 2.145.

4. Results

Fifteen participants were included in the analysis. The reported pre-test and post-test means, mean differences, standard deviations, and paired t values are presented below.

Table 1: Comparison of Pre-Test and Post-Test Pediatric Berg Balance Scale Scores

Measure	Pre-Test Mean	Post-Test Mean	Mean Difference	SD	Paired t	Critical t
Pediatric Berg Balance Scale	47.13	52.60	5.47	1.19	17.83	2.145

The mean Pediatric Berg Balance Scale score increased from 47.13 before intervention to 52.60 after intervention. The mean difference was 5.47. The calculated paired t value of 17.83 was greater than the critical value of 2.145, indicating a statistically significant improvement in balance at $p < 0.05$.

Table 2: Comparison of Pre-Test and Post-Test One-Minute Walk Test Distance

Measure	Pre-Test Mean (m)	Post-Test Mean (m)	Mean Difference (m)	SD	Paired t	Critical t
One-Minute Walk Test	81.33	94.13	12.80	1.61	30.74	2.145

The mean One-Minute Walk Test distance increased from 81.33 m before intervention to 94.13 m after intervention. The mean difference was 12.80 m. The calculated paired t value of 30.74 was greater than the critical value of 2.145, indicating a statistically significant improvement in walking performance at $p < 0.05$.

5. Discussion

The present study examined the effects of combined Vojta therapy and vestibular neuromuscular training on walking performance and static balance in children with Down syndrome. The results demonstrated statistically significant improvements in both outcome measures after 12 weeks of intervention.

The Pediatric Berg Balance Scale mean score increased from 47.13 to 52.60, with a mean improvement of 5.47 points. The paired t value of 17.83 exceeded the critical value of 2.145. This finding suggests that the combined intervention was associated with improved functional balance. The improvement may be related to the contribution of vestibular stimulation to postural orientation and sensory integration, together with neuromuscular exercises targeting muscle activation, coordination, and joint stabilization. The One-Minute Walk Test mean distance increased from 81.33 m to 94.13 m, representing a mean increase of 12.80 m. The paired t value of 30.74 exceeded the critical value of 2.145. The improvement in walking performance may be related to the combined effects of Vojta therapy on automatic postural and locomotor responses and the functional strengthening and coordination components of vestibular neuromuscular training.

The findings are consistent with the dissertation's cited literature. Qian et al. reported immediate improvements in gait parameters following Vojta therapy in individuals with Down syndrome, supporting the potential role of Vojta-based stimulation in gait-related function [9]. Vestibular stimulation exercises have also been reported to improve balance, coordination, and agility in children with Down syndrome [10]. Mechanical vestibular stimulation has additionally been reported to improve balance in children with Down syndrome [13].

The Pediatric Balance Scale was developed as a modified version of the Berg Balance Scale for school-age children with mild to moderate motor impairments and has demonstrated excellent reliability [12]. Overall, the present findings support the potential usefulness of combining Vojta therapy with vestibular neuromuscular training when the clinical goals include improvement of balance and walking performance.

6. Conclusion

The study demonstrated statistically significant improvements in static balance and walking performance following 12 weeks of combined Vojta therapy and vestibular neuromuscular training in children with Down syndrome. The findings support the potential use of this combined physiotherapy intervention to address postural control and functional walking performance in this population.

7. Limitations

- The sample size was small.
- Only children aged 6–12 years were included.
- No long-term follow-up assessment was performed.
- Only walking performance and static balance were assessed.

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