

Hippotherapy Therapeutic Effect on Postural Balance in Children with Down Syndrome: Systematic Review

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Abstract

Background: Loss of postural balance in DS children results in deterioration of gait activities and daily living tasks, so it has a significant impact on quality of life. Many interventions have been intended to improve balance in DS children.

Aim of Study: The aim was to examine the effect of hippotherapy on postural balance in children with down syndrome.

Subjects and Methods: Search was made on children with down syndrome aged from 2 to 18 years. Search was made in Pubmed, Pedro, Cochrane and goggle scholar web site up to date. Systematic review of randomized controlled trials, the intervention used was hippotherapy as a group programs four studies were selected according to inclusive and exclusive criteria.

Results: Four articles were included in this review. Although the current level of evidence is weak, our synthesis found that children with down syndrome, Data were extracted independently using a modified standardized Excel template from American Academy for cerebral palsy and Developmental Medicine's (AACPD), hippotherapy had a significant effect postural balance in children with down syndrome.

Conclusion: The current literature on hippotherapy is limited. Large randomized controlled trials using specified protocols are needed to more conclusively determine the effects on children with down syndrome. From the current evidence, it appears that hippotherapy have positive effects on postural balance in children with down syndrome.

Key Words: Hippotherapy – Equine therapy – Horse riding therapy – Postural balance – Down syndrome.

Introduction

DOWN syndrome (DS) is a chromosomal disorder occurring in about 1 per 650 to 1000 live births, due to chromosome 21 Dierssen [1]. It is the most

common chromosomal abnormalities, and the most frequent abnormalities of autosomal chromosomes [2].

Down syndrome is characterized by altered psychomotor development, resulting in gait and balance impairments, increased risk of congenital defects and organic disorders, as heart and gastrointestinal defects, immune disorders and leukemia, as well as disorders of the endocrine/metabolic systems [3].

Balance is one of the major factors that affect the safety and independence skills of down syndrome children, and is the hardest function to acquire. The gross motor skills are consistently low compared to those of normal children, and balance shows the largest difference [4].

Balance and gait play a critical role in activities of daily living for humans, and can be affected by interior or exterior factors as the subject becomes older. Movement is limited due to the dysfunction of balance and gait. Additionally, life quality and participation in daily living are affected [5].

One of the therapies used in improving postural balance in DS is Hippotherapy [6]. Hippotherapy is a physical, occupational, and speech therapy that utilizes the natural gait and movement of a horse to provide motor, and sensory input. It is based on improvement of neurologic functions, and sensory processes, and used for patients with physical and mental disorders [7].

Studies reported that the rhythmic sway of the horse spine stimulates postural reflexes of the hippotherapy patient/practitioner, resulting in balance training and postural and motor improvements [8].

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The previous reviews on hippotherapy summarized clinical trials, but did not attempt to synthesize what is known from current evidence or describe what type of children with down syndrome respond best to hippotherapy and what types of outcomes result. Therefore, the purpose of this systematic review is to examine the efficacy of hippotherapy on postural balance in children with down syndrome.

Subjects and Methods

Study identification:

The following databases were searched to identify appropriate studies to be included in this review: PubMed, Cochrane Reviews, PEDro results and Google results with full text. Keywords utilized were “Down syndrome and postural balance”, “Postural balance”, “Down syndrome and Hippotherapy” “Hippotherapy”, “Postural balance and Hippotherapy” and “Down syndrome”. In addition, we selected “relevant article” links on the databases and research reports from our reference lists to assemble a comprehensive list of hippotherapy studies. Furthermore, reference lists of relevant articles were searched to identify additional articles for potential inclusion. The present study contained two descriptive analysis and two meta analysis and the time length of this study was from March 2020 to October 2020.

Study selection:

In order to be considered for inclusion in this review, studies had to meet all of the following criteria: (1) Types of studies: Published randomized controlled trials according to level of evidence. (2) Types of participants: The review included children (2-18 years) with Down syndrome from both sexes. (3) Types of Intervention: All randomized controlled studies that evaluated the effect of hippotherapy on postural balance in children with down syndrome were incorporated in this review. (4) Types of outcome measure: (A) The primary outcome measures related to balance were considered in this review, including static and dynamic balance. (B) Secondary outcomes as improving gait, increasing muscle endurance, increasing range of motion and improving flexibility and motor coordination. Studies were excluded from the review if they met any of the following criteria: (1) Review articles, survey, case reports, case series or nonrandomized studies including retrospective studies. (2) Studies evaluated heterogeneous diagnosis such as adults, or children with other disorders rather than Down syndrome. (3) Studies intervention for balance other than hippotherapy. (4) Studies measured outcomes which not related to balance.

Validity assessment:

The authors reviewed studies that met the inclusion and exclusion criteria independently. A 1-point PEDro scale (Physiotherapy Evidence Database, 1999) was used to rate the validity of each study. A copy of this scale can be obtained at <http://www.pedro.org.au/english/downloads/pedro-scale>. It was determined by the authors that low-scoring studies lacked the level of rigor necessary to provide valid information. Therefore, any article that scored 9/11 or below on the PEDro scale was excluded from this review. After independently rating each article, the four authors met to discuss the ratings of each article. If a discrepancy in rating occurred, discussion about the rating was used to reach a consensus for a final rating. The Data were extracted independently using a modified standardized Excel template from American Academy for cerebral palsy and Developmental Medicine's (AACPDM) revised version (2004).

Results

This chapter is represented according to criteria included in Cochrane Handbook for Systematic Reviews of Intervention by Higgins et al., [9]. Total number of 45857 studies were identified from search in PubMed, Cochrane, PEDro databases and additional zero studies from the other sources (screening the reference lists of all relevant articles). After excluding all duplicate studies, a total of 25161 studies have been screened then, 14597 studies have been excluded and the full-text articles of 5342 studies which appear to meet the eligibility criteria have been assessed. Results of the search are presented in the following PRISMA flowchart (Fig. 1).

Description of the included studies:

A detailed description of each study includes description of participant, intervention for study and control groups, outcomes measures used and summarized result (Table 1).

Giagazoglou et al., (2012) studied the effects of a hippotherapy program on static balance and strength in adolescents with intellectual disability (ID) on 19 adolescents with moderate ID. The experimental group attended a 10-week hippotherapy program. To assess static balance, three tasks of increasing difficulty (Double-Leg Stance with opened or closed eyes, and One-Leg Stance with opened eyes) were performed while standing on an EPS pressure platform (Loran Engineering S.r.l., Bologna, Italy). The strength measurements consisted of three maximal isometric half-squats from the seating position (knee joint at 90°). The hippo-

therapy intervention program resulted in significant improvements in strength parameters, and on the more complex balance task (i.e. standing on one leg).

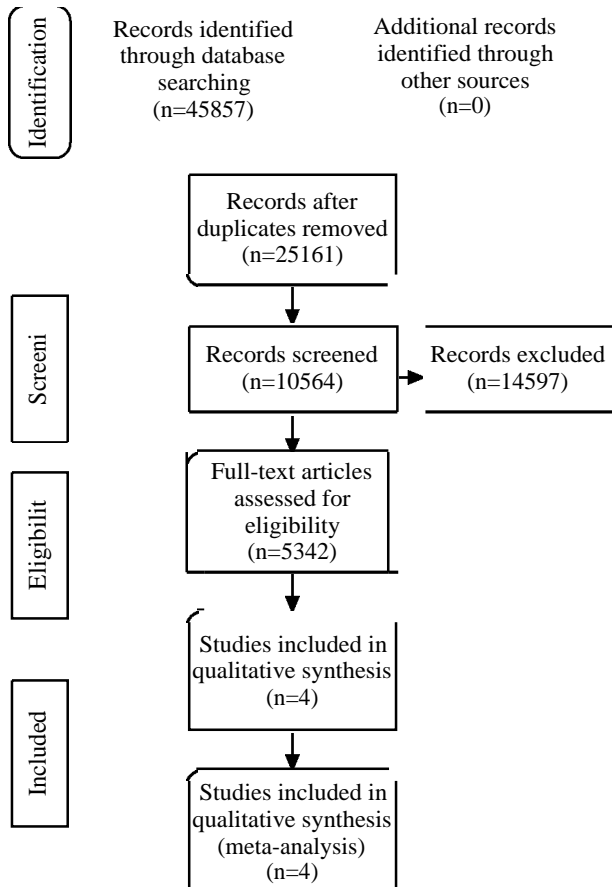


Fig. (1): PRISMA Flow chart.

Silkwood-Sherer et al., [13] assessed the effectiveness of hippotherapy for the management of postural instability in children with mild to moderate balance problems and to determine whether there is a correlation between balance and function on 16 children (9 boys and 7 girls). Intervention was in form of 40-45 minutes session with an appropriately trained hippotherapy horse, twice weekly for 6 weeks. Balance was measured with the Pediatric Balance Scale (PBS), and of function, as measured with the Activities Scale for Kids-Performance (ASKp), were performed. Results showed significant improvement of PBS and the ASKp post-intervention measures in comparison to baseline.

Espindula et al., (2016) evaluated posture and postural alignment before and after the hippotherapy in 5 individuals with Down syndrome (DS). Subjects were evaluated by the software SAPO before and after 27 sessions of the hippotherapy. Results showed significant improvement of shoul-

der, head, hip, and lower limbs alignment, in addition to decrease in kyphosis and head protrusion.

Costa et al., (2017) analyzed the effects of hippotherapy program on global motor coordination variables in individuals with Down syndrome (DS). The study was an observational, analytical, cross-sectional study on 20 individuals who received hippotherapy more than 3 months and 21 individuals who do not practice hippotherapy. The outcome measurement was the Körperkoordinations test for Kinder (KTK) test, consisting of four tasks: Balance on beams, Single-lever jump, Sidejump and Transfer on platform for analysis of motor coordination for individuals. Results showed a significant difference ($p < 0.01$) between groups regarding the Lateral Leap Motor Quotient, and the Total Motor Ratio. Also, the individuals that practice hippotherapy presented better results in the global motor coordination, with significant difference ($p < 0.05$). In hippotherapy group, 5% had high global motor coordination, 40% good and 55% normal, whereas in control group only 10% had good global motor coordination and 90% normal global motor coordination. On the other hand there was no significant difference ($p = 0.25$) between both groups regarding balance part of the test.

Participants:

Detailed descriptions of patient characteristics are given as in (Table 2).

Stat methods:

We analyzed data from the included studies using Review Manager (RevMan - version 5.4, The Nordic Cochrane Center, The Cochrane Collaboration, Copenhagen, Denmark), and Microsoft Excel 2010 (Microsoft Corp., Redmond, WA, USA). A formal meta-analysis was conducted for all outcomes if the data were sufficient. We expressed pooled continuous effect measures as the standardized mean difference (SMD) with 95%CI. We explored and quantified between-study statistical heterogeneity using the I2 test. Because we found high heterogeneity, we used the Der Simonian and Laird random-effects model instead (Der Simonian and Laird, 1986). We couldn't assess publication bias because of the small number of the included studies.

Regarding balance variable, as reflected from (Fig. 2) there were two studies included into the analysis with total case number of 30 cases in the experimental groups and 30 cases in the control groups. The meta-analysis revealed that, there was one study showed a statistically significant effect of the hippotherapy on balance in children with balance abnormalities.

Table (1): Characteristics of interventions of the included studies.

Study	Condition	Study group intervention	Control intervention	Outcome measurement
- (Giagazoglou et al., 2012)	- Adolescents with intellectual disability (ID).	- 30min hippotherapy intervention, twice a week for 10 weeks.	- Regular school schedule (residential school for children with disabilities).	- Static balance, three tasks of increasing difficulty (Double-Leg Stance with opened or closed eyes, and One-Leg Stance with opened eyes). - Strengthen, maximal isometric half-squats from the seating position and measure Maximumvertical Ground Reaction Forces (vGRF) and the mean Rate of Force Development (RFD).
- (Silkwood-Sherer et al., 2012)	- Children with balance problem and can stand for 4 sec (2 of them had DS).	- 40-45min hippotherapy intervention, twice a week for 6 weeks	- NO control.	- Pediatric Balance Scale (PBS), and Activities Scale for Kids-Performance (ASKp).
- (Espindula et al., 2016)	- Children with Down syndrome.	- 30min hippotherapy intervention only no other exercise therapy, once a week for 27 weeks.	- NO control.	- Posture (alignment of shoulder, head, hip, and lower limbs, and kyphosis and head protrusion) evaluated by SAPO software.
- (Costa et al., 2017)	- Children with Down syndrome.	- Hippotherapy intervention for at least 3 months.	- Control and study groups received physiotherapeutic follow-up, participated in occupational therapies, follow-up with speech therapists, Physical Education classes at the study period.	- The Körperkoordinations test für Kinder (KTK) test, consisting of four tasks: Balance on beams, Single-lever jump, Side-jump and Transfer on platform for analysis of motor coordination for individuals.

Table (2): Participants of the included studies.

Studies	Study group					Control group				
	n	Boys	Girls	Age (Mean ± SD)	Duration (in weeks)	n	Boys	Girls	Age (Mean ± SD)	Duration (in weeks)
Giagazoglou et al., (2012)	10	-	-	(15.2±1.9)	10	9	-	-	(15.3±2.2)	10
Silkwood-Sherer et al., (2012)	16	9	7	(10.33±3.3)	6					
Espindula et al., (2016)	5		=	(12.6±3.21)	27					
Costa et al., (2017)	20	11	9	6-14 years	12	21	12	9	6-14 years	12

Furthermore, in (Fig. 2) the forest plot of the mean difference across all studies and 95% CI of the mean difference across all studies (mean difference = -1.1, 95% CI of the mean difference =

-3.32, 1.12), represented by black diamond touching the equator line, showed a non-significant difference between the experimental groups and control groups.

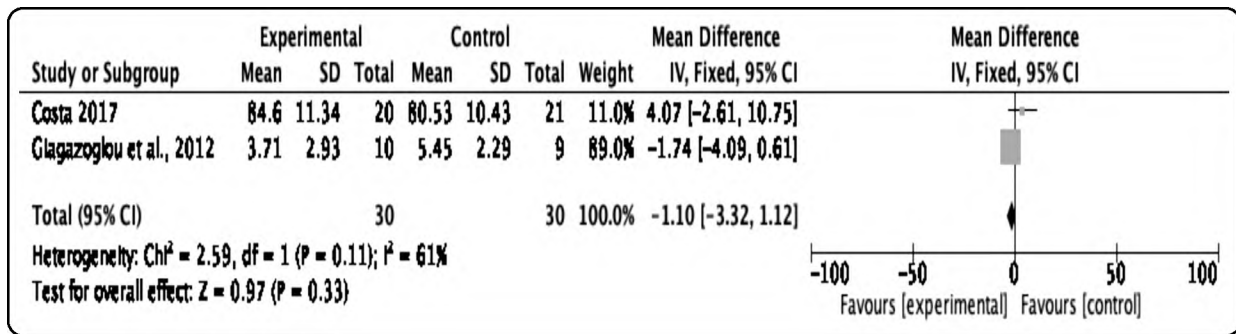


Fig. (2): Forest plot of comparison: Between hippotherapy and control groups.

Limitations of studies:

Research design remains a primary limitation of horseback riding studies in children with down syndrome. Furthermore, the lack of comparison groups and randomization in a majority of the studies makes it difficult to draw conclusions from these results. The two randomized studies in this review also have limitations. Other limitations of these studies include lack of specificity and detail in descriptions of the intervention; for example, in a majority of these studies, it was not clear how long each subject was actually on the horse during the session. We do not know if the studies reported the time of the entire session or time spent on the horse. Due to these limitations, results of these studies must be interpreted with caution.

Discussion

The purpose of the current systematic review is to evaluate the effectiveness of hippotherapy on postural balance in children with down syndrome, this review includes studies published from 2011 up to 2017 and searched on Medline data base through Pub Med and Pedro that most likely include huge amount of papers published each year, Cochrane library also was searched and Google scholar web site.

Only published trials were included in the current systematic review, unavailable relevant articles which may show positive or negative results were not included in the review.

The most important goals of therapy for children with DS is to develop motor functions and mental skills which allow them participate in activity daily living. This is the reason that motor and mental skills should be measured in order to point out the abilities a child can perform Connolly et al., [10].

Hippotherapy is a physical, occupational, and speech therapy that utilizes the natural gait and movement of a horse to provide motor, and sensory input. It is based on improvement of neurologic

functions, and sensory processes, and used for patients with physical and mental disorders Koca et al., [11].

Hippotherapy may have influenced the child's functional ability, level of participation, and sense of self-competence as demonstrated by changes in the outcome measures. The child showed improvements in her GMFM-66 scores across the 3 measurement intervals. One possible explanation for these changes could be that improved strength, balance, and coordination, which were a focus of the intervention sessions, carried over to the functional motor tasks of the GMFM-66. At the 2-month follow-up, the child's mother attributed much of her daughter's success to gains in muscle strength Frank et al., [12].

The results coincided with our results, which confirmed the effectiveness of hippotherapy reflected in improved balance and gait in children with CP who participated in the two-week hippotherapy program. Long-lasting hippotherapy programs and single hippotherapy sessions significantly improved static and dynamic balance, and gait in children with diagnosed balance deficits. A six-week hippotherapy program, consisting of sessions conducted twice a week per 45 minutes, significantly improved postural balance and everyday functioning in children aged 5-16 years Silkwood-Sherer et al., [13].

The study of Mackow et al., [14] revealed that a single hippotherapy session may significantly move the point of the centre of gravity (COG) in the frontal plane, and it may affect the mean speed of oscillation in the sagittal plane in children with CP. The study of Manikowska et al., [15] discovered beneficial effects of a single hippotherapy session on the temporal and spatial gait parameters in children with CP. The speed of gait significantly increased after a single hippotherapy session and the remaining parameters came close to the reference values for a given age.

Limitations of present study:

While this review attempted to systematically synthesize the literature on hippotherapy and THR, we acknowledge several limitations. Our review was limited to only studies available in English. In addition, this review did not consider psychosocial benefits of hippotherapy for children with down syndrome, which is an important aspect of children's function and may influence mobility and gross motor performance.

Conclusion:

Most of the current literature on hippotherapy is limited to repeated measures within-subject designs with small sample sizes. More randomized trials, with larger sample sizes, and consistent protocols are needed to determine the effects of hippotherapy on children with down syndrome. Manualized approaches are to be investigated with samples that systematically vary by age and level and type of disability. The dosage of hippotherapy associated with positive effects should be further investigated to confirm or refute the results of this review. From the current evidence, it appears that hippotherapy have positive effects on postural balance in children with down.

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تأثير ركوب الخيل العلاجي على الإتزان في الأطفال المصابين بمتلازمة داون : فحص منهجي

الهدف : الهدف من هذا الفحص المنهجي هو دراسة تأثير ركوب الخيل العلاجي على الإتزان في الأطفال المصابين بمتلازمة داون.

الأشخاص وطرق البحث : تم إجراء البحث على الأطفال المصابين بمتلازمة داون الذين تتراوح أعمارهم بين سنتين و ١٨ سنة. تم إجراء البحث في موقع Pubmed و Pedro و Cochrane و Goggle scholar محدث. مراجعة منهجية للتجارب المعشاة ذات الشواهد، كان التدخل المستخدم هو العلاج بركوب الخيل كمجموعة برامج مجمعة تم اختيار أربع دراسات وفقاً لمعايير شاملة وحصرية وأجرى التحليل الوصفي بسبب عدم التجانس.

النتائج : أظهرت النتائج أن العلاج بركوب الخيل له تأثير كبير على التوازن الوضعي عند الأطفال المصابين بمتلازمة داون.

الإستنتاج : العلاج بركوب الخيل له تأثير على التوازن الوضعي لدى الأطفال المصابين بمتلازمة داون و له تأثير على أنشطة الحياة اليومية لهم مع الحفاظ على هذا التأثير لفترة طويلة من الزمن.