

Review Article

Efficacy of Balance Training in Improving Postural Control and Balance in Individuals with Down Syndrome: A Literature Review

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A B S T R A C T

Background: A genetic condition known as Down syndrome causes intellectual deficiency, development delay, and typical craniofacial traits. Problems with laterality, visual motor control, reaction time, strength, and balance are common in people with Down syndrome.

Purpose: The objective of this research was to evaluate the impacts of exercise training on the strength as well as balance of children with Down syndrome.

Methods: A literature review using the meta-analyses (PRISMA), with a focus on the years 2007 through 2018, was conducted. PUBMED and Google Scholar are the databases used for article searches.

Results: The recommended exercises were found to be effective in developing the static balance of kids and the static-dynamic balance of kids and teens with Down syndrome.

Conclusion: The strength and balance of kids with Down syndrome have the potential to be enhanced with a specific exercise regimen.

Keywords: Cardiometabolic, Muscle Strength, Proprioception, Obesity, Resistance Training, Postural Balance, Down Syndrome

Introduction

The chromosomal condition known as Down syndrome (DS), also known as trisomy 21, is brought on by the presence of an extra copy of chromosome 21. In most cases, this is connected to the development of physical growth¹. The longer life expectancy of people with Down syndrome is evidence of the improvements in healthcare and standard of living that have been made over the past few decades. A person with Down syndrome only lived an average of 12 years in the 1940s.² One to two infants out of every 1000 live births are said to be affected by Down syndrome. Due to their physical inactivity and poor dietary habits, patients with Down syndrome typically

have a higher risk of developing secondary physiological diseases. Cardiovascular illnesses, pulmonary hypoplasia, osteoporosis, hypotonia in the muscles, osteoarthritis, diabetes mellitus, and obesity are just a few examples of these pathophysiological conditions. Adolescents with DS may specifically suffer from fine motor function difficulties, including issues with making precise finger movements. This may make simple tasks more difficult, like writing, typing, and using utensils. Additionally, because they require strength, balance, and coordination, gross motor activities like push-ups and sit-ups may be difficult for people with DS. Due to sedentary lifestyles and poor dietary habits, patients with Down syndrome are typically

at a greater risk of developing secondary physiological diseases. Among these pathophysiological disorders are cardiovascular illnesses, lung hypoplasia, osteoporosis, muscle hypotonia, osteoarthritis, diabetes mellitus, and obesity.³ Adolescents with DS may, in particular, suffer from specific fine motor difficulties, including issues with making exact finger movements. Writing, typing, and using utensils could become more difficult as a result. In addition, people with DS could have trouble doing large motor activities like push-ups and sit-ups, which call on coordination, strength, and balance.⁴

It has a significant impact on physiotherapy therapies and how well-balanced children with Down syndrome function. It enhances balance, walking ability, and lower limb strength. The functional capacities of people with Down syndrome also increase as a result of this improvement in daily activities. To move or carry out motor tasks in daily life safely, balance control is crucial. For people with Down syndrome, these balance deficits may even worsen motor impairments, increase the risk of body instability and fall-related injuries, and result in activity restrictions or participation restrictions. These postural and balance deficits will also have a serious negative impact on the ability of a person to perform day-to-day activities. The development of balance and postural control in young people with Down syndrome thus brings to light a significant problem⁵. Children with DS typically learn to walk about a year later than healthy infants, which can be partly explained by their balance issues. Children with DS are particularly affected by static and dynamic balance, which means that they may find it difficult to keep their balance when they are moving or standing stationary.⁶

Though many studies have explored the effects of both aerobic exercise and combined exercise, it is generally accepted that resistance exercises are more effective than aerobic exercises at increasing muscle mass. According to reports, elderly people with intellectual disabilities experience a functional decline at an earlier age due to inadequate muscle mass and strength. There is, however, less research that has examined the benefits of resistance exercise for people with DS, particularly for adults or elderly people⁷. The hip abductor and knee extensor muscles of children with Down's syndrome are observed to be weaker than those of individuals without the condition. As per Cioni et al., in comparison with the children who do not have mental retardation and those who have mental retardation but do not have Down's syndrome, children with this condition have less quadriceps strength. Using the Bruininks-Osterriksky Test of Motor Proficiency (BOTMP), it was discovered that Down's syndrome-affected children performed considerably worse on the balance subset than

the control group. Using the balance sub-test of the BOTMP, a six-week program of vertical and horizontal jump training for Down syndrome children has significantly improved balance. The findings of this study cannot, however, be applied generally because it did not focus solely on children with Down syndrome.⁸

Physical fitness can be categorized: as physiological fitness, Fitness with a health focus, and Fitness with a skill focus (balance, agility, power, coordination, reaction time, speed, etc.). Down syndrome patients were less physically fit than people without disabilities, according to studies.⁹ They will have difficulty with balance, equilibrium, defensive responses, and problems with muscle movement, which will cause them to need a lot of assistance when they're sitting or standing and delay their ability to control their posture and move around. Between the ages of 2-3 years, the majority of kids used to be able to walk on their own. Slow postural reactions and balance problems make it difficult to maintain stability. Such balance issues may be caused by mechanisms of higher-level postural regulation, such as a small cerebellum and brainstem, delayed cerebellar maturation, and delayed cerebellar maturation.¹⁰ When only a fragment of chromosome 21 is present in extra copies, partial trisomy 21 also occurs, which is extremely uncommon. In about 4% of affected people, translocation is another factor that contributes to the development of Down syndrome. 2 percent of people with DS often have mosaicism for trisomy 21. Rare trisomy 21 partial situations arise¹¹.

The objective of this research was to determine how exercise training impacts the strength and balance of children with Down syndrome. Children with Down syndrome frequently exhibit impairments in both their gross motor skills and cognitive development. Children with DS often reach gross motor milestones including sitting, crawling, and walking at a rate that is around twice that of typically developing kids. This can be ascribed in part to their weak muscles and poor muscle tone, which can make it more difficult for them to develop the strength and coordination required for gross motor abilities¹². Balance training may benefit kids with DS in other ways outside just enhancing their balance, such as enhancing their physical fitness overall, coordination, and muscle strength. As kids grow more adept and self-assured in their physical abilities, it might also assist to increase their self-esteem and confidence¹³.

To attempt to determine whether balance training for people with Down syndrome is useful, this study will do so.

Objective of the Study

To evaluate the effectiveness of balance training exercises for Down syndrome – a review of the literature

Materials and Methods

Study Design: A review of the literature using Cross ref meta database in addition to Google Scholar, PUB MED, and Preferred Reporting Items for Meta-Analyses (PRISMA).

Study Selection: Articles that met the following criteria were chosen for inclusion in the study: meta-analyses, systematic reviews, randomized trials with controls, observational studies, and case-control trials.

Keywords: Cardiometabolic, Down syndrome, exercise; muscle power, proprioception, obesity, resistance training, and postural balance.

The inclusion standards include Down syndrome-related articles with full-text content that are solely published in English and that span the age range of 5 to 17 years. Additionally, from 2007 to 2022, articles were published.

The exclusion criteria are articles in other languages with no related title, or abstract and articles that did not include those the above age of 18 years. Articles with no related keywords

Methodology

An additional copy of chromosome 21 causes the chromosomal abnormalities known as Down syndrome (DS), also called trisomy 21. Usually, growth and development of the physical body are related to this. The literature was reviewed using the Crossrefmetadatabase and Preferred Reporting Items for Meta-Analyses (PRISMA), with an emphasis on the years 2007 through 2018. The databases used for the article searches are PUBMED and Google Scholar (Figure1).

Results

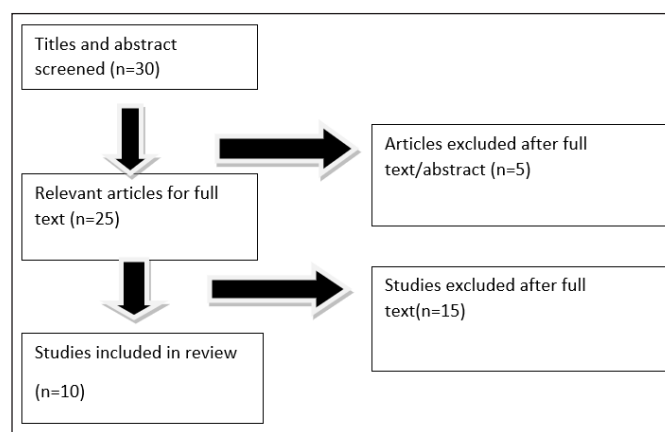


Figure 1. Methodology

Table 1. Details & conclusion: Review of Literature

S.no	Author	Year	Type	Conclusion
1.	Samia Abdel Rahman Abdel Rahman	2010	Randomized controlled trial	The goal of the study was to find out how Wii-Fit games used as a virtual reality-based therapy affected the balance of Down syndrome youngsters. The Bruininks-oseretsky test of motor competence was used to gauge balance. 30 Down syndrome kids, both boys, and girls, between the ages of 10 and 13, participated in the study. The participants were randomly split into two groups of equal size, with the control group receiving standard physical therapy along with a program of three Wii Fit games. For six weeks, both groups continued their respective programs. In comparison to the control group, the study group's balance significantly improved, according to the findings. Wii-fit games were originally used as a virtual reality-based therapy to help youngsters with Down syndrome with their balance.
2.	sukriti Gupta	2011	Randomized controlled trial	The key finding of this study is that, as compared to the control group, children with Down's syndrome were able to strengthen their lower limb muscles and improve their overall balance after completing a six-week exercise training program. The strength of all muscle groups examined enhanced post intervention. This shows that the six-week procedure was long enough to result in a statistically significant difference.

3.	Chunxiao Li	2013	Randomized-controlled trials	Four separate outcomes of fitness, including muscle strength and endurance, balance, body composition, and cardiovascular fitness, were assessed in Down syndrome children using a variety of exercise programs. While other outcomes revealed limited positive or less conclusive evidence, exercise interventions had moderate to high effects on improving muscular strength and balance. Results trends indicate that physical activity interventions enhance muscular strength and balance.
4.	Christophe Maïano	2017	Systematic review	To find out how exercise programs specifically made to help children and teenagers with Down syndrome with their balance were received, a systematic review study was carried out. Exercises were administered for a duration of 6–12 weeks in all studies that focused on kids with Down syndrome. The static balance and static-dynamic balance of kids with Down syndrome were improved by the 12-month exercise program (from pre-test to post-test).
5.	M. B. Saquetto	2017	Systematic review	In this study, the effects of whole-body vibration (WBV) exercise on the muscle strength of kids and teens with Down syndrome are examined. There were a total of five trials with a total of 171 patients that compared WBV with exercise and control. The muscle strength of kids and teenagers with Down syndrome who underwent WBV training was significantly different from that of those who did not, according to two studies. The research analyzed in this systematic review revealed that WBV exercise improves balance, body composition, and bone mineral density (BMD). The study's findings demonstrated that children and teenagers with Down syndrome who engage in whole-body vibration training experience improvements in their balance, BMD, muscle strength, and body composition.
6.	Rehaam Saeedal-sakhawi	2019	Randomized controlled study	Children with Down syndrome are the subject of randomized controlled research. Three groups of kids each had an equal number of members. Group A received standard physiotherapy treatments. The workouts in group B were the same as in group A, plus additional training in core stability exercises. Along with a treadmill exercise program, group C received the same exercise intervention as Group A. Following a 3-week follow-up, it was discovered that improvements in functional balance and stability indices were effective in all three groups, favoring groups B and C.
7.	Angela Palomba	2020	Randomized controlled study	The balance and postural control of people with Down syndrome (DS) can be significantly improved by frequent physical activity, according to studies. Future research may contrast and mix various forms of physical activity to maximize these advantages. Regular exercise is advised for people with DS to improve their balance and postural control and lower their risk of falling. We should encourage and support frequent physical activity as a component of DS patients' overall care plans as advocates for their health and wellbeing.
8.	Yun-A Shin PhD	2021	Systematic review	According to these findings, resistance and balance training to address musculoskeletal issues is a successful method for helping people with Down syndrome minimize injuries, exhaustion, and falls when exercising, as well as to enhance their overall health. However, as a drawback of our study, there were only 20 participants, and the study only lasted for 8 weeks. To use a longer period of exercise duration and enlarge the study population, additional investigations are required.

9.	Jithangi Waniga-singhe	2021	Descriptive study	A descriptive study was carried out to examine the outcomes of exercise programs, particularly to enhance balance in young people with Down syndrome. The ability to balance was much lower in children with Down syndrome than in typically developing peers of the same age. Balance-related dynamic aspects were still more impacted than stability-related static aspects. Balance skills in people with Down syndrome emerged as they matured.
10.	Ayesha Razzaq	2022	Randomizer controlled trial	The ages of the two groups of Down syndrome kids, who ranged in age from 5 to 17, were chosen at random. Twenty participants were chosen. Both Group A and Group B received balance training, while Group B received exercises for core stability. A six-week therapy program was carried out. Results were much better in group B than in group A after the six-week treatment period. Exercises for core stability perform better than balance training.

Discussion

A full or partial extra copy of chromosome 21 comes from faulty cell division, which is the genetic disease known as Down syndrome. This extra genetic material causes the abnormalities in development and physical characteristics leading to Down syndrome. Clinical signs that describe it include orthopedic, cardiovascular, neuromuscular, ocular, cognitive, and perceptual deficits. Children's fine and gross motor abilities are both impacted by this hereditary condition, which is the most prevalent genetic cause of developmental impairment. The purpose of the study is to determine how well Down syndrome sufferers' balance may be improved by balance training exercises. The majority of publications demonstrate how balance training exercises can improve balance in people with Down syndrome. Among all of them, physical therapy balance training interventions highlights as the best treatment approach which can be given alone or with exercises compared to other treatment approaches.

The Bruininks Oseretsky Test of Motor Proficiency (BOTMP) and pediatric Berg balance were employed as outcome measurements in these articles. The outcome measures for the balance subscale evaluated balance. According to Mohamed Ahmed Eid's Ph.D. study, whole-body vibration could be a helpful intervention method for enhancing children with Down syndrome balance and muscle strength.

Regular physical activity may significantly improve static and dynamic balance in individuals with Down syndrome, according to Angela Palomba's analysis of the data. Future research may therefore concentrate on contrasting or combining several forms of exercise to see which one will provide the greatest advantages. Aside from that, we are confident that every person with DS should be encouraged to engage in regular exercise to help them improve their balance and posture and reduce the risk of falling¹⁴.

The youngsters were evenly split into three groups, as demonstrated by Rehaam Saeedalsakhawi. Group A received standard physiotherapy treatments. The workouts in group B were the same as in group A, plus additional training in core stability exercises. Along with a treadmill exercise program, group C received the same exercise intervention as Group A. Following a 3-week follow-up, functional balance and stability indices in all three groups are found to have significantly improved in favor of groups B and C15.

A randomized controlled trial by Ayeesha Razzaq indicated that balance training is ineffective for children with Down syndrome, except for 1 out of 10 articles.

Limitations

The limitations of this study stem from the exclusion of non-English journal papers, which may have prevented other research from meeting the criteria for inclusion. Additionally, some potential literature may be overlooked despite carefully selecting search terms and techniques.

Recommendations

Your inclusion and exclusion criteria should be made explicit: Describe the traits of the kids you want to include in the study in detail. For instance, you might choose to restrict the study to Down syndrome sufferers aged 5 to 17 years. Apply the right outcome metrics: Select appropriate outcome metrics that can adapt to changes in the balance. The Bruininks Oseretsky Test of Motor Proficiency (BOTMP) and the Berg Balance Scale are two examples of outcome measurements.

Conclusion

In this evaluation of the literature, the effectiveness of balance training programs to enhance balance in people with Down syndrome was examined. This study concluded that Down syndrome-affected youngsters had fewer

imbalances thanks to physical activity, which included balancing exercises.

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