

Attention to the child with Down Syndrome from a multimodal approach to Physical Rehabilitation

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Abstract

Physical rehabilitation in children with Down syndrome should be multidisciplinary, early, and personalized, addressing physical conditions and promoting autonomy. Recent studies support its effectiveness in optimizing motor function, preventing sequelae, and improving social participation. Objective: To analyze the diversity of therapeutic modalities used as a means of physical rehabilitation in schoolchildren with Down syndrome. Methodology: This is a descriptive-retrospective bibliometric study that conducts a bibliographic review using four international databases to compile various studies on the variety of therapeutic modalities used as a means of physical rehabilitation in schoolchildren with Down syndrome, and thus assess their effectiveness in addressing the physical conditions associated with the syndrome. Results: The results obtained indicate that the findings in the articles reviewed in the last five years emphasize various rehabilitation modalities for the care of children with Down syndrome. Conclusions: The

effectiveness of applying various modalities such as aquatic therapy, equine therapy, occupational therapy, and others was demonstrated in the reviewed research.

Keywords: *Physical Rehabilitation, Down Syndrome, Multimodal Approach*

Introduction

Among the diverse group of children with intellectual disabilities who are integrated into the current educational system are those diagnosed with Down Syndrome (DS), who require multidisciplinary attention due to the variety of comorbidities and disorders associated with it.

Down syndrome is a genetic condition caused by the presence of an extra copy of chromosome 21 (trisomy 21), which leads to distinctive phenotypic characteristics, varying degrees of intellectual disability, and an increased risk of medical comorbidities. It is also associated with alterations in growth and cognitive, motor, and social development (Bull et al., 2022). These authors also attribute various clinical manifestations to it, such as cardiac anomalies, respiratory and musculoskeletal complications, psychomotor delay, hypotonia, and ligamentous laxity, among others.

Among respiratory complications, some authors, such as Bull et al. (2022), mention obstructive sleep apnea (OSA), which, according to them, affects more than 60% of children with Down syndrome. Anatomical obstructions of the upper airways also appear, requiring interventions.

The most frequent musculoskeletal abnormality is atlantoaxial instability (AAI), a common orthopedic complication in children with Down syndrome (DS), characterized by excessive mobility between the first (atlas) and second (axis) cervical vertebrae. Atlantoaxial instability occurs in 10–30% of these children, requiring periodic radiological evaluation. Computed tomography (CT) and dynamic radiography are key to preventing neurological complications.

Physical rehabilitation plays a crucial role in the diagnosis, monitoring, and therapeutic management of the aforementioned complications. The benefits of reducing these complications are evident, employing various rehabilitation methods to improve quality of life and prevent further consequences.

Authors such as Pacheco (2024) and Reynoso & Adarmí (2025), Among the benefits of physical rehabilitation in school children with Down syndrome, the following stand out: improvement of

gross and fine motor development (coordination, balance, gait); muscle strength and tone (hypotonia characteristic of Down syndrome); sensory and cognitive integration (exercises improve attention and learning); prevention of obesity, heart disease, postural problems, and it contributes to autonomy and socialization in group activities that promote inclusion.

The main physical-therapeutic alternatives point to neuromotor physiotherapy through balance exercises (walking on lines), strengthening of core and lower limbs Reynoso & Adarmí, (2025); hydrotherapy and adapted swimming to improve resistance and muscle relaxation, Madrid, (2024); and sports activities with adjustments to promote strength and coordination, (Murga, 2025).

From a medical-preventive point of view, periodic evaluations of the spine (scoliosis), hips (instability) and feet (flat feet) are suggested; cardiac monitoring (due to the high prevalence of congenital heart disease); weight control to avoid obesity and its musculoskeletal complications; early detection of hypothyroidism and visual/auditory problems that affect motor development. (Murga,2025).

The multidisciplinary approach emphasizes the collaborative work of physiotherapists, occupational therapists, psychologists, and family involvement, and supports evidence for Multimodal Interdisciplinary Rehabilitation Programs (MIRMPs), which include physical exercise combined with structured psychosocial interventions. These programs are superior to unimodal treatments in reducing pain intensity, improving physical function, and decreasing work disability in patients with chronic low back pain and generalized musculoskeletal pain. Watson, et al. (2022).

Incorporating pain neuroscience education strategies alongside cognitive-behavioral therapy within a multimodal framework produces significant improvements in pain reduction and self-efficacy, surpassing the effects obtained solely with manual therapy or isolated exercise. This approach facilitates the patient's reconceptualization of pain, decreasing the perceived threat and promoting adaptive behaviors. (Kamper, et al., 2021).

Multimodal treatment models that combine specific therapeutic exercise, manual therapy techniques for modulation of the autonomic nervous system, and gradual exposure strategies to feared movements have proven to be more effective than isolated interventions in patients with subacromial pain syndrome and upper extremity tendinopathies, particularly when considering long-term prognosis and symptom recurrence. (Pieters et al., 2023).

Many studies indicate that the variety of therapeutic modalities, including physical rehabilitation, aquatic therapy, and equine therapy, among others, have clearly demonstrated their effectiveness in some systems affected by Down syndrome. Objective: To analyze the diversity of therapeutic modalities used as a means of physical rehabilitation in school-aged children with Down syndrome, with emphasis on the resource or method used and the objective of the treatment.

Methodology

This is a descriptive literature review, analyzed according to the recommendations for qualitative studies through the synthesis and discussion of the main findings. The following steps were followed to carry out the study: a review of national journals in the field of physical rehabilitation; a search for articles in the international literature; data collection; analysis of the studies; and discussion of the results. The Boolean operator AND was used for study selection. The keywords "physical rehabilitation," "rehabilitation modality," and "Down syndrome" were used in four international databases: Google Scholar, SciELO, and Redalib, as well as international repositories.

The inclusion criteria were studies published in the last 5 years in international sources and written in Spanish. Duplicate articles, studies outside the established timeframe, and those that did not include a rehabilitation method other than physical exercise were excluded. For initial eligibility, the titles of each record were considered to verify their relevance to the topic. Then, the abstracts were analyzed, followed by the full text to extract information relevant to the discussion. Data such as the author, objective, type of research, and main results were used for data analysis and synthesis.

Results and discussion

The first three pages of the Google Scholar search engine were consulted until the sources for the period 2020 to 2025 were exhausted. 55 studies were identified, of which, after applying the eligibility selection with inclusion and exclusion criteria, 22 studies were selected, and to compose the final version of the research, only 8 studies were selected with the inclusion and exclusion criteria, as shown in the flow diagram.

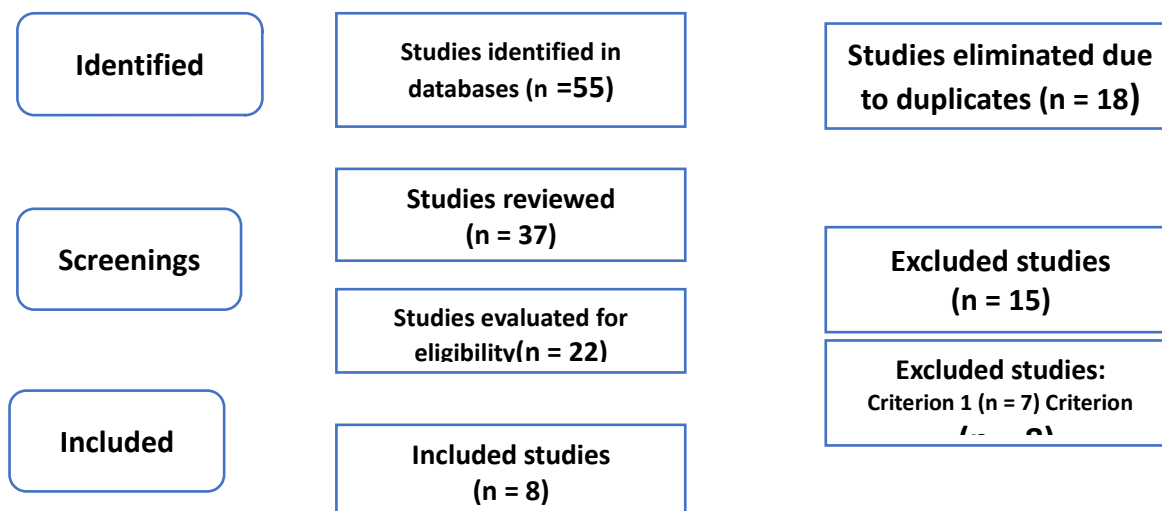


Figure 1. Flowchart of the study identification process

Findings resulting from the analysis of the selected studies *Diversity of Resources or Means in Physical Rehabilitation for Down Syndrome*

Physical rehabilitation for people with Down syndrome employs a wide range of innovative and traditional methods, adapted to the specific needs of this population. The eight studies reviewed highlight objectives aimed at addressing motor, cognitive, and sensory areas through multifaceted interventions.

Among the most relevant methods or resources used in the eight reviewed studies are aquatic therapy; multisensory stimulation; eccentric exercise; the Bobath Method; equine therapy; respiratory physiotherapy; virtual reality; and comprehensive early intervention.

The multisensory stimulation used in the study by Ruiz et al. (2022) is a therapeutic and educational technique that aims to activate the senses (sight, hearing, touch, smell, taste, and proprioception) to improve cognitive, emotional, and physical development, especially in people with disabilities, neurodevelopmental disorders, or older adults.

Table1. List of studies included in the review

	Author and year	Study	Resource used	Treatment Objective
1	Alban. (2023)	Multisensory module for cognitive development in children with prefrontal lesions	Intelligent module	Cognitive stimulation
2	Ruiz, EAA, & Ruiz, RSA (2023).	Digital ecosystem for multisensory stimulation in children with Down syndrome.	Digital ecosystem	Multisensory stimulation
3	Córdova, JPA, Velez, APM, & Guanoluisa, KAM (2024).	Playful virtual reality in visual and cognitive training in children with Down syndrome.	Virtual reality	Visual and cognitive training
4	Pacheco Pozo, MPE DOWN IN THE AQUATIC ENVIRONMENT. (2024).	Equine therapy to develop psychomotor skills in preschool children with Down syndrome.	Equine therapy	Psychomotor skills
5	Pasto Yanchatipan, AI (2024).	Respiratory physiotherapy in patients with Down syndrome (Bachelor's thesis, Riobamba, National University of Chimborazo).	Breathing exercises	Respiratory system
6	Madrid Concha, J. (2024).	Methods for training students with Down syndrome in the aquatic environment	Aquatic environment	Aquatic therapy
7	Murga Lemus, JR (2025).	Literature review of the therapeutic benefits of eccentric exercise as a treatment to improve muscle strength in patients with Down syndrome aged 10 to 15 years	The eccentric exercise	Muscle strength
8	Reynoso, M., & Adarmí, G. (2025).	Literature review of the therapeutic benefits of the Bobath method in psychomotor delay in patients with Down syndrome aged 0-10 years (Doctoral dissertation).	Bobath Method	Psychomotor Development

Ruiz et al. (2022) also employ digital environments and smart modules with lights, sounds, and textures to enhance sensory integration.

The use of multisensory stimulation is based on principles such as individualization, adapting to each person's sensory needs; non-directiveness, allowing participants to freely explore stimuli without

pressure; safety, using safe materials and environments to prevent overstimulation; and the principle of sensory integration, which aims to organize the nervous system's responses to stimuli.

Among the benefits of this approach for children with Down syndrome, this author states that it reduces stereotypies, improves attention, and promotes communication, exploration of the environment, and motor and cognitive development, addressing the intellectual disability that is often associated with them.

Equine therapy, or hippotherapy, is a therapeutic method that uses the horse's movement and the human-animal bond to improve physical, cognitive, emotional, and social areas in people with disabilities. In this review, Pacheco (2024) discusses its use to strengthen balance, posture, and emotional connection in young children with Down syndrome.

Among the elements to highlight regarding the use of this method, the author points out how the transmission of the horse's movement stimulates the pelvis and spine, improving balance and posture; it also increases confidence and self-esteem through the bond with the horse. Furthermore, it integrates tactile, visual, and auditory stimuli as multisensory stimulation.

The benefits of the environment for children with Down syndrome are framed in the physical order: in the improvement of muscle tone, coordination and gait; the cognitive order stimulates attention and memory, and in the social and emotional order it increases interaction and reduces anxious behaviors.

Findings related to new technologies as a means of physical rehabilitation in children with Down syndrome were found in the studies by Ruiz et al. (2023) and Córdoba et al. (2024). In the digital ecosystem developed by Ruiz et al. (2023), environments are used to enhance multisensory stimulation. This ecosystem also combines tablets and sensors with traditional techniques to stimulate attention and learning.

In the case of Córdoba et al. (2024), ludic virtual reality (LVR) is used as a methodology that combines immersive digital environments with game elements to promote learning and rehabilitation. It is based on principles such as: sensory immersion for visual, auditory, and kinesthetic stimulation; interactivity through active user participation in designed tasks; gamification

with the use of game mechanics (rewards, levels) for motivation; and personalization through adaptation to individual needs.

Both authors propose interactive games and 3D environments to train visual, cognitive, and coordination skills, with immediate feedback, in individuals with Down syndrome. Regarding the benefits of virtual reality and digital ecosystems for individuals with Down syndrome, both studies mention improved motor coordination; reinforced cognitive learning through repetition in safe environments; increased motivation by making therapies fun activities; and greater independence in activities of daily living (Pérez et al., 2022).

Respiratory physiotherapy, a specialty that seeks to prevent, treat and stabilize dysfunctions of the respiratory system through manual techniques, exercises and patient education, is fundamental in people with Down syndrome (DS), due to their anatomical characteristics (muscle hypotonia, narrow airways, higher incidence of respiratory infections)

Pasto (2024) employs techniques such as incentive spirometry and recurrent postural drainage, common in people with Down syndrome. This approach is based on improving pulmonary ventilation through thoracic expansion techniques; draining secretions to reduce infections; and promoting the strengthening of the diaphragm and intercostal muscles. It also aims to stimulate effective coughing to prevent mucus accumulation.

Specifically in SD the benefits are expressed in the decrease of respiratory infections (pneumonia, bronchitis); in the improvement of oxygenation and lung capacity Guillén et al., (2020); in the prevention of atelectasis due to accumulation of secretions; and the strengthening of respiratory muscles, improving physical resistance.

Aquatic therapy is a rehabilitation method that uses the physical properties of water (buoyancy, viscosity, hydrodynamic resistance and temperature) to facilitate movement, improve muscle strength, coordination and relaxation.

Its principles of buoyancy, viscous resistance, hydrostatic pressure, and water temperature are fundamental because they reduce joint impact, allow for less strenuous movement, promote progressive muscle strengthening, improve circulation and proprioception, and encourage muscle relaxation.

The following benefits of aquatic therapy have been demonstrated in children with Down syndrome:

- Improves muscle tone (characteristic hypotonia).
- It stimulates gross and fine motor coordination.
- It promotes sensory integration.
- It promotes socialization and self-esteem.

For their part, Madrid (2024) considers it a therapeutic means to improve coordination, muscle tone and motor confidence; he includes flotation exercises, resistance and directed games, promoting relaxation and psychomotor development.

Eccentric exercise refers to the phase of a muscle movement in which the muscle lengthens under tension, acting as a brake or controller of the movement; it occurs when the external force exceeds the force generated by the muscle, such as when lowering a weight.

As principles it refers

1. Greater force production: muscles can generate more force in the eccentric phase than in the concentric phase
2. Lower energy expenditure: although more force is produced, oxygen consumption is lower compared to concentric actions
3. Controlled muscle damage: induces micro-lesions that stimulate hypertrophy and adaptation
4. Selective fiber recruitment: Primarily activates type II (fast-twitch) muscle fibers

Street band (2025) showed the therapeutic benefits of eccentric exercise as a treatment to improve muscle strength in children with Down syndrome aged 10 to 15 years using eccentric contractions, which are less fatiguing and more effective in hypotonia.

Other benefits were also demonstrated (Schoenfeld, 2020), focusing on:

- Muscle hypertrophy, a greater stimulus for growth
- Improved strength and power, the foundation for explosive sports
- Injury prevention strengthens tendons

-Metabolic efficiency, ideal for populations with cardiovascular limitations

The Bobath Method is a neurodevelopmental rehabilitation approach designed to improve postural control and movement in individuals with neuromotor impairments. Developed in the 1940s, it is based on neuroplasticity, promoting more efficient movement patterns by facilitating normal postures and movements.

According to authors Reynoso & Adormí (2025), the Bobath Method for children aged 0-10 years is a neurodevelopmental therapy that corrects abnormal postural patterns and improves motor control through guided movements.

The method's key principles include individualization, postural control, inhibition of abnormal reflexes, facilitation of normal movements, and sensorimotor integration. Benefits for individuals with Down syndrome include improved muscle tone, gross and fine motor development, advancement of milestones such as sitting, crawling, and walking, sensory integration, support for proprioception and balance, and increased independence by facilitating activities of daily living (ADLs).

Conclusions

1. The diversity of media reflects the need to personalize interventions from the playful-aquatic to the technological (virtual reality, digital ecosystems) and the physiological (eccentric exercise).
2. The current trend integrates technological innovation with conventional therapies, highlighting the role of interdisciplinarity in rehabilitation. These approaches not only improve physical capabilities but also promote social inclusion.
3. Recent studies highlight its impact on autonomy, physical and emotional health, supported by a preventative medical approach. In short, physical rehabilitation for school children with Down syndrome should be comprehensive, personalized, and evidence-based, combining traditional exercises with technological innovations.

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