TRANSCRANIAL CEREBELLAR DIRECT CURRENT STIMULATION AND GAIT TRAINING IN CHILDREN WITH DOWN SYNDROME: RANDOMIZED CONTROLLED DOUBLE-BLIND CLINICAL TRIAL

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SUMMARY

The objective of the research project is to compare the effects of ten sessions of treadmill gait training associated with the application of active and placebo cerebellar anodal transcranial direct current stimulation (tDCSa) on the domain of Activity (mobility and functional balance) and Participation of the ICF in children with Down Syndrome (DS). This is a randomized, placebo-controlled, double-blind clinical trial involving 30 children diagnosed with DS, aged between 3 and 8 years, who meet the eligibility criteria. The participants will be evaluated one week before, one week after, and one month after the intervention, using the Timed Up and Go, 10-Meter Walk Test, Pediatric Balance Scale, and Participation and Environment Measure for Children and Youth. The experimental group will perform treadmill gait training combined with the application of active cerebellar tDCS. The control group will perform treadmill gait training associated with the application of placebo tDCS. The speed of the gait training will be established according to the child's performance in each session. tDCS will be applied with the anode electrode positioned over the cerebellar region and the cathode electrode over the central supraorbital region. The intervention will involve ten intervention sessions, with a frequency of five sessions per week, carried out over two consecutive weeks and lasting 20 minutes each. Considering the potential effect of cerebellar tDCS, it is expected that the intervention will increase the effect size of gait training in children with DS.

Keywords: Down syndrome; gait, balance; child; physiotherapy; transcranial direct current stimulation.

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Introduction

Down Syndrome (DS) is a genetic condition characterized by a chromosomal abnormality, caused by an extra copy of chromosome 21, which leads its bearer to exhibit specific characteristics. It is recognized as the main cause of cognitive impairment, being considered one of the most frequent numerical anomalies of autosomal chromosomes. In this population, we can observe a variability of deficits in the learning process and development, directly impacting selective motor control, compromising motor acquisitions and the functional independence of the individual (JAIN et al., 2022; KARIMI; NELSON, 2023; KIM et al., 2017).

Regarding movement, and especially gait, children with DS exhibit difficulty in motor coordination. The delay in neuropsychomotor development present from birth and the reduction in cerebellar volume cause children to exhibit compensatory patterns and strategies, including impairments in movement timing and adaptation to movement changes, postural and balance deficits, co-contraction of agonist and antagonist muscles, spinal column abnormalities, and joint instability, especially in the hip, knee, and ankle (KAMIŃSKA et al., 2023; VALENTÍN-GUDIOL et al., 2017).

The improvement of gait and postural control are considered fundamental therapeutic objectives for the rehabilitation of children with DS. Physical activity programs can contribute to achieving these goals, in addition to promoting encouragement for a better lifestyle and delaying the development of age-related and sedentary lifestyle diseases (KAMIŃSKA et al., 2023; VALENTÍN-GUDIOL et al., 2017).

Properly conducted treadmill gait training results in improvements in functional mobility, static and dynamic balance, gross motor functions, physical conditioning, and gait pattern. The results are related to gait training providing the training of a specific task, with multiple repetitions of the gait steps, facilitating motor learning due to the repetitive training of this function, resulting in the stimulation of processing and responses of the central nervous system (KAMIŃSKA et al., 2023; VALENTÍN-GUDIOL et al., 2017).

Transcranial direct current stimulation (tDCS) has been known to induce long-lasting changes in cortical excitability. Cortical modulation is dependent on the polarity of the applied current. tDCS allows for two types of stimulation: anodal current, which increases cortical excitability, favoring the depolarization of the neuronal membrane, or cathodal current, where the stimulus has an inhibitory effect by hyperpolarizing the neuronal membrane (FREGNI et al., 2021; THIBAUT et al., 2013).

Considering the perspective of optimizing the effect size of treadmill gait training, the complexity and intensity of the negative impact of DS on neuropsychomotor development, understanding the effects of tDCS in this population appears promising. As it is considered a safe, inexpensive, and easy-to-apply resource, tDCS could positively contribute to the rehabilitation of children with DS, if scientifically demonstrated that its neurophysiological effects are capable of enhancing the learning of new motor strategies that result in improved performance in activities (mobility and functional balance) and participation.

The hypothesis of the study is that ten sessions of treadmill gait training associated with anodal tDCS over the cerebellum will result in clinically relevant effects on the Activity domain (mobility and functional balance) and Participation of the International Classification of Functioning, Disability and Health (ICF) in children with DS.

Thus, the objective of the project is to compare the effects of ten sessions of treadmill gait training associated with anodal tDCS on the active and placebo cerebellum in the domain of Activity (functional mobility and functional balance) and Participation of the ICF in children with Down syndrome.

Methodology

This is a randomized, placebo-controlled, double-blind clinical trial involving 30 children diagnosed with DS, aged between three and eight years, who meet the eligibility criteria.

The participants will be evaluated one week before, one week after, and one month after the intervention ends. The evaluation will consist of measuring functional

mobility (Timed Up and Go and 10-meter walk test), functional balance (Pediatric Balance Scale), and social participation (Participation and Environment Measure for Children and Youth).

The experimental group will perform treadmill gait training after the application of active tDCS on the cerebellum. The control group will perform treadmill gait training after the application of placebo tDCS on the cerebellum. The speed of the gait training will be set according to the child's performance in each session. tDCS will be applied to the cerebellum, with an intensity of 1mA (GRECCO et al., 2015). The intervention will involve ten intervention sessions, with a frequency of five sessions per week, carried out over two consecutive weeks and lasting 40 minutes each (20 minutes of tDCS and 20 minutes of treadmill gait training). The results will be analyzed statistically.

Expected results

Considering the potential effect of anodal tDCS on the cerebellum, it is expected that the intervention will increase the size of the effect of gait training in children with DS, as well as optimize the effects of neurofunctional training on the domain of Activity and Participation of the ICF, with just ten intervention sessions. The therapeutic approach studied could represent a paradigm shift in the neurofunctional rehabilitation of children with DS, through an effective, low-cost, and short-duration intervention.

Conclusion

The research project schedule involves the start of recruitment and evaluation procedures in October 2024. The results obtained will be analyzed and presented in scientific articles.

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