

# How to handle with spasticity in children with C.P.? Review article/scoping

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## Abstract

**Objective:** Incidence of noncommunicable illnesses in adults with and without cerebral palsy (CP) should be compared. This study examined the trunk muscle activity during horseback riding machine exercise in children with spastic cerebral palsy. Appropriate trunk muscle activity is required to execute functional tasks in cerebral palsy. The activity of the trunk muscles, including both sides of the rectus abdominis, external oblique, latissimus dorsi, and erector spinae, in sitting posture and during horseback riding machine exercise were assessed using a surface electromyography on 10 children with spastic cerebral palsy.

**Methods:** The Clinical Practise Research Datalink's primary care data were used in a cohort study. To compare the risk of any noncommunicable disease, cancer, cardiovascular disease, type 2 diabetes mellitus, and respiratory disease between persons with and without CP, Cox models stratified by matched set and adjusted for potential confounders were constructed.

**Results:** 1,705 persons with CP and 5,115 adults without CP who were age-, sex-, and general practise matched were included in the analysis. According to adjusted analyses, persons with CP had a 75% higher risk than adults without CP of having any noncommunicable disease (hazard ratio [HR] 1.75, 95% confidence interval [CI] 1.58-1.94). They had a higher risk of respiratory disease (HR 2.61, 95% CI 2.14-3.19) and cardiovascular disease (HR 1.76, 95% CI 1.48-2.11). There was no proof that the risk of type 2 diabetes or cancer had increased.

**Conclusions:** Adults with CP were more likely to develop noncommunicable diseases, particularly respiratory and cardiovascular conditions. These results underline the necessity of clinical vigilance in identifying noncommunicable diseases in CP patients as well as further investigation into the causes and treatment of noncommunicable diseases in this population.

**Keywords:** Cerebral palsy, Spasticity, Spastic CP, posture, non communicable Disease

## INTRODUCTION

A non-progressive injury to the developing brain results in cerebral palsy (CP), a diverse and chronic neurological condition. In this illness, the developing central nervous system is injured or malformed, which has an impact on the motor function and postural development before, during, or soon after birth. [1]

"Cerebral" relates to the brain, and "Palsy" denotes that muscles lack control. Epilepsy, osteoporosis, and dysphasia may develop in the youngster as a result of difficulties performing daily tasks and maintaining mobility, posture, and neuromuscular control. [2]

More than 170 years ago, the English orthopaedic surgeon William Little coined the phrase "cerebral paralysis" when he connected a difficult labour and neonatal hypoxia with limb stiffness and ensuing musculoskeletal malformations. Through the years, According to the panel of experts, cerebral palsy is a collection of long-term, but not irreversible, motor and/or movement impairments that result from a non-progressive interference, lesion, or abnormality of the developing or immature brain. Cerebral palsy is mostly diagnosed based on motor function and postural issues that start in early childhood and last all the way to the end of life; these issues are non-progressive but do alter with age. The primary symptoms of cerebral palsy are motor function abnormalities, which are commonly accompanied by additional dysfunctions such secondary musculoskeletal issues, epilepsy, sensory, perceptual, cognitive, communication, and behavioural issues. [28] The characteristics of interdisciplinary clinical care of CP are reviewed here. We give a historical overview of the condition and discuss changes over time in our knowledge of its causes, diagnoses, and therapies. With an emphasis on current and future best practises, we examine the rising popularity of non-invasive management techniques and advancements in rehabilitation that take advantage of the nervous system's

built-in plasticity. [2] This illness is the outcome of a brain insult or injury that occurs before birth or in infancy, causing the formation of faulty neural connections that result in chronic abnormal limb strength, control, or both. [3]

A significant disadvantage in children with unilateral cerebral palsy (UCP) is motor dysfunction. Children's engagement in daily activities, schooling, and play may be further restricted by this deficiency. [4] Disabilities such as motor dysfunctions, sensory disturbances, perception, cerebral challenges, behaviour problems, epilepsy, and subsequent musculoskeletal concerns can result from various prenatal, perinatal, and postnatal complications. [5]

While the prevalence of CP has been reported to range from 1.5 to 4 per 1000 live births in internationally published literature, the range recorded for India is larger and ranges from 2.08 to 3.88 per 1000 live births. [6] Defects in postural balance are among the most significant issues in kids with cerebral palsy. For children with cerebral palsy, maintaining the seated equilibrium, which is necessary to carry out independent daily living tasks, is a significant problem. [7]

Exercises that help improve trunk stability are necessary for children with cerebral palsy, but it can be challenging to obtain smooth, functional motions. Therefore, it is essential to maintain enough trunk muscle strength and endurance in order to sustain seated postures and functional motions during daily tasks. [8-10] The pre-conception, prenatal, perinatal, and postnatal risk factors for CP can be separated. Epilepsy, especially drug-resistant epilepsy, as well as mental retardation, visual and hearing impairment, as well as eating and behavioural difficulties, are all conditions that frequently coexist with CP. The severity of the child's motor issues ranges from modest to very severe, leaving them completely dependent on their carers.[5]

Spasticity is characterised as an inappropriate involuntary muscular activity linked to upper motor neuron paralysis, or alternatively as a velocity dependent increased resistance to passive muscle stretch. Functional issues with daily living activities (ADLs) like locomotion, feeding, washing, using the restroom, and clothing can be brought on by spasticity. Over time, spasticity may also result in issues like muscle soreness or spasms, difficulties moving in bed, trouble transferring, and bad seating and gait, dystonic posturing muscle, contracture resulting in bone distortion, joint subluxation or dislocation, and reduced functional independence. Contractures happen when the muscles, ligaments, and tendons surrounding the joint experience structural changes, resulting in a decrease of joint motion. Soft tissue shortening and stiffness limit normal movement and render the joint resistant to stretching. However, children with cerebral palsy benefit from spasticity. A stronger tone might be advantageous for the child. It aids in maintaining the legs straight, which supports the child's weight in defiance of gravity. The child that has stronger trunk extensors can stand and walk a short distance. Spasticity may maintain bone density and muscular mass. The severity and kind of spasticity can vary greatly depending on a child's mood, level of exhaustion, stress, and head and limb position. While one limb may exhibit one type of spasticity, another may exhibit a different type. Spasticity impairs freedom in daily tasks by causing contractures, incorrect posture, and trouble moving. The soft tissues are getting shorter and stiffer benefits include maintaining bone density and muscle mass. Any condition that affects the upper motor neuron in the central nervous system might cause spasticity in children. Lower cortical input to the descending reticulospinal and corticospinal pathways results from injury to the upper motor neuron, which results in weakness, loss of motor control, and a decrease in the number of voluntarily activated motor units. The absence of the usual inhibition of the reflex arcs inside the grey matter of the spinal cord caused by the decrease of these descending tracts results in an overactive reflex arc and spasticity. Damage to the developing oligodendroglia between 20 and 34 weeks of gestation causes spastic diplegia. Periventricular leukomalacia is the most frequent neuropathologic finding on neuroimaging. The majority of cases of spastic hemiplegia, which is most frequently seen in infants born at term, are caused by in utero or perinatal stroke. The majority of kids with spastic hemiplegia have high levels of functional ability, normal cognitive capacities, and the capacity to continue walking independently. Cognitive loss, seizures, behavioural issues, sleep disorders, vision impairment, and hearing impairment are more common in children with CP. [11] [Personnel with CP employ four functional classification systems to provide a common method for evaluating their support and therapy needs. For children between the ages of 2 and 18 years old, the gross motor function classification system (GMFCS) is used to describe gross motor function, particularly the capacity to walk. GMFCS is a term used to describe both self-initiated movements and movements supported by aids like wheelchairs, canes, crutches, or walkers. For kids between the ages of 4 and 18 years old, the usual usage of both hands and upper extremities is categorised using the Manual Ability Classification System (MACS). The ability of people with CP to engage in daily communication (sending or receiving a message) is categorised using the Communication Function Classification System (CFCS). The CFCS takes into account all forms of communication, including spoken words, hand signals, eye contact, visuals, communication boards, and speech-generating technology. For children aged 3 and older, the Eating and Drinking Ability Classification System (EDACS) is used to describe the eating and drinking function. The EDACS evaluates eating and drinking efficiency (the amount of food lost and the time taken to eat) as well as eating

and drinking safety (risk for aspiration or choking). [12] In order to reduce pain and muscle spasms, facilitate brace use, improve posture, reduce muscle contractures and deformities, facilitate mobility and dexterity, improve patient ease of care and hygiene/self-care, and other combined procedures, children with spastic CP typically require clinical interventions for muscle overactivity. One of the most prevalent patterns in children with CP, particularly those who have hemiparesis, is spastic equinus/equinovarus foot. It may be due to the spastic overactivity of calf muscles (e.g. gastrocnemii, soleus and tibialis posterior), calf muscles contracture/shortening, drop-foot during the swing phase of gait due to muscle weakness (e.g. tibialis anterior, extensor digitorum/hallucis), imbalance between the tibialis anterior and peroneus muscles leading to hindfoot varus in the swing phase of gait. motor tibial nerve branches choose the best therapeutic course of treatment for the foot, which may involve TNB. Adults with stroke have used ultrasound to identify the anatomical landmarks of the tibial nerve motor branches for controlling spastic equinovarus foot. To the best of our knowledge, no prior research has addressed a comparable problem in kids. Therefore, the primary goal of this study was to locate via ultrasound the anatomical landmarks of the tibial motor nerve branches to the gastrocnemii, soleus, and tibialis posterior muscles for selective motor nerve blocks to treat spastic equinovarus foot in kids with cerebral palsy. According to our opinion, identifying these anatomical landmarks may be particularly helpful for clinicians who perform nerve blocks under the supervision of an EMG to make the process of nerve targeting in a paediatric setting easier as well as for clinicians who are new to the US-guided nerve block technique in paediatric patients to make the process of nerve recognition easier. [29]

## METHODS:

**Framework and search history:** To locate papers written in the English language, a search was conducted in Medline using PubMed, Google Scholar, and manually retrieved pertinent publications by cross-referencing. The search terms also included management and prevention methods for cerebral palsy, early brain lesions, and prenatal stroke. To present an updated picture, we concentrated on articles over the last five years, from 2017 to 2021.

The study aims to shed insight on current cerebral palsy developments and suggest new directions for ongoing research in this area. We chose a variety of published articles for this purpose, including original research, review articles, and systematic reviews that we believe are pertinent to our study. The determinants of cerebral palsy were examined in paediatric patients with ACSH between April 2019 and August 2019 who ranged in age from three months to 18 years old using an unmatched case-control study design. All young people with cerebral palsy and healthy controls who visited the hospital's paediatric inpatient, outpatient, and emergency departments during the study period made up the study population.

**2.1 Study Environment and Design:** This study was carried out from April to August 2019 in the paediatric outpatient, emergency, and inpatient units at Ayder Comprehensive Specialised Hospital (ACSH), Mekelle, Ethiopia. The primary, secondary, and tertiary levels of care in Ethiopia's healthcare system are organised into a three-tier system.

**2.2 Case and control inclusion criteria:** All children with a clinical diagnosis of cerebral palsy (motor weakness defined as a score of less than or equal to four on the Medical Research Council Scale for Muscle Strength), in at least one limb associated with activity limitation and presumed central origin of weakness based on neurological examination conditional on the carers, were included as cases. These children ranged in age from 3 months to 18 years.

**2.3 Case and control exclusion criteria:** Children who had at least one of the following conditions were included in the study, including both cases and controls: (1) obstructive hydrocephalus (2) history of cancer (3) signs of delayed development during infancy (4) diagnosis of a genetic syndrome (5) primary neuromuscular problem.

**2.4 Sample Size:** To determine the sample size, the main risk variables were newborn infections, hyperbilirubinemia, and birth asphyxia.

**A dependent variable:** The following dependent variable was used: a cerebral palsy clinical diagnosis.

**Unrelated variables:** The following independent variables were used: (1) socio-demographic details (patient's age, sex, place of residence, and birth order); (2) maternal details (maternal education status); and (3) prenatal/ pregnancy-related details (antenatal care (ANC), maternal illnesses, antibiotic use, malaria). Congenital malformations, neonatal hospitalisations, central nervous system CNS infections in infancy, and head trauma are among the postpartum and early childhood risk factors. Intrapartum risk factors include labour duration, rupture of membranes, gestational age at birth, place of delivery, style of delivery, and (4) intrapartum variables. Because early signs and symptoms that are

suggestive of CP may really be a normal variation or developmental lag and tend to recover in many children, a diagnosis of CP is mostly dependent on clinical observations and is typically more trustworthy after 2 years of age. Clinical indications of CP may persist in some kids up until they are 4-5 years old. They emphasised early diagnosis to improve long-term functional outcomes on the theory that doing so would positively modulate their impact on neuroplasticity, i.e., they reported that early and accurate diagnosis of CP is possible based on a combination of findings from medical history, neuroimaging, and standardised individually administered neurological and motor assessment tools. Medical personnel with specialised training and experience in using the tools should administer and interpret them. According to their analysis, Novak et al. discovered that: The Prettl Qualitative Assessment of General Movements (98% sensitivity), the Hammersmith Infant Neurological Examination (90% sensitivity), and term-age magnetic resonance imaging (MRI) are the most sensitive tests for identifying CP risk in infants under 5 months of corrected age.

The Hammersmith Infant Neurological Examination (90% sensitivity), the Developmental Assessment of Young Children (83% C index), and MRI (86-89% sensitivity) are the most accurate methods for identifying CP risk in children younger than six months of corrected age. [13]

### Results:

After removing the excluded individuals, 5,115 patients without CP were matched to 1,705 patients with at least one record of CP who were at least 18 years old during the study period and underwent research-standard follow-up. The median age of patients at the beginning of follow-up, both those with and without CP, was reported to be 29 years old. Patients with CP tended to be underweight more often than they did overweight or obese. When compared to the sitting position, the horseback riding machine exercise significantly increased the muscle activation of the rectus abdominis, right erector spinae, right latissimus dorsi, and erector spinae (P .05).

### DISCUSSION:

Instead of being a medical entity in the conventional sense, cerebral palsy is a clinical term used to describe children who have non-progressive brain lesions or injuries that were acquired during the antenatal, perinatal, or early postnatal periods. [14] Spastic, athetoid, or ataxic palsies are the most prevalent manifestations; it is also one of the most common causes of motor dysfunction in children and is commonly linked to other issues such developmental delays, sensory defects, and epilepsy. The goal of clinical therapy for kids with CP is to maximise function and participation in activities while minimising the consequences of conditions including epilepsy, feeding difficulties, hip dislocation, and scoliosis that can exacerbate the condition. [15] However, underlying brain injuries are mostly responsible for the neuro developmental results. Lesions of the grey matter are more frequent in children with CP. Like El-Tallawy et al. [16] It has been hypothesised that the male sex has a biological susceptibility because of potential changes in how the brain is organised, hereditary diseases, or the influence of female hormones, which may reduce the effects of brain damage [12–14]. The majority of CP patients also had higher birth orders. This is in line with another study that Sharma et al. [17] conducted in India. Our findings may have implications for younger moms who give birth to higher-order babies without enough information about pregnancy-related difficulties and who, as a result, display delayed health-seeking behaviour compared to mothers of higher parities. In our study, it was determined that the use of vacuum or forceps during operative vaginal deliveries, which are vaginal deliveries, was significantly related with the emergence of CP. [18] According to this study, cerebral palsy patients sat far more comfortably in the functional sitting position than they did in their original placements. The child with CP with a hypotonic trunk was able to stand up straighter thanks to the extensor muscles of the back and neck contracting to fight gravity. For three of the kids using a saddle-style seat meant to keep the legs in a posture that prevented spasticity, the significance of a solid foundation for an ideal functional sitting position was clear. Although spasticity was not specifically quantified in this study, At least in part, the benefits of the functional sitting position can be understood as having a positive impact on spastic movement patterns. As soon as the pelvis leaned forward in this position, there appeared to be a stretch effect on the spastic muscles. This may be in line with the claim that there are "key points of control" (Bobath 1980): Proximal locations, from which one can affect postural tone and movement patterns across the body (Bryce 1976), free up more distant regions to move actively. The myoelectric activity of the affected muscles must be measured in order to validate this notion. The position of the pelvis is a crucial consideration when adjusting chairs to provide postural control over time. In this study, we sought to learn more about the factors of the course taken by children with cerebral palsy (CP) between the ages of 9 and 15 years in terms of their gross motor function. motor performance The findings indicated that children with poor selective motor control, tetraplegia, weak muscles, mild to moderate limitations in hip and knee extension, spasticity of the hamstrings in both legs, and children in special education showed a less favourable course of gross motor function than children who were less affected. Selective motor control was the most significant of these characteristics. Our findings somewhat corroborated findings for limb distribution

and cognitive impairment from studies of persons with CP that were conducted retrospectively. Its authors also discovered that mobility decline was most frequently reported by persons with tetraplegia and that intelligence level was associated with mobility decline. Although Jahnsen et al. established a link between decline in mobility and a lack of physiotherapy (PT) and physical activity, the relationship between the course of gross motor function and ROM and muscular strength has not been specifically addressed in the literature. The significance of selective motor control was also discussed in a review article<sup>22</sup>, which noted that while clinicians have concentrated on treating positive CP symptoms like spasticity, the prognosis for locomotion will ultimately depend on negative symptoms like selective motor control and strength. . Additionally, our analyses revealed no association between the total amount of spasticity in the lower limbs and the trajectory of gross motor function, but there was a significant link between the two. [20] Regarding the degree of motor impairment and the presence of coexisting disorders, CP is a varied condition. Depending on the degree of motor impairment, including ambulatory and feeding status, and the existence of concomitant diseases including epilepsy and dysphagia, the connection between CP and NCD may vary. Young individuals with CP exhibited higher risks of cardio-metabolic morbidity than adults without CP, according to a more recent cross-sectional study. [21] In the study by MacPhail et al. (1998), riders with diplegic CP responded during therapeutic horseback riding with normal equilibrium reactions 65%–75% of the time, whereas riders with quadriplegic CP only responded normally 10%–35% of the time. The severity of the gross motor function in children with CP is categorised using the Gross Motor Function Classification System (GMFCS). Children with CP have higher gross motor function when their GMFCS is lower. Therefore, among children with CP under the age of 12, the change score of the GMFM interacted with severity and age. In THR programmes, the reduction of spasticity and abnormal movement patterns with the ensuing promotion of "normal" movement skill was frequently emphasised as the desired outcome. [22] CP is a common, incapacitating condition. To contribute effectively to the multidisciplinary management team, neurologists who treat both children and adults must be conversant with the clinical symptoms, common comorbidities, and best treatments. Care teams must address rehabilitation measures to preserve and enhance function in addition to managing seizures, paralysis, spasticity, cognitive impairment, and dietary problems. The use of evidence-based techniques, notably constraint-induced therapy, will guarantee the greatest possible progress for both children and adults. According to research, the pathogenesis and treatment of CP throughout a patient's life depend on brain plasticity. This characteristic has focused research on functional recovery, and neuroplasticity-based rehabilitation methods are currently being developed. Specific In meticulously planned clinical studies, pharmacological and non-pharmacological rehabilitation strategies for people with CP must also be evaluated. [24] In paediatric neurology, children with cerebral palsy and cognitive impairment are a major concern. Children with CP must be managed in a complex way that involves many different disciplines if their quality of life is to be improved. [25] Adults with CP were more likely to develop noncommunicable diseases, particularly respiratory and cardiovascular conditions. These results underline the necessity for clinical vigilance in identifying noncommunicable diseases in CP patients and for additional study into the causes and treatment of noncommunicable diseases in this population. Gross and fine motor skills are abnormal in people with cerebral palsy (CP). Comorbid diseases include epilepsy, intellectual disability (ID), and visual and hearing impairment are common in people with CP. While there were significant gains in survival among CP children between 1983 and 2010, these improvements were not seen among teenagers, adults with CP who are 15 to 60 years old and feed orally, or all individuals with CP who are >60 years old. This growing disparity in survival may be caused by a number of CP-related conditions, such as the severity of motor impairments, the existence of seizures, ID, musculoskeletal disorders, and mental health issues. This growing difference may also be explained by the increased risk of non-communicable disease (NCD) among those with CP. [26]

### **Control of Spasticity:**

The treatment team faces a significant problem in managing spasticity. People with cerebral palsy, as well as carers and parents caring for someone with this impairment, have access to a variety of therapy options. They are essential to a person with CP's capacity to function and live a better life and can all be helpful at all stages of this disability. The treatment of cerebral palsy spasticity is not standardised. But in order to implement the right interventions, a proper assessment of the individual impairments producing disability is required. The degree of functional impairment brought on by the spasticity and its location determine the therapy plan. In general, oral drugs including baclofen, diazepam, clonazepam, and tizanidine are used to treat spasticity in children with cerebral palsy. In general, oral drugs including baclofen, diazepam, clonazepam, and tizanidine are used to treat spasticity in children with cerebral palsy. orthopaedic surgery, physical therapy, occupational therapy, and splinting and casting. Orthoses, splints, and casts are all medical devices used to hold the body in a specific position. These tools are used to stop or reverse abnormalities in the spastic limb and/or to aid cerebral palsy patients in overcoming activity restrictions like standing and walking difficulties. and repeated casting can increase the range of motion in a contracture-prone joint. In occupational therapy practise, serial casting is an intervention technique that is being employed To address stiffness

and associated contractures in children with cerebral palsy, in addition to other therapy modalities/protocols. The foundation of serial casting is the idea that shortened muscles still have the plasticity to lengthen. Long-term stretching reduces spasticity and has biomechanical advantages. But there is a distinction between serial casting and inhibitive casting. Inhibitory casting only employs a single static cast, and its goal is to improve function by shortening rather than lengthening muscle. Ankle-foot orthoses, or AFOs, are the most prevalent type of orthosis. AFOs are usually made to restrict undesirable ankle movements, particularly ankle plantar flexion (foot pointed downward). (Fig. 1) Looking down. AFOs can be fixed to prevent ankle mobility or articulating to provide some ankle movement. Children with hemiplegic and spastic diplegic cerebral palsy have both shown improved walking efficiency when plantar flexion is prevented with the aid of AFOs. The children's walking patterns are better when wearing AFOs as compared to barefoot walking. AFOs have been demonstrated to improve children with cerebral palsy who frequently walk on their toes' capacity to transition from sitting to standing. The use of AFOs for standing up from a sitting position, however, did not aid cerebral palsy patients who can stand on a flat foot since the AFOs tended to . Children with cerebral palsy have been proven to expend less energy when walking after using AFOs. According to one study, children with spastic diplegic cerebral palsy who wore hinged AFOs used less oxygen while walking. [27]

### Conclusion:

Children with spastic cerebral palsy showed considerably higher activity in the rectus abdominals, external oblique, latissimus dorsi muscle, and erector spinae after horseback riding machine exercise than those in the sitting posture. CP is a common, burdensome disorder. To contribute effectively to the multidisciplinary management team, neurologists who treat both children and adults must be conversant with the clinical symptoms, common comorbidities, and best treatments. Care teams must address rehabilitation measures to preserve and enhance function in addition to managing seizures, paralysis, spasticity, cognitive impairment, and dietary problems.

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