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Balance and gait of spastic cerebral palsy patients at a selective rehabilitation center in Bangladesh

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Submitted by **Jamil Ashrafi Ananna**, for the partial fulfillment of the requirements for the degree of Bachelor of Science in Physiotherapy (B.Sc. in PT.)

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Declaration

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also declare that for any publication, presentation or dissemination of information of the study. I would be bound to take written consent from Department of Physiotherapy of Bangladesh Health Professions Institute (BHPI).

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Content

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Acronyms

ADL - Activities of Daily Living

AUC - Area Under the Curve

BCPR- Bangladesh CP Register

BHPI - Bangladesh Health Professions Institute

BPF - Bangladesh Protibondhi Foundation

CP - Cerebral Palsy

CRP - Center for the Rehabilitation of the Paralyzed

GLM-CPR - Global Low-and Middle-Income Country CP Register

GMFCS - Gross Motor Function Classification System

GMFCS-E&R - Gross Motor Function Classification System-Expanded and Revised

HICs - High-Income Countries

ICC - Intraclass Correlation Coefficient

ICF- International Classification of Functioning, Disability and Health

IRB - Institutional Review Board

LMICs - Low-and Middle-Income Countries

NGO - Non-Governmental Organization

PBS- Pediatric Balance Scale

SATCo - Segmental Assessment of Trunk Control

SDD - Smallest Detectable Difference

SPSS - Statistical Package for the Social Sciences

SWIDB - Society for the Welfare of the Intellect

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Abstract

Purpose: To investigate the gait and balance characteristics of children with spastic cerebral palsy who attended a selective rehabilitation facility in Bangladesh. ***Objectives:*** To explore the sociodemographic features (age, gender, type of cerebral palsy, parental education, place of delivery), to assess gait parameters (walking speed, cadence, stride length), to evaluate balance using the Pediatric Balance Scale (PBS), and to examine the relationships among balance, gait performance, and other variables such as limb involvement and maternal education. ***Methods:*** This cross-sectional study involved 102 children with spastic cerebral palsy at the Pediatric Unit of the Centre for the Rehabilitation of the Paralyzed (CRP), Savar. Data were collected using structured questionnaires and standardized clinical tools including the PBS and observational gait analysis. Descriptive statistics were used to present the demographic and clinical profiles, and inferential statistics such as chi-square and correlation tests were applied to examine associations. ***Results:*** Among 102 participants, 48% were quadriplegic, 43.1% diplegic,7.8% triplegic, and 1% monoplegic . The average age was 7.17 years (SD = 2.239). Most children were born after 38 weeks (81.4%), but 57.8% did not cry immediately after birth, indicating potential birth complications. Notably, 69.6% were delivered in hospitals and 52% had normal vaginal delivery. Regarding balance, complex postural tasks like standing on one foot showed a strong correlation with PBS scores (r = 1.000), and placing alternate foot on a stool also showed high correlation (r = 0.679). However, gait parameters such as stride length (r = 0.280) and speed (r = 0.030) showed weaker relationships. There was a borderline association between maternal education and balance outcomes (p = 0.051). The findings highlight that spastic CP children exhibit persistent gait and balance deficits, even after rehabilitation. ***Conclusion:*** There is a strong relationship between dynamic balance tasks and overall motor function in children with spastic cerebral palsy. Sociodemographic factors, especially maternal education and early neonatal events, are important in shaping functional outcomes. These results underscore the need for early diagnosis, structured rehabilitation, and parent-focused interventions in low-resource settings like Bangladesh.

Keywords:

Gait, Balance, Spastic Cerebral Palsy, Pediatric Balance Scale, Rehabilitation, Bangladesh.

Chapter-I Introduction

1.1 Background

According to the Centers for Disease Control and Prevention, cerebral palsy is a group of disorders that affect a person's posture, movement, and balance (Vitrikas et al., 2020). Although they may alter throughout time as a result of a damage to the developing brain, clinical results are permanent and non progressive (Nelson et al., 2020). In the United States, one out of every 323 children has cerebral palsy, which is the most common physical handicap in children and has stayed relatively constant throughout time (Trisnowiyanto et al., 2020).

A group of early-onset, non-progressive neurodevelopmental disorders brought on by brain injury are collectively referred to as cerebral palsy (CP). With a frequency of about two per 1000 live births, cerebral palsy is a prevalent cause of impairment in children (Khandaker et al., 2019). Globally, an estimated 17 million people with cerebral palsy (CP) (Novak et al., 2020). The epidemiology of CP has been extensively studied in high-income countries (HICs). Clinical traits and risk factors for CP may differ between LMICs and HICs (Velde et al., 2019). One of the main risk factors for HICs is preterm birth. Bangladesh has a much lower rate of preterm births of infants with cerebral palsy (18.5 percent vs. 42.9 percent) than Australia, according to a survey of patients at rehabilitation clinics (Speyer et al., 2019).

In LMICs, CP is still widely linked to several prenatal and birth-related factors, such as birth hypoxia (Morgan et al., 2021). Additionally, more research is being done on the role infections play in the etiology of CP and effective prophylactic measures, which is crucial in low-resource countries where infections are still common (Morgan et al., 2021).

These clinical symptoms occur outside of the expected developmental stages based on age. Other research has revealed clinical outcomes such as hearing loss, blindness, and scoliosis advancement due to muscle spasm (Ikeudenta et al., 2020). Cerebral palsy is diagnosed clinically by identifying the diagnostic characteristics. The nature of the movement problem can be further characterized as tight muscles (spasticity), uncontrollable motions (dyskinesia), poor coordination (ataxia), or other/mixed (Amrulloh et al., 2021).

About 80% of children with cerebral palsy suffer from spasticity, the most common mobility issue. Cerebral palsy can be categorized as diplegia, hemiplegia, or quadriplegia based on which limbs are affected (Vitrikas et al., 2020). One of the most prevalent traits of children with cerebral palsy is poor postural control (Levitt et al., 2021). Postural control is vulnerable to adverse circumstances during childhood since it is a long-term, complex process (Hadders et al., 2017). Postural problems can significantly interfere with daily work because postural regulation is a crucial part of all motor actions (Zadniker et al., 2011).

The main feature of cerebral palsy is a lack of control over one's posture (CP). Non progressive brain damage and subsequent neurological impairments can affect the development of movement and posture (spasticity, muscle weakness, co-contractions and visual impairment) (Kranke et al., 2015). Postural deficits have been found in children and people with both mild and severe forms of CP, according to studies (Sah et al., 2019). The activities of daily living are hampered by dysfunctional posture control. The relationship between the various portions of the body, as well as the body and a reference frame, is referred to as posture (Evkaya et al., 2020).

According to Choi et al. (2019), maintaining, attaining, or restoring the center of mass in relation to the base of support is the process by which balance is attained. Balance is the result of the cooperation of several bodily systems, such as the vestibular, visual, auditory, proprioceptive, and higher-level premotor systems (Acar et al., 2021).

Maintaining a particular postural alignment, like sitting or standing; facilitating voluntary movement, like changing postures; and regaining equilibrium after external disturbances, like a trip, slip, or push, are the functional goals of the balance system (Dasoju et al., 2021). There is disagreement over the best way to test balance in CP patients in a routine clinical setting. There is no one clinical balancing test that can adequately assess balance because it is such a complex, task-dependent phenomenon (Kusumoto et al., 2021).

It is one of the most prevalent causes of motor disability in children. CP refers to a collection of mobility and postural abnormalities that limit activities and are caused by non progressive disturbances in the developing fetus or infant brain (Patel et al., 2020). Children with CP have movement and cognitive difficulties, which necessitate a multifaceted treatment strategy involving a variety of health specialists over a long period of time (AlSaif et al., 2015). Abnormal regulation of movement and/or posture, early onset, and no apparent underlying progressive pathology are all characteristics of CP. Damage to the motor cortex causes movement and postural problems (Lazzari et al., 2015).

As people age, chronic muscle imbalance and the anomalies that ensue might cause increasing disability. One of the most significant problems that children with cerebral palsy encounter is poor postural control (Kasse et al., 2015). For kids with CP, maintaining postural control—which is essential for carrying out daily tasks—can occasionally be a major challenge (Bonnechere et al., 2017). Children with cerebral palsy (CP) have a disorganized walking pattern and poor motor control because of disruptions to the central nervous system in the developing brain (Clutterbuck et al., 2019). It is acknowledged that one of the main causes of these kids' gait problems is poor balance regulation (Tarakci et al., 2013).

Cerebral palsy (CP), a group of permanent but non-progressive movement impairments brought on by issues in the developing brain, is one of the most prevalent causes of juvenile impairment (Jahan et al., 2021). Studies from high-income countries (HICs) have mostly influenced worldwide estimates of CP prevalence since low- and middle-income countries (LMICs) lack population-level epidemiological data (Saloojee et al., 2021).

In HICs, CP registers have made a significant contribution to the generation of population-level data on CP epidemiology over time. The formation of register networks has created new options for CP research as well as assessment of the needs of individuals with CP and their families, in addition to individual work and collaboration between registers (Furtado et al., 2021). Networks of registers that share a common data set make it possible to compare the epidemiology of CP across member regions over time and provide enough instances to investigate tiny subgroups (Imam et al., 2021). There has been an increase in the availability of population-based CP data from low resource settings in recent years, thanks to the introduction of CP registries in LMICs. The findings of those population-based research revealed a higher frequency of CP in LMICs than in HICs, as well as differential epidemiological and clinical characteristics (King et al., 2022).

Along with eventual musculoskeletal abnormalities such bone deformities and contractures, cerebral palsy is characterized by primary neuromuscular impairments like stiffness, muscle weakness, and reduced selective motor control (Rayan et al., 2017). Cerebral palsy is primarily a mobility problem, although it is often associated with deficits in perception, cognition, behavior, communication, and sensory perception activity restrictions that are believed to be brought on by these factors working together (Suren et al., 2012).

Depending on their particular symptoms, patients with cerebral palsy may get a range of therapies, from medication and surgery to physical therapy. Because it emphasizes movement, function, and maximizing the child's capacities, physiotherapy (PT) is a crucial component of the illness's treatment (Fonzo et al., 2020). To promote, maintain, and regain psychological, physical, and social well-being, physiotherapists employ physical approaches (Collado-Garrido et al., 2019). Along with teaching parents how to take care of their children at home, including bathing, feeding, clothing, and other tasks, physiotherapists also offer advice on mobility aids (Rayan et al., 2017).

1.2: Rationale

The most prevalent condition that pediatric physiotherapists face is cerebral palsy. Everywhere in the world, physiotherapists treat and rehabilitate children with cerebral palsy using their individual approach. In Bangladesh, physiotherapy is a relatively recent medical specialty. Children with cerebral palsy receive various therapies from the physiotherapists in the CRP pediatric unit. For many children with cerebral palsy to survive in the community, they require improved physiotherapy care. Physiotherapists in the CRP Pediatric unit employ various treatments to help children with cerebral palsy improve their motor function in both their upper and lower extremities. But there is no valuable research about balance and Gait of spastic cerebral palsy patients at center for the rehabilitation of the paralyzed. This study was investigate about the balance and gait of spastic CP children for the management of cerebral palsy children. Since physiotherapy is a relatively new field, it is crucial to use evidence-based treatment methods to provide patients with better care. This will enable the physiotherapist to continue helping youngsters with cerebral palsy and modify the red indicator. Additionally, the researcher would like to conduct the study for special interest and to build evidence to support the physiotherapy profession in Bangladesh. To adequately establish physiotherapy in Bangladesh, evidence-based practice is crucial. Additionally, the globe is moving away from traditional treatment and toward evidence-based practice. Therefore, it is our responsibility to produce evidence on the many physiotherapy professions. In addition to adding evidence-based knowledge for the physiotherapy profession, this project will produce evidence for the physiotherapist. . There is limited evidence on balance and gait of cerebral palsy children attended at Centre for the Rehabilitation of the Paralyzed. So, researcher would like to conduct this study

1.3: Research Question

How is the balance and gait of spastic cerebral palsy patients at a selective rehabilitation center?

1.4: Study objectives

General objectives:

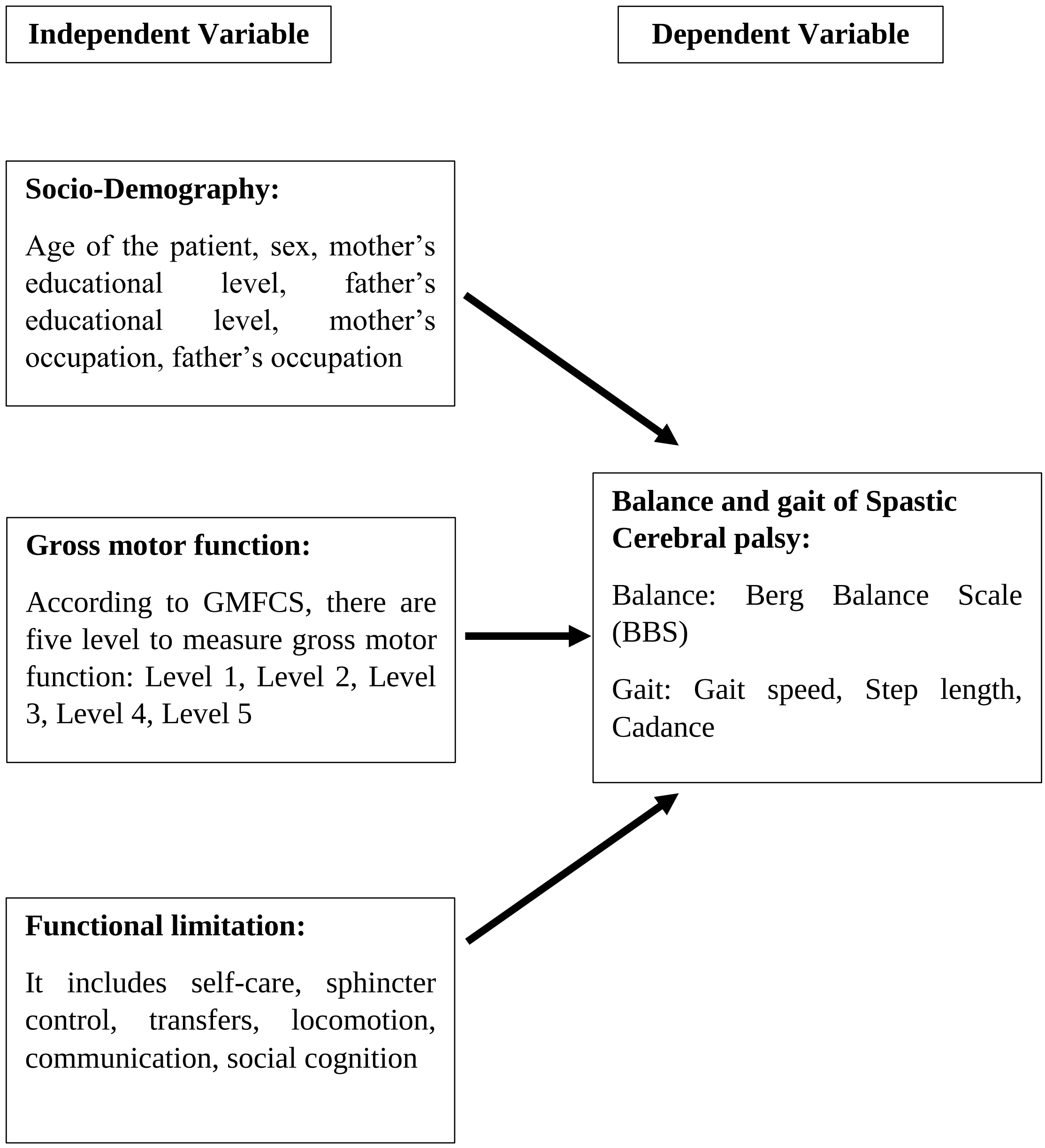
To find out balance and gait of spastic cerebral palsy patients at a selective rehabilitation centre in Bangladesh

Specific objectives:

1. To demonstrate the socio-demographic characteristics among the participants.
2. To describe balance of spastic cerebral palsy patients
3. To find the gait parameters of spastic cerebral palsy patients
4. To explore any relationship between different variables.

1.5: Variables

Conceptual Framework



1.6: Operational Definition

Cerebral Palsy: Cerebral palsy is a disorder of movement, muscle tone or posture that is caused by damage that occurs to the immature, developing brain, most often before birth. An individual with Cerebral Palsy will likely show signs of physical impairment. Cerebral Palsy affects muscles and a person's ability to control them. Balance, posture, and coordination can also be affected by Cerebral Palsy. Tasks such as walking, sitting, or tying shoes may be difficult for some, while others might have difficulty grasping objects.

Other complications, such as intellectual impairment, seizures, and vision or hearing impairment also commonly accompany Cerebral Palsy.

Spastic Cerebral Palsy: Spastic cerebral palsy is the most common type of cerebral palsy wherein spasticity is the major impairment. Spastic cerebral palsy is caused by damage to the motor cortex and the pyramidal tracts of the brain, which connect the motor cortex to the spinal cord. It refers to increase muscle tone, stiffness and overall affects the motor function. Symptoms present according to the involvement of patient's body parts or limbs like, spastic hemiplegia, spastic quadriplegia, spastic diplegia and spastic monoplegia.

Balance: Balance refers to the ability of spastic cerebral palsy (CP) patients to maintain a stable and upright posture, both statically (e.g., standing still) and dynamically (e.g., during movement or transition). It will be quantitatively assessed using standardized clinical tools such as the Pediatric Balance Scale (PBS) or the Berg Balance Scale (BBS), depending on the age group, and may also be supported by observational analysis of postural control during functional tasks within the rehabilitation setting.

Stride length: The stride length is the distance between two successive placements of the same foot. It consists of two step lengths, left and right, each of which is the distance by which the named foot moves forward in front of the other one.

Step length: It is the linear distance in the plane of progression between two successive points of foot floor contact of the opposite feet.

Speed: The rate at which a person covers a specific distance during walking, typically measured in meters per second (m/s).

Cadence: It means number of steps per unit time.

Cerebral palsy (CP) is a wide term for a group of non progressive posture and movement issues (Novak et al., 2013). CP is caused by a number of reasons, the majority of which are connected to events that occur early in brain development and result in life-long lesions and abnormalities (Steuri et al., 2017).

Secondary motor impairments may vary in severity from modest to severe, and lesions can influence sensation, cognition, communication, and/or behavior (Levitt et al., 2018). The most common signs are loss of muscular strength and decreased muscle tone. Motor impairments in the trunk and limbs create the inability to produce enough force to maintain antigravity postural control, resulting in a variety of atypical postures (Gulati et al., 2018). Posture control refers to the capacity to regulate the posture of the limbs or the complete body in space in order to attain stability and alignment (Morgan et al., 2016).

Postural control affects not just standing and sitting but also the capacity to move in the right order. While the amount of research on postural control in children with cerebral palsy is increasing, the majority of it is descriptive and observational (Ryan et al., 2017). Children with cerebral palsy frequently benefit from adaptive seating, which entails modifying seating apparatuses to improve sitting posture and/or postural control in those with limited movement. Adaptive seating systems have advanced significantly since their introduction in the 1960s (Tinderholt et al., 2017).

Adaptive sitting has been shown to help children with cerebral palsy with their postural control (Novak et al., 2014). It has been discovered that postural control improves functional capacity, such as daily living task performance (ADL), occupational performance and satisfaction, and upper extremity (UE) function. The benefits persisted even after the intervention was stopped, suggesting that adaptive sitting could support physical function (Monbaliu et al., 2017). The International Classification of Functioning, Disability, and Health (ICF) model states that a person's health condition and their environment are dynamically linked. According to Schiariti et al. (2015), body structure/function, activity, and involvement are the elements of functioning in the ICF paradigm.

Since each element is interrelated, altering one could have an unexpected effect on the others. Both human and environmental factors influence these elements (Selb et al., 2015). In therapeutic contexts, environmental modifications, including adaptive sitting devices, are utilized to improve postural control; in some situations, this may lead to gains in the activity and participation components of the ICF model (Dos et al., 2012).

According to a recent study, neonatal encephalopathy was more common in Bangladeshi infants with cerebral palsy than in Australian infants. Similarly, a Nigerian hospital-based investigation discovered that post infectious brain injury, bilirubin encephalopathy, and neonatal hypoxia were the primary causes of cerebral palsy (CP) (Power et al., 2019). Clinical sample studies may not be representative of all children with CP, and children with CP in LMICs have limited access to specialized care. The disparity between those who can and cannot afford rehabilitative therapies may be systemic (Nuri et al., 2020).

Therefore, to investigate the clinical characteristics and risk factors for children with cerebral palsy in LMICs, large population-based research are necessary. Over the past 30 years, numerous research on the epidemiology of CP have been made possible by general population-based registers and surveillance programs (Jackman et al., 2022). Tracking the incidence and prevalence of CP, learning about risk factors and comorbidities, developing and assessing preventative strategies, and monitoring service delivery are the main objectives of these projects (Hadders-Algra et al., 2021). To the best of our knowledge, none of the 38 established CP registers and monitoring systems in the world today are located in LMICs (Khandaker et al., 2019).

High-income countries (HICs) are the source of the great majority of research on mortality and causes of death in children with cerebral palsy (Jahan et al., 2019). Most children with CP live to adulthood in HICs, despite the fact that childhood CP mortality is higher than in the general child population (Badawi et al., 2021). Children with more severe motor types of cerebral palsy are more likely to die young, according to HIC research (Shengyi et al., 2021).

The risk of death is further increased for children with cerebral palsy (CP) who also have respiratory infections, other chronic diseases, and associated abnormalities (such as intellectual, epilepsy, visual, hearing, or speech). Population-based statistics on CP mortality in children from low-income nations are scarce (Namaganda et al., 2020). As of right now, very few studies from LMICs have been conducted using extremely selected institutional samples, such as patients at hospitals or rehabilitation centers (Imam et al., 2021).

A major aspect in producing such evidence in HICs and accurately determining the cause of death (CoD) and risk factors for mortality in children with CP is the availability of administrative health databases, such as birth, death, and CP registrations. However, essential amenities (such as death registries) are absent from many low-income areas (Andrews et al., 2019).

Without these systems, LMICs usually use verbal autopsy to identify the immediate and underlying CoD in particular child and adult groups (Mushta et al., 2021). However, verbal autopsy and/or community level mortality data for children with cerebral palsy are typically unavailable in LMICs like Bangladesh (Jahan et al., 2019).

Clinical manifestations of cerebral palsy are varied and encompass a broad range of conditions. Although they can include a variety of problems such poor balance and sensory deficits, they are primarily mobility diseases (Vitrikas et al., 2020). Comorbidities among individuals with cerebral palsy range from 20 percent to 25 percent, and include pain (75 percent), intellectual disability (50 percent), incapacity to walk (33 percent), hip displacement (33 percent), incapacity to speak (25 percent), epilepsy (25 percent), incontinence (25 percent), and behavioral or sleep disorders (Bambang et al., 2020).

Cerebral palsy sequelae include spasticity and contractures; eating difficulties, drooling, communication difficulties, osteopenia, osteoporosis, fractures, discomfort, and irregularities in gastrointestinal function that lead to vomiting, constipation, and bowel blockage (Signore et al., 2011). According to estimates from the World Health Organization and the Bangladesh Bureau of the Census, parasitic infections, malnutrition, and diseases are the main causes of disability in Bangladesh (Novak et al., 2020).

Three potentially pertinent research were found while searching for systematic reviews of the impact of flexible sitting on postural control outcomes (Schiariti et al., 2014). A systematic review (SR) of the literature on the impact of adaptive sitting on children with cerebral palsy was conducted by Roxborough between 1982 and 1994. Of the eight investigations, only two examined postural control outcomes in children under three years old: head control in children under three years old and trunk extension in children aged two to six (Novak et al., 2013).

Permanent impairments in movement and postural development (CP) are included in one of the most recent and commonly recognized criteria of cerebral palsy. Children with CP have a decline in mobility, self-care, and social function as a result of this disruption in movement and posture development (Curtis et al., 2018). therapies intended to improve a child's motor skills in the hopes of increasing engagement and activity, which would ultimately improve the child's quality of life (Levitt et al., 2018). By identifying and addressing motor system deficiencies, therapists employ a range of training techniques to assist kids in improving their motor function (Santamaria et al., 2016). Spasticity, movement quality, postural stability, involvement distribution, strength, range of motion limitations, and decreased endurance are only a few of the impairments that have been connected in multiple studies to motor function (Saavedra et al., 2020). Studies measuring postural control using scales and functional tests or during normal functional tasks were insufficient, however study indicated a clear correlation between postural control and functioning in children with cerebral palsy (CP) (Barbado et al., 2019).

At different trunk levels, the static, active, and reactive balance are evaluated using a segmental approach. Depending on the environment and motor function, different levels of static, active, and reactive balance are required (Malone et al., 2016). The tester can assess the segmental level of each of the previously described components of postural control by looking at each facet of postural balance separately. This enables the therapist to create a more focused therapeutic objective in clinical practice (Curtis et al., 2015).

The TCMS and its sub scores were compared to the mobility and self-care categories of the Functional Independence Measure for Children (WeeFIM) in order to evaluate their discriminative validity (Park et al., 2013). Children were gathered from both inpatient and outpatient settings at the Children Therapy Centers of the Foundation Regional Group Zurich and the Rehabilitation Centre for Children and Adolescents at the University Children's Hospital Zurich in Affoltern am Albis. The inclusion criteria were as follows: (1) neurological disease such as CP (GMFCS level I–IV); (2) acquired brain damage; (3) spinal cord injury; and (4) age 5–19 years. The pupils have to be able to comprehend and adhere to simple instructions. According to Adar et al. (2017), exclusion criteria included discomfort or medical restrictions on weight bearing, as well as surgery or botulinum toxin injections during the previous three months. An informed consent form was filled out by parents and teenagers who were at least 15 years old. Children under the age of 15 assisted in the conduct of this study. The study was approved by the canton of Zurich's ethical council and adhered to good clinical practice principles and the Declaration of Helsinki. The goal was to gather information on a minimum of fifty children. A sample size of above fifty is deemed sufficient by the COSMIN group (Marisco et al., 2017).

The Berg balance scale (BBS) and the pediatric balance scale (PBS) are both effective measures for assessing balance. However, there have been few reports of BBS and PBS scores in teenage cerebral palsy (Jantakat et al., 2015). The study's goals were to look into functional balance capacities in adolescents with cerebral palsy as measured by the BBS and PBS, compare total PBS and BBS scores across Gross Motor Function Classification System-Expanded and Revised (GMFCS-E&R) levels, and compare

static balance PBS and BBS scores within each GMFCS-E&R level (Niiler et al., 2020). Fifty-eight school-aged adolescents with cerebral palsy between the ages of 12 and 18 were recruited, with GMFCS-E&R levels ranging from I to IV. The Kruskal–Wallis test was used to compare the median PBS and BBS scores across the various GMFCS-
E&R levels (Calacci et al., 2016).

The differences in static balance scores between the PBS and the BBS within the same GMFCS-E&R levels were investigated using Wilcoxon signed-rank tests. The BBS and PBS scores differed amongst the four GMFCS-E&R levels, according to the findings. Only individuals with cerebral palsy and level III GMFCS-E&R had a significant difference between their BBS and PBS scores (Erden et al., 2021). In adolescents with cerebral palsy, the BBS and PBS are valid and trustworthy methods for clinical assessment and discriminating between degrees of functional balance (Hurria et al., 2014).

A group of neurological conditions that affect posture and movement development and limit activities are collectively referred to as cerebral palsy (CP) (Addison et al., 2018). When CP patients are compared to those who develop normally, their motor development is not age-appropriate because of their limited functional movements (Kerr et al., 2017). Numerous studies have demonstrated that adolescents with cerebral palsy (CP) have a decline in gross motor ability during puberty or the early stages of adulthood (Groh et al., 2019). Teens with CP therefore require more attention from caretakers beginning at age 14 (Travis et al., 2017).

Hanna (2019) conducted a 5-year longitudinal cohort study in which the gross motor skills of 657 children with cerebral palsy (CP) ranging in age from 16 months to 21 years were evaluated up to ten times. They found that patients with GMFCS levels III, IV, and V had decreased motor function, with the largest losses occurring in those with GMFCS level IV. The performance of several crucial gross motor tasks changed in a clinically meaningful way when the average GMFM66 score dropped by 4.7 to 7.8 points. Functional balance and gross motor competence are directly related (Gan et al., 2018); functional mobility is decreased by poor postural control during daily tasks, especially in people with moderate to severe cerebral palsy. Kumban and colleagues (2013) found that children with GMFCS levels I and II spend less time practicing sit-to-stand motions than children with GMFCS levels III-E&R. (Kumban & colleagues, 2013). Slow motions were used to make up for poor functional balance. Additionally, the mechanical efficiency of functional activity is much poorer and directly related to balance in individuals with low Berg balance scale (BBS) scores (Lebowitz et al., 2018).

In order to help children with cerebral palsy learn how to balance in their daily lives, Pavao and colleagues promoted postural control assessment during functional activities (Pavao et al., 2013). Two functional balance tests that have been proposed as appropriate for this population are the BBS and the pediatric balance scale (PBS) (Pavao et al., 2013). The BBS examines both static and dynamic balance during functional motions. Only a small number of studies have documented BBS scores for children with cerebral palsy (Aisen et al., 2011). For usage with young children, PBS is a modified form of BBS. Recent studies have shown that children with GMFCS levels of I to III who are 4 to 10 years old can have their functional balance differences distinguished by the PBS (Deshpande et al., 2016).

According to Chen et al. (2018), the BBS and PBS have both been proven to be valid assessments that correlate with the performance of functional tasks like daily activities. The validity and reliability of both tests have been assessed in children under the age of 15 (Yi et al., 2017), and a recent study examined the use of the PBS in CP patients aged 0–18 with GMFCS levels of I–V (Pavao et al., 2019).

The BBS and PBS's potential for teens with moderate to severe cerebral palsy (CP) between the ages of 15 and 18 who are suffering declines in function and balance, however, is not well understood. In this study, we hypothesized that these individuals would find the PBS static balance tasks easier than the BBS ones. The PBS is therefore thought to be a helpful functional balancing test for teenagers with cerebral palsy, especially those with moderate to severe disabilities. In this study, CP adolescents with GMFCS levels ranging from I to IV had their BBS and PBS evaluated, with PBS being looked at within each GMFCS-E&R level. Additionally, we were curious about the BBS and PBS reliability in adolescents with cerebral palsy (Jantakat et al., 2015). A group of neurological conditions that affect posture and movement development and limit activities are collectively referred to as cerebral palsy (CP) (Saether et al., 2019). When CP patients are compared to those who develop normally, their motor development is not age-appropriate because of their limited functional movements (Kerr et al., 2017). Numerous studies have demonstrated that adolescents with cerebral palsy (CP) experience a decline in gross motor ability during puberty or the early stages of adulthood (Bar-Haim et al., 2018). Teens with CP therefore require more assistance from caretakers beginning at the age of 14 (Rosenbaum et al., 2016).

Cerebral palsy (CP), the most common neuromuscular disorder in children, causes physical and sometimes intellectual difficulties (Karaby et al., 2016). Despite advancements in diagnosis and treatment, the frequency of CP has grown in line with the higher survival rates of preterm infants (Niebaum et al., 2018). Regardless of the prevalence of CP, the treatment objectives remain the same. Children with diplegic CP may lack trunk control due to stiffness and weakness in their trunk muscles (Pavo et al., 2017). A balanced sitting posture is encouraged by the coordinated activation of the trunk's extensors and flexors. Some children with CP may need to rely on their parents for everyday duties, depending on their neurological status (O'Shea et al., 2020).

Physical disabilities, according to the majority of reports, are the most common (41.5 percent). Visual disability (19.7 percent), speech and hearing (19.6 percent), intellectual 5 difficulties (7.4 percent), cerebral palsy (7.0 percent), multiple disabilities (3.4 percent), and mental illness (3.4 percent) are the most common disabilities (1.4 percent) (Hoare et al., 2019). According to, the overall prevalence rate for preschool and primary aged children (ages 3-10) with disabilities is approximately 2.6 (2,559,222), or nearly 10 percent of the childhood population. There are also an estimated 2.6 million children with disabilities in Bangladesh, of whom less than 1,500 have admission to an education in special schools sponsored by the Government of Bangladesh (Ministry of Social Welfare) (Jahan et al., 2021).

Children with cerebral palsy are treated to improve their quality of life, lessen their reliance on family members, and enable them to perform daily duties as independently as possible. Because it enables the upper extremities to carry out daily chores in an appropriate manner, maintaining a good sitting posture is crucial (Karabay et al., 2019).

Gait is the coordinated and repetitive pattern of limb movements that facilitates human walking and running. It involves a dynamic interplay of the musculoskeletal and nervous systems to maintain rhythm, balance, and forward progression. A normal gait cycle includes two primary phases: the stance phase, where the foot remains in contact with the ground for support, and the swing phase, where the limb moves forward to prepare for the next step. Efficient gait is essential for daily functional mobility and is influenced by factors such as age, muscle strength, joint range of motion, and neurological control. Any disruption in these components can result in gait abnormalities, which may affect independence and quality of life (Novacheck, 2008).

In individuals with spastic cerebral palsy (CP), gait is often significantly impaired due to increased muscle tone, spasticity, contractures, and poor voluntary motor control. Common gait abnormalities in spastic CP include scissoring gait, where the legs cross over each other due to tight adductors; toe-walking, caused by calf muscle spasticity; and crouch gait, resulting from hamstring overactivity and hip flexion. These deviations often lead to reduced walking efficiency, increased energy expenditure, and higher risk of falls. Moreover, gait abnormalities may vary depending on the subtype of CP, with diplegic and hemiplegic children showing different patterns of movement deviations (Rodda & Graham, 2001).

Several intrinsic and extrinsic factors influence gait in children with spastic CP. These include the severity of brain injury, degree of muscle imbalance, joint stiffness or deformities, and neurological factors such as impaired motor planning and proprioception. Environmental and socioeconomic factors, such as access to early intervention and physical therapy services, also play a role in gait development. Additionally, gait patterns may change over time due to growth spurts, muscle shortening, or secondary musculoskeletal complications, necessitating periodic reassessment and individualized rehabilitation plans (Damiano & DeJong, 2009).

Assessment of gait is an essential part of physiotherapy and rehabilitation in CP management. It helps in identifying abnormal movement patterns, determining functional limitations, and tracking progress over time. Tools such as the Observational Gait Scale (OGS), 3D gait analysis, and the Gross Motor Function Classification System (GMFCS) provide valuable insights for therapists and clinicians. A comprehensive gait assessment supports goal-oriented treatment planning, including the selection of therapeutic exercises, orthotic devices, and surgical interventions if necessary (Damiano & DeJong, 2009).

Rehabilitation centers adopt a multidisciplinary approach to improve gait in children with spastic CP. Interventions include physical therapy for strengthening, stretching, and balance training; occupational therapy for enhancing coordination; and assistive devices to support mobility. Advanced approaches such as partial body weight-supported treadmill training (PBWSTT), hydrotherapy, and neuromuscular electrical stimulation (NMES) have shown promising outcomes. In some cases, pharmacological interventions like botulinum toxin injections or surgical options such as selective dorsal rhizotomy (SDR) are used to manage spasticity and improve gait quality (Rodda & Graham, 2001; Damiano & DeJong, 2009).

Early diagnosis and intervention are critical in preventing long-term gait deterioration in children with CP. With timely and appropriate therapy, many children can achieve functional ambulation and better participation in daily activities. Continuous support, family involvement, and access to rehabilitative services significantly impact long-term gait outcomes and overall quality of life. Research continues to emphasize the importance of tailored, child-centered therapy programs in promoting better gait patterns and independence (Novacheck, 2008; Damiano & DeJong, 2009).

Chapter-III	Methodology

3.1 Study Design

This study was conducted using Cross Sectional design. Survey methodology was chosen to meet the study aim as an effective way to collect data.

3.2 Study Site

The study was conducted in pediatric unit of Center for the Rehabilitation of the Paralyzed (CRP). It is a tertiary level of rehabilitation center. It is a non-government organization working for the development of health care delivery system of Bangladesh through providing Physiotherapy, Occupational therapy, Speech and Language therapy services in indoor and outdoor programs. Pediatric unit provides service for child with different types of disability.

3.3 Study population

A population refers to the entire group of people who meet the criteria set by the researcher. The populations of this study were the cerebral palsy children who were admitted at pediatric unit in CRP from the month of January to April.

3.4 Sample size

Sample is a group of subjects are selected from population, who are used in a piece of research (Hicks, 2009). A sample is a smaller group taken from the population. Sometimes the sample size may be big and sometimes it may be small, depending on the population and the characteristics of the study. When the sample frame is infinite, the equation of finite population correction in case of cross-sectional study is:

$$n = \frac{z^2pq}{d^2}$$

$$= \frac{(1.96)^2 \times 0.34 \times (1-0.34)}{(0.05)^2}$$

$$= \frac{0.862}{(0.05)^2}$$

$$= 344.82$$

Here, n = Sample size

Z (confidence interval) = 1.96

d = margin of error at 5% (standard value of 0.05)

P (prevalence) =0.34% (Khandakar et al., 2019)

And, q= (1-p)

= (1-0.34)

= 0.66

The actual sample size was, n= 344.82

Researcher has taken 102 participants as sample. Due to time limitation the researcher has chosen 102 participants to conduct this study; within the short time it could not be possible to conduct the study with a large number sample.

3.5 Sampling Technique

Findings the appropriate number and type of people taking part in the study is called “sampling” (Hicks, 2009). The study was the one of the easiest, cheapest and quicker method of sample selection. The researcher used this procedure, because, getting of those samples whose criteria were concerned with the study purpose.

3.6 Study period

The duration of the study period is 1st june 2024 to 31 may 2025.

3.7 Inclusion Criteria:

1. Participants had to be diagnosed with spastic cerebral palsy, confirmed by a neurologist or pediatrician based on clinical assessment and medical history (Rosenbaum et al., 2007).
2. Participants had to be aged between 5 to 18 years old to focus on the developmental aspects of balance and gait (Sutherland et al., 2009).
3. Participants with varying degrees of spasticity, as assessed by the Modified Ashworth Scale (MAS), will be included, ranging from mild to severe (Bohannon & Smith, 1987).
4. Participants had to be able to comprehend and follow simple verbal instructions to ensure the accuracy of gait and balance testing (Dodd et al., 2003).
5. Both the patient and their legal guardian (if the patient is under 18 years of age) had to provide informed consent to participate in the study.

3.8 Exclusion criteria:

1. Patients with additional neurological conditions such as epileptic disorders, muscular dystrophy, or acquired brain injuries were excluded to ensure that the observed balance and gait deficits were solely attributable to spastic cerebral palsy (Novak et al., 2013).
2. Participants with severe intellectual disabilities that would have prevented them from completing the study assessments or participating in interventions were excluded (Shields et al., 2012).
3. Participants who had undergone orthopedic surgeries in the last six months were excluded, as these might have interfered with balance and gait due to recovery or rehabilitation (Graham et al., 2011).
4. Participants who had received botulinum toxin injections in the past 6 months were excluded as these might have altered the spasticity levels and affect gait and balance assessments (Koman et al., 2004).
5. Individuals who were completely non-ambulatory were excluded, as the study focused specifically on gait and balance, which were not be applicable to non-ambulatory participants (Graham et al., 2011).

3.9 Data Processing

3.9.1 Data Collection Tools

- Record or Data collection form
- Informed Consent
- Bangla questionnaire - Papers, pen, pencil, measurement tape, stop watch etc.

3.9.2 Data Collection Procedure

At the very beginning researcher clarified that, the participant has the right to refuse to answer of any question during completing questionnaire. They can withdraw from the study at any time. Researcher also clarify to all participants about the aim of the study. Participants were ensured that any personal information would not be published anywhere. Researcher took permission from each volunteer participant by using a written consent form. After getting consent from the participants, standard questionnaire was used to identify the complain and collect demographic information. Questions were asked according to the Bangla format. For conducting the interview, the researcher conducted a face-to-face interview and asked questions. Physical environment was considered strictly. Stimuli that can distract interviewee were removed to ensure adequate attention of interview. Interviewee was asked questions alone as much as possible with consent as sometimes close relatives can guide answer for them. The researcher built a rapport and clarified questions during the interview. Face to face interviews are the most effective way to get full cooperation of the participant in a survey. Face to face interviews are also effective to describe characteristics of a population. Face to face interviews was used to find specific data which describes the population descriptively during discussion. According to the participants' understanding level, sometimes the questions were described in the native language so that the patients can understand the questions perfectly and answer accurately. All the data were collected by the researcher own to avoid the errors.

3.10 Data Analysis

Descriptive statistics were used to analyze data. Descriptive statistics refers methods of describing a set of results in terms of their most interesting characteristics (Hicks, 2009). Data were analyzed with the software named Statistical Package for the Social Science (SPSS) version 25.0. The variables were labeled in a list and the researcher established a computer-based data definition record file that consist of a list of variables in order. The researcher put the name of the variables in the variable view of SPSS and defined the types, values, decimal, label alignment and measurement level of data. The next step was cleaning new data files to check the inputted data set to ensure that all data has been accurately transcribed from the questionnaire sheet to the SPSS data view. Then the raw data were ready for analysis in SPSS. Data were collected on frequency and contingency tables. Measurements of central tendency were carried out using the mean plus standard deviation (SD) for variables. By this study a lot of information was collected.

3.11 Ethical Consideration

The researcher maintained some ethical considerations: Researcher has followed the Bangladesh Medical Research Council (BMRC) guideline & WHO research guideline. A research proposal was submitted to the physiotherapy department of BHPI for approval and the proposal was approved by the faculty members and gave permission initially from the supervisor of the research project and from the course coordinator before conducting the study. The proposal of the dissertation including methodology was presented to the Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI) for oral presentation defense was done in front of the IRB. Then the necessary information was approved by Institutional Review Board and was permitted to do this research. After getting the permission of doing this study from the academic institute the researcher had been started to do it. The researcher had been taken permission for data collection from the Pediatric dept. CRP, Savar. The participants would be informed before to invite participation in the study. A written consent form used to take the permission of each participant for the study. The researcher ensured that all participants were informed about their rights and reserves and about the aim and objectives of the study. Researcher also ensured that the organization (CRP) was not hampered by the study. All kinds of confidentiality highly maintained. The researcher ensured not to leak out any type of confidentialities. The researcher was eligible to do the study after knowing the academic and clinical rules of doing the study about what should be done and what should not. All rights of the participants were reserved and researcher was accountable to the participant to answer any type of study related question.

3.12 Informed consent

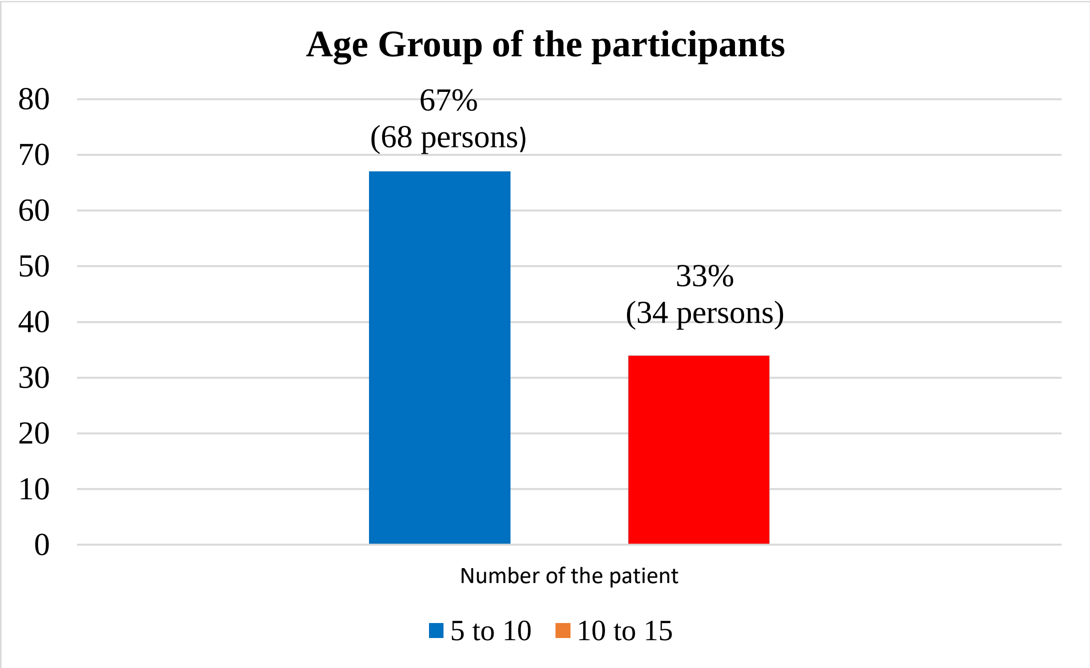
The careers of the participant was informed verbally about the title, aims and purpose of the research project. They were received a clear description of the study and aware the research is the part of the study process; they may take part as volunteer.

Before participating in the study the researcher was provided them a written consent form to sign, responsible physiotherapist sign as a witness. The researcher was also signed in the consent form. The careers of the participant should be informed clearly that their information might be there might be some changes in service delivery system of physiotherapy which might be helpful for their children future. The careers of the participants was informed that they have the right to withdraw consent and discontinue participation at any time without any prejudice.

4.1 Socio-Demographic information

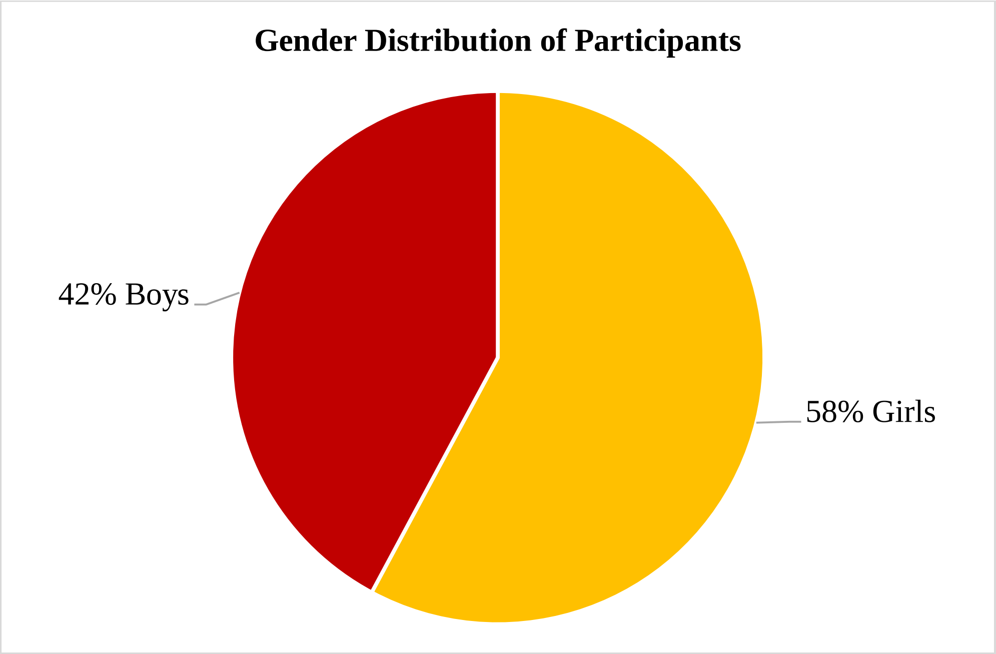
4.1.1 Age of the participants

The bar diagram shows the age distribution of patients with Spastic Cerebral Palsy. The data is divided into two age ranges: “5 to 10 years” and “10 to 15 years”. The majority of patients, 67% of total population which is 68 persons, are aged five to ten years. In comparison, only 33% patients which is the rest of the 34 people, are between the ages of 10 and 15. This shows that Spastic Cerebral Palsy is more commonly diagnosed or treated in younger children in this dataset, implying a probable trend in early identification or prevalence in this age group.



4.1.2 Gender of the participants

The pie chart titled "Gender Distribution of Participants" visually represents the proportion of male and female participants included in the study population. According to the data shown, 58% (60 person) of the participants are girls, while 42% (42 person) are boys. This indicates that there is a higher number of female participants compared to male participants in the study.

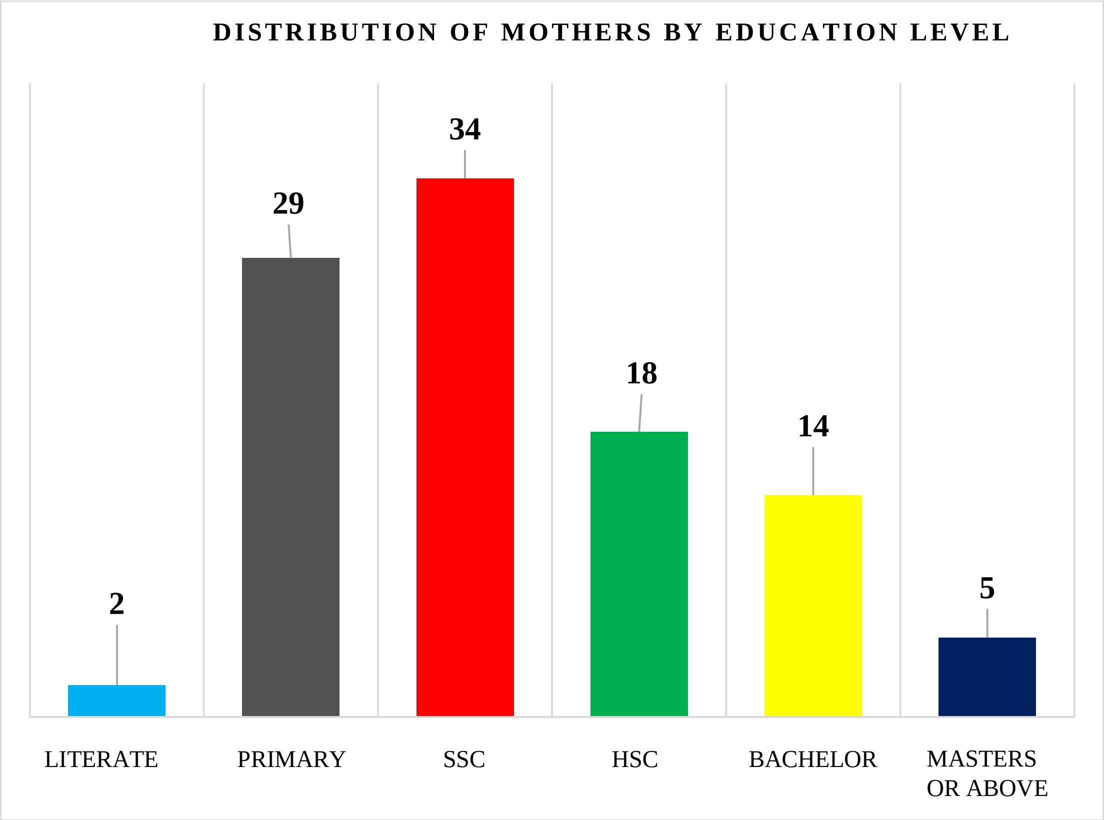


The chart is divided into two clearly distinguished colored segments: the yellow portion represents girls, and the red portion represents boys. The larger yellow segment signifies that girls constitute the majority of the sample, which may reflect the demographic distribution or intentional sampling strategy of the research.
This gender imbalance might be relevant depending on the focus of the study. For instance, if gender-specific outcomes are being analyzed, the predominance of female participants may influence the overall findings and interpretations. Therefore, this distribution is an important characteristic of the study population that should be considered when analyzing the results.

Overall, the chart provides a clear visual summary of the gender composition of the participants, highlighting a greater representation of girls in the study sample.

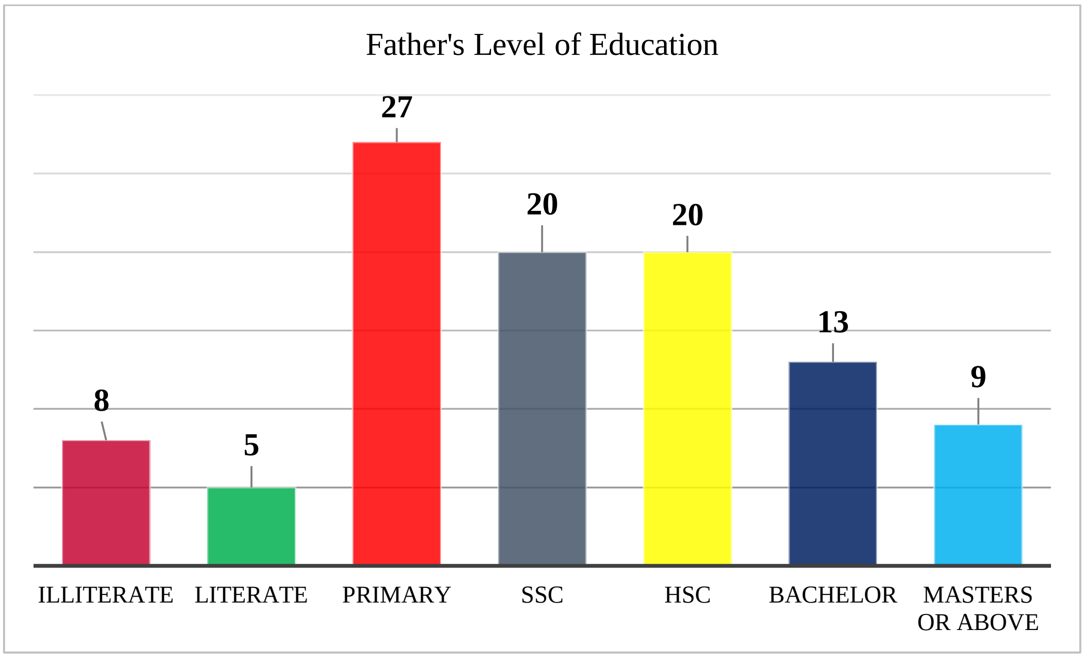
4.1.3 Types of mother's education level

The bar chart illustrates the distribution of mothers according to their highest attained education level. The majority of the mothers have a secondary school certificate (34), followed closely by those with a primary education (29). A smaller proportion holds higher school certificates (18) or a bachelor's degree (14), while only a few have attained a master's degree or above (5). The lowest number of respondents (2) are literate without formal schooling. This distribution indicates that most mothers in the sample have a moderate level of education, with fewer attaining higher academic qualifications.



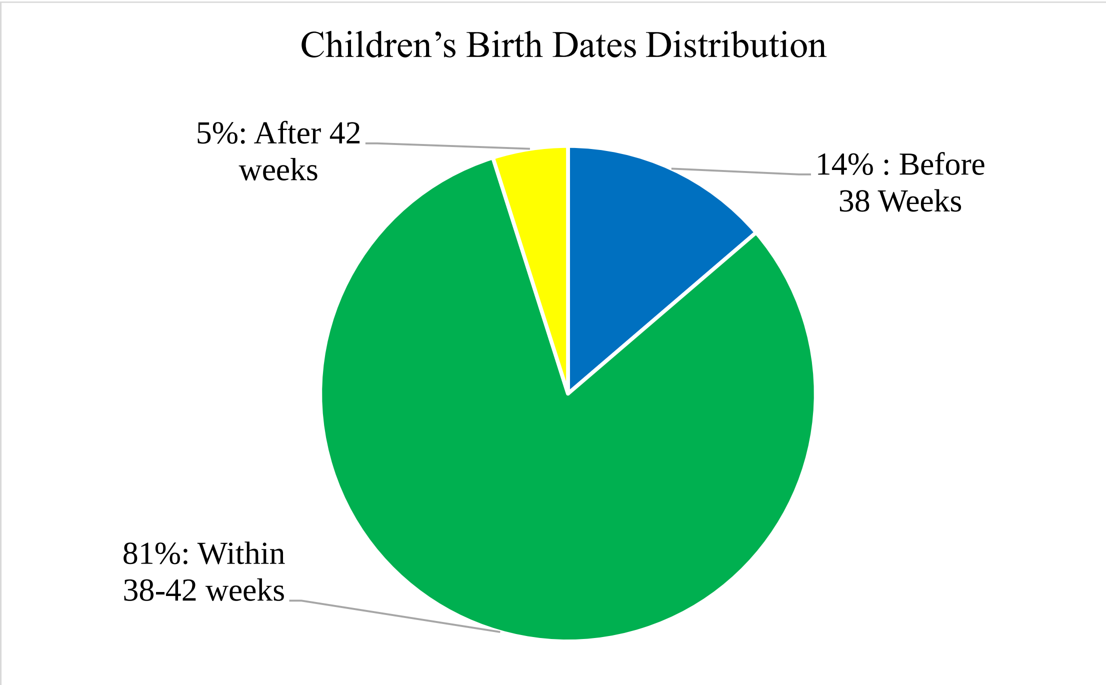
4.1.4 Types of father's education level

The bar chart displays the distribution of fathers based on their highest level of education. The largest group of fathers completed primary education (approximately 27), followed by those with Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) qualifications, both around 20 in number. A smaller number of fathers attained a bachelor's degree (about 13), while fewer completed education at the master's level or above (around 09). Additionally, a small portion of the sample consists of illiterate (8) and literate (5) fathers without formal schooling. This distribution suggests that most fathers have at least primary or secondary education, with a smaller percentage pursuing higher education.



4.1.5 Children's birth time distribution

This pie chart shows the distribution of children's birth dates based on the duration of pregnancy. According to the chart, 81% of the children (83 people) were born within 38 to 42 weeks, 14% children (14 people) were born before 38 weeks and 5% (5 people) were born after 42 weeks. The blue segment represents births before 38 weeks, the green segment represents births within 38 to 42 weeks and the yellow segment represents births after 42 weeks. The data indicates that the majority of children were born within 38 to 42 weeks of pregnancy.

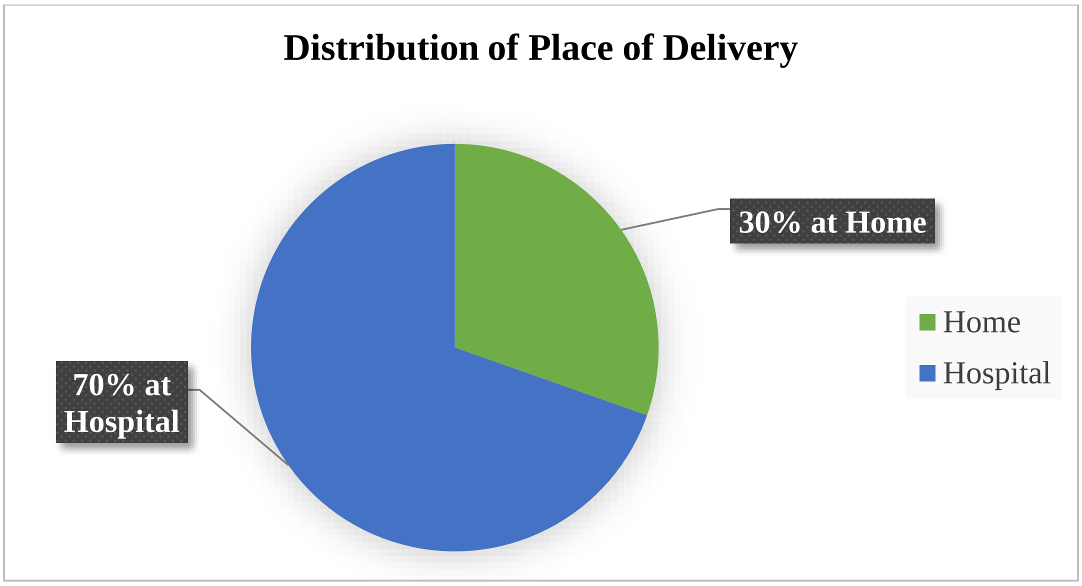


4.1.6 Place of delivery

The pie chart titled "Distribution of Place of Delivery" illustrates the proportion of childbirths that occurred either at home or in a hospital setting among the study population. According to the chart, a significant majority of the deliveries, accounting for 70%, (71 person) took place in hospitals, indicating a higher reliance on institutional or clinical facilities for childbirth. On the other hand, 30% (31 person) of the births occurred at home, reflecting a smaller segment of the population that either preferred or had access only to home-based delivery services.

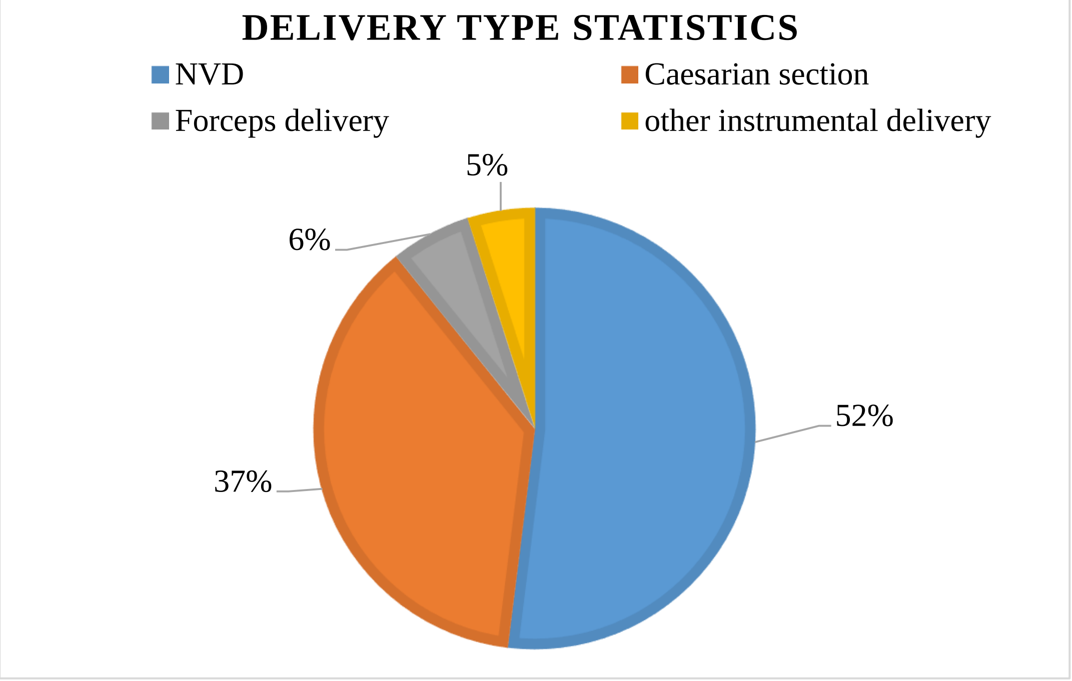
The chart is divided into two distinct color-coded segments: blue representing hospital deliveries and green representing home deliveries. This distribution suggests that hospital-based childbirth is more prevalent in the study population, possibly due to better access to medical facilities, increased awareness of maternal health, or policy-driven health interventions.

Overall, the data highlights a clear preference for institutional delivery over home delivery, which may reflect improvements in healthcare infrastructure or changing attitudes toward maternal and neonatal care.



4.1.7 Types of delivery

The pie chart titled "Delivery Type Statistics" presents the distribution of different methods of childbirth. It shows that Normal Vaginal Delivery (NVD) is the most common type, accounting for 52% (53 person) of all deliveries. This indicates that more than half of the births occur naturally, without surgical intervention. The second most common method is Caesarian Section, which represents 37% (38) of the total, suggesting that a significant number of deliveries are performed surgically. Forceps Delivery makes up 6%, (6 person) indicating cases where a medical instrument is used to assist during childbirth. Lastly, Other Instrumental Deliveries, such as vacuum-assisted births, account for 5% (5 person). Overall, the chart highlights that while the majority of births happen through normal vaginal delivery, a considerable portion requires medical or surgical assistance, reflecting the varied nature of modern obstetric care.

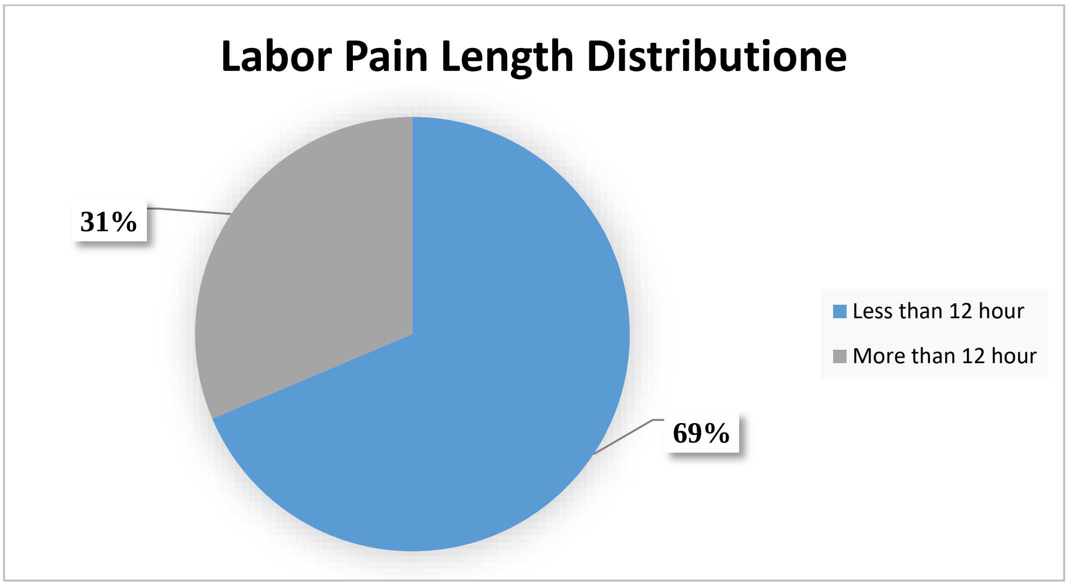


4.1.8 Duration of labor pain

The pie chart titled "Labor Pain Length Distribution" presents a clear depiction of the duration of labor pain experienced by women during childbirth, categorized into two groups: labor pain lasting less than 12 hours and labor pain extending beyond 12 hours. According to the chart, the majority of women, constituting 69%, experienced labor pain for less than 12 hours. This is represented by the larger segment of the pie chart. A shorter duration of labor pain is often considered typical in many uncomplicated pregnancies, especially among multiparous women (those who have given birth before). This duration may also reflect efficient uterine contractions, effective labor progress, and timely medical interventions when necessary, which all contribute to a quicker labor process.

On the other hand, 31% of the women endured labor pain for more than 12 hours, as shown in the smaller segment of the pie chart. Prolonged labor can occur due to a variety of factors such as fetal malposition, inadequate uterine contractions, or a narrow birth canal. Extended labor pain often increases physical exhaustion and emotional stress for the mother and can raise the risk of medical interventions such as assisted deliveries or caesarean sections.

This distribution provides valuable insights into labor experiences within the studied population. The data emphasizes that while a substantial proportion of women undergo shorter labor periods, a significant minority still face prolonged labor, which may warrant targeted medical support and monitoring to reduce complications and improve maternal and neonatal outcomes. These findings can be useful for healthcare providers to prepare better for labor management strategies and for educating expectant mothers about potential labor scenarios.



Labor Pain Length Distributione
31%
69%
Less than 12 hour
More than 12 hour

4.1.9 Children's crying after birth

Did the child cry just after birth

Variable	Frequency	Percent
Yes	43	42.2
No	59	57.8

The table illustrates whether the children with spastic cerebral palsy cried immediately after birth. Out of the total participants, 57.8% (n=59) did not cry just after birth, while 42.2% (n=43) did cry. This indicates that a significant proportion of the children experienced delayed crying at birth, which may suggest perinatal complications such as birth asphyxia—potentially contributing to the development of cerebral palsy.

4.1.10 Types of limb involvement

The pie chart shows the distribution of affected limbs among respondents.

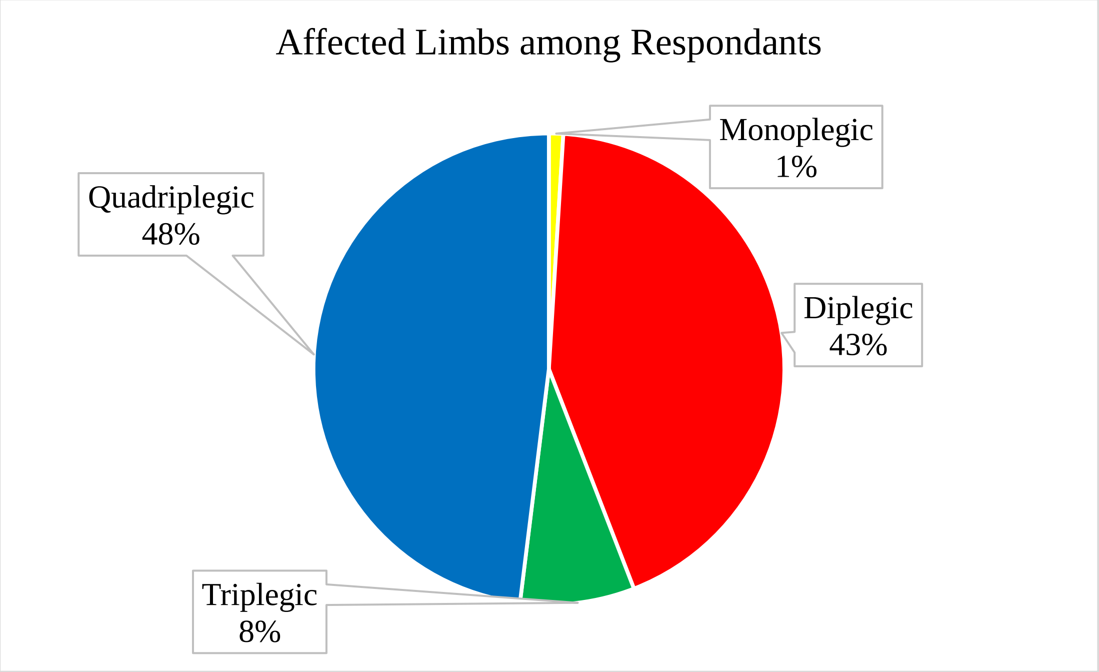
Quadriplegic: The highest proportion of respondents are quadriplegic, with approximately 49 individuals (48%) affected.

Diplegic: This is followed closely by diplegic respondents, numbering around 44 (43%).

Triplegic: A smaller number of respondents are triplegic, with about 08 (8%) individuals.

Monoplegic: The least common condition is monoplegia, affecting only a few respondents (1%).

These data highlights that quadriplegia and diplegia are the most prevalent patterns of limb involvement in the study population



4.2 Association between

a) Sex vs limb involvement

b) Mother's education vs pediatric balance score category

c) Born time vs balance category

Chi-Square Tests

Variable	Chi-Square	P-value	Comment
Sex vs limb involvement	3.553[a]	.314	No significant association between sex and limb involvement (p > 0.05).
Mother's education vs pediatric balance score category	18.248[a]	.051	Significant association between mother's education vs pediatric balance score category at the 5% level.
Born time vs Balance category	.755[a]	.944	No significant association between time of birth and balance category (p >> 0.05).

Descriptive Summary of the Table:

The chi-square analysis was conducted to assess the relationship between various demographic and clinical variables and balance outcomes in children with spastic cerebral palsy. The first variable, *sex vs. limb involvement*, yielded a chi-square value of 3.553 with a p-value of 0.314, indicating no statistically significant association between the sex of the child and the pattern of limb involvement. This suggests that male and female participants in the sample were similarly affected in terms of limb distribution.

The second comparison, *mother's education vs. pediatric balance score category*, showed a chi-square value of 18.248 and a p-value of 0.051. Although this result does not reach the conventional level of statistical significance ($p < 0.05$), it is very close to the threshold and suggests a potential relationship that may become significant with a larger sample size. This near-significance could indicate that maternal education might influence or be associated with the balance development of children, possibly reflecting differences in awareness, care-seeking behavior, or engagement in rehabilitation practices.

The third variable, *born time vs. balance category*, produced a chi-square value of 0.755 and a very high p-value of 0.944. This clearly indicates no statistically significant association between the time of birth (preterm, term, or post-term) and the pediatric balance outcomes, suggesting that balance impairments in this sample may not be directly influenced by gestational age at birth.

In summary, while most relationships explored in the table were not statistically significant, the borderline result involving maternal education points to a potentially important area for further research. This highlights the value of considering sociodemographic factors alongside clinical assessments in understanding balance deficits in children with spastic cerebral palsy.

4.3: Exploring the Relationship Between Balance and Gait Parameters With Functional Performance Scores in Children With Spastic Cerebral Palsy

Co-relation

Variable	P-Value	Comments
Standing on one foot vs Overall Balance Score	1	Perfect correlation, indicating this variable is strongly associated with the main measure.
Placing alternate foot on stool vs Overall Balance Score	.679**	Shows a strong positive correlation, suggesting a significant relationship.
Stride length vs Overall Balance Score	.280**	Indicates a weak but statistically significant positive correlation.
Speed vs Overall Balance Score	.030	Very weak correlation, suggesting little to no linear relationship.

Description:

The table presents the Pearson correlation coefficients between several balance and gait-related variables and a primary measure (possibly a balance or motor function score). The variable *"Standing on one foot"* shows a perfect positive correlation (r = 1.000), indicating it is directly and completely associated with the main measure—this suggests it plays a central role in assessing balance performance. The variable *"Placing alternate foot on stool"* demonstrates a strong positive correlation (r = 0.679), reflecting a significant and meaningful relationship with the main outcome, likely highlighting its importance in dynamic balance tasks.

On the other hand, *"Stride length"* shows a weak but statistically significant positive correlation (r = 0.280), which may imply that while gait characteristics like stride length contribute to the main measure, their influence is limited. Lastly, *"Speed"* exhibits a very weak correlation (r = 0.030), indicating minimal or no meaningful linear relationship with the primary measure in this context.

Overall, the results suggest that balance-oriented tasks (like standing on one foot or stepping onto a stool) are more closely related to the main performance indicator than gait parameters such as stride length or walking speed.

Chapter-V Discussion

The balance and gait traits of children with spastic cerebral palsy (CP) who attended a selected rehabilitation facility in Bangladesh were examined in this study. The results provide important new information about how sociodemographic factors, rehabilitation access, and neuromuscular deficits interact to affect functional outcomes in children with spastic cerebral palsy. The study's findings demonstrate notable abnormalities in gait metrics such stride length, cadence, and walking speed, as well as obvious deficits in both static and dynamic balance. These results highlight the difficulty of treating and controlling motor impairments associated with cerebral palsy, particularly in environments with limited resources, and are in line with international literature.

The most prevalent form of cerebral palsy, spastic cerebral palsy, is characterized by non-progressive injury to the developing brain that results in hypertonia, decreased muscular coordination, and limited voluntary movement. A necessity for both balance and walking, postural control is significantly impacted by these deficits. Single-limb support tasks, such balancing on one foot or shifting feet on a stool, were particularly challenging for the kids in this study and had a significant correlation with their total Pediatric Balance Scale (PBS) ratings. These results are consistent with those of Jantakat et al. (2015), who found that children with CP, especially those in GMFCS levels III to V, have noticeably worse balance abilities when assessed using the PBS and BBS. This supports the notion that the underlying deficiencies in neuromuscular control, which primarily impact the lower extremities and trunk muscles necessary for maintaining equilibrium, are the cause of balance abnormalities in cerebral palsy.

Additionally, the study's correlation analysis found that while simple gait parameters like walking speed showed a weaker link, complicated balance tests and total functional performance showed a substantial correlation. This suggests that while though walking speed is frequently employed as a general mobility measure, it could not adequately represent the complex impairments that impact children with spastic cerebral palsy's everyday mobility. Rather, the underlying deficits brought on by spasticity and poor motor coordination are more noticeable in tasks that test dynamic balance and postural control. The study Selective Motor Control Correlates with Gross Motor Ability, Functional Balance, and Gait Performance in Ambulant Children with Bilateral Spastic Cerebral Palsy (2022) further confirmed this by demonstrating a direct correlation between functional mobility and selective motor control. Children with cerebral palsy's total gait efficiency is negatively impacted by their incapacity to choose engage muscles without causing undesired co-contractions. This makes it extremely difficult for them to maintain balance or execute reciprocal stepping motions.

In this study, shortened stride length and cadence, together with disorganized foot placing patterns, were examples of gait disorders. In addition to reflecting the difficulties in maintaining coordinated and rhythmic walking, these anomalies also show compensatory strategies frequently used by children with cerebral palsy to prevent instability and falls. These variations limit the child's participation in social and academic activities and raise the energy cost of walking. Children with spastic diplegia often have asymmetrical gait patterns and widen their stances for more stability, even if this results in less efficient walking, according to research by Clutterbuck et al. (2019). These trends were supported by our research, which found that children continued to exhibit notable departures from age-appropriate gait norms even after undergoing some degree of rehabilitation.

Relevantly, the results of the study Effect of a New Physical Therapy Concept on Dynamic Balance in Children with Spastic Diplegic Cerebral Palsy (2014) are in agreement with the findings of this investigation. According to that study, children with cerebral palsy benefit greatly from structured physical treatment, especially when it focuses on dynamic balance, in terms of postural stability and walking ability. The article's rehabilitation strategy placed a strong emphasis on task-specific training, core stability, and increasing challenge—all of which are in line with the most recent worldwide guidelines for pediatric neuro rehabilitation. Although the effects of therapy type and dosage were not precisely evaluated in our investigation, the ongoing deficiencies in gait and balance point to the necessity of more rigorous and customized treatment regimens. This is particularly important in places like Bangladesh, where there are still significant obstacles to therapeutic access, consistency, and affordability.

The sociodemographic setting in which this study was carried out is another crucial component. The findings indicated that about 30% of the children were born at home, and the majority of the moms of the children had only completed elementary or secondary school. These results suggest that early diagnosis, prompt intervention, and rehabilitation outcomes may be impacted by systemic health inequities. It's interesting to note that maternal education showed a borderline correlation ($p = 0.051$) with balance categories, despite the majority of demographic variables not showing statistically significant associations. This may indicate that moms with higher levels of education are better equipped to identify motor development problems early, seek the right care, and adhere to recommendations for home-based therapy. The results of the paper Rehabilitation position of Children with Cerebral Palsy in Bangladesh (2021), which examined how socioeconomic position and caregiver awareness affect access to and use of rehabilitation services, are in line with this idea.

Additionally, the study found that 57.8% of newborns did not cry right away, which is a sign that prenatal hypoxia is frequently present. These results corroborate earlier research that suggested birth-related issues, like as hypoxia and delayed crying, are important risk factors for spastic cerebral palsy, especially in low-resource environments when perinatal care may be insufficient. The very high prevalence of CP among the participants may be due to deficiencies in perinatal monitoring, emergency response, or postnatal follow-up in Bangladeshi healthcare facilities, even though 69.6% of deliveries took place in hospitals. This finding is consistent with international research that shows that CP is still closely linked to avoidable causes such infections, birth trauma, and newborn encephalopathy in low- and middle-income countries (LMICs).

Inadequate integration of community-based rehabilitation, inadequate therapist training, and a lack of uniformity in diagnostic methods all contribute to the difficulties in managing cerebral palsy in LMICs. In this sense, the study offers a useful paradigm for clinicians operating in settings with limited resources by utilizing well-established instruments such as the Pediatric Balance Scale and observation-based gait metrics. These methods can help guide goal-setting in therapy and provide important insight into the functional skills of children with cerebral palsy, even in the absence of advanced motion analysis systems.

Although this study's clinical focus was mostly on physical performance, children with cerebral palsy who have balance and gait issues also face emotional, social, and intellectual challenges. Children who have trouble moving around are frequently stigmatized, kept out of school events, and have worse self-esteem. These difficulties highlight the value of comprehensive rehabilitation programs that incorporate psychosocial support, caregiver education, and inclusive community practices in addition to physical treatment. The results of this study lend credence to the idea that a child's independence and general quality of life can be improved by increasing functional mobility through targeted therapy, caregiver education, and systemic support.

Additionally, the conversation highlights the necessity of monitoring functional results in children undergoing rehabilitation treatments over an extended period of time. Although this study offers a useful cross-sectional perspective, future investigations should focus on assessing how intervention affects balance and gait over time. Clinicians would be able to better allocate resources, modify goals over time, and maximize therapy intensity if they had a better understanding of the trajectory of functional improvements—or deterioration.

Furthermore, the present results support the global endeavor to produce data on CP in LMICs. Low-income data are severely underrepresented in CP research, as noted by Khandaker et al. (2019) and the Bangladesh Cerebral Palsy Register (BCPR). This study, by analyzing a small subset of spastic CP patients at CRP, gives a much-needed perspective on functional problems in a Bangladeshi rehabilitation context. It emphasizes the importance of creating local registries, carrying out population-level monitoring, and customizing international rehabilitation models to meet regional requirements.

Despite receiving therapy in a reputable rehabilitation center, many children continued to exhibit significant limitations in postural control and gait, highlighting the chronic nature of these impairments. The findings strongly advocate for more intensive, individualized, and task-oriented rehabilitation approaches, as well as greater investment in caregiver education and public health infrastructure. By bringing local rehabilitation practices into line with international evidence and by consistently.

Limitation of the study:

The current study had some potential limitations. The main limitation of this study was its short duration. The study was conducted with 102 Cerebral Palsy children which was a small number of samples.

This study only conducted in Pediatric Unit of CRP, Saver, that is not cover the full area of Bangladesh.

The data collection was challenging in hospital site. Such as:

- The timing of the patients' therapy sessions did not match with my data collection schedule.

- The patients were not cooperative during the data collection process.

The researcher did not find relevant research done in this topic area in Bangladesh. So, relevant information about balance and gait of spastic cerebral palsy patients for Bangladesh was very limited in this study.

Chapter-VI Conclusion

The purpose of this study was to investigate the gait and balance traits of children with spastic cerebral palsy (CP) who were enrolled in a selected rehabilitation facility in Bangladesh. The results provide important new information about the functional impairments these kids experience, emphasizing the intricate connection between sociodemographic variables, rehabilitation accessibility, and neuromuscular deficiencies. According to the findings, children with spastic cerebral palsy have a difficult time maintaining both static and dynamic balance, and they exhibit noticeable anomalies in gait metrics such walking speed, cadence, and stride length.

Many participants found it especially challenging to complete postural control tasks, such as standing on one foot or stepping onto a stool, and these tasks had a high link with their total Pediatric Balance Scale (PBS) scores. These results demonstrate how spasticity affects motor control, especially in the trunk and lower limbs, which are crucial for balance and walking. Complex activities involving dynamic control were stronger markers of total motor function than simple gait measurements like speed, which showed minimal relationships. This backs the use of balance-focused evaluations and treatments for the treatment of spastic cerebral palsy.

The study also found that many children have compensatory and inefficient gait patterns, such as asymmetrical movement and shorter strides, which are likely used to improve stability but at the expense of walking efficiency and energy expenditure. These gait abnormalities can limit participation in daily activities and impede social and educational inclusion. Even after some degree of rehabilitation, persistent deficits indicate the need for more focused and intensive physiotherapy approaches.

According to sociodemographic study, the majority of moms only had a primary or secondary education, and a sizable percentage of children were born at home. It's interesting to note that balancing outcomes were nearly significantly correlated with maternal education level, indicating that education may have an impact on awareness, healthcare-seeking behavior, and therapy adherence. Additionally, the large proportion of newborns who did not cry right away raises the possibility of prenatal issues like hypoxia, which is known to increase the incidence of spastic cerebral palsy in environments with little resources.

The results highlight how crucial early diagnosis, easily available rehabilitation treatments, and caregiver education are to the successful management of cerebral palsy. This study's utilization of standardized instruments, such as the PBS and observational gait analysis, shows how valuable data may be obtained to guide treatment decisions even in settings with limited resources.

The study concludes by pointing out that children with spastic cerebral palsy experience long-lasting gait and balance issues that restrict their functional independence. Rehabilitation techniques must be multifaceted, evidence-based, and tailored to each patient in order to overcome these obstacles. These tactics should include physical therapy, family support, and systemic changes in the way healthcare is provided. Additionally, in low- and middle-income nations like Bangladesh, developing local databases and making contributions to CP registries will improve service planning and research. Overall, this study adds important evidence to the field of pediatric rehabilitation and emphasizes how urgently structured, easily accessible, and continuous interventions are needed to help children with spastic cerebral palsy live better lives.

Recommendation:

It is recommended that early screening and diagnosis programs be introduced at the community and primary healthcare levels to identify children at risk of spastic cerebral palsy, allowing for timely intervention. Structured and individualized physiotherapy programs focusing on improving balance and gait should be implemented, considering each child's gross motor function level. Community-based rehabilitation (CBR) initiatives must be expanded, especially in rural and underserved regions, to ensure accessibility and continuity of care. Furthermore, educating caregivers—particularly mothers—on home-based therapy practices and the importance of consistent follow-up can significantly enhance treatment outcomes. Given the observed influence of maternal education on balance outcomes, awareness campaigns should be developed to empower parents with knowledge and skills necessary for rehabilitation support. Inclusive education policies must also be strengthened so that children with spastic cerebral palsy are given equal opportunities in schools and society. Additionally, longitudinal and large-scale studies across various regions of Bangladesh are recommended to build a more comprehensive evidence base, which can guide national rehabilitation strategies. Finally, government and health policymakers should prioritize funding, infrastructure, and training in pediatric neuro rehabilitation to improve the long-term quality of life for children living with cerebral palsy.

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Appendixc

24th December, 2024

Head

Department of Physiotherapy

Centre for the Rehabilitation of the Paralysed (CRP)

Chapain, Savar, Dhaka-1343

Through: Head, Department of Physiotherapy, BHPI.

Subject: Prayer for seeking permission to collect data for conducting research project.

Sir,

With due to respect and humble submission to state that I am Jamil Ashrafi Ananna, a student of 4th year B.Sc. in physiotherapy at Bangladesh Health Professions Institute (BHPI). The Ethical committee has approved my research project entitled: **"Balance and gait of spastic cerebral palsy patient at a selective rehabilitation centre**: A cross sectional study**"** under the supervision of Muhammad Millat Hossain Associate Professor & Course Coordinator, Department of Rehabilitation Science, BHPI,CRP,Savar,Dhaka-1343. I want to collect data for my research project from the Department of Physiotherapy at CRP. So, I need permission for data collection from the Musculoskeletal Unit of Physiotherapy Department at CRP-Savar, Dhaka-1343. I would like to assure that anything of the study will not be harmful for the participants and the Department itself.

I, therefore pray and hope that you would be kind enough to grant my application and give me permission for data collection and oblige thereby.

Forwarded
15.01.2025
Dr. Shazal Kumar Das, PhD
Assistant Professor and Head
Department of Physiotherapy
BHPI, CRP, Savar, Dhaka-1343.

Yours faithfully,
Jamil Ashrafi Ananna
Jamil Ashrafi Ananna

4th Year B.Sc. in Physiotherapy

Class Roll: 26; Session: 2019-20

Bangladesh Health Professions Institute (BHPI)

(An academic Institution of CRP)

CRP-Chapain, Savar, Dhaka-1343.

Approved
21/1/25
Prof. Dr. Mohammad Anwar Hossain, PhD
Professor Physiotherapy Department BHPI
Senior Consultant & Head
Physiotherapy Department
CRP, Savar, Dhaka-1343

Recommended & Forwarded
15.01.25
Muhammad Millat Hossain
Associate Professor
Project & Course Coordinator
Dept. of Rehabilitation Science
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Scanned with CamScanner

বাংলাদেশ হেলথ্ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)
Bangladesh Health Professions Institute (BHPI)
(The Academic Institute of CRP)

BANGLADESH HEALTH PROFESSIONS INSTITUTE

Ref: CRP-BHPI/IRB/12/2024/1033

Date: 15/12/2024

To
Jamil Ashrafi Ananna
4th Year B.Sc. in Physiotherapy
Session: 2019-20, Student ID: 112190508
BHPI, CRP, Savar, Dhaka1343, Bangladesh

Subject: Approval of the thesis proposal "Balance and gait of spastic cerebral palsy patients at a selective rehabilitation centre in Bangladesh" by the ethics committee.

Dear Ananna,
Congratulations.
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above mentioned dissertation, with yourself, as the author and Muhammad Millat Hossain, Associate Professor & Course Coordinator, Department of Rehabilitation Science, BHPI, CRP, Savar, Dhaka-1343 as thesis supervisor. The following documents have been reviewed and approved:

Sl. No.	Name of the Documents
1	Research Proposal
2	Questionnaire (English version)
3	Information sheet & consent form.

The purpose of this study is to find out balance and gait of spastic cerebral palsy patients at a selective rehabilitation centre in Bangladesh. The study involves use a questionnaire that may take 15 to 20 minutes to answer. Any instruction or precaution for collection of specimen and there is no likelihood of any harm to the participants and participation in the study may benefit the participants. The members of the Ethics Committee have approved the study to be conducted in the presented form at the meeting held at **9 AM on 15 July 2024 at BHPI (44th IRB Meeting).**

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Muhammad Millat Hossain,
Associate Professor & Course Coordinator, MRS
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Consent Form (English)

Assalamualaikum,

I am Jamil Ashrafi Ananna, I am conduction this thesis for B.Sc in Physiotherapy program titled "**Balance and gait of spastic cerebral palsy patients at a Selected Rehabilitation Center in Bangladesh**" by this I would like to know about the balance and gait of CP patients. Now I want to ask some personal, balance, and gait related question. This will take approximately 20-25 minutes.

I would like to inform you that this is a purely academic study and will not be used for any other purpose. Your participation in the research will have no impact on your present or future treatment in the area. All information provided by you will be treated as confidential and in the event of any report or publication it will be ensured that the source of information remains secret.

Yours participation in this study is voluntary and you may withdraw yourself at any time during this study without any negative questions. You also have the right not to answer a particular question that you don't like or do not want to answer during interview.

If you have any query about the study or your right as a participant, you may contact with me and/or my research supervisor, Muhammad Millat Hossain, Associate Professor & Course Coordinator, Department of Rehabilitation Science, BHPI, CRP, Savar, Dhaka-1343.

Do you have your consent to proceed with the interview? So may I have your consent to proceed with the interview?

□Yes □ No

Signature and date of the Participant: ……………………………………….

Signature and date of the Interviewer: ...………………………………….

Questionnaire (English)

Title: Balance and gait of spastic cerebral palsy patients at a Selected Rehabilitation Center in Bangladesh

Patient's personal identification

1.1	Patient‘s name:	
1.2	Patient ID No:	
1.3	Address:	
1.4	Mobile No:	

Part-1: Socio – demographic information

Question Number	**Questions**	**Response**
1	Age of the patient	Year………month……
2	Sex	□ Boy □ Girl
3	Mother's educational level	□ Illiterate □ Literate □ Primary □ Secondary school certificate (SSC) □ Higher secondary certificate (HSC) □ Bachelor □ Masters or above

4	Father's educational level	□ Illiteracy □ Literate □ Primary □ Secondary school certificate (SSC) □ Higher secondary certificate (HSC) □ Bachelor □ Masters or above
5	When did your child born?	□ Before 38 weeks □ After 38-41 weeks □ After 42 weeks
6	Place of delivery	□ Home □ Hospital
7	Type of delivery	□ NVD (Normal Vaginal Delivery) □ Caesarian section □ Forceps delivery □ Other instrumental delivery

8	What was the duration of labor pain?	□ Less than 12 hours □ More than 12 hours
9	Did your child cry just after birth?	□ Yes □ No
10	Involvement of limb	□ Monoplegic □ Diplegic □ Quadriplegic □ Triplegic □ Hemiplegic

Berg Balance Scale

Item Description	Number Description	Marks
3.1. Sitting to standing	4. able to stand without using hands and stabilize independently 3. able to stand independently using hands 2. able to stand using hands after several tries 1. needs minimal assist to stand or to stabilize 0. needs moderate or maximal assist to stand	
3.2. Standing to sitting	4. sits safely with minimal use of hands 3. controls descent by using hands 2. uses back of legs against chair to control descent 1. sits independently, but has uncontrolled descent 0. needs assistance to sit	
3.3. Transfers	4. able to transfer safely with minor use of hands 3. able to transfer safely; definite need of hands 2. able to transfer with verbal cueing and/or supervision 1. needs one person to assist 0. needs two people to assist or supervise to be safe	
3.4. Standing unsupported	4. able to stand safely 30 seconds 3. able to stand 30 seconds with supervision (spotting) 2. able to stand 15 seconds unsupported 1. needs several tries to stand 10 seconds unsupported 0. unable to stand 10 seconds unassisted	
3.5. Sitting unsupported	4. able to sit safely and securely 30 seconds 3. able to sit 30 seconds under supervision 2. able to sit 15 seconds 1. able to sit 10 seconds	

	0. unable to sit 10 seconds without support	
3.6. Standing with eye close	4. able to stand 10 seconds safely 3. able to stand 10 seconds with supervision (spotting) 2. able to stand 3 seconds 1. unable to keep eyes closed 3 seconds but stays steady 0. needs to help keep from falling	
3.7. Standing with feet together	4. able to place feet together independently and stand 30 seconds safely 3. able to place feet together independently and stand for 30 seconds with Supervision 2.able to place feet together independently but unable to hold for 30 seconds 1.needs help to attain position but able to stand 30 seconds with feet together 0.needs help to attain position and /or unable to hold for 30 seconds	
3.8. Standing with one foot in front	4. able to place feet tandem independently and hold 30 seconds 3. able to place foot ahead of other independently and hold 30 seconds 2. able to take small step independently and hold 30 seconds 1. needs help to step, but can hold 15 seconds 0. loses balance while stepping or standing	

3.9. Standing on one foot	4. able to lift leg independently and hold 10 seconds 3. able to lift leg independently and hold 5 to 9 seconds 2. able to lift leg independently and hold 3 to 4 seconds 1. tries to lift leg; unable to hold 3 seconds but remains standing 0. unable to try or needs assist to prevent fall	
3.10. Turning 360 degrees	4. able to turn 360 degrees safely in 4 seconds 3. able to turn 360 degrees safely in one direction only in 4 seconds or less 2. able to turn 360 degrees safely but slowly 1. needs close supervision (spotting) or constant verbal cueing 0. needs assistance while turning	
3.11. Turning to look behind	4. looks behind/over each shoulder; weight shifts include trunk rotation 3. looks behind/over one shoulder with or no trunk rotation 2. turns head to look to level of shoulder; no trunk rotation 1. needs supervision when turning 0. needs assist to keep from losing balance or falling	

3.12. Retrieving object from floor	4. able to pick up an eraser safely and easily 3. able to pick up eraser but needs supervision 2. unable to pick up eraser but reaches 1 to 2 inches from eraser and keeps balance independently 1. unable to pick up eraser; needs supervision while attempting 0. unable to try, needs assist to keep from losing balance or falling	
3.13. Placing alternate foot on stool	4. stands independently and safely and completes 8 steps in 20 seconds 3. able to stand independently and complete 8 steps >20 seconds 2. able to complete 4 steps without assistance, but requires close supervision 1. able to complete 2 steps; needs minimal assistance 0. needs assistance to maintain balance or keep from falling, unable to try	
3.14. Reaching forward with outstretched arm	4. can reach forward confidently >10 inches 3. can reach forward >5 inches, safely 2. can reach forward >2 inches, safely 1. reaches forward but needs supervision 0. loses balance while trying, requires external support	

Total Score: ……../56

Parameter measurements

Measurement of step length:

Distance from unaffected heel to affected heel	
So, step length	

Measurement of stride length:

Stride length=total step/total distance=

Total step	Total distance(m)	Stride length(ts/td)

Measurement of speed:

Speed=distance/time=

Speed	

Measurement of cadence (number of steps in 1 min):

Number of steps	Time (/min)

সম্মতি ফর্ম (বাংলা)

আসসালামুয়ালাইকুম,

আমি জামিল আশরাফী অনন্যা, বিএসসি ইন ফিজিওথেরাপি প্রোগ্রামের জন্য "বাংলাদেশের একটি নির্দিষ্ট পুনর্বাসন কেন্দ্রে স্পাস্টিক সেরিব্রাল পালসি রোগীদের ভারসাম্য ও হাঁটার ধরন" শিরোনামে এই গবেষণা পরিচালনা করছি। এই গবেষণার মাধ্যমে আমি সেরিব্রাল পালসি (CP) রোগীদের ভারসাম্য ও হাঁটার ধরন সম্পর্কে জানতে চাই। এখন আমি কিছু ব্যক্তিগত, ভারসাম্য ও হাঁটার ধরন সম্পর্কিত প্রশ্ন জিজ্ঞাসা করতে চাই। এটি সম্পন্ন হতে আনুমানিক **২০-২৫ মিনিট** সময় লাগবে।

আমি আপনাকে জানাতে চাই যে এটি সম্পূর্ণ **একটি একাডেমিক গবেষণা** এবং অন্য কোনো উদ্দেশ্যে ব্যবহার করা হবে না। গবেষণায় আপনার অংশগ্রহণের ফলে **আপনার বর্তমান বা ভবিষ্যতের চিকিৎসার ওপর কোনো প্রভাব পড়বে না**। আপনি যে তথ্য প্রদান করবেন তা **সম্পূর্ণ গোপন রাখা হবে**, এবং যদি এই গবেষণা থেকে কোনো প্রতিবেদন বা প্রকাশনা তৈরি হয়, তবে তথ্যের উৎস গোপন রাখা হবে।

আপনার **এই গবেষণায় অংশগ্রহণ সম্পূর্ণ স্বেচ্ছাসেবী** এবং আপনি চাইলে যে কোনো সময় এই গবেষণা থেকে **প্রত্যাহার করতে পারেন**, এতে কোনো নেতিবাচক প্রভাব পড়বে না। আপনি যদি কোনো প্রশ্নের উত্তর দিতে না চান বা **অস্বস্তি বোধ করেন**, তবে সেটি **উত্তর না দেওয়ার অধিকার** আপনার রয়েছে।

যদি এই গবেষণা বা **আপনার অধিকার** সম্পর্কে কোনো প্রশ্ন থাকে, তাহলে আপনি আমার সাথে অথবা আমার গবেষণা তত্ত্বাবধায়ক **মুহাম্মাদ মিল্লাত হোসেন**, সহযোগী অধ্যাপক ও কোর্স সমন্বয়কারী, পুনর্বাসন বিজ্ঞান বিভাগ, **বিএইচপিআই, সিআরপি, সাভার, ঢাকা-১৩৪৩** এর সাথে যোগাযোগ করতে পারেন।

আপনি কি সাক্ষাৎকারটি চালিয়ে যেতে সম্মত?

তাহলে, **আমি কি আপনার সম্মতি পেতে পারি?**

☐ **হ্যাঁ**

☐ **না**

অংশগ্রহণকারীর স্বাক্ষর এবং তারিখ: ....

সাক্ষাৎকার গ্রহণকারীর স্বাক্ষর এবং তারিখ: ....

প্রশ্নমালা (বাংলা)

শিরোনাম: বাংলাদেশে একটি নির্বাচিত পুনর্বাসন কেন্দ্রে স্পাস্টিক সেরিব্রাল পালসি রোগীদের ভারসাম্য ও হাঁটার ধরণ

অংশ - ১: রোগীর পরিচিতি

১.১	রোগীর নাম:	
১.২	রোগীর আইডি নম্বর:	
১.৩	ঠিকানা:	
১.৪	মোবাইল নম্বর:	

পার্ট-১ : আর্থ-সামাজিক জীবনযাপন সংক্রান্ত তথ্যাবলী

প্রশ্ননং	ইঙ্গিত	উত্তর
১	রোগীর বয়স	বছর.........মাস......
২	লিঙ্গ	☐ ছেলে ☐ মেয়ে
৩	মাতার শিক্ষাগত যোগ্যতা	☐ নিরক্ষর ☐ অক্ষর জ্ঞান সম্পন্ন ☐ প্রাথমিক ☐ এস এস সি ☐ এইচ এস সি ☐ স্নাতক/ডিগ্রি/বি এ ☐ স্নাতকোত্তর বা অন্যান্য ডিগ্রি

৪	পিতার শিক্ষাগত যোগ্যতা	☐ নিরক্ষর ☐ অক্ষর জ্ঞান সম্পন্ন ☐ প্রাথমিক ☐ এস এস সি ☐ এইচ এস সি ☐ স্নাতক/ডিগ্রি/বি এ ☐ স্নাতকোত্তর বা অন্যান্য ডিগ্রি

পার্ট-২: মেডিকেল সম্পর্কিত তথ্যাবলী

প্রশ্ননং	প্রশ্ন	উত্তর
৭	আপনার শিশু কখন জন্ম গ্রহণ করেছিল	☐ ৩৮-সপ্তাহের আগে ☐ ৩৮ সপ্তাহের পরে ☐ ৪২ সপ্তাহের পরে
৮	ডেলিভারির স্থান	☐ বাড়িতে ☐ হাসপাতালে
৯	ডেলিভারির ধরন	☐ নরমাল ☐ সিজার ☐ শল্য চিকিৎসার মাধ্যমে ☐ অন্যান্য যন্ত্রপাতির মাধ্যমে ডেলিভারি
১০	প্রসববেদনার সময় কতক্ষণ ছিল	☐ ১২ ঘন্টার কম ☐ ১২ ঘন্টার বেশি
১১	আপনার শিশুটি কি জন্মের সঙ্গেসঙ্গে কেঁদেছিল	☐ হ্যাঁ ☐ না
১২	অঙ্গের সম্পৃক্ততা	☐ মনোপ্লোজিক ☐ ভাইপ্লোজিক ☐ কোয়াড্রিপ্লোজিক ☐ ট্রাইপ্লোজিক ☐ হেমিপ্লোজিক

বার্গ ভারসাম্য স্কেল

পদের বর্ণনা	সংখ্যার বর্ণনা	মার্ক
৩.১ বসা থেকে দাঁড়ানো	৪. স্বাধীনভাবে হাত ব্যবহার না করেই দাঁড়াতে এবং টিকে থাকতে পারে। ৩. স্বাধীনভাবে হাত ব্যবহার করেই দাঁড়াতে পারে। ২. কয়েকবার চেষ্টার পর দাঁড়াতে পারে। ১ . সামান্য সাহায্যের দরকার হয়। ০. মাঝারি থেকে সর্বোচ্চ সাহায্যের দরকার হয়।	
৩.২ দাঁড়ানো থেকে বসা	৪. নিরাপদে বসতে পারে হাতের কম ব্যবহার করে। ৩. হাত ব্যবহার করে বসে। ২. বসার সময় পায়ের পেছন দিক চেয়ারের সাথে লাগিয়ে দেয়। ১. স্বাধীনভাবে বসে, তবে বসাটা তার নিয়ন্ত্রণে নেই। ০. বসতে সহায়তা দরকার।	
৩.৩ স্থানান্তর	৪. হাতের কম ব্যবহার করে নিরাপদে স্থানান্তর হতে পারে। ৩. হাতের বেশি ব্যবহার করে নিরাপদে স্থানান্তর হতে পারে। ২. মুখ দিয়ে বলে তদারকি করতে হয়। ১. একজন লোকের সাহায্য লাগে। ০. দুইজন লোকের সাহায্য লাগে।	
৩.৪ বিনা সহায়তায় দাঁড়ানো	৪. নিরাপদে ৩০ সেকেন্ড দাঁড়াতে পারে। ৩. মুখ দিয়ে বলার পর ৩০ সেকেন্ড দাঁড়াতে পারে। ২. সাহায্য ছাড়াই ১৫ সেকেন্ড দাঁড়াতে পারে। ১. সাহায্য ছাড়াই কয়েকবার চেষ্টার পর ১০ সেকেন্ড দাঁড়াতে পারে। ০. সাহায্য ছাড়া ১০ সেকেন্ড দাঁড়াতে পারে না।	
৩.৫ বিনা সহায়তায় বসা	৪. নিরাপদে ৩০ সেকেন্ড বসে থাকতে পারে। ৩. মুখ দিয়ে বলার পর ৩০ সেকেন্ড বসে থাকতে পারে। ২. সাহায্য ছাড়াই ১৫ সেকেন্ড বসে থাকতে পারে। ১. সাহায্য ছাড়াই কয়েকবার চেষ্টার পর ১০ সেকেন্ড বসে থাকতে পারে। ০. সাহায্য ছাড়া ১০ সেকেন্ড বসতে পারে না।	

পদের বর্ণনা	সংখ্যার বর্ণনা	মার্ক
৩.৬. চোখ বন্ধ করে দাঁড়ানো	৪. নিরাপদে ১০ সেকেন্ড দাঁড়াতে পারে। ৩. মুখ দিয়ে বলার পর ১০ সেকেন্ড দাঁড়াতে পারে। ২. ৩ সেকেন্ড দাঁড়াতে পারে। ১. ৩ সেকেন্ড দাঁড়িয়ে থাকতে পারে তবে চোখ বন্ধ রাখতে পারে না। ০. সাহায্য না করলে পড়ে যায়।	
৩.৭. দুই পা একসাথে রেখে দাঁড়ানো	৪. স্বাধীনভাবে একসাথে দুই পা রেখে ৩০ সেকেন্ড দাঁড়াতে পারে। ৩. মুখ দিয়ে বলার পর স্বাধীনভাবে একসাথে দুই পা রেখে ৩০ সেকেন্ড দাঁড়াতে পারে। ২. দুই পা রেখে ৩০ সেকেন্ডের কম সময় দাঁড়াতে পারে। ১. দাঁড়াতে সাহায্য করতে হয়, তবে ৩০ সেকেন্ড থাকতে পারে। ০. সম্পূর্ণ সাহায্যের দরকার হয়।	
৩.৮. একপায়ের সামনে অপর পা রেখে দাঁড়ানো	৪. স্বাধীনভাবে এক পায়ের সামনে অপর পা রেখে ৩০ সেকেন্ড দাঁড়াতে পারে। ৩. দুই পা একসাথে রেখে ৩০ সেকেন্ড দাঁড়াতে পারে। ২. ছোট ছোট পদক্ষেপ ফেলে ৩০ সেকেন্ড দাঁড়াতে পারে। ১. সাহায্যের দরকার হয়, ১৫ সেকেন্ড দাঁড়াতে পারে। ০. ভারসাম্য হারিয়ে ফেললে।	
৩.৯. এক পায়ে দাঁড়ানো	৪. স্বাধীনভাবে এক পা তুলে ১০ সেকেন্ড রাখতে পারে। ৩. স্বাধীনভাবে এক পা তুলে ৫ সেকেন্ড রাখতে পারে। ২. স্বাধীনভাবে এক পা তুলে ৩-4 সেকেন্ড রাখতে পারে। ১. ৩ সেকেন্ড রাখতে পারে না, তবে দাঁড়িয়ে থাকে। ০. চেষ্টা করে না।	
৩.১০. ৩৬০° ঘুরতে পারা	৪. ৪ সেকেন্ডে নিরাপদে ৩৬০° ঘুরতে পারে। ৩. পরীক্ষার নির্দেশ অনুযায়ী ৪ সেকেন্ডে নিরাপদে ৩৬০° ঘুরতে পারে। ২. নিরাপদে ৩৬০° ঘুরতে পারে তবে ধীরে। ১. মুখ দিয়ে বলে কাজটা করাতে হয়। ০. সাহায্যের দরকার হয়।	

৩.১১ পেছনের দিকে তাকানোর উদ্দেশ্যে ঘোরা	৪. পেছনে তাকাতে পারে/ দুই বাহুর উপর দিয়ে; মধ্য শরীর ঘুরবে। ৩. পেছনে তাকাতে পারে/ দুই বাহুর উপর দিয়ে; মধ্য শরীর ঘুরবে না। ২. বাহুর উপর দিয়ে তাকানোর চেষ্টা মাথা ঘোরায়। ১.মুখ দিয়ে বলে কাজটা করাতে হয়। ০.মাটিতে পড়া থামানো সাহায্যের দরকার হয়।	
৩.১২ মেঝে থেকে কোনো জিনিস তোলা	৪. নিরাপদে এবং সহজে মেঝে থেকে রাবার তুলতে পারে। ৩. মেঝে থেকে তুলতে পারে তবে বলে দিতে হয়। ২. রাবার তুলতে পারে না, তবে নিয়ন্ত্রণ না হারিয়ে ১-২. ইঞ্চি এগোতে পারে। ১. রাবার তুলতে পারে না, তবে মুখে বলে দিতে চেষ্টা করে। ০.চেষ্টা করে না/ পড়ে যায়।	
৩.১৩ অপর পা ফেলার চেষ্টা	৪.স্বাধীনভাবে দাঁড়ায় এবং ২০ সেকেন্ডে ৮টি ধাপ ফেলে। ৩. স্বাধীনভাবে দাঁড়ায় এবং ২০ সেকেন্ডে বেশি সময়ে ৮টি ধাপ ফেলে। ২. সাহায্য ছাড়াই ৪টি ধাপ ফেলে তবে বলে দিতে হয়। ১.২টি ধাপ ফেলে, সামান্য সহায়তায়। ০. সহায়তা না করলে পড়ে যায়।	
৩.১৪ **বাহু প্রসারিত করে সামনে এগিয়ে যাওয়া**	৪. অপর্যাপ্ত ১০ ইঞ্চির বেশি এগোয়। ৩. নিরাপদে ৫ ইঞ্চির বেশি এগোয়। ২. নিরাপদে ২ ইঞ্চির বেশি এগোয়। ১. সামনে এগোয় তবে বলে দিতে হয়। ০.চেষ্টা করতে গিয়ে নিয়ন্ত্রণ হারায়।	

মোট স্কোর: .... / ৫৬

হাটার প্যারামিটার মাপা

ধাপের দৈর্ঘ্য নির্ণয়ঃ

ভাল পা থেকে আক্রান্ত পায়ের দূরত্ব	
অতএব ধাপের দৈর্ঘ্য	

দীর্ঘ দূরত্ব নির্ণয়ঃ

মোট ধাপ	মোট দুরত্ত (মিটার)	দীর্ঘ দূরত্ব নির্ণয়

গতি নির্ণয়ঃ

গতি (দুরত্ত/সময়)	

ক্যাডেঞ্জ নির্ণয়ঃ

ধাপের সংখ্যা	সময়(/মিনিট)