PROPORTION, ASSOCIATED FACTORS AND NEED FOR SURGICAL INTERVENTION OF HIP DYSPLASIA AMONG CHILDREN WITH CEREBRAL PALSY ATTENDING CLINIC AT MUHIMBILI NATIONAL HOSPITAL

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Proportion, associated factors and need for surgical intervention of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital

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A dissertation submitted in partial fulfillment for the degree of
Masters of Medicine in Orthopedics and Traumatology of the
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October 2024.

CERTIFICATION

The undersigned certify that they have read and hereby recommend for examination of dissertation entitled "**Proportion, associated factors and need for surgical intervention of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital',** in fulfillment of the requirements for the degree of Master of Medicine (Orthopedic and Traumatology) of Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **John Chagula** declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature……. Date……

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DEDICATION

I dedicate this work to my beloved mother, Evelyne Chagula, Her tireless support, encouragement, and constant prayers have been the driving force behind my achievements. Her belief in my abilities and her sacrifices have made this work possible. I am forever grateful for her love and guidance throughout my academic journey.

ABSTRACT

Hip dysplasia is not uncommon among children with cerebral palsy (CP) especially those with spasticity. It may result into hip pain and impairment of functions. Customized therapy approaches are necessary based on the child's condition, as the deformity varies greatly depending on the child's CP type, CP topographic pattern, and gross motor function classification score. Early surgical intervention is essential in preventing hip dislocation and improve quality of life. In LMICs like Tanzania, there is a limited data to show magnitude of hip dysplasia, making it difficult to establish standard treatment protocol.

Objective: To determine proportion, associated factors and need for surgical intervention of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital.

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Methods: A descriptive cross-sectional study was conducted involving 206 children with CP attended clinic at MNH between June 2023 to December 2023.Ethical clearance was obtained from the MUHAS IRB. Participant parents or legal guardians provided a verbal and/or written informed consent prior to study enrollment A guided questionnaire was used to interview eligible participants; further examinations were also done including hip assessment, Standard AP x ray of Hip taken and was interpreted by principal investigator on RMP. Patients were assigned treatment group based on their RMP value according to standard literatures. The data were coded and entered into a statistical analyzing tool SPSS version 24. A variable with a P-value of 0.05 or less was considered statistically significant. Target population was patient with CP attending at MNH clinic.

Results: 206 patients were recruited for the study, Of the study participants, 112 (54.4%) were male and 115 (55.8%) were over the age of five, with a range of 3 to 9. 155 (75.2%) had spastic type of CP, 100 (48.5%) had Quadriplegia pattern , and 74 (35.9%) had GMFCS IV & V. Hip dysplasia was found in 36 (17.5%) of the patients recruited and 3 (1.5%) of participants had hip dislocation, children with GMFCS IV and V had high risk of hip dysplasia 36.5% $p<0.001$, Spastic quadriplegia has high risk of hip dysplasia 44.1% $p<0.001$, Those with children with hip joint pain had higher risk of hip dysplasia by 38.9% $p<0.001$. Out of 26 children with hip dysplasia 69.4% needs surgical intervention.

Conclusion: The results of this study indicate that a significant percentage of CP patients have hip dysplasia, and the majority require surgery intervention. Despite making numerous clinic visits to the pediatric MNH, large number of individuals with hip dysplasia were previously undiagnosed. This emphasizes the significance of the hip surveillance program, in which patients are evaluated by orthopedic surgeon according to their risk status and pelvic x-rays results. This helps in early identification and treatment of hip dysplasia.

Key words: Cerebral palsy: Hip dysplasia: Associated factors: Surgical Intervention

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LIST OF ABBREVIATIONS

CP	Cerebral Palsy
GMFCS	Gross Motor Function Classification System
MNH	Muhimbili National Hospital
MOI	Muhimbili Orthopedic Institute
RMP	Reimer's migration percentage
SPSS	Statistical Package for the Social Sciences
LMIC	Low- and middle-income countries

OPERATIONAL DEFINITIONS

1. Cerebral palsy was defined as follows: collections of conditions that lead to a disorder of motor function, movement, and posture that affect the developing and immature brain, resulting in dysfunction of the central nervous system.

2. In this study Hip dysplasia was defined as a disorder where the femur and pelvic bones of the hip joint are not adequately aligned with normal acetabulum.

3. In this study, the type of CP was defined as the type of movement disorder that is present as well as the afflicted area of the brain.

4. In this study, the topographic pattern of CP was defined as the body region that has been affected by the disease.

5. In this study, the gross motor function classification system was defined as system that provides a framework for describing the level of functional impairment based on motor skills and mobility among patients with CP

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Cerebral palsy (CP) refers to a heterogenous group of conditions that leads to a disorder of motor function, movement, and posture which affects the growing and undeveloped brain, resulting in a permanent and nonprogressive dysfunction of the central nervous system (1)It is common neurologic disorder in children with a prevalence of approximately 2 per 1000 live births(2).

Hip dysplasia is the second most common orthopedic disorder for children with CP (after ankle deformity) that can potentially cause notable pain and disability (3,4).

Hip dislocation following hip dysplasia may lead to pain and functional impairment affecting the ability to sit, stand, or walk, and impaired quality of life (3–5). The overall incidence of hip dysplasia in children with CP has been estimated to be approximately 20-35%, higher incidence in countries where hip surveillance is implemented. The severity of hip disease is directly related to the age of the patient, type of CP and CP topographic pattern, presence of hip joint pain. Also, it directly correlates with gross motor impairment as graded by the Gross Motor Function Classification System (GMFCS) (3,6).

Increased muscle rigidity caused by cerebral palsy spasticity results in fixed myostatic contractures. The proximal femur is pulled into adduction, flexion, and internal rotation by the spastic and tensed hip adductor and flexor muscles, thereby forcing the femoral head out of the hip joint leading to hip dysplasia (7)

The Reimer's migration percentage from standard Anterior Posterior (AP) pelvic x ray is the reliable tool to show how much the ossified femoral head has been dislocated from the ossified acetabular roof, which is widely used in children with cerebral palsy to determine the degree of subluxation or dislocation (8,9)

Hip disorders in children with CP cover a wide spectrum of pathology ranging from the hip at risk, to subluxated hips, dislocated hips, and dislocated hips with degenerative arthritis and pain (10).

The treatment of Hip dysplasia in cerebral palsy focuses on the management of the sequel of the disease and prevention of musculoskeletal progression of spasticity and deformity. It depends on the degree of dysplasia, functional status of the patient, and patient age. This includes surgical and non-surgical treatment procedure, Surgical treatment options include preventive, reconstructive, and salvage procedures (11,12).

Early surgical interventions While the child has not yet developed a mature gait pattern, it is required for the treatment of hip dysplasia. This allows the kid to have a firm walking base, prevents gait degeneration, loss of hip motion, and the possibility of osteoarthritis. Early surgical treatment has been shown to improve child in-person care, hygiene, positioning and prevention of hip dislocation (4,13,14).

1.2 Problem Statement

The diagnosis of hip dysplasia is commonly missed because there are no symptoms in the early stages of the condition. Early diagnosis and therapy are largely dependent on awareness of this illness and routine surveillance through clinical examination and serial hip radiographs (14). Preventing hip dislocation after hip dysplasia in children with CP requires regular pelvic radiographic examinations by Orthopedic surgeon, followed by early surgery (4). Despite significant number of CP patients at pediatric MNH clinic radiological hip assessment is not routinely done. This may delay identification of these musculoskeletal deformities and leading to progressive hip dislocation and poor quality of life among CP children. The purpose of this study is to determine the proportion, associated factors and need for surgical intervention of hip dysplasia among children's with cerebral palsy.

1.3 Conceptual Framework

Conceptual framework below shows link between dependent and independent variables. Dependent variables were Sex, Age, GMFCS and CP type and topographic pattern, Hip pain and independent variables were Hip dysplasia and need for surgical intervention.

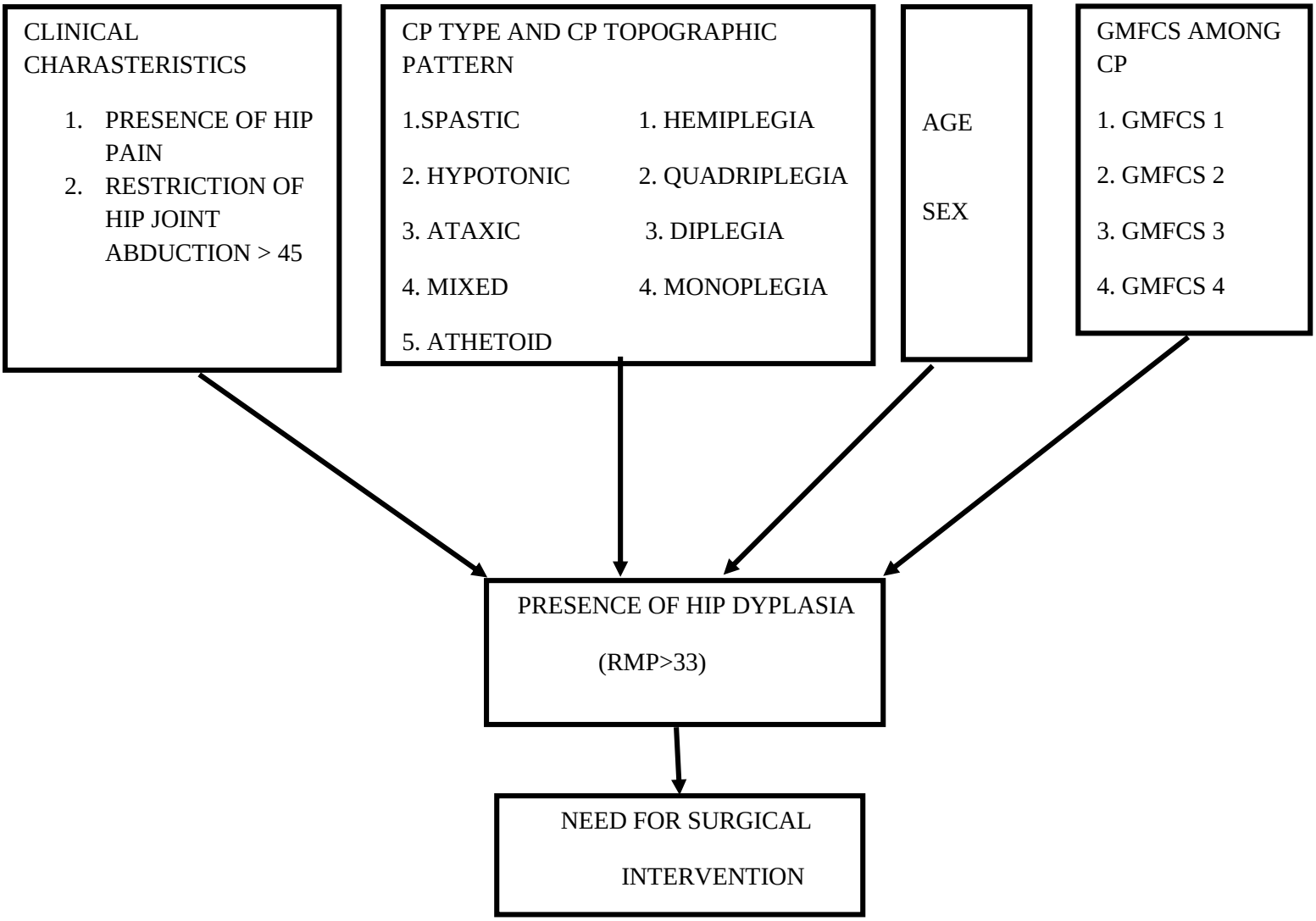


Figure 1: Conceptual Framework

1.4 Rationale

The results of this study will provide a general overview of hip dysplasia among CP patients, including its proportion, type, and topographic pattern. The study findings also will assist in determining the percentage of children with hip dysplasia who required surgical intervention at MNH. These findings helped to a establish routine radiological hip assessment for CP pediatric patients attending clinic at MNH and improved quality of life.

1.5 Broad Research Questions

What is the proportion, associated factors and need for surgical intervention of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital?

1.5.1 Specific research questions

1. What is the proportion of hip dysplasia among children with cerebral palsy attending a clinic at Muhimbili National Hospital?

2. What are the factors associated with hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital?

3. What is the proportion of cerebral palsy children attending clinic at Muhimbili National Hospital with hip dysplasia who required surgical intervention?

1.6 Objectives

1.6.1 Broad Objective

To determine proportion, associated factors and need for surgical intervention of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital.

1.6.2 Specific Objectives

1. To determine the proportion of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital.
2. To determine factors associated with hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital
3. To determine the proportion of cerebral palsy children attending clinic at Muhimbili National Hospital with hip dysplasia who required surgical intervention.

1.7 Literature Review

1.7.1 Proportional of hip dysplasia among CP children

Hip dysplasia is the second most common problem in CP pediatric patients after ankle deformity. Different studies had reported a different proportion of hip dysplasia in children with CP depending on the RMP value. A study conducted by Gunnar et al. in Sweden reported that among the 212 children involved in this study, 57 (27%) developed hip dysplasia measured by RMP >33% (3). Similar results were reported by a study done by Elkamil et al. in Norway, where he assessed the risk of hip dysplasia among pediatric patients and found that 18 of 119 children (15.1%) had hip dysplasia with RMP>33% (4). Furthermore, a study conducted in Bangladesh found that out of 8/40 children (20%), had hip dysplasia measured by RMP > 33%(15). Synchronous findings were obtained in a study done in India by Kunju et al. regarding the assessment of the severity of hip dysplasia in CP patients and reported that 31/101 children (30.6%) had hip displacement measured by RMP > 33% (16). Moreover, a research study conducted in Nigeria by Omololu et al. reported that 2.2% of the 284 children who underwent an 8-year assessment period were found to have congenital hip dysplasia (17)

Despite the proportion of hip dysplasia among CP children being manifested in several research studies, at our settings this phenomenon has not been documented in the literature. Therefore, this study aimed to determining the proportion of hip dysplasia among cerebral palsy pediatric patients attending clinic at Muhimbili National Hospital.

1.7.2 Factors associated with hip dysplasia among children with CP.

Several factors have been linked with hip dysplasia among children with CP including patient Age, patient functional status as measured by GMFCS, type and pattern of CP and presence of Hip pain. Hip dysplasia frequently manifests in early childhood, when the joints are still growing and developing. Young children with CP exhibit poor posture control, aberrant muscular tone, and restricted mobility. Which may impact hip joint alignment and natural development. The majority of dislocations in CP children are known to happen before the age of five years. This has been supported by a study done by Gunnar et al. in Sweden, which found that Hip dysplasia in children with CP frequently starts at around age 2–3 (3).In line with this study, another study

by Tasneem et al. in Bangladesh reported that hip dysplasia was more commonly observed among children over 5 years of age (15).

Risk for hip dysplasia may increase with higher levels of functional impairment, as indicated by the GMFCS. Children with higher GMFCS levels (IV and V) typically have more severe physical impairments, including significant limitations in their ability to control movement and maintain postural stability. This Lack of control of leg movement and muscle imbalances have contributed to the development of hip dysplasia. This has been supported by a study done by Gunnar et al. in Sweden, which found that Hip dysplasia is higher in patients with higher level of GMFCS by 64% for those with GMFCS level V**.** According to a study by Tasneem et al. in Bangladesh, children with higher GMFCS levels (IV and V) have a 62.5% higher risk of hip dysplasia (15).Similar study by Kunju PAM in India found that risk of hip dysplasia in higher by 50 % in children with GMFCS IV and V (16).The same findings were reported by the Bih Hwa study in Malaysia, which showed that the risk of hip dislocation increased gradually as GMFCS levels rise (18).

Another risk factor for hip dysplasia among children with CP is spasticity and this is due to increase muscle tone, stiffness and abnormal contractions leading to increased risk of hip dysplasia. This has been supported by a study done by Gunnar et al. in Sweden, which found that children with spastic quadriplegia had higher risk of Hip dysplasia by 79% (3).Another study by Tasneem et al. in Bangladesh, reported that children with spastic diplegia had higher risk of hip dysplasia by 50% (15).A study done by Kunju et al. in India also found a higher risk of hip dysplasia in patients with spastic quadriplegia by 83% (16).

Hip pain, which is a clinical symptom of hip dysplasia and is caused by decreased joint congruence, is also a risk factor for hip dysplasia. According to research by Bagg et al. in the USA, 45% of patients with displaced hips complained of hip pain (5).Similar findings were reported by J. W. Pritchett in the USA, who discovered that 33% of patients with hip dysplasia reported experiencing hip pain (19). Further research by Sharan et al. in India, reported that almost 50% of patients with hip dysplasia have significant hip pain from an abnormal joint position (20).

Despite several literatures published on risk factors of hip dysplasia among children with CP, no study has been documented locally and in our environment; as a result, this study aimed to determine factors associated with hip dysplasia among pediatric patients with cerebral palsy attending clinic at Muhimbili National Hospital

1.7.3 Proportional of CP patients with hip dysplasia in need of surgical intervention

Children with CP have muscle spasms that may cause severe pain, contracture, and difficulties in rehabilitation therapy. Early surgical intervention prevents these complications, which manifest in early childhood when the joints are still growing and developing, leading to a good outcome. Usually, these complications develop in the first 2–3 years of life, calling for early surgical intervention. Study by Shrader et al in USA reported that early orthopedic surgical intervention during childhood can change treatment outcomes, minimize the number of necessary reconstructive procedures, and obviate the need for further salvage surgery (12). A study by Sharan et al. in India reported that early surgical intervention at the age of 4 years, when the patient has not yet achieved a mature gait pattern, is associated with the best functional outcome (20). Mohammad et al in Egypt reported that delayed hip dysplasia surgery after 3 years can result in a worse clinical outcome, physical impairment, and potential radiological repercussions on the patients (21).

Surgical treatment is performed to a number of patients with progressive dysplasia, as graded by RMP, with the aim of keeping mobile, positioned hips to preserve seating balance and prevent pain. Operative therapies include soft tissue surgery (preventive) by the release of the adductor or gracilis muscles, hip reconstruction by femoral osteotomy with or without pelvic osteotomy, and salvage procedures by femoral head and neck resection or replacement. According to a study by Spiegel in the USA, soft tissue surgery should be considered when there is dysplasia as shown by RMP > 33%, and hip reconstruction is a possibility for people who have had unsuccessful soft tissue surgery or who have developed dysplasia with RMP > 50% of displacement (10).Similar results were found in a study by Shrader et at in USA reported that, soft tissue surgery should be considered when there is dysplasia as shown by RMP > 33%.(12)A study by Alaric et al in India reported that soft tissue surgery is advisable when there is hip dysplasia of RMP>33% aim at reduce adductors muscle pull, reconstructive surgery such as

Femoral or pelvic osteotomy when hip dysplasia is >50% aim at restore normal hip anatomy and Salvage procedure such as proximal femur excision and arthroplasty/arthrodesis when hip dysplasia represented by RMP>100% aims at reduce pain and easy care for children (14).

Early surgical intervention, including soft tissue surgery and hip reconstruction, aims to rebalance the muscles, restore motion, relieve pain, and improve function outcomes. Study by Stott et al. in New Zealand, evaluated soft tissue releases for spastic hip disorders, and it was discovered that out of 467 children, 241 (52%) children had reduced hips as indicated by the RMP (22).A study by Cindy et al. in France reported that for patients with hip dysplasia who underwent surgery, there was an 82% decrease in hip pain (23). Study by Sharan et al. in India reported that there is an improvement in GMFCS by 2 levels when reconstructive surgery is done during early childhood (20).So far several studies have been done on need for surgery among CP pediatric patients with hip dysplasia and related outcomes but no study has been documented in our environment; as a result, this study aimed to determining the proportion of cerebral palsy children attending clinic at Muhimbili National Hospital with hip dysplasia who require surgical intervention.

CHAPTER TWO

2. METHODOLOGY

2.1 Study Design

This was a descriptive cross-sectional study,

2.2 Study Population

Children with cerebral palsy attending clinic at Muhimbili National hospital from June 2023 to December 2023.

2.3 Study Area

The study was conducted at MNH which has a pediatric neurology clinic specifically for CP patients that is operates on Mondays and Wednesdays. The number of patients attending CP clinic ranges from 20-30 patients per day of which new case are 3-5 patients. Patients are routinely reviewed by team of pediatric neurology and pediatrician where clinical examination and diagnostic investigation including blood work out and radiologic assessment done to all patients and depending on specific patients‘s needs they are usually sent to pharmacy for drug collection, Physiotherapist and Occupational Therapist or pediatric Orthopedic surgeons accordingly. Not all patients who visits the clinic receives a standard radiologic pelvic AP x-ray as part of hip surveillance.

2.4 Sample Size Estimation

A pilot study conducted on September to December 2022 out of 230 CP pediatric patients reviewed at MNH clinic 37 patients were having Hip dysplasia so Proportional of hip dysplasia was 37/230= 16%

Using the Fisher ‘s formula to calculate the sample size

$$N = \frac{Z^2.P(1-P)}{\Delta^2}$$

Z is the reliability coefficient for normal distribution, which given a 95% confidence level was 1.96

P is the proportional estimate 16 %

Δ is the desired precision study error (5%)

The sample size from the formula was 206 patients.

2.5 Inclusion and Exclusion criteria

2.5.1 Inclusion Criteria

- Patients with cerebral palsy that who attended clinic at Muhimbili National Hospital.
- Patients with cerebral palsy aged from 2 years to 18 years of age.

2.5.2 Exclusion Criteria

- Patients whose parent or legal guardian who did not consent for the study.
- Patients who have undergone previous surgery on the hip.
- Patients with neural tube defects and other neuromuscular syndromes.

2.6 Sampling technique:

A convenient sampling technique was used. All patients who met the eligibility criteria were included. During a study period a total of 211 children were considered for the study, 206 children met inclusion criteria and included in the study and 5 children were excluded from the final analysis due to incomplete data.

2.7 Study Variables

1) Dependent variables:

Primary outcome: Hip dysplasia

Secondary outcome: Need for surgical treatment

2) **Independent variables**: Age, sex, residential area, Hip pain, restriction of hip joint abduction<45degree, type of CP, CP topographic pattern, GMFCS

2.8 Enrollment and Data Collection

Data were collected from parents/guardians of eligible patients attending pediatric cerebral palsy clinic at MNH. Clinic days are Monday and Wednesday, one day in every week was randomly selected by flip a coin, one side of coin marked as Monday and other side as Wednesday then the side on display after flip a coin that particular day was picked for participants recruitment. Eligible participants were included consecutively during the study period until the sample size was reached, those who refused to consent were excluded. The source of data was obtained from the children's case notes and specific information including Demographic data was obtained from parents or legal guardians who consented for the study using structured English/Swahili questionnaire by researcher. Patient were examined by researcher with assistance of pediatrician to determine type of CP and topographic pattern of CP, Gross Motor Function Classification Score, presence of hip joint pain and restriction of hip joint abduction < 45.

CP is divided into different types according to the most common movement-related problems found. The main categories of CP consist of:

1. Spastic CP: This kind is the most prevalent form of CP, and it is characterized by elevated muscular tone (spasticity), which causes jerky and stiff movements
2. Dyskinetic CP: This kind is marked by uncontrollable and involuntary movements, such as twisting, writhing, or sluggish, flowing movements.
3. Ataxic CP: This kind is marked by unstable motions and difficulty with exact movements and is characterized by issues with balance, coordination, and fine motor abilities.
4. Mixed CP: This kind is marked by a variety of movement-related deficits, which results in the classification of mixed CP.
5. Hypotonic CP: This kind is marked by low muscle tone; individuals with hypo tone are often floppy or have reduced resistance to passive movement.

CP Topographic Pattern was assessed by researcher under assistant of pediatrician: The topographic pattern of cerebral palsy (CP) is the distribution of the affected body parts and the motor deficits. this includes:

1. Hemiplegia: Hemiplegic CP primarily affects one side of the body. Usually, one arm and one leg on the same side are involved.
2. Diplegia: Diplegic cerebral palsy primarily affects the legs and lower body. There may be a minor amount of involvement in the upper body as well.
3. Quadriplegia: All four limbs, the trunk, and occasionally the face are affected by quadriplegic CP. Significant functional restrictions and severe motor impairments are frequent occurrences.
4. Monoplegia: A single limb, usually an arm or a leg, is impaired in monoplegia cerebral palsy (CP).

The GMFCS was assessed by researcher with assistant of pediatrician, is a five-level ordinal scale, with level I being the greatest function and level V denoting the lowest function. Patients were classified depending on age related GMFCS. This includes:

1. Level I. Children they have unhindered walking ability as well as good coordination and balance.
2. Level II: children who can walk, although with certain limits. For longer trips or in difficult environments, they could need handheld mobility devices or assistive technologies.
3. Level III: children who use walkers or crutches to help them walk. They have a restricted capacity for independent walking, particularly outside or on uneven terrain.
4. Level IV: children who must use wheelchairs or other mobility aids for the majority or all of their mobility. With help, they might be somewhat mobile on their own.
5. Level V: Children with severe disabilities who depend on mobility aids and require full help they have no self-mobility.

The degree of hip dysplasia in CP is best determined by Reimers' migration percentage (RMP) from standard Pelvic AP x ray where patients were positioned both limbs in neutral (adduction/abduction), pelvic in horizontal and patella facing upward and analyzed by researcher with the assistance of a single radiologist for all patients using clear canvas software, the RMP value from mostly affected joint was recorded. As RMP describes the percentage of the ossified femoral head displaced lateral to the acetabular margin on an anteroposterior hip radiograph as demonstrated in figure below

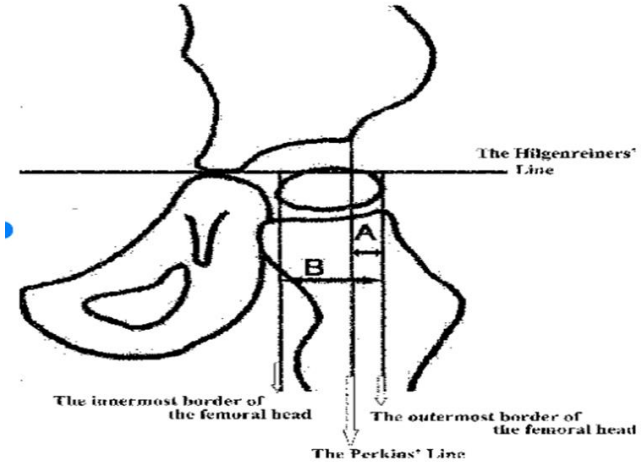


Figure 2: Measurement of Reimers' Migration Percentages
(copyright Pinar Doruk Analan, Faculty of medicine, Baskent University Adana Research and Education Cantre Turkey)

Reimers' migration percentage values (RMP)=A/B * 100

RMP value of every participant was documented. In this study hip dysplasia was defined RMP > 33%. Those Pediatric patients reported to have hip dysplasia who required surgical intervention after physical examination and radiologic assessment were referred to MOI pediatric clinic, this includes those patients with RMP > 33 with restriction of hip joint abduction < 45 degree and those patients with RMP > 40% despite presence or absence of restriction of hip joint abduction < 45 degree.

2.9 Data Management and Analysis

The questionnaires were tested and pre-tested and data collected was coded and checked to ensure quality. Data was entered into excel spreadsheets and data was then exported to SPSS version 20 for analysis.

Categorical variables were summarized by using frequencies and percentages. Numerical variables were summarized using means, standard deviation (median and IQR).

Descriptive analysis was used, where proportional hip dysplasia was calculated by dividing the total number of children with CP who have hip dysplasia by the total number of CP patients obtained during the study period.

To assess factors associated with hip dysplasia, we used multivariable logistic regression with presence of hip dysplasia (Binary variable) as the outcome variable. Independent variables considered included CP type, CP topographic pattern GMFCS, Hip joint pain, restriction of hip joint abduction> 45, age and sex. A variable with a P-value of 0.05 or less was considered statistically significant.

Descriptive analysis was used, where the proportion of hip dysplasia who required surgical intervention was calculated by dividing the total number of CP children with hip dysplasia who required surgical intervention by the total number of CP patients who were diagnosed with hip dysplasia during the study period.

2.10 Ethical Consideration

Ethical clearance was obtained from Muhimbili University of Health and Allied

sciences where the clearance was taken from the MUHAS ethical review board and permission to collect data at CP clinic was obtained from the management of the Muhimbili National Hospital. Because some of participants have cognitive impairment, we obtained verbal and written consent from parents or legal guardians with possibility to withdraw at any time, they feel not comfortable without compromise with their treatments at the clinic. Data obtained was used for research purpose and kept confidential.

CHAPTER THREE

3.0 RESULTS

Table 1: Characteristics of the study participants (N=206

Variables	Frequency (n)	Percent (%)
Age	**Median (IQR): 5 (3-9)**	
< 5 years	91	44.2
≥5 years	115	55.8
Sex		
Male	112	54.4
Female	94	45.6
GMFCS Level		
Level 1	69	33.5
Level 2	37	18.0
Level 3	26	12.6
Level 4	17	8.3
Level 5	57	27.7
Type of CP		
Spastic	155	75.2
Athetoid	6	2.9
Mixed	18	8.7
Hypotonic	27	13.1
CP Topographic patterns		
Monoplegia	25	12.1
Diplegia	76	36.9
Hemiplegia	5	2.4
Quadriplegia	100	48.5
Ever been diagnosed with Hip dysplasia		
Yes	2	1.0
No	204	99.0
Symptoms of Hip joint pain		
Yes	54	26.2
No	152	73.8
Restriction of hip joint movements		
Yes	61	29.6
No	145	70.4
Hip dysplasia		
Yes	36	17.5
No	170	82.5

This study included 206 children, majority of them112 (54.4%) were males and 94 (45.6%) were females. The majority of children recruited were 5 years and above 115 (55.8%). The median Age was 5 ranging from 3-9 yrs. More than three-quarters of the study participants had spastic CP as shown in Table 1.

The most common distribution of CP was Quadriplegia with 100 (48.5%), followed by Diplegia 76 (39.6%). Majority of children had gross motor function classification system (GMFCS) 69 (33.5%), followed by level 5 57 (27.7%).

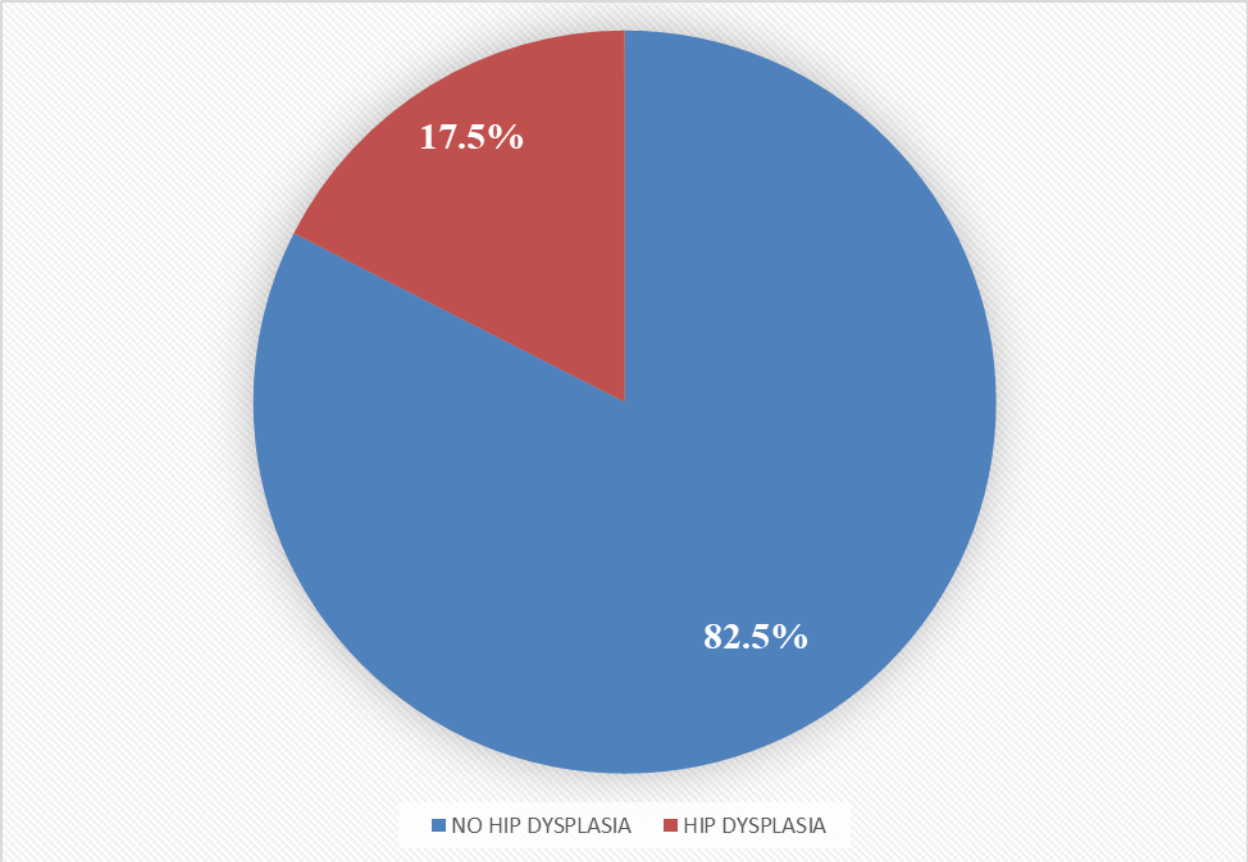


Figure 3: Proportional of hip dysplasia among CP children attended clinic at at MNH

The study revealed that the proportion of hip dysplasia among children with cerebral palsy who attended the clinic at MNH was 17.5%(36/206). As shown in Figure 3.

Table 2: Bivariate analysis on factors associated with hip dysplasia

Variables	Hip dysplasia		P-value
	Yes	No	
Age			
< 5 years	14 (15.4)	77 (84.6)	0.482
≥5 years	22 (19.1)	93 (80.9)	
Sex			
Male	14 (12.5)	98 (87.5)	0.040
Female	22 (23.4)	72 (76.6)	
GMFCS Level			
Level I-III	9 (6.8)	123 (93.2)	
Level IV-V	27 (36.5)	47(63.5)	<0.001
CP and Topographic subtypes			
Spastic Quadriplegia	26 (44.1)	33 (55.9)	<0.001
Other CP and Topographic subtypes	10 (6.8)	137 (93.2)	
Symptoms of Hip joint pain			
Yes	21 (38.9)	33 (61.1)	
No	15(9.9)	137 (90.1)	<0.001
Restriction of Hip Joint abduction			
Yes	25(41.0)	36(59.0)	<0.001
No	11(7.6)	134(92.4)	

Hip dysplasia was significantly higher among females (23.4% vs 12.5%) of hip dysplasia as compared to males. Again, hip dysplasia was higher among CP patients with GMFCS levels VI and V compared to GMFCS I-III (36.5% vs 6.8%). Children with the spastic quadriplegia subtype had a higher proportion of Hip dysplasia 44.1% as compared to other subtypes combined. CP children who reported the presence of hip joint pain had a higher proportion of hip dysplasia 38.9% as compared to those children without hip joint pain. Restriction of hip abduction >45 had a higher proportion of Hip dysplasia 41% compared to those without restriction of hip joint abduction>45 as shown in Table 2.

Table 3: Univariate and Multivariate analysis of factors associated with hip dysplasia among children with CP

Factors	Univariate analysis		Multivariate analysis	
	COR (95% CI)	**P-value**	**AOR (95% CI)**	**P-Value**
Sex				
Male	Ref			
Female	2.14 (1.02-4.47)	0.043	2.15 (0.86-5.38)	0.103
GMFCS Category				
Level I-III	Ref			
Level IV-V	7.85 (3.44-17.93)	<0.001	2.44 (0.93-6.44)	0.021
CP and Topographic subtypes				
Other CP and Topographic subtypes	Ref			
Spastic Quadriplegia	10.79 (4.74-24.57)	<0.001	13.26 (4.57-38.48)	<0.001
Symptoms of Hip joint pain				
No	Ref			
Yes	6.06 (2.82-13.04)	<0.001	8.2 (2.88-23.36)	<0.001
Restriction of hip joint movements				
No	Ref			
Yes	8.46 (3.80-18.81)	<0.001	2.91 (0.66-12.92)	0.160

Factors that were significantly associated with hip dysplasia were Sex, GMFCS category, CP type and topographic, Hip joint pain, and restriction of hip joint abduction >45 degrees as shown in Table 3. CP children with a GMFCS category IV-V were associated with more than two times higher odds [AOR=2.44; 95% CI (0.93-6.44)] of having hip dysplasia compared to GMFCS category I-III. CP children with spastic quadriplegia were associated with more than thirteen times higher odds [AOR 13.26 95%CI (4.57-38.48)] of having hip dysplasia compared to other CP types and topographic patterns combined. CP children reported having hip joint pain were associated with more than eight times higher odds [AOR 8.20 95%CI (2.88-23.36)] of having hip dysplasia compared to those not reported hip joint pain.

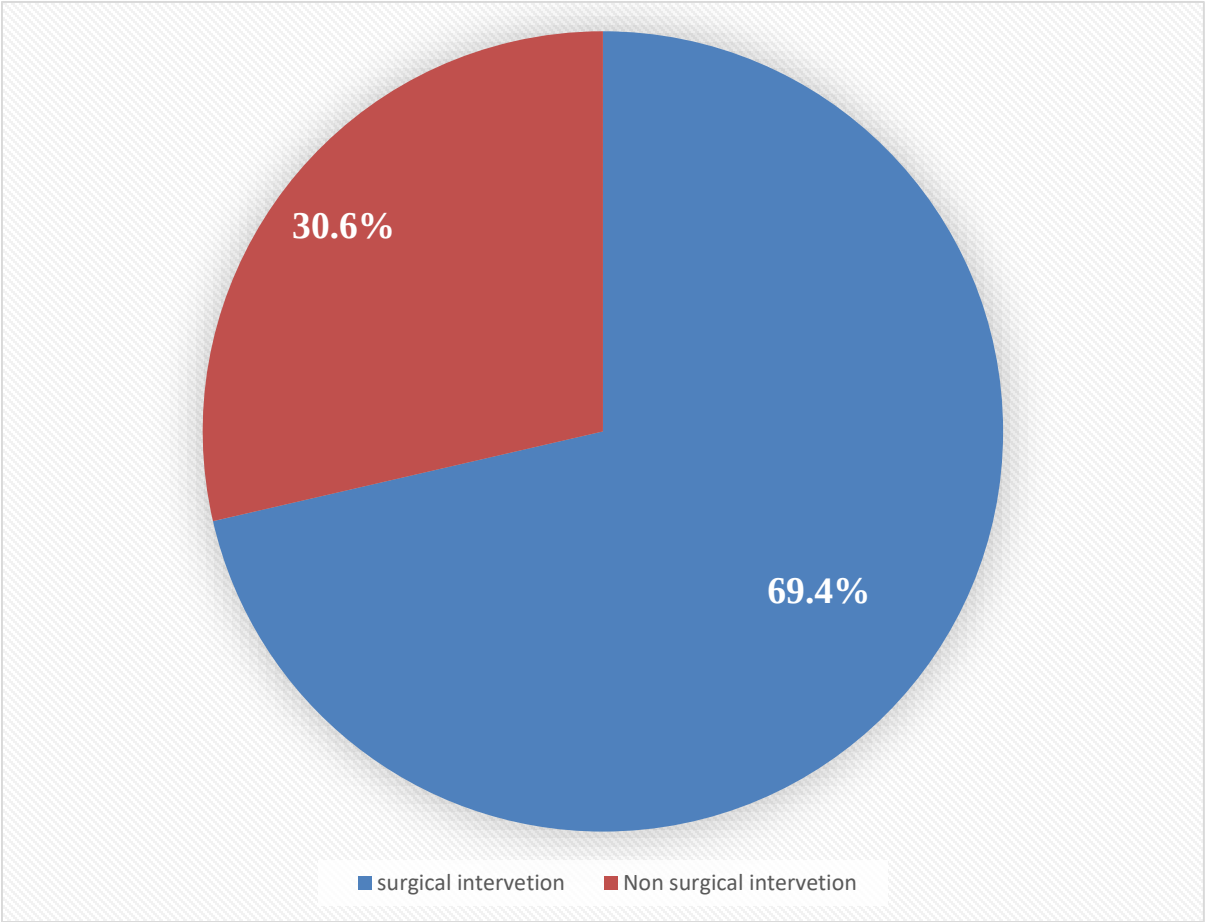


Figure 4: Proportional of hip dysplasia children with CP who required surgical intervention

In this study, 25/36 (69.4%) children with hip dysplasia required surgical intervention as seen in Figure 4.

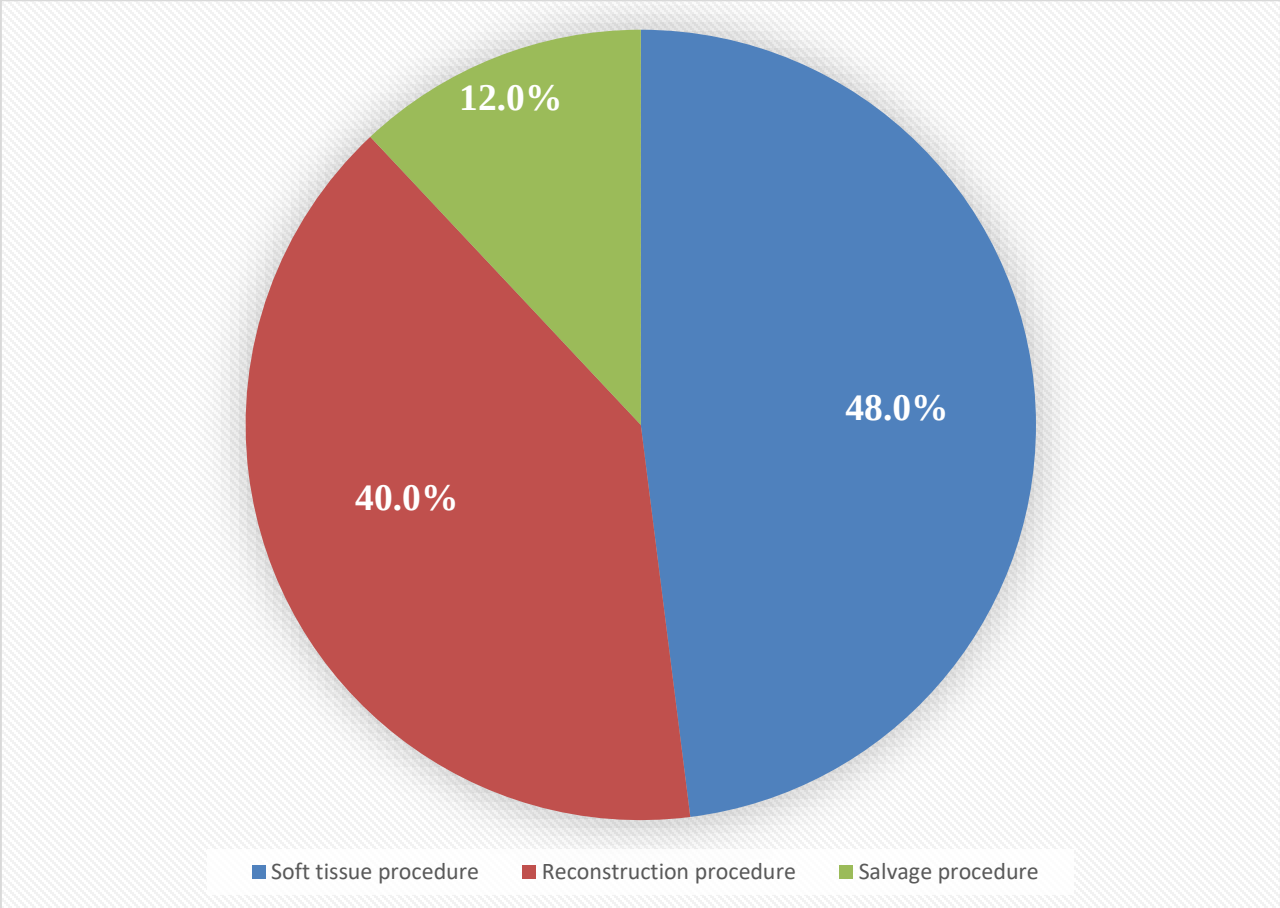


Figure 5: Type of surgical intervention of hip dysplasia among CP children.

Results from this study reported that, 12(48%) required soft tissue release surgery, 10 (40%) required reconstructive surgery and 3 (12%) required salvage surgery as indicated in figure 5.

A B



Figure 6: (A) Pelvic radiograph of a 9-year-old girl showing hip dysplasia of the right. (B) Pelvic radiograph of 9 years' girl with hip dysplasia after reconstruction surgery (Inferior epiphysiodesis using screw).

CHAPTER FOUR

4.0 DISCUSSION

Hip dysplasia is the second most common abnormality among CP patients after foot and ankle, it often went on unnoticed in its early stages of the disease since there are no symptoms, so routine hip surveillance with physical examination and pelvic x ray is necessary for early detection and intervention. The magnitude of hip dysplasia among CP patients in LMICs such as Tanzania was unknown. This study aimed to determine the proportion, associated factors, and need for surgical intervention of hip dysplasia among children with cerebral palsy attending the clinic at Muhimbili National Hospital. In our study, we found that 17.5% of children with CP had hip dysplasia, factors associated with Hip dysplasia included GMFCS score, CP type and topographic pattern, and presence of hip joint pain. The majority of patients with hip dysplasia required surgical intervention.

The proportion of hip dysplasia among CP patients attending the clinic at MNH found in our study was consistent with previous studies. A study done by Elkamil et al.'s in Norway found that 15.1% of children with CP had hip dysplasia, while a study conducted in Bangladesh by Karim et al. discovered that 20% of children with CP had the condition. These results were lower compared to a study conducted in Sweden by Gunnar et al., which found that 27% of children with CP had hip dysplasia, this is due to the fact that significant proportion of children hip dysplasia were being discovered more in countries where hip surveillance program existed (3,4,15). Additionally, some of the children identified in this study had hip dislocation 3/206 (1.5%), which is one of the complications of hip dysplasia. These findings highlight the necessity of implementing a hip surveillance program for patients with CP in order to detect the condition early and provide timely intervention.

Hip dysplasia in children with cerebral palsy has been associated to numerous factors across various literatures. The results of this study showed that there was no statistically significant correlation between gender and hip dysplasia ($p>0.1$). The findings of this study were consistence with those of earlier studies by Gunnar et al. in Sweden, Ching et al. in the USA, and Karim et al. in Bangladesh (15,18,24)

The risk assessed in this study was CP type and topographic pattern, the results in this study reported that spastic quadriplegia has a higher risk of hip dysplasia by 44.1% ($p<0.001$). These results were consistent with those of other studies done in Sweden by Gunnar et al, Bangladesh by Karim et al and India by Kunju et al (4,15,16) .This was due to the fact that increased rigidity in the muscles as a result of cerebral palsy spasticity leading into the proximal femur being forced into adduction, flexion, and internal rotation, which forces the femoral head out of the hip join (14). When multivariate analysis is conducted using a logistic regression model, spastic quadriplegia has remained a significant predictive factor; this result implies that spastic quadriplegia is a reliable clinical predictor of hip dysplasia.

The results in this study reported that children with GMFCS of IV and V had higher risk of hip dysplasia by 36.5% ($p<0.001$). These results were consistent with those of other studies done in Sweden by Gunnar et al, Bangladesh by Karim et al and India by Kunju et al, which reported that GMFCS IV & V has a higher risk for hip dysplasia (4,15,16)This was due to the fact that highest risk of hip dysplasia occurring in children and adolescents was reported among those with greater gross motor functional disability, as indicated by the Gross Motor Function Classification System (GMFCS) (14)When multivariate analysis is conducted using a logistic regression model, GMFCS has remained a significant predictive factor; this result implies that GMFCS level is a reliable clinical predictor of hip dysplasia.(18)

The results in this study reported that there is a higher risk of hip dysplasia among CP patients with hip joint pain by 38.9% ($p<0.001$). The results in this study were consistent with those of other studies done in the USA by Pritchett et al and by Bagg et al both reported that a higher risk of hip dysplasia in children with hip joint pain, this is due to the fact that the position of the hip in dysplasia had significant effect on the amount of pain it generated (5,19). When multivariate analysis is conducted using a logistic regression model, presence hip joint pain remained significant predictive factor; this result implies that, presence of hip joint pain is a reliable clinical predictor of hip dysplasia.

The findings in this study indicated that there was no statistically significant correlation between restriction of hip joint abduction < 45 degree and hip dysplasia ($p>0.1$), these results were consistent with research conducted in Sweden by Gunnar et al. on the features of hip dysplasia,

which concluded that restriction of hip abduction is a poor indication of hip dysplasia in CP patients.(25) In contrast, a study conducted by Custovic et al and India by Agarwal et al reported that a clinical sign of developmental dysplasia of the hip in children was the restriction of hip joint abduction >45 degrees.(26,27)

The proportion of CP children with hip dysplasia attending clinic at MNH who required surgical intervention was assessed, the results in this study revealed that 69.4% (n=25) required surgical intervention and it went further and analyzed on type of surgical intervention required, this is according to the Reimers migration percentage and clinical presentation of the patient which shows that 12 (48%) require soft tissue release surgery, 10 (40%) require reconstructive surgery, and 3 (12%) require salvage surgery. The results in this study were higher as compared to other studies, In Sweden, Elkamil et al. conducted a study which revealed that 32% of children with cerebral palsy underwent surgical intervention, and that the majority of these children underwent reconstruction surgery (15.4%) and majority of children received surgery when they were five years old. Same study done Norway by Elkamil et al. which revealed that 45 % of children with cerebral palsy underwent surgical intervention, and that the majority of these children underwent soft tissue surgery (23.5 %). And majority of children in Norway received surgery when they were seven years old. This is due to the fact that a hip surveillance program was implemented in Sweden, resulting in the early detection and treatment. This improved the children's GMFCS level, reduced their hip joint pain, and enhanced their quality of life (4,20,22,23). This led to the importance of Global hip surveillance models which are based on the patient’s age, the functional level determined by the Gross Motor Function Classification system (GMFCS), standardized clinical exam, and radiographic indices such as the migration percentage (MP), as critical indicators of progressive hip displacement.(14)

CHAPTER FIVE

5.0 CONCLUSION, RECOMMENDATION AND LIMITATIONS

5.1 Conclusion

This is one of the first studies exploring hip dysplasia among children with CP in our setting. The results of this study indicate that significant number of children had hip dysplasia, the disease is most common among children with spastic quadriplegia. Additionally, it indicated that the majority of CP patients with hip dysplasia required surgical intervention. The findings of this study highlight the importance of early detection and treatment, which has significant implications for clinical practice. Also, it contributed to the body of knowledge on the subject by providing insightful information about risk factors for hip dysplasia.

5.2 Limitations and Mitigations.

1. As this is a single-center study, it may not truly reflect the proportion of hip dysplasia in children with CP in the wider population.
2. Long-term treatment follow-up was not feasible due to the available time given to conduct this study This is due to the fact that some patients with hip at risk need 6/12 months of RMP monitoring from pelvic x-ray.
3. This cross-section study can't explain the causal relationship between risk factors and the occurrence of hip dysplasia
4. Lack of standardization of diagnostic criteria and radiographic assessment

5.3 Recommendation

1. Using a multidisciplinary approach should include pediatric orthopedic surgeons for early detection and treatment since there is high burden of hip dysplasia in CP children and majority of them required surgical intervention.
2. Introduction of the hip surveillance program for CP children at risk (GMFCS VI and V, children with Spastic quadriplegia, and those with hip joint pain as these showed to be risk factors for hip dysplasia.
3. Prospective, multi-center study to establish the magnitude of the problem and to establish nationwide CP management protocol.

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APPENDICES

Appendix I: Questionnaire.

Code number …….

File number …….

BIODEMOGRAPHICS

1. Age…… a) <5yrs

b) 5-10 yrs.

c)>10 yrs.

2. Sex a) Male

b) Female

3. Place of residence …….

4. Phone number …….

HIP DYSPLASIA RELATED INFORMATION

5. Type of Cerebral Palsy 1) Spastic

2) Athetoid

3) Ataxic

4) Mixed

5) Hypotonic

6. CP Topographic pattern 1) Monoplegia

2) Diplegia

3) Hemiplegia

4) Quadriplegia

7. Gross Motor Function Classification Scale (GMFCS)-Level

1. LEVEL 1

2. LEVEL 2

3. LEVEL 3

4. LEVEL 4

5. LEVEL 5

8. Have you ever being diagnosed with hip dysplasia 1. YES

2. NO

9. Age at hip dysplasia diagnosis…….

10. If you have received any re-habitation services 1. YES

2. NO

11. Is there any symptom of Hip pain? 1. YES

2. NO

12. if no in QN 10 the researcher will examine both Hip joint for presence of pain

1. Presence of hip joint pain

2. Absence of hip joint pain

13. If there is restriction of hip joint movement > 45-degree abduction 1. YES

2. NO

14. RMP value from pelvic x ray ……

15. RMP value from pelvic x ray 1. <33%

2. between 33% and 50%

3. >50%

16. Presence of Hip dysplasia (RMP>33) 1. YES

2. NO

NEED FOR SURGICAL TREATMENT

17. Needs for surgical intervention 1. YES

2. NO

18. Type of surgical intervention	1. soft tissue/Preventive procedure
	2. reconstruction procedure
	3. salvage procedure

Appendix: II Consent Form
Consent Form appendix 1

ID No……

Consent to participate in the study

Greetings!! My name is Dr John Chagula, I am a postgraduate student at MUHAS, investigating on prevalence, associated factors and need for surgical intervention of hip dysplasia among pediatric patients with cerebral palsy attending clinic at Muhimbili National Hospital

Purpose of the study: To determine prevalence, associated factors and need for surgical intervention of hip dysplasia among pediatric patients with cerebral palsy attending clinic at Muhimbili National Hospital

What Participation Involves

The parent/guardian who choose his/her child to be part of this study they will be asked questions to obtain basic information then appropriate examination will be done to the child and pelvic x ray will be taken. Parent/guardian will be given results and counselled on way forward according to his/her patient conditions.

Confidentiality

All information collected on questionnaires will be entered into computer with identification number and kept anonymous. The electronic data will be ensured with confidentiality and only used for research purpose and management of the patient.

Risks

We do not expect that any harm will happen to you because of joining this study.

Purpose of the study

Taking part in this study is completely your choice. If you choose not to participate in the study or if you decide to stop participating in the study you will continue to receive all services that you would normally get from this hospital. You can stop participating in this study at any time,

even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve penalty or loss of any benefits to which you are otherwise entitled.

Benefits

If you agree to take part in this study, will benefit by knowing your children status in term of hip dysplasia and those who will be diagnosed with hip dysplasia will be referred to MOI for further treatment.

Cost

No payment will be requested from you as a fee to participate in the study

Who to Contact

If you ever have questions about this study, you should contact the study Principal Investigator Dr. John Chagula, Muhimbili University of Health and Allied Sciences, P.O.Box 65001,, Dar es Salaam).Mob 0713911911. If you ever have questions about your rights as a participant, you may call **Professor Bruno Sunguya, Chairman of the Senate Research and Publications Committee P.O.Box 65001,Dar es Salaam.. Tel: 215 0302 - 6.**

Signature:

Do you agree??

Participant agrees ……

Participant does NOT agree ……....

I _____ have read the contents in this form. My questions have been answered. I agree to participate in this study.

Signature of participant /relative_____

Signature of the Investigator _____

Date of signed consent _____ _____

APPENDIX III: Swahili Version – fomu ya ruhusa
DODOSO LA KUJUMUIKA KWENYE TAFITI

Nambari ya Utambulisho……

Habari yako! Naitwa Dkt.John Chagula,ni mwanafunzi wa Udaktari Bingwa chuo Kikuu cha Afya na Sayansi Shirikishi,MUHAS ninayefanya tafiti juu ya Nafanya utafiti juu ya hali ya ugonjwa, viashiria hatarishi na uhitaji wa huduma ya upasuaji kwa watoto wenye shida ya nyoga kati ya ugonjwa wa kupooza kwa ubongo wanaohudhulia kliniki katika Hospitali ya taifa Muhimbili.

Nini kinahitajika katika ushiriki wa utafiti huu

Wazazi/Walezi watakaokubali Watoto wao kuingia kwenye utafiti huu wataulizwa maswali kuhusu hali ya makazi na Watoto wao watafanyiwa uchunguzi wa kitabibu ikiwemo kipiga picha ya x ray ya nyonga ili kuweza kuona hali ya nyonga ya mtoto kisha mzazi/mlezi atapewa majibu kuhusu mtoto na kushauriwa nini cha kufanya kutokana na majibu ya mtoto

Usiri

Taarifa zote zitakazokusanywa kwa dondoo zitaingizwa kwenye compyuta bila majina.Taarifa hizi zitakua siri na zitatumika kwenye utafiti tu na matibabu yako.

Athari ya kushiriki

Hatutegemei athari yoyote ya ushiriki wako kwenye utafiti huu.

Hiari ya ushiriki

Ushiriki wako katika utafiti huu ni wa hiari.Endapo utaamua kutoshiriki katika utafiti huu,utaendelea kupata huduma za matibabu kama ilivyo ada na kwamba unaweza acha kushiriki muda wowote hata kama umesharidhia kwa kusaini kibali cha utafiti.Kutoshiriki kwenye utafiti huu hakutapelekea kupata adhabu yoyote au kutopata haki yako ya kimatibabu.

Faida za Ushiriki

Endapo utaridhia kushiriki kwenye utafiti huu,utanufaika kwa mtoto kuchunguzwa kuhusu hali ya shida ya nyonga na endapo mtoto atabainika kuwa na shida ya nyonga atapewa rufaa kwenda kitengo cha mifupa MOI kwa matibabu Zaidi.

Gharama

Hakuna gharama zozote unazotakiwa kulipa ili kushiriki utafiti huu.

Mawasiliano

Endapo utakuana maswali zaidi juu ya utafiti huu unaweza wasiliana na Mtafiti Dkt.John Chagula, MUHAS,P.O Box 65001 Dsm.Mob 0713911911**.** Kama una maswali juu ya haki ya ushiriki wako kwenye utafiti huu unaweza wasiliana na Professor Bruno Sunguya Mwenyekiti wa Kamati za Tafiti na Machapisho,MUHAS P.O.BOX 65001 DsM. Namba ya simu 2150302-6.

SAHIHI

Je unakubali kushiriki?

Mshiriki amekubali…….. Mshiriki hajakubali……

Mimi…….nimesoma fomu hii na maswali yangu yamejibiwa.Nakubali kushiriki kwenye utafiti huu.

Sahihi ya Mshiriki/Ndugu……

Sahihi ya Mtafiti……..

Tarehe…….

APPENDIX IV: Ethical clearance

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/1804 Date: 19/07/2023

MUHAS-REC-07-2023-1804
JOHN CHAGULA
SCHOOL OF MEDICINE
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: HIP DYSPLASIA: BURDEN AND THE NEEDS FOR SURGICAL INTERVENTION AMONG CEREBRAL PALSY PEDIATRIC PATIENTS VISITING A CLINIC AT MUHIMBILI NATIONAL HOSPITAL BETWEEN JUNE 2023 TO DECEMBER 2023

Reference is made to the above heading.

I am pleased to inform you that the Chairperson has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 19/07/2023
EXPIRATION DATE OF APPROVAL: 19/07/2024

STUDY DESCRIPTION:

Purpose:
To determine prevalence, associated factors and need for surgical intervention of hip dysplasia among children with cerebral palsy attending clinic at Muhimbili National Hospital between June 2023 to December 2023
The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided:
https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014764.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Masoud,

Chairperson, MUHAS Research and Ethics Committee



APPENDIX VI: Permission letter

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF HEALTH

MUHIMBILI NATIONAL HOSPITAL

In reply please quote;

Ref. No.: MNH/CRTCU/Perm/2023/455 **Date: 04th August, 2023**

Head of Department,
Paediatrcis and Child Health,
Muhimbili National Hospital

Noted, Appreciated.
10-08-2023

RE: PERMISSION TO COLLECT DATA AT MNH.

Name of Student	**John Chagula**
Title	**"HIP Dysplasia burden and the Need for Surgical Intervention Among Cerebral Palsy Paediatric Patients Visiting a Clinic at MNH Between June 2023 to December, 2023".**
Institution	Muhimbili University of Health and Allied Sciences
Supervisors	Dr. Kitugi S. Nungu (MUHAS)
Co - Supervisor	Dr. David Kombo (MNH)
Period	04th August, 2023 to 30th January, 2024

Approval has been granted to the above mentioned student to collect data at MNH. **A final study report should be lodged with Clinical Research, Training and Consultancy Unit.** Dissemination of study findings to MNH stakeholders shall be overseen by **Dr. David Kombo** (MNH) Co – supervisor.

Kindly ensure that the student abide to the ethical principles and other conditions of the research approval.

Sincerely,

CLINICAL RESEARCH & CONSULTANCY UNIT P. O. Box 65000 DAR ES SALAAM MUHIMBILI NATIONAL HOSPITAL

Dr. Jessie Mbwambo
Head of Clinical Research, Training and Consultancy Unit

c.c DMS
c.c Dr. David Kombo
c.c **John Chagula.**

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