

2026-02

The Proportion Of Cereblar Palsy In Children Among Neurologic Cases Having Pediatric Follow- Up Clinic And Associated Factors At Tibebe Ghion Specialized Hospital, Bahir Dar, North Ethiopia, 2025; Cross-Sectional Study

Desta, - Sendu

<http://ir.bdu.edu.et/handle/123456789/17364>

Downloaded from DSpace Repository, DSpace Institution's institutional repository



**BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE AND
HEALTH SCIENCES SCHOOL OF MEDICINE DEPARTMENT
OF PEDIATRICS AND CHILD HEALTH**

**THE PROPORTION OF CEREBLAR PALSY IN CHILDREN
AMONG NEUROLOGIC CASES HAVING PEDIATRIC
FOLLOW-UP CLINIC AND ASSOCIATED FACTORS AT
TIBEBE GHION SPECIALIZED HOSPITAL, BAHIR
DAR, NORTH ETHIOPIA, 2025; CROSS-SECTIONAL STUDY**

BY- SENDU DESTA (MD, PCH, RESIDENT)

**THESIS RESEARCH SUBMITTED TO BAHIR DAR UNIVERSITY
COLLEGE OF MEDICINE AND HEALTH SCIENCES SCHOOL OF
MEDICINE, DEPARTMENT OF PEDIATRIC AND CHILD HEALTH AS
PARTIAL FULFILLMENT OF SPECIALITY CERTIFICATE IN
PEDIATRICS AND CHILD HEALTH.**

FEBRUARY, 2026

BAHIR DAR, ETHIOPIA

BAHIRDAR UNIVERSITY COLLEGE OF MEDICINE AND
HEALTH SCIENCES SCHOOL OF MEDICINE DEPARTMENT OF
PEDIATRICS AND CHILD HEALTH

THE PROPORTION OF CEREBLAR PALSY IN CHILDREN
AMONG NEUROLOGIC CASES HAVING PEDIATRIC FOLLOW-
UP CLINIC AND ASSOCIATED FACTORS AT TIBEBE GHION
SPECIALIZED HOSPITAL, BAHIR DAR ,NORTH ETHIOPIA

BY- DR.SENDU DESTA (MD)

Email: SINEDU@gmail.com

Mobile phone: 0942042057 / 09011154627

ADVISORS

Dr. AchenefMotbainor(PhD, Asso.Prof.of Public Health)

Email:motbainor2@gmail.com

Tele: +251-913036325/0965316565

Dr. Mequanint Haile (MD, Assistant Professor of pediatrics and child health)

Email: mequaninthaile@gmail.com

Tele: +251918448046

FEBRAURY, 2026

BAHIRDAR, ETHIOPI

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my advisors Dr. AchenefMotbinorand Dr. MequanintHaile whogave me their time to teach and guide me in all aspects of the development of this thesis work. In addition, I also thank data collectors and supervisor.

I also want to thank Bahir Dar University College of Medicine and Health Sciences, Pediatric and Child Health Department for giving me the chance for the training and do this research.

Acronyms

CT scan Computed tomography scan

CPCerebral palsy

DM Diabetic mellitus

EPI-Data Epidemiological Data

GCS Glasgow coma scale

HTN Hypertension

IVH Intraventricular hemorrhage

LMIC low-middle income countries

MAS Meconium aspiration syndrome

NICU Neonatal Intensive Care Unit

OPD Outpatient Department

PCH Pediatrics and Child Health

PROM Premature rupture of amniotic membrane

PVL Periventricular leukomalacia

TGSH Tibebe Ghion Specialized Hospital

SPSS Statistical package for social sciences

TGSH Tibebe Ghion Specialized Hospital

USA United States of America

WHO World Health Organization

Abstract

Background: Cerebral palsy is the most common physical and motor disability in the globe, particularly in low income countries. Although the burden of the problem is higher in developing regions, especially in sub-Saharan Africa, it remains understudied in these areas. In Ethiopia, there is currently no adequate study that estimates the prevalence of cerebral palsy. This lack of data limits effective healthcare planning, resource allocation, and the development of targeted interventions to improve the quality of life for affected children and their families.

Objective: To determine the proportion of cerebral palsy in children among neurologic cases having pediatric follow-up clinic and associated factors, Tibebe Ghion Specialized Hospital Bahir Dar, North, Ethiopia, 2025

Methods: A hospital-based cross-sectional study was conducted among pediatric patients diagnosed with cerebral palsy attending the pediatric referral follow-up clinic at Tibebe Ghion Specialized Hospital. The study period was encompassing case January 1-30, 2026. Using a computer-generated simple random sampling technique, eligible patient records were selected. Data were abstracted using a structured Kobo data collection tool, then exported to Microsoft Excel and subsequently analyzed using SPSS version 27. Bivariable Logistic regression analysis was performed to identify factors associated with cerebral palsy. Variables with a p-value ≤ 0.25 in the bivariable analysis were included in the multivariable logistic regression model, and variables with a p-value < 0.05 were considered statistically significant.

Results: Total of 324 children pediatric referral follow-up clinic neurologic patients were included in the study, of which 86 of cerebral palsy, giving a proportion of 26.5 % (95% CI: 21.7%–31.3%). Of these, 192 (59.3%) were males and 132 (40.7%) were females, yielding a male-to-female ratio of 1.46:1.

After multivariable logistic regression analysis, Children whose mothers had no ANC follow-up (AOR = 2.20, 95% CI: 1.10–4.40, $p = 0.026$), Maternal antepartum hemorrhage (APH) (AOR = 6.87, 95% CI: 1.02–46.21, $p = 0.047$), children with CNS infection (AOR = 6.872; 95% CI: 1.926–18.973) and perinatal asphyxia (AOR = 10.898; 95% CI: 5.273–22.523) were independently associated with cerebral palsy.

Conclusion: Lack of maternal antenatal care, maternal antepartum hemorrhage, and perinatal asphyxia and central nervous system infections found to be significant determinants for cerebral palsy. The findings emphasize the importance of strengthening antenatal care services, early identification and management of high-risk pregnancies, strict intrapartum monitoring, prevention and prompt treatment of perinatal asphyxia, and effective management of neonatal infections and infection prevention to reduce the burden of cerebral palsy.

Key terms: Proportion, Associated factors Cerebral palsy, Tibebe Ghion, Ethiopia

Table of contents

Contents

ACKNOWLEDGEMENT.....	iii
Acronyms.....	iv
Abstract	v
LIST OF TABLE.....	x
LIST OF FIGURE.....	xi
1. Introduction.....	1
1.1. Background	1
1.2. Statement of the problem	1
1.3. Significance of study	3
1.4. Justification of the study	3
2. Literature review.....	4
2.1. Magnitude of cerebral palsy	4
2.2. Risk factors of cerebral palsy.....	4
2.2.1. Prenatal risk factors	4
2.2.2. Neonatal risk factors.....	5
2.2.3. Post-natal factors	6
3. Conceptual framework.....	7
4. OBJECTIVE.....	8
4.1.General Objective	8
4.2.Specific Objectives	8
5. METHODS	9
5.1. Study Setting	9
5.2. Study Design and Period	9

5.3.Population.....	9
5.3.1. Source of population	9
5.3.2. Study population	9
5.4. Eligibility Criteria.....	10
5.4.1. Inclusion criteria	10
5.4.2. Exclusion criteria	10
5.5. Sample Size Determination and sampling procedure.....	10
5.5.1. Sample size determination for first objective	10
5.5.2.Sample size determination for second objectives	11
5.5.3.Data Collection Tools and Techniques.....	11
5.6. Data Analysis and Management	12
5.7. Variable of the study.....	12
5.7.1. Dependent variable	12
5.7.2. Independent variable	12
5.8. Operational definition	13
5.9. Data Collection Tools and Techniques.....	14
5.10. Data Quality Controls.....	14
5.11. Data Analysis and Management	14
5.12. Ethical Consideration	15
5.13. Dissemination of Study Results.....	15
6. Result	15
6.1. Socio-demographic characteristics.....	15
Prenatal characteristics.....	16
Intrapartum, Natal and Postpartum Characteristics	16
6.2. Proportion of Cerebral Palsy and Its characteristics	16
6.3. Factors Associated with Cerebral Palsy.....	17

6.3.1. Multivariable Logistic Regression Analysis	17
7. DISCUSSION	20
8. STRENGTH AND LIMITATION OF THE STUDY	23
8.1. Strengths of the Study	23
8.2. Limitations of the Study	23
9. CONCLUSION	23
10. RECOMMENDATION.....	23
11.List of references	25
12. Appendixes.....	29
12.1.Questionnaire	30
Declaration	Error! Bookmark not defined.

LIST OF TABLE

Table 1. Socio-demographic Characteristics of Study Participants (N = 324)at Tibebe Ghion Specialized Hospital, 2025	15
Table 2 Multivariate Logistic Regression Analysis of risk factors associated with child Cerebral palsy...	19

LIST OF FIGURE

Figure 1. Conceptual frame work on associated factors to cerebral palsy used different literature review (33-38)	7
Figure 2. Sub-types of cerebral palsy	17

1. Introduction

1.1. Background

Cerebral Palsy (CP) is a heterogeneous group of disorders that causes varying degrees of physical disability in children. It is defined as a permanent, non-progressive neurological condition resulting from injury to the developing fetal or infant brain(1). It is one of the most common causes for motor impairment.

In addition to motor dysfunction, cerebral palsy is also frequently associated with impairment in cerebral cortex dysfunctions of sensation, perceptual, cognitive, communication and behavioral disorders, epilepsy and secondary musculoskeletal disorders(1, 2). Cerebral Palsy can significantly impact on various aspects of childhood development, including behavioral, feeding difficulties, sleep disturbance and social skills. This problem has a high burden to family, society and country. It is usually diagnosed after two years, but early prediction and diagnosis based on risk factors are now possible. Early intervention is important to reduce complications and supporting rehabilitation.

Cerebral palsy can be classified by its body distributions, pattern of motor involvement and posture or functional impairment(3). The gross motor function classification system (GMFCS) has important implications for diagnosis and classification of cerebral palsy according to severity- Level I walks without limitation, Level II walks with limitations, Level III walk using hand-held mobility devices, Level IV self-mobility with limitations, and Level V transporting with manual wheelchair (4). CP can be classified based on body distribution like unilateral/bilateral, or based on number of limb involvement. It can also be classified by pattern of motor involvement like spastic, dyskinetic, hypotonic, ataxic or mixed(5).

Cerebral palsy can be diagnosed and estimated by based on clinical presentation, a precise interview concerning the pregnancy, labor process, neonatal and infant condition, the course of development and the current performance of the child's motor function. In addition to this it needs brain imaging like brain MRI, CT SCAN and TF U/S(1).

1.2. Statement of the problem

Cerebral palsy imposes a significant burden on health and well-being of affected children, their families, and society at large-both in developed and developing countries(6). According to the

World Health Organization (WHO) estimates that 10% of children (approximately 200 million) suffer from physical disability, cognitive impairment and impaired learning difficulty worldwide(7). Farther more, over three-fourth of the world's disable population live in low income countries , including Africa(8).

Recent population based researches from world reported that the prevalence of CP was 1-4 per 1,000 live birth. However, this prevalence varies by country: 1.89 per 1,000 live births in Norway(9), 2.2 per 1,000 live births in Denmark(10), and greater than 3.4 per 1,000 live births in Bangladesh(6).

Although the prevalence in Africa is reported to be within a similar range -2 to 10 cases per 1,000 live births in countries like Egypt, Uganda, and South Africa-, most of these are hospital-based studies with methodological limitations, making it difficult to draw definitive comparison with high-income countries.(11, 12) there is notable lack of comprehensive , population-based research on cerebral palsy in low- and middle-income countries , leading to underestimation of the problem and insufficient attention to prevention and early intervention strategies(13).

A recent study conducted in Africa in 2024 reported a cerebral palsy the prevalence rate of 3.34 per 1,000 live births. Among identified cases, spastic cerebral palsy was the most common type, accounting for approximately 69.3% . Quadriplegic cerebral palsy was the second most prevalent subtype, observed in 41.49%. Dyskinetic cerebral palsy was present in 10.88%, while ataxic CP account for 5.36%(13).

In Ethiopia, limited hospital-based data exist. For example a study from Tikur Anbessa Specialized Hospital indicated that out of 500-700 neurologic cases seen annually, 20-30% were diagnosed with cerebral palsy(14). Despite cerebral palsy being the most common cause of motor disability in children, there is a still significant gap in national data regarding its prevalence, risk factors and clinical profiles. This highlights the urgent need for more focused research to inform public health strategies and improve outcomes for children with CP in Ethiopia.

There are different types of risk factors that are responsible for cerebral palsy. It can be pre-conceptual, prenatal, perinatal or postnatal((15). Among risk factors most commonly associated with prenatal and perinatal events. Prenatal causes like maternal systemic illness, drug intake, alcohol and others; perinatal risks such as maternal infection, HTN, DM, drug intake, vaginal bleeding, PROM , multiple pregnancy(16).

1.3. Significance of study

Determining the magnitude of cerebral palsy and its associated risk factors has important implications for patients, clinicians, policymakers, and researchers. For patients and families, early identification and intervention can improve outcomes and quality of life. For clinicians, the findings provide evidence to strengthen prevention through better management of maternal conditions, improved antenatal care, careful monitoring during labor, and prompt treatment of neonatal illnesses. For government and public health sectors, the study supports the development of effective maternal and child health programs to reduce the burden of cerebral palsy. Additionally, it offers a foundation for future researchers to explore further preventive strategies and long-term outcomes.

1.4. Justification of the study

Cerebral palsy is one of the most common causes of childhood motor disability, with significant impact on the physical, emotional, social and economic well-being of affecting children and their families. Despite its lifelong consequences, CP remains largely preventable and manageable when risk factors are identified early and addressed appropriately. Understanding the prevalence and associated factors of CP is essential for planning effective preventive, diagnostic, and therapeutic strategies.

In many low- and middle- income countries, including our setting, there is limited epidemiological data on the burden of cerebral palsy and its contributing factors. Most cases are often diagnosed late and potential risk factors during the antenatal, perinatal, or postnatal periods may go unrecognized. A lack of local evidence hinders the development of targeted interventions and policies aimed at reducing the incidence and severity of CP.

Conducting a cross-sectional study to determine the prevalence and associated factors of cerebral palsy will fill an important knowledge gap and contribute to evidence –based decision-making. The finding of this study will support health care providers and policy makers in implementing early detection programs, improving maternal and neonatal care services, and promoting preventing measures. Ultimately, the study will help reduce the burden of cerebral palsy and improve the quality of life for children and families affected by the condition

2. Literature review

2.1. Magnitude of cerebral palsy

Cerebral palsy is the most common neurodevelopmental disability in the globe. Although prevalence of cerebral palsy was not known in Ethiopia, 1-4 per 1,000 live births in developed countries ([17](#)).

Systematic review of results of global burden of diseases done in forty-one regions from 27 countries across five continents indicated that the prevalence of cerebral palsy is decreasing in developed countries but increasing in middle- and low-income countries. From meta-analysis prevalence of cerebral palsy in pre and perinatal in high income countries was 1.5 per 1,000 (with 95% CI 3.0-3.9) live births and 1.6 per 1,000 live births in postnatal period. Although limited data available in middle and low income countries the result showed that increase the magnitude of cerebral palsy about 3-4 per 1,000 (with 95% CI 1.4-16) live births in pre and perinatal period ([18](#)).

The epidemiology of cerebral palsy in children of low and middle income country studied in Bangladesh, Nepal, Indonesia and Ghana showed that 86.6% CP acquired from prenatal and perinatal and median age at diagnosis were 3 years. They concluded that severe form of CP most commonly occur in LMIC, rural area and most risk factors are preventable ([19](#)).

Systematic review and meta-analysis was done, in McGill University, Montreal, Canada, the prevalence of CP based on birth weight and gestational age, showed that Cerebral palsy increases while decrease birth weight and GA. The highest prevalence occurred in 1,000-1499 gm birth that was 58.9 per 1,000 with CI 95% 53.06-66.01 and based on GA highest in before 28 wk gestation delivery (111.8 per 1,000 live births with 95% CI 69.53-179.78; $p < 0.0327$) ([17](#)).

2.2. Risk factors of cerebral palsy

2.2.1. Prenatal risk factors

A study conducted in Australia reported that intrauterine infection, particularly chorioamnionitis, was significantly associated with cerebral palsy (CP). The findings indicated that neonatal exposure to clinical chorioamnionitis increased the risk of CP by approximately 140%, while histological chorioamnionitis increased the risk by 80% ([20](#)).

A prospective cohort study investigating the association between genetic factors and CP demonstrated a significant prevalence of Mendelian genetic disorders among individuals clinically diagnosed with CP, suggesting a substantial genetic contribution to the condition(21).

A case–control study conducted in Sweden in 2006 identified several maternal and obstetric risk factors associated with CP. These included advanced maternal age (>40 years) (OR = 1.4, 95% CI: 1.3–2.4), primiparity, maternal malnutrition, and maternal medical conditions such as epilepsy, preeclampsia (OR = 1.5, 95% CI: 1.3–2.4), type I diabetes mellitus, and thyroid disease. Additional risk factors included cigarette smoking, breech vaginal delivery, instrumental delivery, emergency cesarean section, assisted reproduction, and intrauterine growth restriction(22).

In India, a retrospective study conducted among 100 children with CP found that prenatal maternal risk factors were strongly associated with the condition. Maternal anemia increased the risk by 7.3 times, preeclampsia by 3.3 times, eclampsia by 8.6 times, vaginal bleeding by 8.6 times, and multiple pregnancy by 4.8 times(23).

Furthermore, a retrospective case–control study conducted in the Podlaskie Province examined perinatal risk factors for CP. The study identified spontaneous abortion, premature rupture of membranes, placental abruption, uterine rupture, and vaginal bleeding as significant risk factors associated with cerebral palsy(24).

2.2.2. Neonatal risk factors

An analysis of CP prevalence among singletons, twins, and triplets in western Austria showed that the prevalence was highest among triplets (28 per 1,000 survivors per year), followed by twins (7.3 per 1,000 survivors per year) and singletons (1.6 per 1,000 survivors per year) (25).

A systematic review and meta-analysis conducted in Canada demonstrated that the proportion of CP increases among preterm and low birth weight infants. The overall prevalence of CP was 2.11 per 1,000 live births, while extremely preterm infants had a prevalence of 111.8 per 1,000 live births and infants with birth weight 1,000–1,499 g had 59.8 per 1,000 live births (16). Prevalence by gestational age was reported as follows: GA 28–31 weeks, 43 per 1,000; GA 32–36 weeks, 7 per 1,000; GA >36 weeks, 1.4 per 1,000 live births. Prevalence by birth weight was: <1,500 g, 59 per 1,000; 1,500–2,500 g, 10 per 1,000; >2,500 g, 1.3 per 1,000(17).

A systematic review conducted at the University of Oxford suggested that in preterm infants, CP is commonly associated with periventricular leukomalacia (PVL), intraventricular hemorrhage (IVH), and bronchopulmonary dysplasia (BPD), highlighting possible mechanisms linking prematurity to CP([26](#)).

A national study in Finland analyzed 2,242 children to compare the incidence of CP among very preterm, moderate preterm, late preterm, and term infants. The prevalence of CP increased as gestational age decreased: very preterm, 8.7%; moderate preterm, 2.4%; late preterm, 0.6%; term infants, 0.1%([27](#)).

In the United States, a review of 23 studies indicated that perinatal hypoxia and/or ischemia accounted for a minority (approximately 3%) of CP cases, though the authors recommended further research to clarify the strength of this association([28](#)).

2.2.3. Post-natal factors

Study was done in 2018; perinatal stroke encompasses heterogeneous type of brain injury that affects more than 5 million worldwide, so perinatal stroke risks for hemiplegic CP ([29](#)). Perinatal stroke commonly associated with embolization, sepsis, DIC, coagulopathy (2/3) and CHD and common in term baby and diagnose by autopsy and studied for four years([29](#)).

Study was done in Europe collaborative group, showed significant impacts on cerebral palsy relation to post natal acquired causes like neonatal infection, kernicterus, and trauma([30](#)).

Study was done 2008, hospital Gohandua, Nigeria, children who developed seizure within 48 hours of after delivery, had significant relation to CP([31](#)). Kernicterus become a significant problem, despite hyperbilirubinemia management especially low-income countries. Three clinical review, in Nigeria, kernicterus the most common risk of CP([32](#)).

3. Conceptual framework

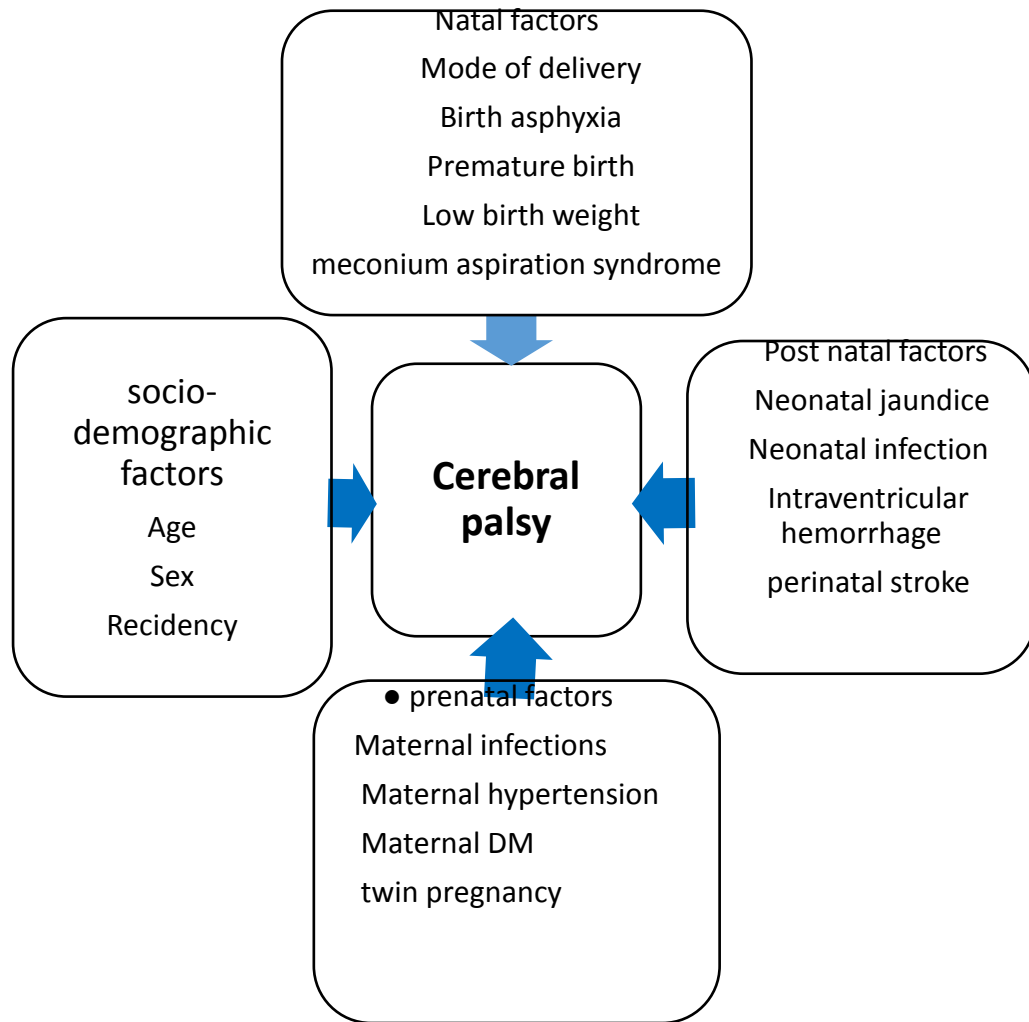


Figure 1.Conceptual frame work on associated factors to cerebral palsy used different literature review ([33-38](#))

4. OBJECTIVE

4.1.General Objective

- ✓ The general objective of the study was to determine the proportion of cerebral palsy among neurologic diseased children who receiving care at pediatric and child health follow-up clinic and associated factor who visit Tibebe Ghion Specialized Hospital, Bahir Dar, Northwest, Ethiopia 2025

4.2.Specific Objectives

- ✓ To determinethe proportion of cerebral palsy children who visitto pediatric follow up clinic Tibebe Ghion Specialized hospital, Bahir Dar, North, Ethiopia 2025.
- ✓ To assessthe factors associated with the development of cerebral palsy amongwith neurologic diseased children who receiving careat pediatric and child health follow-up clinicTibebe Ghion specialized hospital, Bahir Dar, North, Ethiopia 2025.

5. METHODS

5.1. Study Setting

The study was conducted in Bahir Dar University Tibebe Ghion Specialized Hospital (TGSH). Tibebe Ghion Specialized Hospital is situated about 7 km from Bahir Dar city center and 491 km from Addis Ababa on the road to Motta city. It serves approximately 5 to 7 million people and functions as a teaching hospital for Bahir Dar University's College of Medicine and Health Sciences. The hospital has various departments including Internal Medicine, Surgery, ACCPM, ECCM, Obstetrics, and Gynecology, Ophthalmology, Radiology, Dermatovenereology, ENT, Psychiatry, and Dentistry.

Department of pediatrics and child health is one of the major specialties which has pediatric cardiologist, hemato-oncologist, and emergency and critical care single in each sub-specialty and also more than 12 pediatricians serve the community. The hospital pediatrics department contains pediatrics emergency, pediatric OPD, pediatric referral follow-up clinic, pediatric critical ward, pediatrics cardiac unit, hemato-oncology ward, pediatrics ICU and NICU facilities.

5.2. Study Design and Period

A retrospective cohort study was conducted from January 1-30 2026, at Tibebe Ghion Specialized Hospital, Bahir Dar.

5.3. Population

5.3.1. Source of population

All neurologic patients age 1 year-15 years who visited pediatric follow up clinic from September 1, 2023-August 30, 2025 period at Tibebe Ghion Specialized Hospital.

5.3.2. Study population

The study consisted of randomly selected children aged 1 year to 15 years who were diagnosed with neurologic diseases and visited Tibebe Ghion Comprehensive Specialized Hospital (TGCSH) from September 1st, 2023, to August 30th, 2025.

5.4. Eligibility Criteria

5.4.1. Inclusion criteria

All children 1-15 years with a diagnosed neurological disorder attending Tibebe Ghion Specialized Hospital during the study period, with complete records.

5.4.2. Exclusion criteria

Children without neurological disorders, those with posttraumatic or acquired CP after age 2, incomplete records, or repeated entries.

5.5. Sample Size Determination and sampling procedure

5.5.1. Sample size determination for first objective

The Sample size will be determined using a single population proportion formula by considering the following parameters: $p = 30\%$ ([39](#)), $Z = 1.96$, $d = 0.05$ and $CI = 95\%$, where, p = estimated prevalence of disease; Z = Z statistic (probability of normal distribution), d = precision (margin of error), and CI = confidence level.

$$n \text{ (cases)} = \frac{Z^2 \times p(1-p)}{d^2}$$

Since the source of population is $<10,000$ I used sample size calculation, $N=2700$ (estimated total neurologic cases seen for last 3yrs in pediatric follow-up clinic)

$$n_i = \frac{(1.96)^2 \times 0.3(1-0.3)}{(0.05)^2} = 323$$

$$N_f = n_i / (1 + n_i/N)$$

$$N_f = 289$$

With 10% for incomplete chart simple size $n=318$

Where N_f = the desired sample size, n_i = initial sample size

The data will be extracted using computer-generated simple random sampling technique of patient records.

5.5.2. Sample size determination for second objectives

To determine the sample size needed to assess factors associated with cerebral palsy, the double population proportion formula was used:

$$n = [(Z_{\alpha/2} + Z_{\beta})^2 \times (p_1(1 - p_1) + p_2(1 - p_2))] / (p_1 - p_2)^2 \text{ (40)}$$

Where:

- n = sample size per group
- $Z_{\alpha/2} = 1.96$ (for 95% confidence interval)
- $Z_{\beta} = 0.84$ (for 80% power)
- p_1 = proportion of cerebral palsy among exposed group (with risk factor)
- p_2 = proportion of cerebral palsy among unexposed group (without risk factor)

No	Factors for cerebral palsy	Outcome in unexposed	Outcome in exposed	CI	Power	AOR	Sample size	Adding incomplete cards	Reference
	Perinatal asphyxia	31.56	40.7	95%	80%	4.68	321	324	
	CNS infection	22.66	25.9	95%	80%	3.93	261	264	
	Preterm and LBW	17.82	12.6	95%	80%	2.82	318	321	

The sample size calculation using single population is smaller than the factors. So that the final sample size is 324.

5.5.3. Data Collection Tools and Techniques

A retrospective cohort study was conducted using a retrospective review of medical records of children diagnosed with neurologic cases. Data were collected for cases recorded in between September 1, 2023 up to August 30, 2025. A computer generated simple random sampling technique was used to select study participants from a total of 2200 pediatric neurologic cases recorded from September 1, 2023 up to August 30, 2025 period. Since the study design was a retrospective chart review, medical record numbers were first listed from the registration log

book. A medical card number was selected by computer generated method randomly and continued until sample size of 324 children with neurologic cases. The questionnaire includes socio-demographic characteristics, clinical profiles and potential risk factors, all of which were developed based on a review of relevant literature. The data was collected by five health professionals. Printed questionnaires, Paper, pencil, rubber, pen, and patient card records were used to collect data.

5.6. Data Analysis and Management

Data were abstracted using a structured Kobo data collection tool, then exported to Microsoft Excel and subsequently analyzed using SPSS version 27. Logistic regression analysis was performed to identify factors associated with cerebral palsy. Variables with a p-value ≤ 0.25 in the bivariable analysis were included in the multivariable logistic regression model, and variables with a p-value < 0.05 were considered statistically significant

5.7. Variable of the study

5.7.1. Dependent variable

- Cerebral palsy

5.7.2. Independent variable

- **Socio-demographic factors**
 - ✓ Age
 - ✓ Sex
 - ✓ Residency
- **Prenatal factors**
 - ✓ Maternal infection
 - ✓ Maternal drug intake/alcohol
 - ✓ Maternal hypertension
 - ✓ Maternal DM
- **Perinatal factors**
 - ✓ Mode of delivery
 - ✓ Asphyxia
 - ✓ Low birth weight

- ✓ Preterm/post term delivery
- **Neonatal factors**
 - ✓ Neonatal infection
 - ✓ Meconium aspiration syndrome
 - ✓ Respiratory distress syndrome
 - ✓ Neonatal jaundice
 - ✓ Intraventricular hemorrhage

5.8. Operational definition

Cerebral palsy is a group of permanent, nonprogressive disorder of motor and posture due to developing fetus or infant brain injury, diagnosed by clinical criteria. Diagnostic criteria of cerebral palsy are based on surveillance of cerebral palsy in Europe (SCPE) or ACPR (Australian CP Register) criteria([1](#)).

Perinatal asphyxia is the failure of the newborn to initiate and maintain adequate respiration after birth, often determined clinically by persistent low Apgar scores (<7 at 5 minutes) or biochemical evidence of impaired oxygenation.

CNS infection: A verified central nervous system infection, including meningitis, encephalitis, or brain abscess, diagnosed via clinical assessment, CSF analysis, or imaging ([41](#)).”

Neonatal hyperbilirubinemia refers to an elevated serum bilirubin level in newborn infants that leads to yellowish discoloration of the skin and sclera, which may require treatment to prevent complications such as bilirubin neurotoxicity ([42](#)).”

- **Prenatal period**- The period during pregnancy.
- **Preterm** –Neonate who delivered before 37wk of pregnancy
- **Term**-The baby delivered at 37wk-416/7wk
- **Perinatal**–Period between28wks before delivery and up to7 days after delivery

- **Post natal** – A time after neonate period.
- **Neonatal age** –Age of baby ≤ 28 days
- **Low birth weight- Birth weight** <2500gm

5.9. Data Collection Tools and Techniques

Data was extracted using structured checklists after the identification of medical registration number from pediatric follow-up clinic registration abstract. The questionnaire includes socio-demographic characteristics, clinical profiles and potential risk factors, all of which were developed based on a review of relevant literature. The data was collected by five health professionals. Printed questionnaires, Paper, pencil, rubber, pen, and patient card records were used to collect data.

5.10. Data Quality Controls

Data collectors received training on how to extract data effectively and data was checked for completeness on the same day of the extraction. Pretest was conducted on 5% of patient records at Felege Hiwote Specialized hospital; these records were included in the final analysis. Based on the results of pretest, the data collection format was revised. The prior knowledge of data collectors and supervisors regarding the associated factors and their documentation in patient records was contributed to high-quality data extraction. Additionally, a checklist was prepared and categorized according to the study variables.

5.11. Data Analysis and Management

Data were abstracted using a structured Kobo data collection tool, then exported to Microsoft Excel and subsequently analyzed using SPSS version 27. Descriptive statistics such as frequencies and percentages were used to summarize the characteristics of the study participants. Crude odds ratios (COR) with 95% confidence intervals were calculated to assess the association between each independent variables and the outcome variable. Variables with p-value less than 0.25 in the bivariable analysis were included in the multi-variable logistics regression model. Adjusted odds ratios (AOR) with corresponding 95% confidence interval were computed in the multivariable model to control for potential cofounders. A P-value of less than 0.05 was considered statically significant. The models goodness of fit was assessed using the Hosmer-Lemeshow test.

5.12. Ethical Consideration

The research proposal was approved by the Ethical Review Board of Bahir Dar University, College of Medicine and Health Sciences, and ethical clearance was obtained from the board. Ethical clearance and supporting letter was submitted and was obtained from the hospital management. To ensure confidentiality of the patients' information, the name and address of the patient's was not recorded during the data collection. No one other than the investigator had access to the collected data. Investigator used the collected data only to answer the stated objectives.

5.13. Dissemination of Study Results

Findings of this paper will be communicated to TGSH though hard copy, to school of medicine, department of pediatrics and child health though hard copy and presentation. Attempt will be, made to publish in national and international journal access and others outside as well.

6. Result

6.1. Socio-demographic characteristics

A total of 324 pediatric neurological cases were included in the study. Of these, 192 (59.3%) were males and 132 (40.7%) were females, yielding a male-to-female ratio of 1.46:1.

The majority of participants were preschool-aged children (59.9%), followed by school-aged children (22.2%) and adolescents (17.9%). The mean ($\pm$ SD) age of the participants was 5.93 ± 3.92 years. Most children were from rural areas (65.1%) (table1).

Table 1. Socio-demographic Characteristics of Study Participants (N = 324)at Tibebe Ghion Specialized Hospital, 2025

Variable	Category	Frequency (n)	Percentage (%)
Age Group	Preschool	194	59.9
	School-age	72	22.2
	Adolescent	58	17.9
Gender	Male	192	59.3
	Female	132	40.7
Residence	Rural	211	65.1
	Urban	113	34.9

Note: Preschool (1–5 years), School-age (6–10 years), Adolescent (11–15 years).

Prenatal characteristics

Among children diagnosed with cerebral palsy, more than half (57.0%) were born to mothers who had no antenatal care (ANC) follow-up during pregnancy. A history of maternal hypertension was reported in 27.9% of cases, while maternal infections occurred in 15.2%. The most commonly reported infections were urinary tract infection (8.2%) and chorioamnionitis (7.0%). In addition, other maternal conditions identified during pregnancy included antepartum hemorrhage (5.8%) and diabetes mellitus (4.7%).

Intrapartum, Natal and Postpartum Characteristics

Seven (8.1%) deliveries occurred at home, and the vast majority of births (95.3%) were singleton. Regarding the mode of delivery, 38.4% were delivered by cesarean section, 32.0% by spontaneous vaginal delivery (SVD), and 24.4% by instrumental-assisted vaginal delivery. Low birth weight was observed in 5.8% of neonates. Perinatal asphyxia was documented in 61.6% of children with cerebral palsy. Additionally, central nervous system (CNS) infections were identified in 17.4% of cases, with 67.2% occurring during infancy and 32.8% during the neonatal period. Meconium aspiration syndrome (MAS) was present in 15.1% of cases.

6.2. Proportion of Cerebral Palsy and Its characteristics

In this study, cerebral palsy (CP) accounted for 26.5% (95% CI: 21.7–31.3%) (n = 86) of pediatrics neurologic cases (N = 324), indicating a substantial burden within the study population. The predominant subtype was spastic quadriplegic CP (75%), followed by spastic hemiplegic CP (15%), dyskinetic CP (9%), and spastic diplegic CP (1.2%) (Figure 2). The predominance of spastic quadriplegia indicates a high proportion of severe motor impairment. Most children with CP had comorbid conditions. Intellectual disability was the most frequent (80%), followed by language disorder (77.9%), epilepsy (74.4%), malnutrition (61.6%), and musculoskeletal contractures (7%). These comorbidities are well-recognized complications of cerebral palsy and significantly contribute to functional limitation and reduced quality of life. All children with epilepsy were receiving antiepileptic medication. However, none were enrolled in regular physiotherapy programs, which is concerning given that multidisciplinary rehabilitation

is a cornerstone of cerebral palsy management to prevent complications and improve functional outcomes.

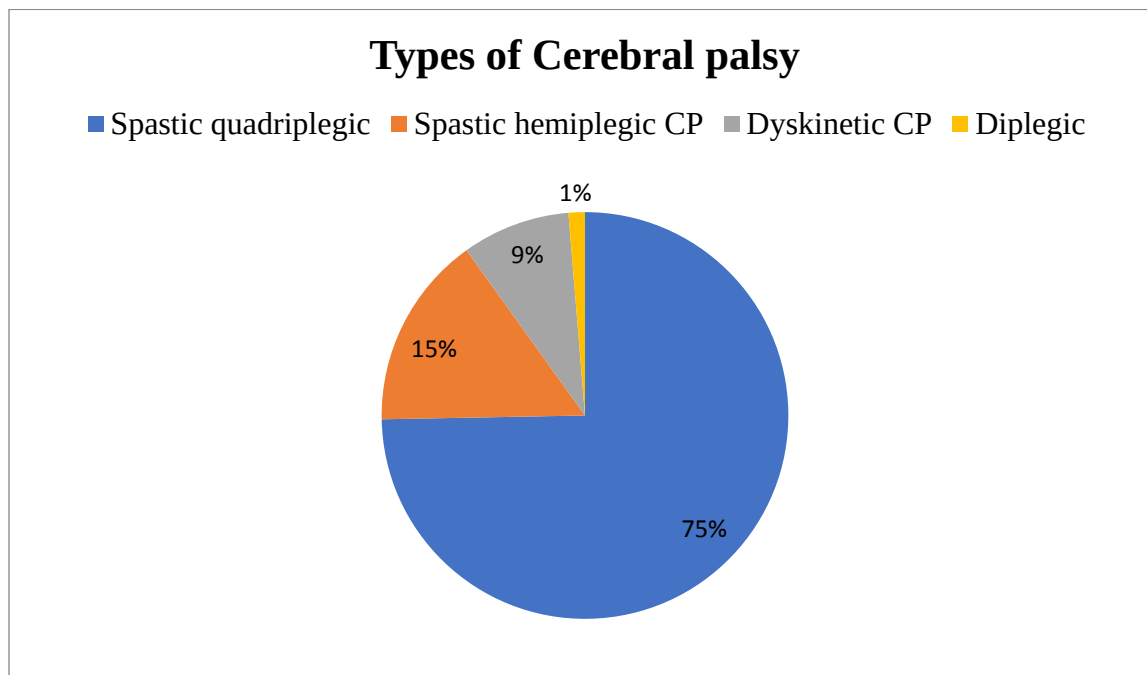


Figure 2. Sub-types of cerebral palsy

6.3. Factors Associated with Cerebral Palsy

6.3.1. Multivariable Logistic Regression Analysis

Variables with a p-value < 0.25 in the bivariable analysis were included in the multivariable logistic regression model to control for potential confounding factors. The included variables were maternal hypertension, ANC follow-up, maternal infection, antepartum hemorrhage (APH), maternal diabetes mellitus, mode of delivery, central nervous system (CNS) infection, perinatal asphyxia, jaundice, and meconium aspiration syndrome (MAS).

After adjusting for potential confounders, the following variables were significantly associated with cerebral palsy:

Children whose mothers had no ANC follow-up were 2.20 times more likely to develop cerebral palsy compared to children whose mothers attended ANC follow-up (AOR = 2.20, 95% CI: 1.10–4.40, p = 0.026). This indicates that lack of ANC follow-up is an independent risk factor

for cerebral palsy. In addition to this, children born to mothers with a history of APH had 6.87 times higher odds of developing cerebral palsy compared to children whose mothers did not experience APH (AOR = 6.87, 95% CI: 1.02–46.21, $p = 0.047$). Children delivered by cesarean section were 3.74 times more likely to develop cerebral palsy compared to those delivered via spontaneous vaginal delivery (SVD) (AOR = 3.74, 95% CI: 1.30–10.74, $p = 0.014$). Instrumental delivery was not significantly associated with cerebral palsy after adjustment (AOR = 1.50, 95% CI: 0.44–5.18, $p = 0.517$). Children with a history of CNS infection had 6.05 times higher odds of developing cerebral palsy compared to those without CNS infection (AOR = 6.05, 95% CI: 1.93–18.97, $p = 0.002$). This shows CNS infection is a strong independent predictor of cerebral palsy. Moreover, perinatal asphyxia was also the strongest predictor of cerebral palsy. Children with a history of perinatal asphyxia were 10.90 times more likely to develop cerebral palsy than children without perinatal asphyxia (AOR = 10.90, 95% CI: 5.27–22.52, $p < 0.001$).

Other variables, including maternal hypertension (AOR = 1.82, 95% CI: 0.83–4.00, $p = 0.138$), maternal infection (AOR = 2.26, 95% CI: 0.67–7.61, $p = 0.188$), instrumental delivery (AOR = 1.50, 95% CI: 0.44–5.18, $p = 0.517$), and MAS (AOR = 1.82, 95% CI: 0.83–3.99, $p = 0.138$) were not significantly associated with cerebral palsy after adjusting for other factors.

Table 2 Multivariate Logistic Regression Analysis of risk factors associated with child Cerebral palsy.

Variables	Category	CP	Non-CP	COR	AOR	P-value
ANC follow-up	Yes	37	136		1	-
	No	49	102	1.766(1.073-2.906)	2.199(1.099-4.399)	0.026
Maternal HTN	Yes	24	43	1.755(0.987-3.121)	1.817(0.826-3.997)	0.138
	No	62	195		1	-
Maternal infection	Yes	13	9	4.531(1.861-11.032)	2.260(0.671-7.613)	0.188
	No	73	229		1	-
Maternal bleeding(APH)	Yes	8	7	4.835(1.13-20.685)	6.872(1.022-46.206)	0.047
	No	78	231		1	-
MOD	C-Section	33	17	12.314(6.153-24.645)	3.735(1.299-10.736)	0.014
	Instrumental	21	18	7.401(3.561-15.383)	1.504(0.437-5.177)	0.517
	SVD	32	203		1	-
CNS infection	Yes	15	13	3.657(1.661-8.05)	6.046(1.926-18.973)	0.002
	No	71	225		1	-
PNA	Yes	53	31	10.724(6.031-19.071)	10.898(5.273—22.523)	.<001
	No	33	207		1	-
MAS	Yes	13	20	1.755(0.987-3.121)	1.817(0.826-3.997)	0.138
	No	73	218		1	-

7. DISCUSSION

The proportion of CP was 26.5%, indicating a substantial clinical burden on pediatric healthcare services and hospital resources. This finding is lower than a study conducted at TikurAmbessa Specialized Hospital, where 35.8% of neurologic cases were diagnosed with CP([43](#)). However, it is higher than a hospital-based prospective cross-sectional study conducted in India, where the prevalence was 6.98%([44](#)).The variation in prevalence across studies may be attributed to differences in study settings, socioeconomic conditions, availability of specialized care, presence of pediatric neurologists, diagnostic practices, and management of perinatal complications.

In this study, a male predominance was observed, with 53.5% of cases occurring in males and 46.5% in females, resulting in a male-to-female ratio of 1.15:1. This finding is consistent with previous studies reporting a higher susceptibility among males, with ratios around 1.3:1([45](#)). The biological vulnerability of males may be related to differences in brain development, genetic susceptibility, and the neuroprotective effects of female hormones([46](#), [47](#)).

The most commonly affected age group was 1–5 years, accounting for 78.94% of cases, whereas the least affected group was 11–15 years (3.5%). This finding is consistent with studies from Northern India, where the majority of CP cases were also identified in the 1–5-year age group([44](#)).This may be explained by increased healthcare-seeking behavior during early childhood, when developmental delays and motor impairments become more apparent.

Regarding clinical subtypes, spastic quadriplegic cerebral palsy was the most common type (75%), followed by spastic hemiplegic (15%), dyskinetic (8%), and spastic diplegic (1.2%). Similar patterns were reported in studies conducted in Addis Ababa and Saudi Arabia ([39](#), [48](#)).The predominance of spastic quadriplegia may reflect a high proportion of severe perinatal insults such as birth asphyxia and central nervous system infections.

ANC follow-up was significantly associated with cerebral palsy. Children whose mothers had no ANC follow-up were 2.2 times more likely to develop cerebral palsy compared to those whose mothers attended ANC follow-up (AOR = 2.20, 95% CI: 1.10–4.40, $p = 0.026$). This finding emphasizes the importance of regular antenatal care in monitoring maternal and fetal health, preventing complications such as maternal infections, hypertension, and antepartum hemorrhage.The result is consistent with previous studies in Ethiopia and other low- and middle-

income countries, which have reported that inadequate ANC is a risk factor for adverse perinatal outcomes, including cerebral palsy(49).

Maternal antepartum hemorrhage (APH) was also significantly associated with cerebral palsy. Children born to mothers with APH had nearly seven times higher odds of developing cerebral palsy (AOR = 6.87, 95% CI: 1.02–46.21, $p = 0.047$). APH can lead to fetal hypoxia and compromised placental perfusion, which may contribute to neurological injury, consistent with prior research showing that maternal bleeding is an important antenatal risk factor for cerebral palsy(50).

Maternal infections during pregnancy were significant in the bivariable analysis but lost significance in the multivariable model (AOR = 2.26, 95% CI: 0.67–7.61, $p = 0.188$). This suggests that the effect of maternal infection may be mediated through perinatal complications, such as perinatal asphyxia or CNS infection, rather than being an independent risk factor.

Maternal hypertension and diabetes mellitus were not significantly associated with cerebral palsy after adjustment, although hypertension showed a trend toward increased risk (AOR = 1.82, 95% CI: 0.83–4.00). This aligns with some studies reporting that maternal hypertension contributes to adverse perinatal outcomes, but its direct association with cerebral palsy is less consistent and may depend on the severity and management of hypertension during pregnancy(51).

Perinatal asphyxia was the strongest predictor of cerebral palsy in this study. Children with a history of perinatal asphyxia were nearly eleven times more likely to develop cerebral palsy compared to children without asphyxia (AOR = 10.90, 95% CI: 5.27–22.52, $p < 0.001$). This finding is consistent with previous studies in Ethiopia, in sub-Saharan Africa and globally which consistently report perinatal asphyxia as a leading cause of cerebral palsy, although the magnitude of association in the present study was higher(40, 45, 52). Nevertheless, the direction of the effect is similar. The finding is further supported by a meta-analysis conducted in different countries (53, 54).The pathophysiological mechanism involves hypoxic-ischemic injury to the developing brain, leading to permanent motor deficits(55). This finding reinforces the critical importance of effective intrapartum monitoring and neonatal resuscitation.

Similarly, central nervous system (CNS) infection was significantly associated with CP (AOR = 6.046; 95% CI: 1.926–18.973; $p = 0.002$). Children who had CNS infections during the neonatal or infancy period were six times more likely to develop CP,highlighting the role of preventable

neonatal and infant infections in long-term neurodevelopmental outcomes. This finding is supported by a study conducted at Hawassa Comprehensive Specialized Hospital, which reported a 3.5-fold increased risk ([40](#)). The higher magnitude observed in this study may be due to differences in healthcare access, vaccination coverage, and early treatment of infections.

There was also meta-analysis study in South Africa, Sub-Saharan and Latin America 23% with 95% CI: 19-26% neonatal meningitis was significant risk for CP ([56](#)). There is also study and Uganda ([57](#)). CNS infections, such as meningitis or encephalitis, can cause direct neuronal injury, white matter damage, and subsequent motor impairment ([58](#), [59](#)).

Mode of delivery showed a significant association with CP. Children delivered by cesarean section had higher odds of CP (AOR = 3.735; 95% CI: 1.299–10.736; $p = 0.014$) compared to those delivered by spontaneous vaginal delivery. This association may reflect emergency cesarean sections performed due to fetal distress or obstetric complications rather than the procedure itself being causative ([60](#)).

Meconium aspiration syndrome (MAS) was associated with cerebral palsy in the bivariable analysis but lost significance in the multivariable model (AOR = 1.82, 95% CI: 0.83–3.99, $p = 0.138$). This indicates that MAS may contribute indirectly through associated hypoxia rather than being an independent risk factor ([61](#)).

8. STRENGTH AND LIMITATION OF THE STUDY

8.1. Strengths of the Study

This study provides important local evidence regarding the magnitude and associated factors of cerebral palsy in the study area, where limited prior data exist. The use of random sampling and an adequate sample size improved representativeness. Multivariable logistic regression analysis was employed to control for potential confounding variables. Additionally, data were collected using a standardized and pretested tool, enhancing reliability and consistency.

8.2. Limitations of the Study

This was a facility-based study; therefore, the findings may not be generalizable to the broader community. The cross-sectional design limits the ability to establish temporal or causal relationships between risk factors and CP. Furthermore, the use of secondary data from patient charts limited the availability of some important variables, which may have affected the completeness of risk factor assessment.

9. CONCLUSION

This study revealed that the proportion of cerebral palsy among neurologic cases at Tibebe Ghion Comprehensive Specialized Hospital was 26.5%, indicating a substantial burden in the pediatric care setting.

Lack of antenatal care follow-up, maternal infection, maternal antepartum hemorrhage, perinatal asphyxia and central nervous system infection were independently associated with cerebral palsy. Overall, the findings suggest that improving maternal health services, strengthening skilled birth attendance, preventing perinatal asphyxia, and enhancing neonatal infection prevention and management could substantially reduce the occurrence of cerebral palsy in the study setting.

10. RECOMMENDATION

Based on the findings of this study, the following recommendations are proposed:

For Healthcare Providers

Ensure all pregnant women receive regular antenatal care for early detection and management of pregnancy-related complications.

Strengthen intrapartum monitoring to detect fetal distress early and provide timely intervention.

Improve early diagnosis and management of neonatal infections.

Establish effective referral and triage systems for high-risk pregnancies and neonates.

For Tibebe Ghion Comprehensive Specialized Hospital (TGCSH)

Strengthen obstetric labor and delivery monitoring protocols.

Provide training for healthcare professionals on emergency obstetric care and instrumental delivery.

Improve pediatric protocols for management of meningitis and perinatal asphyxia.

Ensure availability of essential diagnostic and treatment resources.

For Public Health Authorities

Expand antenatal care coverage, particularly in rural communities.

Promote community awareness about the importance of ANC, danger signs during pregnancy, and prevention of perinatal asphyxia.

Strengthen maternal and child health programs focusing on infection prevention and safe delivery practices.

For Future Researchers

Conduct multicenter and prospective studies to better establish causal relationships.

Include larger sample sizes and additional clinical and laboratory variables.

Explore long-term outcomes and rehabilitation services for children with cerebral palsy.

11.List of references

1. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol Suppl.* 2007;109:8–14.
2. Sadowska M, Sarecka-Hujar B, Kopyta I. Cerebral palsy: current opinions on definition, epidemiology, risk factors, classification and treatment options. *Neuropsychiatric disease and treatment.* 2020;16:1505–18.
3. Surveillance of cerebral palsy in Europe: a collaboration of cerebral palsy surveys and registers. Surveillance of Cerebral Palsy in Europe (SCPE). *Dev Med Child Neurol.* 2000;42(12):816–24.
4. Graham D, Paget SP, Wimalasundera N. Current thinking in the health care management of children with cerebral palsy. *Med J Aust.* 2019;210(3):129–35.
5. Bekteshi S, Monbaliu E, McIntyre S, Saloojee G, Hilberink SR, Tatishvili N, et al. Towards functional improvement of motor disorders associated with cerebral palsy. *Lancet Neurol.* 2023;22(3):229–43.
6. Khandaker G, Muhit M, Karim T, Smithers-Sheedy H, Novak I, Jones C, et al. Epidemiology of cerebral palsy in Bangladesh: a population-based surveillance study. *Dev Med Child Neurol.* 2019;61(5):601–9.
7. Engle PL, Black MM, Behrman JR, Cabral de Mello M, Gertler PJ, Kapiriri L, et al. Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world. *Lancet.* 2007;369(9557):229–42.
8. Hillman RE, McAuliffe MJ, Lin E, Robb MP, Murdoch BE, Martin-Harris B, et al. IALP NEWS. *Folia Phoniatica et Logopaedica.* 2008;60(1):54–6.
9. Hollung SJ, Vik T, Lydersen S, Bakken IJ, Andersen GL. Decreasing prevalence and severity of cerebral palsy in Norway among children born 1999 to 2010 concomitant with improvements in perinatal health. *Eur J Paediatr Neurol.* 2018;22(5):814–21.
10. Petersen TG, Forthun I, Lange T, Villadsen SF, Nybo Andersen AM, Uldall P, et al. Cerebral palsy among children of immigrants in Denmark and the role of socioeconomic status. *Eur J Paediatr Neurol.* 2019;23(3):507–16.
11. El Tallawy HN, Farghaly WM, Rageh TA, Shehata GA, Metwaly NA, Abo Elftoh N, et al. Epidemiology of major neurological disorders project in Al Kharga district, New Valley, Egypt. *Neuroepidemiology.* 2010;35(4):291–7.
12. Donald KA, Samia P, Kakooza-Mwesige A, Bearden D. Pediatric cerebral palsy in Africa: a systematic review. *Semin Pediatr Neurol.* 2014;21(1):30–5.
13. Abate BB, Tegegne KM, Zemariam AB, Wondmagegn Alamaw A, Kassa MA, Kitaw TA, et al. Magnitude and clinical characteristics of cerebral palsy among children in Africa: A systematic review and meta-analysis. *PLOS Global Public Health.* 2024;4(6):e0003003.
14. Tsige S, Moges A, Mekasha A, Abebe W, Forssberg H. Cerebral palsy in children: subtypes, motor function and associated impairments in Addis Ababa, Ethiopia. *BMC pediatrics.* 2021;21:1–11.
15. Bangash AS, Hanafi MZ, Idrees R, Zehra N. Risk factors and types of cerebral palsy. *J Pak Med Assoc.* 2014;64(1):103–7.
16. Sadowska M, Sarecka-Hujar B, Kopyta I. Cerebral Palsy: Current Opinions on Definition, Epidemiology, Risk Factors, Classification and Treatment Options. *Neuropsychiatr Dis Treat.* 2020;16:1505–18.

17. Oskoui M, Coutinho F, Dykeman J, Jetté N, Pringsheim T. An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. *Dev Med Child Neurol*. 2013;55(6):509–19.
18. McIntyre S, Goldsmith S, Webb A, Ehlinger V, Hollung SJ, McConnell K, et al. Global prevalence of cerebral palsy: A systematic analysis. *Dev Med Child Neurol*. 2022;64(12):1494–506.
19. Jahan I, Muhit M, Hardianto D, Laryea F, Chhetri AB, Smithers-Sheedy H, et al. Epidemiology of cerebral palsy in low- and middle-income countries: preliminary findings from an international multi-centre cerebral palsy register. *Dev Med Child Neurol*. 2021;63(11):1327–36.
20. Shatrov JG, Birch SC, Lam LT, Quinlivan JA, McIntyre S, Mendz GL. Chorioamnionitis and cerebral palsy: a meta-analysis. *Obstetrics & Gynecology*. 2010;116(2 Part 1):387–92.
21. Chopra M, Gable DL, Love- Nichols J, Tsao A, Rockowitz S, Sliz P, et al. Mendelian etiologies identified with whole exome sequencing in cerebral palsy. *Annals of clinical and translational neurology*. 2022;9(2):193–205.
22. Thorngren-Jerneck K, Herbst A. Perinatal factors associated with cerebral palsy in children born in Sweden. *Obstetrics & Gynecology*. 2006;108(6):1499–505.
23. Chauhan A, Singh M, Jaiswal N, Agarwal A, Sahu JK, Singh M. Prevalence of cerebral palsy in Indian children: a systematic review and meta-analysis. *The Indian Journal of Pediatrics*. 2019;86(12):1124–30.
24. Kułak W, Sobaniec W, Okurowska-Zawada B, Sienkiewicz D, Paszko-Patej G. Antenatal, intrapartum and neonatal risk factors for cerebral palsy in children in Podlaskie Province. *Child Neurology—Neurologia Dziecięca*. 2009;18(36):19–24.
25. Strijbis EM, Oudman I, van Essen P, MacLennan AH. Cerebral palsy and the application of the international criteria for acute intrapartum hypoxia. *Obstet Gynecol*. 2006;107(6):1357–65.
26. Linsell L, Malouf R, Morris J, Kurinczuk JJ, Marlow N. Prognostic factors for cerebral palsy and motor impairment in children born very preterm or very low birthweight: a systematic review. *Dev Med Child Neurol*. 2016;58(6):554–69.
27. Hirvonen M, Ojala R, Korhonen P, Haataja P, Eriksson K, Gissler M, et al. Cerebral palsy among children born moderately and late preterm. *Pediatrics*. 2014;134(6):e1584–93.
28. Ellenberg JH, Nelson KB. The association of cerebral palsy with birth asphyxia: a definitional quagmire. *Dev Med Child Neurol*. 2013;55(3):210–6.
29. Dunbar M, Kirton A. Perinatal stroke: mechanisms, management, and outcomes of early cerebrovascular brain injury. *Lancet Child Adolesc Health*. 2018;2(9):666–76.
30. Cans C, McManus V, Crowley M, Guillem P, Platt MJ, Johnson A, et al. Cerebral palsy of post-neonatal origin: characteristics and risk factors. *Paediatr Perinat Epidemiol*. 2004;18(3):214–20.
31. Argüelles PP. Parálisis cerebral infantil. *Hospital Sant Joan de Dèu*. 2008;36(1):271–7.
32. Nottidge VA, Okogbo ME. Cerebral palsy in Ibadan, Nigeria. *Dev Med Child Neurol*. 1991;33(3):241–5.
33. Olusanya BO, Gladstone M, Wright SM, Hadders-Algra M, Boo N-Y, Nair M, et al. Cerebral palsy and developmental intellectual disability in children younger than 5 years: Findings from the GBD-WHO Rehabilitation Database 2019. *Frontiers in public health*. 2022;10:894546.
34. Patel DR, Neelakantan M, Pandher K, Merrick J. Cerebral palsy in children: a clinical overview. *Translational pediatrics*. 2020;9(Suppl 1):S125.
35. UK NGA. Cerebral palsy in under 25s: assessment and management. 2017.

36. Stavsky M, Mor O, Mastrolia SA, Greenbaum S, Than NG, Erez O. Cerebral palsy—trends in epidemiology and recent development in prenatal mechanisms of disease, treatment, and prevention. *Frontiers in pediatrics*. 2017;5:21.
37. Michael-Asalu A, Taylor G, Campbell H, Lelea L-L, Kirby RS. Cerebral palsy: diagnosis, epidemiology, genetics, and clinical update. *Advances in pediatrics*. 2019;66:189–208.
38. Korzeniewski SJ, Slaughter J, Lenski M, Haak P, Paneth N. The complex aetiology of cerebral palsy. *Nature Reviews Neurology*. 2018;14(9):528–43.
39. Tsige S, Moges A, Mekasha A, Abebe W, Forssberg H. Cerebral palsy in children: subtypes, motor function and associated impairments in Addis Ababa, Ethiopia. *BMC Pediatr*. 2021;21(1):544.
40. Bashe B, Assele DD, Ketema W, Shibeshi MS. Factors associated with cerebral palsy among children in Hawassa University comprehensive specialized hospital: Case-control study. *PLoS One*. 2025;20(9):e0333406.
41. Dorsett M, Liang SY. Diagnosis and Treatment of Central Nervous System Infections in the Emergency Department. *Emerg Med Clin North Am*. 2016;34(4):917–42.
42. Merino-Andrés J, Pérez-Nombela S, Álvarez-Bueno C, Hidalgo-Robles Á, Ruiz-Becerro I, Fernández-Rego FJ. Neonatal hyperbilirubinemia and repercussions on neurodevelopment: A systematic review. *Child Care Health Dev*. 2024;50(1):e13183.
43. Labena F. Prevalence of Cerebral Palsy, its Associated Factors and MRI Patho-Anatomic Findings among Patients Attending Paediatrics Neurology Clinic in Tikur Anbessa Specialized Hospital. Master's thesis [Internet]. 2021.
44. Najar BA, Kachroo A, Gattoo IA, Hussain SQ. Cerebral palsy: risk factors, comorbidities and associated MRI findings, a hospital based observational study. *Int J Contemp Pediatr*. 2015;2(2):90–5.
45. Ekanem PE, Nyaga ACK, Tsegay N, Ebuy H, Imbusi EA, Ekanem R, et al. Determinants of Cerebral Palsy in Pediatric Patients in Northern Ethiopia: A Hospital-Based Study. *Neurol Res Int*. 2021;2021:9993912.
46. Reiss AL, Kesler SR, Vohr B, Duncan CC, Katz KH, Pajot S, et al. Sex differences in cerebral volumes of 8-year-olds born preterm. *The Journal of pediatrics*. 2004;145(2):242–9.
47. Vasileiadis GT, Thompson RT, Han VK, Gelman N. Females follow a more “compact” early human brain development model than males. A case-control study of preterm neonates. *Pediatric research*. 2009;66(5):551–4.
48. Al-Jabri BA, Al-Amri AS, Jawhari AA, Sait RM, Talb RY. Prevalence, types, and outcomes of cerebral palsy at a tertiary center in Jeddah, Saudi Arabia. *Cureus*. 2022;14(8):e27716.
49. Wolde1 T, Email, Tebeje2 B, Wondimu2 M, Beyene1 T, Awoke A. Utilization of quality antenatal care and associated factors among immediate postnatal women in Jimma town public hospitals, Oromia, Ethiopia. *Cross Sectional Study Design*. 2023.
50. Gebrekidan MG, Fisseha MA, Belay AG, Abreha GF. Effects of antepartum hemorrhage on maternal and perinatal adverse outcomes in Northern Ethiopia: a retrospective cohort study. *BMC Pregnancy Childbirth*. 2025;25(1):781.
51. Atkinson JA, Gordon HG, Tong S, Walker SP, Mehdipour P, Lindquist AC, et al. Hypertensive disorders of pregnancy and childhood neurodevelopment: A systematic review and meta-analysis. *PLoS Med*. 2025;22(9):e1004558.
52. Chakkarapani E, de Vries LS, Ferriero DM, Gunn AJ. Neonatal encephalopathy and hypoxic-ischemic encephalopathy: the state of the art. *Pediatr Res*. 2025;98(7):2444–58.

53. Mushta SM, King C, Goldsmith S, Smithers-Sheedy H, Badahdah A-M, Rashid H, et al. Epidemiology of cerebral palsy among children and adolescents in Arabic-speaking countries: a systematic review and meta-analysis. *Brain Sciences*. 2022;12(7):859.
54. Zhang S, Li B, Zhang X, Zhu C, Wang X. Birth Asphyxia Is Associated With Increased Risk of Cerebral Palsy: A Meta-Analysis. *Front Neurol*. 2020;11:704.
55. Zhang S, Li B, Zhang X, Zhu C, Wang X. Birth asphyxia is associated with increased risk of cerebral palsy: a meta-analysis. *Frontiers in neurology*. 2020;11:704.
56. Seale AC, Blencowe H, Zaidi A, Ganatra H, Syed S, Engmann C, et al. Neonatal severe bacterial infection impairment estimates in South Asia, sub-Saharan Africa, and Latin America for 2010. *Pediatric research*. 2013;74(1):73–85.
57. Tann CJ, Webb EL, Lassman R, Ssekyewa J, Sewegaba M, Musoke M, et al. Early childhood outcomes after neonatal encephalopathy in Uganda: a cohort study. *EClinicalMedicine*. 2018;6:26–35.
58. Reid SM, Dagia CD, Ditchfield MR, Carlin JB, Reddiough DS. Population- based studies of brain imaging patterns in cerebral palsy. *Developmental Medicine & Child Neurology*. 2014;56(3):222–32.
59. Xu H, Zhang L, Xuan X, Zhu M, Tang J, Zhao X. Intrauterine cytomegalovirus infection: a possible risk for cerebral palsy and related to its clinical features, neuroimaging findings: a retrospective study. *BMC pediatrics*. 2020;20(1):555.
60. O'Callaghan M, MacLennan A. Cesarean delivery and cerebral palsy: a systematic review and meta-analysis. *Obstet Gynecol*. 2013;122(6):1169–75.
61. Adugna M, Asmare K, Wondim A. Meconium aspiration syndrome and associated factors among neonates admitted at neonatal intensive care unit at Northwest Ethiopia comprehensive specialized hospitals Northwest Ethiopia 2023. *BMC Pediatr*. 2025;25(1):167.

12. Appendixes

I. Consent Form

My name is SenduDest (MD) I am a post-graduate student in Bahir Dar University College of Medicine and Health Sciences Department of Pediatrics and Child health. I was conducting my thesis work in Tibebe Ghion Specialized Hospital among cerebral palsy patients who was visiting pediatric and child health follow-up clinic patients in the pediatric department from September 2023-August 2025 by reviewing medical records of the patients.

I need your support and permission for my work to be conducted as needed.

Data collector's name _____ signature _____

Supervisor's name _____ signature _____

12.1.Questionnaire

I. English version Questionnaire

Instruction: please read the question as well as circle for the given number choice or tick the box to those closed-ended questions and write the answer for the open-ended questions.

I. Socio-demographic characteristics		
1.	Child age in years	-----
2.	Child Sex	1. Male 2.Female
3.	Child Place of residence	1. Rural 2. Urban
II. Prenatal history		
1.	Was any maternal illness during or before pregnancy?	1.Yes 2. No If yes ,specify-----
2.	Maternal drug/alcohol intake	1. Yes – mention a type of drug 2. No
3.	Was baby's mother had ANC follow up during pregnancy	1. Yes 2. No 3.Not sure
III. Birth and perinatal history		
1.	Was child born at term	1. Yes, GA----- 2.No→ if no ,gestational age at birth- ---weeks
2	Number of pregnancy	1.Singletone 2.Twin 3. Triplet
3.	Child place of delivery	1. Home 2. Local health center 3. Primary hospital 4.General hospital 5.Tertiary hospital
4.	Mode of delivery	1. Spontaneous vaginal delivery 2.vaginal with instrumental assisted(vacuum/forceps 3. C/S (emergency / elective)
5.	Child birth weight	1.<1000gm 2. <1500gm 3. <2000gm 4.<2500gm-4000gm 5.>4000gm

		6. Unknown
6.	Any complication during delivery	1.Yes 2. No If you say yes ,please specify-----
7.	Was a child crying immediately after delivery?	1.Yes 2. No
IV.Post natal history		
1.	Did the baby require NICU (neonatal intensive care unit) admission?	1. Yes ,how long was stay at hospital 2.No
2.	Was the baby had illness during neonatal age or before one year of age?	1.Yes 2. NO
3.	If question number 1is yes, what type of illness?	1. Jaundice 2. Convulsion 3. Meningitis or sepsis 4. MASS 5. PNA
IV. Developmental history		
1.	Has a child achieved developmental milestones at the expected age?	1.Yes 2. No 3.Not sure
2.	If question number 1is yes, which developmental milestones are affected?	1.Motor(gross/fine 2.Language 3. Social 4.Cognition
3.	At what age a child start walking?	----
5.	Has the child been diagnosed with any of the following condition?	1. Epilepsy 2. Intellectual disability 3. Vision impairment 4. Hearing loss 5. Speech delay
6.	Is the child currently receiving any of the following therapy?	1. Physiotherapy 2. Occupational therapy 3. Speech therapy 4. Medications 5. None
7.	At what age cerebral palsy was diagnosed, if no what is diagnosis?	-----
8.	If question number 7 is yes, what types of cerebral palsy	1.Hemiplegic spastic/dyskinetic 2. Quadriplesic spastic/dyskinetic 3. Paraplesic spastic/dyskinetic 4.Diplesic spastic/dyskinetic 5. Monoplesic spastic/dyskinetic 6. Mixed

Declaration

This is to certify that the thesis entitled "Assessment of Proportion and Associated Factors of Cerebral Palsy Among Neurologic Cases at the Pediatric Follow-Up Clinic of Tibebe Ghion Specialized Hospital, Northwest Ethiopia, 2026", submitted in partial fulfillment of the requirements for the Specialty in Pediatrics and child health, Bahir Dar University, is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

Submitted by: _____ Signature _____ Date _____

Dr.SenduDesta (Pediatric and child health resident) _____

College/Department:_____

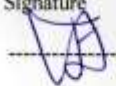
Approved by:

Name of Main advisor

1. Dr. AchenefMotbinor (PhD, Asso.Prof.of Public Health)

Signature _____ Date _____

2. Dr. Mequanint Haile (MD, Assistant Professor of pediatrics and child health)

Signature  _____ Date 21/08/28 E.C.

