



Hearing and Visual Impairment in Children with Cerebral Palsy, A Study in Tertiary Level Hospital in Bangladesh

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Abstract

Background: Cerebral palsy (CP) is a diagnostic term used to describe a group of motor syndromes resulting from disorders of early brain development. CP remains unexplained in most cases and is typically diagnosed outside the neonatal period. Visual impairment decreases the quality of life and hearing impairment hampers linguistic development. This study aimed to observe the visual and hearing impairment of children with cerebral palsy associated with developmental disabilities.

Material & Methods: This is a cross-sectional observational descriptive study carried out in the department of Paediatric Neurology CMH Dhaka from March 2018 to February 2022. The participants (N=120) were from birth to 12 years of age. Detailed information was obtained in each case according to protocol. The pediatric neurologist based on the study definition crosschecked the diagnosis. The hearing assessment was done with the help of an Otolaryngologist in the department of Otolaryngology and the ophthalmological evaluation was done with the help of an ophthalmologist of the department of ophthalmology of CMH Dhaka. Hearing impairment, Ophthalmological motor disturbance, and developmental disabilities were correlated. A convenience sampling technique was used in this study. Relevant data were collected from hospital records. All the information was recorded in the fixed protocol. Collected data were classified, edited, coded, and entered into the computer for statistical analysis by using SPSS 2021. **Results:** In this study, among the 120 children with CP, the mean age of the study was 5.57(SD±3.89) age range of 2-12 years Males were 82(68%) and females were 38(32%), male-female ratio (sex M: F 2.15: 1). Spastic quadriplegia constitutes the predominant group 59(49%), followed by Spastic diplegia 21(18%), Spastic hemiplegia 20(17.5%), dyskinetic CP 09(8%), 7(6%) were mixed CP and 4(3%) were hypotonic CP. Hearing impairment was found in 87 (72%) cases and visual impairment was detected in 92(76%). Among them, the child with Spastic Quadriplegic (83%) and diplegic CP (62%) children had a hearing impairment. Regarding vision, no fix and follow were observed in 69(57%) cases. Among the studied CP child (n=120) 16 children (13.33%) had normal eye finding and 104 (86%) had abnormal eye findings. Refractive error (32.5%) and Squint (19%) were the most common ocular defect among studied patients. Other ocular defect were nystagmus(10%), optic atrophy(12.5%), microphthalmia(10%), corneal opacity(3%), optic hypoplasia(4.1%), cataract(2.5%), pigmentary retinopathy(5%), retro-lental fibroplasias(3.3%) and ptosis(2.5%).

In children with hypotonic (athetoid) and mixed CP, almost all (11 of 11) children had visual impairment. Spastic quadriplegic CP children (80%) and Spastic diplegic CP children (90%) had one or more domains of visual impairment. **Conclusion:** Cerebral Palsy is a non-progressive various form of neurological disorder in children. Early visual screening and hearing assessment can help CP children to minimize mental retardation, learning difficulties, and speech delay.

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INTRODUCTION

In the 1860s, an English surgeon named William Little wrote the first medical descriptions of a puzzling disorder that affected children in the first years of life, causing stiff, spastic muscles in their legs and to a lesser degree, their arms. These children had difficulty grasping objects, crawling, and walking. They did not get better as they grew up nor did they become worse. Their condition, which was called Little's disease for many years, is now known as spastic diplegia. It is one of several disorders that affect control of movement due to developmental brain injury and are grouped under the term cerebral palsy.^[1] Risk factors for cerebral palsy in term or near-term children include intrauterine exposure to infection or inflammation and disorders of coagulation. Interruption of the oxygen supply during birth contributes to approximately 6% of spastic cerebral palsy.^[2] "Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation that is attributed to the non-progressive disturbance that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior, epilepsy, and secondary musculoskeletal problems."^[3] Cerebral palsy (CP) is the most common cause of severe physical disability in childhood, occurring in approximately 2-2.5 in 1,000 life-born infants. No definitive diagnostic tests are available.^[3,4] CP is caused by a broad group of developmental, genetic, metabolic, ischemic,

infectious, and other acquired aetiologies that produce a common group of neurologic phenotypes.^[5] CP is the most common cause of severe physical disability in childhood. It is primarily a neuromotor disorder that affects the development of movement, muscle tone, and posture. The underlying pathophysiology is an injury to the developing brain in the prenatal through the neonatal period. Although the initial neuropathologic lesion is non-progressive, children with CP may develop a range of secondary conditions over time that will variably affect their functional abilities. Multiple epidemiological studies report that half of the children who develop CP were born at term without any identified risk factor.^[6,7] Loss of productivity, dependency, progressive deterioration of motor physical function, recurrent use of rehabilitation services, and reduced life expectancy all contribute to the economic burden.^[8] Ocular problems in children with CP are a major issue. Over 40-75% of children with CP have some form of visual problem or impairment. They may have an acuity loss, field loss, oculomotor problem, and/or a processing problem. Co-morbidities of cerebral palsy include- mental retardation, Cognitive delay, behavioral problems, speech, hearing, and language disorders, and ocular and learning difficulties.^[9] These various secondary conditions are not a part of the primary disabling condition but adversely affect function and quality of life.^[10] CP encompasses multiple etiologic diagnoses based on a broad range of presentations that include type, severity, and bodily distribution of primary motor impairment, associated nonmotor neurologic and behavioral

impairments, and functional deficits. Thus, CP is categorized as spastic, ataxic, or dyskinetic, and the distribution is categorized as bilateral or unilateral.^[11]

Objective

General Objective

To evaluate the hearing and ocular defects in children with cerebral palsy and their correlation with the different types of cerebral palsy.

Specific Objectives

To find out different types of developmental disabilities e.g speech delay, learning difficulties, cognitive delay, behavioral problems, and mental retardation in children with cerebral palsy.

To correlate these developmental disabilities with the types of cerebral palsy in association with the hearing and visual impairments.

MATERIAL AND METHODS

It was a cross-sectional observational hospital-based study conducted in the Paediatric Neurology unit of a tertiary care teaching hospital CMH Dhaka. From January 2018 to June 2022. Children, 2-12 years of age, who reported at child neurology OPD and admitted children in CMH Dhaka were included in the case study. Diagnosis of cerebral palsy is primarily based on history, clinical presentation & physical examination, and confirmation by a Paediatric neurologist. A total of 431 cases were screened and out of them, 120 cases met the protocol inclusion and exclusion criteria. After taking informed consent detailed history was taken from either the patient's

guardian or accompanying attendants. General, systemic, and thorough neurological examinations were done. Diagnosis of cerebral palsy was clinically based on inclusion and exclusion criteria. Motor abnormalities of CP cases were categorized - as hemiplegic/quadriplegic/ataxic/hypotonic/mixed/dyskinetic / diplegic. Developmental disabilities were noted. Hearing assessment and ophthalmological evaluation was done and correlated with types of cerebral palsy through appropriate statistical analysis. The pediatric neurologist based on the study definition crosschecked the diagnosis. The hearing assessment was done with the help of an Otolaryngologist in the department of Otolaryngology and the ophthalmological evaluation was done with the help of an ophthalmologist of the department of ophthalmology of CMH Dhaka. Hearing impairment, Ophthalmological motor disturbance, and developmental disabilities were correlated. A convenience sampling technique was used in this study. Relevant data were collected from hospital records. All the information was recorded in the fixed protocol. Collected data were classified, edited, coded, and entered into the computer for statistical analysis by using SPSS 2021. Ethical clearance was obtained from the ethical committee of CMH, Dhaka.

Inclusion Criteria

Children with cerebral palsy who had:

- Disorder in the development of movement & posture presumably of cerebral origin started before the second year of age.
- The presence of spasticity is characterized by increased tone, reflex, or extensor planter response.

- Delayed milestone of development, which was improving over time.
- The age of the patient was 12 months to 12 years.
- Other varieties of CP, were compatible clinically.

Exclusion Criteria

- Children with progressive neurological disability
- Patients who did not give consent to participate in the study.

RESULTS

In this study, among the 120 children with CP, the mean age of study was 5.57(SD±3.89) age range of 2-12 years Males were 82(68%) and females were 38(32%), and male-female ratio (sex M: F 2.15: 1). [Table 1]

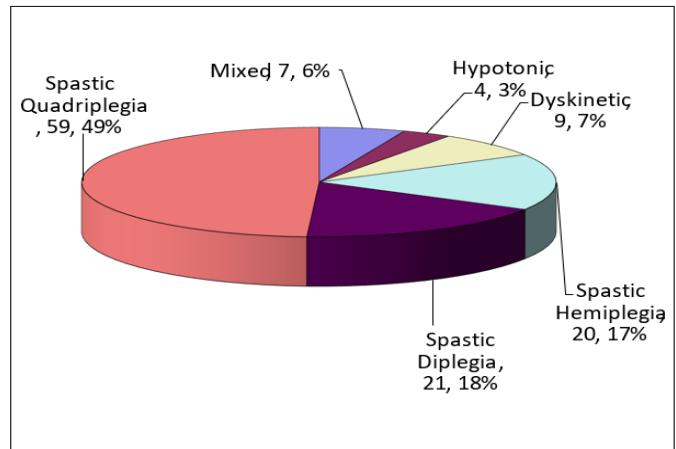


Figure 1: Types of cerebral palsy in children according to muscle tone and limb involvement (N=120)

59, 49.0% of patients had spastic quadriplegia, followed by 21, 18.0% had spastic paraparesis, and 20, 17.0% had spastic hemiparesis. [Figure 1]

Table 1: Demographic characteristics of Cerebral Palsy among study cases (N=120)

Variables	N	%
Age		
2-5 years	51	42.50
5-8 years	32	26.66
8-12 years	37	30.83
Sex		
Male	82	68.33
Female	38	31.66

In this study, among the 120 children with CP, the mean age of study was 5.57(SD±3.89) age range of 2-12 years Males were 82(68%) and females were 38(32%), and male-female ratio (sex M: F 2.15: 1). [Table 1]

Table 2: Clinical types of Cerebral Palsy among study cases (N=120)

Characteristics of CP	N	%
According to tone Spastic	100	83
Dyskinetic	9	7.5
Hypotonic	04	03
Mixed (Spastic and Dyskinetic)	07	06
Limb involvement Quadriplegia	59	49

Diplegia	21	18
Hemiplegia	20	17
Right side	10	8.5
Left side	10	8.5
Mixed/unclear	07	6
Combined types Spastic Quadriplegia	59	49
Spastic Diplegia	21	18
Spastic Hemiplegia	20	17
Dyskinetic CP	09	7.5
Hypotonic CP	04	03
Mixed (Spastic and Dyskinetic)	07	06

Spastic quadriplegia constitutes the predominant group 59(49%), followed by Spastic diplegia 21(18%), Spastic hemiplegia 20(17.5%), dyskinetic CP 09(8%), 7(6%) were mixed CP and 4(3%) were hypotonic CP. [Table 2]

Table 3: Association between Hearing impairment with the type of CP (N=120)

Hearing impairment	Spastic QP n=59	Spastic DP n=21	Spastic HP n=20	Dyskinetic CP n=09	Hypotonic CP n=04	Mixed CP n=7	Total (N=120)
Normal	10	08	08	07	00	00	33
Impaired	49	13	12	02	04	7	87

Hearing impairment was found in 87 (72%) cases and visual impairment was detected in 92(76%). Among them, the child with Spastic Quadriplegic (83%) and diplegic CP (62%) children had a hearing impairment. [Table 3]

Table 4: Association between visual impairment with the type of CP (Visual comorbidities) (N=120)

Visual impairment	Spastic QP n=59	Spastic DP n=21	Spastic HP n=20	Dyskinetic CP n=09	Hypotonic CP n=04	Mixed CP n=07	Total N=120
No fix and follow	44	10	04	--	04	07	69
Fix& Follow	07	07	12	03	--	--	29
Mild/Normal	06	04	04	02	--	--	16
Squint	02	09	07	05	--	--	23

Regarding vision, no fix and follow were observed in 69(57%) cases. [Table 4]

Table 5: Frequency of ocular defect in cerebral palsy (N=120)

Ocular defect	Number	Percentage
Normal eye finding	16	13.33
Refractive error	39	32.5
Squint	23	19.16
Nystagmus	12	10

Optic atrophy	15	12.5
Microphthalmia	16	10
Cataract	3	2.5
Corneal opacity	4	3.07
Optic hypoplasia	5	4.1
Pigmentary retinopathy	6	5
Retro-lental fibroplasia	4	3.3
Ptosis	3	2.5

Among the studied patients (n=120) 16 patients (13.33%) had normal eye finding and 104 patients (86%) had abnormal eye findings. Refractive error (32.5%) and Squint (19%) were the most common ocular defect among studied patients. Other ocular defect were nystagmus(10%), optic atrophy(12.5%), microphthalmia(10%), corneal opacity(3%), optic hypoplasia(4.1%), cataract(2.5%), pigmentary retinopathy(5%), retro-lental fibroplasias(3.3%) and ptosis(2.5%). [Table 5]

Table 6: Association of Hearing and visual impairment with different types of CP children (N=120)

CP Types	Hearing impairment n=87 (72%)	Visual impairment n=92(76%)
Spastic QP n=59	49	46
Spastic DP n=21	13	19
Spastic HP n=20	12	11
Dyskinetic CP n=09	02	05
Hypotonic CP n=04	04	04
Mixed CP n=7	07	07

DISCUSSION

In children with Spastic quadriplegia hearing impairment 83 %(49 Of 59), visual impairment 80% (46 of 59).

In Spastic diplegia 62 %(13 of 21) had a hearing impairment and 90% (19 of 21) had a visual impairment. Children with Spastic hemiplegia suffer almost the same as spastic diplegia. In dyskinetic CP Hearing impairment was seen in 22% (2 of 9) cases. But visual impairment was observed in 55 %(5 of 9) cases. In children with hypotonic (athetoid) and mixed CP, almost all children had global impairment of function. [Table 6]

Hearing and visual defects in children with CP are major problems. The study of finding the visual and hearing impairment in children with CP and their correlation with the types of CP. This study helps to categorize them according to problems and to counsel the parents & provide early intervention. A total 120 number of children with cerebral palsy were included in this study. Although the diagnosis of CP is clinical, not much research has been done to date on cerebral palsy. Neuropathology identified by magnetic resonance imaging (MRI) corresponds well to clinical descriptions of motor impairment in children who have CP. Cerebral palsy can an associated disability,

hearing loss, visual impairments, epilepsy, speech and language disorders, and cognitive impairments.^[12] Hearing impairment as well as visual field loss are usually hidden disabilities. However, early detection and intervention can prevent severe psychosocial, educational, and linguistic repercussions. In this study out of 120 children, 82(68%) were male and 38(32%) were female. Male female ratio (sex M: F 2.15: 1, majority of the children 83(69%) were below 8 years, mean age of the study was 5.57(SD±3.89) years, which may be due to early detection of CP and awareness among parents. In a study by Liptak GS, et al mean age of CP was 9.6 years SD ±4.6; 59% were male 41% were female which is approximately similar to this study.^[14] In this present study, Spastic quadriplegic CP was 59(49%), Spastic diplegic CP case 21(18%, Spastic hemiplegic CP case 20(17%), Dyskinetic CP cases 9 (7%), Hypotonic CP was 4 (3%) and mixed CP were 7(6%). Behairy E H. et al. demonstrate 76.6% was spastic quadriplegia which is nearly similar, 6.67% was spastic hemiplegia, and 3.33% spastic diplegia which is not consistent with this study.^[14] In the study of Mezaal M A et al, 32% was spastic hemiplegia, 18% spastic quadriplegia which was similar but 12% was spastic diplegia, and 16 % mixed CP which was dissimilar to this study. [15] Hearing impairment with different types of CP was observed in some 87 cases. Among the different types of CP, hearing impairment was found in all cases of Hypotonic CP & mixed CP, followed by Spastic QP (83%; 49 of 59), Spastic hemiplegia (66%; 8 of 12), and diplegia (61%; 8 of 13), less in dyskinetic CP 22%(2 of 9). In this study correlation between the type of CP and hearing impairment. 83% in quadriplegic CP. In the study by Mezaal M A et al hearing loss is 63%, that study approximately similar to this

study.^[15] Carvalho E.H. et al found hearing impairment of 28.9% in dyskinetic and quadriplegic CP.^[16] A total of 69 number (57.5%) of CP children had been suffering from severe Visual impairment in the form of no fix and follow. Hypotonic and mixed CP suffer almost all (100%), Spastic QP sufferers (75%), followed by Spastic DP (50%) and Spastic HP (20%). Fix and follow not affected in dyskinetic CP. However, squint is mostly observed in dyskinetic CP (55%) as well as Spastic diplegia (42%) and Spastic hemiplegia (35%). Normal vision was observed only in 13 percent of cases. Among the studied patients (n=120) 16 patients (13.33%) had normal eye finding and 104 patients (86%) had abnormal eye findings. Severe visual impairment is detected mostly in spastic quadriplegic and diplegic CP. Nystagmus, refractory error observed in other types of Cerebral palsy.

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSIONS

Diagnosis of Cerebral Palsy is clinical with multifactorial etiology. Cerebral Palsy is difficult to manage because of the motor disorder and the associated co-morbidities. The vital time to prevent maximum cases of Cerebral Palsy is to provide maximum care of the mother during the gestational period to prevent premature birth, and risk assessment before birth to prevent perinatal insult to the developing brain. Early audio-visual assessment is very important to improve language outcomes in these children.

Recommendation

Physiotherapy interventions, particularly strengthening and to a lesser extent functional

training, in school-aged children with CP should be taken of. Further studies should be conducted involving a large sample size and multiple centers in this regard.

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