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A Review of Gross Motor Function in Children with Cerebral Palsy in Zaria, North-Western Nigeria

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Abstract

Background: Impaired motor function is the hallmark of cerebral palsy and could present with grave implications particularly in resource limited settings. Consequently the identification of motor function and mobility needs in children with cerebral palsy in such settings is vital to providing optimal care.

Objective: To describe the gross motor function in children with cerebral palsy presenting to a child neurology service in Zaria, north-western Nigeria.

Methods: A review of the gross motor function, using the Gross Motor Function Classification System Expanded and Revised (GMFCS- E&R), of children with cerebral palsy (Subjects) who were in steady state of health and who presented at Neurology Clinic of the Departments of Paediatrics and Physiotherapy, of the Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, Nigeria over a five year period was under taken. Other parameters assessed were: age, sex, identified predisposing factor for cerebral palsy, clinical type of cerebral palsy, mode of transport and social class of the subjects.

Results: A total of 235 subjects with age range 5 months to 11 years (mean 2.6 ± 2.4 years) were studied. Of the subjects 148 were males and 87 females (M.F, 1.7:1). Most of the subjects were under 2 years of age (169, 71.91%), in the upper social classes (182, 77.45%), had the spastic clinical type of cerebral palsy (184, 78.30%) and birth asphyxia (106, 45.1%) as the commonest identifiable predisposing factor. Majority of the subjects (143, 60.9%) had severe limitation (GMFCS-E&R Levels IV&V) in gross motor function and this was significantly ($p<0.05$) associated with age less than 2 years and spastic type of cerebral palsy. Out of the 205 (87.2%) Subjects who needed a transport mobility device only 14(6.8%) of them utilized one.

Conclusion: The study was characterized by severe limitation in gross motor function and limited utilization of mobility devices in the subjects. It underscores the need to address mobility issues in children with cerebral palsy in the environment.

Keywords: Cerebral palsy; Gross motor function; Mobility; Impairment; Needs; Devices; Nigeria

Introduction

Cerebral palsy is a significant cause of childhood physical disability [1]. It has been described as "a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances 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 behaviour, by epilepsy, and by secondary musculoskeletal problems" [2]. Its global prevalence is 2 per 1000.3,4 It is a major cause of visit to child neurology clinics, in our centre 5-7 and region of practice8-11, with a case prevalence rate of up to 90%12 of cases seen.

Impairment of motor function is the hallmark, even though variable, in cerebral palsy [3,4]. Better outcomes in cerebral palsy could be achieved with comprehensive management of its impaired motor functions [5-13]. Spasticity, topographical distribution of impairment, acquisition of motor abilities before 2 years of age, associated visual impairment, and the availability of family support and health care services are some factors that could influence the characteristics of motor function [14]. The use of several treatment modalities such as physiotherapy, botulinum toxin, intrathecal baclofen injections, orthopedic surgery and utilization of orthoses, for impairment in motor functioning, have been reported with variable successes [15,16]. Utilization of these contemporary modalities is limited in settings like ours, where management of children with special health care needs such as in cerebral palsy, is challenged by dearth of specialist care providers and services, high cost of accessing care where available, paucity of health information, poor traditional practices and a high expectation of recovery by caregivers [17-19].

A grasp of the impairment in motor function, such as that of the gross motor function, could help obviate some of the management challenges. This it can achieve through provision of information that

could be useful in planning, determining and providing appropriate therapy for impaired gross motor function as well as monitoring the progress of therapy. Furthermore, such knowledge would help in identifying mobility needs and augment the counseling of parents or caregivers. The Gross Motor Function Classification System (GMFCS) 20 which provides insight into the gross motor function of children with cerebral palsy could provide such knowledge.

The GMFCS is a valid and reliable tool that describes routine self-initiated movement with emphasis on sitting, transfers and mobility in children with cerebral palsy [20]. It has been expanded more recently, as the Gross Motor Function Classification System Expanded and Revised version (GMFCS-E&R), to include the 12 to 18 years age band and emphasize the concepts inherent in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF) [20].

Reports on motor function classification using the GMFCS in Nigeria are few [9,21]. They indicate a high prevalence of those in the most impaired levels of the GMFCS, and a significantly negative impact of severe motor function impairment on nutrition9 and the health related quality of life (HRQoL) [21], in children with cerebral palsy.

The aim of the study was to describe the gross motor function, using the GMFCS-E&R, in children with cerebral palsy that are attending a tertiary health facility in northwestern Nigeria.

Methods

The recorded gross motor function of children with cerebral palsy who presented at the Neurology Clinic of the Department of Paediatrics, and the Department of Physiotherapy, Ahmadu Bello University Teaching Hospital (ABUTH) Shika-Zaria over a five year period, between January 2005 and December 2009, were reviewed.

The hospital, ABUTH, is the foremost Teaching Hospital in Northern Nigeria. The paediatric neurology clinic is run by three consultants and assisted by registrars on a weekly basis. The clinic receives referrals of childhood neurological disorders from within the hospital and the 19 northern states that make up Northern Nigeria. All new cases undergo medical clerkship by a registrar and reviewed by one of the consultants. In such clerking the clinical assessment of motor function in each child (subject) presenting with cerebral palsy are recorded in detail. Details of each subject's gross motor function include the subject's motor function capacity (what the child can do), performance (what the child does usually) and time of achievement of gross motor developmental milestones. Each child diagnosed with cerebral palsy is routinely referred to the department of physiotherapy where motor functions are also evaluated by a chief physiotherapist and need for physical therapy determined. Those requiring physical therapy are offered physiotherapy three times weekly. In addition to the paediatrician and physiotherapist, a clinical psychologist, nutritionist and social worker constitute the basic rehabilitation team to whose services the child with cerebral palsy is exposed to. The outcome of such services is reviewed on a quarterly basis by the team whose objectives include: minimizing the physical impact of motor impairment, preventing the development of contractures, improving nutritional status of patients, identification and ensuring appropriate management of co morbidities, and the provision of psychosocial support to patients and their caregivers.

Criteria for case inclusion were: a diagnosis of cerebral palsy, evidence of detailed clinical assessment of gross motor function in both departments, and a steady state health status at time of diagnosis in the neurology clinic. Children who had cerebral palsy but also presented with an acute illness such as a febrile illness or diarrhoea related disease at the time of assessment were excluded. These conditions are associated with prostration and could have influenced the physical examination of the musculoskeletal system at presentation.

The records of the clinical assessment of gross motor function in the subjects, from the departments of paediatrics and physiotherapy, were reviewed simultaneously to encompass every detail of each subject's gross motor function. Review of gross motor function was based on documented current gross motor milestone at presentation, time of achievement, and characteristics of mobility (capacity and performance of gross motor function). Where there was a discrepancy between recorded capacity and performance the variable in which the subject displayed a higher ability is designated as the gross motor function. This is because the authors agree that emphasis should be on abilities rather limitations in children with disabilities and the fact that environment can influence motor function [20]. The patient's resultant gross motor function was further classified using the Gross Motor Function Classification System-Expanded and Revised (GMFCS-E&R). The GMFCS-E&R is a standardized 5 level classification system based on self-initiated movement with particular emphasis on sitting, transfers and mobility [Table 1] [20]. The emphasis in the GMFCS-E&R is on usual performance. For the purpose of this study those in the GMFCS-E&R Levels I-III (Those with mild to moderate limitations in gross motor function) were classified as being in the Upper Levels while those in Levels IV and V (Those with severe limitations) as being in the Lower Levels of GMFCS-E&R.

GMFCS – E&R Levels and characteristics	No of Subjects	Percent of Total
I-Walks or sits without limitations	20	8.5
II -Walks or sits with limitations but no external support. Creeps or crawls on hands and knees.	27	11.5
III-Walks with assisted mobility. Sits with limited external support. Rolls and creeps forward on stomach.	45	19.1
IV-Sits with adaptive equipment. Rolls to supine or prone position.	55	23.4
V- Limited ability to maintain antigravity head and trunk postures and control arm and leg movements	88	37.5
Total	235	100

Table 1: The distribution of GMFCS – E&R20 levels in the subjects.

Other parameters of the subjects assessed were age, sex, social class distribution, mode of transporting child to the clinic, identifiable causes and clinical types of cerebral palsy. Social class distribution (Classes I-V) was determined by the authors using the Ogunlesi et al classification [22]. In this study, those in Social Classes I-III were further grouped as being in the Upper Social Classes while those in Classes IV and V were grouped in the Lower Social Classes. The

clinical types of cerebral palsy were classified according to the physiologic and topographical motor abnormalities identified and into the Spastic, Dyskinetic, Ataxic and the Mixed types [23].

Ethical approval was obtained from the ethical committee of ABUTH Zaria.

Data analysis was carried out using Epi Info 3.5.3. Frequencies and proportions were tabulated while Chi-square test, with Yates Correction where applicable, was used in determining the relationship between the subjects' Gross Motor Function and other clinical features. A p-value less than 0.05 was regarded as significant.

Results

There were 304 cases of cerebral palsy out of the total 723 new paediatric neurology cases seen in the clinic giving a prevalence rate of 42% for cerebral palsy. However only 235(77.3%) of the cases, who fulfilled the eligibility criteria, were analyzed.

The GMFCS-ER distribution

The distribution of the GMFCS-ER levels among the 235 cases was as follows; I, 20(8.5%); II 27(11.5%); III 45(19.1%); IV 55(23.4%) and V 88(37.5%) cases respectively. Majority (143, 60.9%) were in the Lower Levels of the GMFCS-E&R. A total of 205(87.2%) subjects needed to be physically carried to the clinic (requiring a transport mobility device) by caregivers and only 14 (6.8%) of them utilized a manually operated pram or wheel chair.

Age, sex and GMFCS-E&R distribution

There were 148 males and 87 females (M: F, 1.7:1). The age range was 0.4 to 11 years (mean: 2.6 ± 2.4 years, median: 1.6years). Majority (169, 71.91%) were under the age of 2 years [Table 2]. Most of those in the lower GMFCS-E&R levels (124, 86.7%) were significantly (χ2=39.61, df=1, p=0.00) below 2 years of age [Table 3].

Age (years)	Sex (%)		Total (%)	GMFCS-E&R Level				
	M	F		I	II	III	IV	V
<2 years	111(75)	58(66.67)	169(71.91)	10(50)	13(48.14)	22(48.89)	44(80)	80(90.9)
2 years - <4 years	21(14.19)	17 (19.54)	38(16.17)	4(20)	7(25.93)	14(31.11)	9(16.36)	4(4.55)
> 4 years	16(10.81)	12(13.79)	28(11.92)	6(30)	7(25.93)	9(20)	2(3.64)	4(4.55)
Total (%)	148(100)	87(100)	235(100)	20(100)	27(100)	45(100)	55(100)	88(100)

Table 2: Age, sex and GMFCS-E&R level distribution of the subjects.

Subjects' characteristics	No of subjects, n=235(%)	Subjects in Upper GMFCS-E&R (I-III) levels, n=92(%)	Subjects in Lower GMFCS-E&R (IV-V) levels, n=143(%)	P value
Age(years)				
<2	169 (71.9)	45 (48.9)	124 (86.7)	0.00
≥2	66 (28.1)	47 (51.1)	19 (13.3)|	
Social class				
I-III	182(77.4)	73 (79.3)	109 (76.2)	0.58
IV-V	53(22.6)	19 (20.7)	34 (23.8)	
Predisposing factor				
Birth asphyxia	106 (45.1)	35 (38)	71 (49.7)	0.08
Others	129 (54.9)	57 (62)	72 (50.3)	
Clinical type				
Spastic	184 (78.3)	61 (66.3)	123 (86)	0.00
Others	51 (21.7)	31 (33.7)	20 (14)	

Table 3: Relationship between some characteristics of the subjects and their GMFCS-E&R levels.

Social Class, Identifiable Predisposing Factors and GMFCS-E&R Levels

There were more (182, 77.45%) children in the Upper Social Classes [Table 4]. However the social class of the subjects did not significantly influence their GMFCS-E&R level [Table 3].

Also, birth asphyxia which was the commonest (106, 45.10%) identifiable predisposing factor for cerebral palsy [Table 5] was not significantly associated with the GMFCS-E&R levels [Table 3].

Clinical type and GMFCS-E&R levels

Spasticity was the dominant clinical type [Table 6]. It was made up of the following subtypes: Quadriplegia 99 (42.13%), Hemiplegia 60 (25.53%) and Diplegia 25 (10.64%). Spasticity was significantly (χ2=12.8, df=1, p=0.00) associated with lower GMFCS-E&R levels [Table 3].

Discussion

Cerebral palsy was a major presenting disorder in our Neurology Clinic and majority of the subjects had severely limited gross motor function, were physically dependent on caregivers for mobility and had limited utilization of assistive mobility devices. The high prevalence of cerebral palsy among neurological disorders in our study corresponds with findings in reports from other regions of the country [8,11,12]. It underscores the significance of cerebral palsy among childhood neurodevelopmental disorders in the country.

Studies on motor function using the GMFCS classification indicate a variable distribution among populations with cerebral palsy [9,21,24-28]. A high proportion of cases in the lower GMFCS levels has been reported from other regions in Nigeria [9,2] , Brazil [24] and

Japan [25] while a higher GMFCS levels have observed in population based studies from Holland [26], Australia [27], and Sweden [28]. The finding in our study, and in other studies with a similar outcome [9,21], could have been influenced by the tertiary health care setting in which the study was conducted. Tertiary health institutions are apt to receiving more severe cases of cerebral palsy whose management could not be addressed at lower levels of health care delivery or at home.

Social Class	GMFCS-E&R LEVELS					Total (%)
	I	II	III	IV	V	
I	5(25)	5(18.52)	5(11.11)	10(18.18)	5(5.68)	30(12.77)
II	4(20)	5(18.52)	7(15.56)	15(27.27)	11(12.5)	42(17.87)
III	8(40)	11(40.74)	23(51.11)	18(32.73)	50(56.82)	110(46.81)
IV	2(10)	3(11.11)	5(11.11)	9(16.36)	12(13.64)	31(13.20)
V	1(5)	3(11.11)	5(11.11)	3(5.46)	10(11.36)	22(9.37)
Total (%)	20(100)	27(100)	45(100)	55(100)	88(100)	235(100)

Table 4: Association between social class distribution and GMFCS-E&R levels of the subjects.

Predisposing Factor	GMFCS-E&R Levels (%)					Total (%)
	I	II	III	IV	V	
Birth asphyxia	8(40)	11(40.74)	16(35.56)	25(45.46)	46(52.27)	106(45.10)
Bilirubin Encephalopathy	6(30)	9(33.33)	14(31.11)	17(30.90)	21(23.86)	67(28.51)
Meningitis	3(15)	4(14.82)	8(17.78)	11(20)	18(20.46)	44(18.72)
Trauma/Accidents	0(0)	0(0)	1(2.22)	1(1.82)	2(2.27)	4(1.71)
Not known	3(15)	3(11.11)	6(13.33)	1(1.82)	1(1.14)	14(5.97)
Total (%)	20(100)	27(100)	45(100)	55(100)	88(100)	235(100)

Table 5: Association between identifiable predisposing factor and GMFCS-E&R levels in the subjects.

Clinical Type	GMFCS-E&R Levels					Total (%)
	I	II	III	IV	V	
Spastic	18(90.0)	21(77.78)	22(48.89)	48(87.27)	75(85.23)	184(78.30)
Dyskinetic	0(0)	6(22.28)	9(20)	2(3.64)	5(5.68)	22(9.36)
Ataxic	2(10.0)	0(0)	0(0)	0(0)	0(0)	2(0.85)
Mixed	0(0)	0(0)	14(31.11)	5(9.09)	8(9.09)	27(11.49)
Total (%)	20(100)	27(100)	45(100)	55(100)	88(100)	235(100)

Table 6: Association between clinical type of cerebral palsy and GMFCS-E&R levels of the subjects.

The high prevalence of lower level GMFCS functioning in the subjects might have negative implications for their nutritional status, HRQoL and long term survival [9,21,25]. Okeke et al. [9] and Tella et al. [2]1 in their studies, which were conducted in similar circumstances as in our study, observed a significantly negative association between lower GMFCS levels and these variables (nutrition and HRQoL). Also Touyama et al. [25] reported a significantly lower long term survival rate for those in GMFCS level V. In their cohort study, 85.3% of those with cerebral palsy that died were in GMFCS level V.

The setting of our study could also have influenced the predominantly upper social class distribution of the subjects. This is at variance with the observation that cerebral palsy is more prevalent in more deprived socio-economic population [29,30]. The subjects' social class distribution could have been as result of their caregivers' class capacity to access and afford health care. In addition to increased accessibility to rehabilitative care, increased opportunities for child play activities and social support, and greater family resources could confer a better motor outcome in subjects in the upper social classes [14].

Being less than 2 years of age was significantly associated with having severe impairment of gross motor function and been in the lower GMFCS levels. Early and severe manifestations of motor abnormalities have been found accountable for early presentation in cerebral palsy [9,21,29,30]. Additionally, caregiver discontentment with outcome of treatment has also been adduced as reason for reduction in the number of older children with cerebral palsy visiting tropical child neurology clinics [7,17,18]. Attainment of motor milestones such as sitting independently before 2years of age has been associated with more successful pre-walking and walking abilities [13]. This would imply that there is a less favorable outcome with regards to pre- walking and walking abilities in the subjects. It is important to note that children classified before 2 years of age are less likely to display GMFCS level stability over time [31,32] The enormous variation associated with development of gross motor abilities in this age group has been advanced as one of the reasons [32] However Palisano et al observed that change in GMFCS level was less likely in those classified at levels I and V, and that those classified at age less than 6 years were likely to be reclassified at a lower level [31] Consequently the possibility of a change in GMFCS level conferring a better outcome in gross motor function among subjects in the lower GMFCS levels is unlikely.

Spastic cerebral palsy was the dominant clinical type and this has also been reported severally among children with cerebral palsy [3,4,30]. Also the high number of those with spastic cerebral palsy in the lower GMFCS levels buttresses the reported association between spasticity and higher levels of disability [13,33].

The use of assistive technology in achieving mobility in cerebral palsy is well established in developed countries [16,20,34,35] In these settings classification and monitoring of motor function, the availability of skilled manpower, a variety of assistive and adaptive mobility devices, and a well suited environment ease mobility constraints. Less than ten percent (6.8%) of the subjects who required assisted mobility utilized a manually operated device for transport. This could be adducible to one or a combination of factors that includes: poor awareness about the existence of such devices, lack of the devices, inadequate rehabilitative facilities, and inability to access these facilities where they are available. The implication is that majority of the subjects are manually transported. This increases the burden of physical care and exposes the child to a hazard such as trauma during transportation. About one-fifth of the study population had milder impairment indicating the need for adaptive devices such as truncal and pelvic braces, and hand-held assistive mobility devices.

The consequences of immobility are grim. Children with impaired mobility could be denied benefits of physical activity which could be physical (increased mobility, reduced contractures, increased muscular strength and endurance), social (developing relationships and social skills) or psychological (enhanced self-esteem and body image) [34,35] Impaired mobility could result in bed sores, hypostatic pneumonia, disuse muscular atrophy, development of contractures and fractures [36-40]. These could increase the risk of mortality which is higher in cerebral palsy than in the normal population [41]. In addition other normal systemic functions that might be mildly affected such as intellectual function could become under developed as a result of isolation that is commonly associated with immobility. Impaired motor function also increases the physical and psychosocial burden on caregivers [42,43]. Overwhelming burden in these caregivers could result in child abuse or neglect, psychopathology and abdication of other social responsibilities [42,43].

Preventing the consequences of immobility would improve outcomes in cerebral palsy. This would require a multi-dimensional approach. The objectives of such an approach should include: the identification of the magnitude of cerebral palsy in any given population and its mobility needs, provision of comprehensive rehabilitative services and tackling the risk factors of cerebral palsy. These objectives should be championed by the health system in respective countries and in collaboration with other relevant agencies.

Limitations of the Study

The study did not assess the impact of the subjects' environment on gross motor function and the stability of the gross motor function over time. These would have been useful in further identifying and addressing the mobility needs of the subjects. A prospective study of these would provide such valuable insight.

Conclusion

The study observed a high prevalence of severe impairment in gross motor function among the subjects with most being in GMFCS levels IV and V. This was significantly associated with age below 2 years and spastic cerebral palsy. There was also a limited utilization of assistive mobility devices. It highlighted the relevance of the comprehension of gross motor function and the use of mobility facilities, in the management of cerebral palsy, in our practice.

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