Association Between Gross Motor Function and Associated Impairments among Children with Severe Cerebral Palsy in Selected Hospitals in Kano City

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Abstract

Associated impairments may produce even greater activity limitation than the motor impairments that are the hallmark of cerebral palsy. In this study, the association between gross motor function and associated impairments in children with severe cerebral palsy in selected hospitals in Kano city was evaluated. It was a cross sectional study that recruited 52 participants using a purposive sampling technique. Gross Motor function was assessed with Gross Motor Function Classification System (GMFCS) and spasticity was measured with modified Ashworth scale. Associated impairments were evaluated both objectively and subjectively. The data obtained was analysed with inferential statistic of Chi-square at alpha level of 0.05 .The children in this study comprised of 17(32.7%) females and 35(67.3%) males with mean age of 2.0846 ± 1.76 years. Majority of them had spastic (42.3%) and athetoid (42.3%) Cerebral palsy (CP) types. There was significant association between Gross Motor function and each of speech (P<0.05) and hearing (P<0.05) impairments. Children with severe forms of CP in Kano suffered more speech (73.1%) and cognitive impairments (53.85%) when compared with the other forms of associated impairments. Impairment of ability to speak well or understand spoken word was significantly connected with severity of deterioration of physical function in children with CP. There was therefore the need for thorough assessment of associated impairments in children with cerebral palsy especially hearing and speech impairment with prompt referral to the appropriate health personnel for further evaluation early treatment.

Keywords: *Gross Motor Function, Associated Impairments, Severe Cerebral Palsy.*

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Introduction

Cerebral palsy (CP) is 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' (Bax et al, 2005). Because of their motor problems, children with CP experience limitations of physical activities and participation restrictions (McManus et al., 2006). Since the impairment of motor function is the hall-mark in cerebral palsy, information about factors associated with gross motor function in such children is necessary in order to establish realistic physiotherapy treatment goals (Obembe et al, 2013). Gross Motor Function (GMF) refers to the child's ability to accomplish motor activities, such as rolling, sitting, crawling, standing and walking and climbing (Palisano et al, 1997).

Studies have assessed the association between each of spasticity (Ries et al, 2013), motor type (Obembe et al, 2013), topographical distribution of spastic CP types (Muzaffar et al, 2012; Obembe et al, 2013; Pfeifer et al, 2009; Ries et al, 2013) and GMF among children with CP in which spastic hemiplegia was found to be associated with better function (Pfeifer et al, 2009).

It is obvious that most of the studies above concentrated more on establishing association between CP types and GMF while other equally important associated impairments were given less attention. According to Bax et al. (2005) the impairments of motor function in children with CP are often accompanied by disturbances of sensation, perception, cognition, communication, behaviour, by epilepsy and by secondary Musculoskeletal problems. Associated disorders though usually neglected may interfere with the ability to function in daily life (Adding et al, 2006) and they could further compromise mobility, physical and educational development; and eventual social integration of the child suffering from CP (Nottigde and Okogbo 1991). According to Soleimani et al, (2011), associated disorders may sometimes lead to even greater disability than those motor impairments that are usually seen as the hallmark of CP. Since CP is more prevalent in developing nations (Lagunju et al, 2006; Adding et al, 2006) and up to 80% of children with CP suffer such additional impairments (Adding et al, 2006), it is pertinent to evaluate the association between associated disorders in children with CP and their GMF in a Nigerian community. The aims of this study are to assess impairments of vision, speech, cognition and hearing; including spasticity, seizure/epilepsy and oropharyngeal dysphagia among children suffering from severe CP and to evaluate their associations with GMF.

Methods

The study was a cross sectional survey that recruited children diagnosed with CP who were receiving treatment at the out-patient units of physiotherapy departments in Muhammad Abdullahi Wase Specialist Hospital, Murtala Muhammad Specialist Hospital and Aminu Kano Teaching Hospitals in Kano city using purposive sampling technique. Only the children with confirmed diagnoses of CP and those with severe forms of CP (Gross Motor Function Classification System, GMFCS IV and V) were included because it is believed that children with severe forms of CP may suffer more associated impairments.

Data Collection Procedure

Ethical clearances were obtained from the ethical committees of all the hospitals involved in the study while written informed consents were obtained from the caregivers of the participating children.

Assessment of Gross Motor Function

The GMF was evaluated using the Gross Motor Function Classification System (GMFCS). GMFCS has inter-rater reliability of ICC=0.84. (Bodkin et al 2003) and ICC=0.996 (Ko et al, 2011) with Intra-rater reliability ICC = 0.972-0.996 (Ko et al, 2011), It has high concurrent validity with the mobility domain of paediatric disability inventory (Ko et al, 2011). The GMFCS is a 5 point ordinal scale that assesses self-initiated function during sitting, standing and walking (Soleimani et al, 2011). The GMFCS classify children into five levels of function such that children on level 'I' have the most independent motor function, while children at level 'V' have the least. The participants for this study were those at level IV and V as described below:

In level IV, affected children function only in supported sitting but independent mobility is very limited to rolling, creeping on stomach, or crawling but without reciprocal leg movement. Older children in this category may use powered mobility (Palisano et al, 1997).

Children in level V are very dependent even in basic anti-gravity postural control; they have poor neck control and cannot sit independently. All areas of motor function are very limited (Palisano et al, 1997).

Assessment of Spasticity

The modified Asworth scale [MAS] (Bohannon and Smith 1987) was used to assess spasticity. It has test-retest reliabilities of ICC = 0.66-0.80, ICC = 0.21-0.72 and ICC = 0.59-0.82 for hamstrings, calf muscles and hip adductors respectively among children with CP (Fosang at al, 2003). It has a criterion validity of r = -0.042 to r = 0.47 in patients with traumatic brain

injury (Allison & Abraham, 1995). MAS is a 6 point ordinal scale scored from 0 to 4. A score of '0' means no spasticity; a score of 4 means the limb is rigid in either flexion or extension. The detailed description of the modified Ashworth scale can be obtained in Bohannon and Smith (1987). The presence of spasticity was indicated by a catch or resistance to passive stretching of a muscle. All spasticity measurements were conducted in the morning between 9-10am.

Procedure for Measurement of Spasticity

Hamstrings: With the patient in prone, fully relaxed, the lower limb under test had the knee joint flexed to the maximum and this was followed by passive extension of the same joint and the degree resistance offered by the hamstrings muscles was noted and recorded.

Biceps: With the patient in supine, fully relaxed, the upper limb under test had the elbow joint flexed to the maximum and this was followed by passive extension of the same joint and the degree resistance offered by the biceps muscles was noted and recorded.

Assessment of Seizure and Epilepsy

All patients with confirmed diagnosis of seizure and epilepsy by the referring physician were first captured. Subjective history was used to screen the other children for seizure and epilepsy using the definition of seizure as a brief temporary disturbance in the electrical activity of the brain (Brown, 2014) and epilepsy as 'separate occurrences of two or more unprovoked seizures' (International league against epilepsy, 1989) as guides. Hence, caregivers report of an episode of seizure or several episodes of seizures were recorded.

Assessment of Visual Impairment

All the children with confirmed diagnosis of visual impairment by the referring physician were captured initially. For the rest of other children, subjective report by the caregiver of the child's inability to see very well was captured. This was followed by physical assessment of the eye for weakness of extra-ocular muscles and strabismus and the evaluation of child's ability to follow moving objects with the eyes to gauge very slow vision or probable loss of visual acuity. The child's comprehension of what was seen is also tested.

Assessment of Impairment of Cognitive Function

A questionnaire adopted from the SPARCLE project was used to assess the level of cognitive impairment in the children. It can be obtained in Soleimani et al, (2011). The researcher administered the questionnaire on the caregiver.

The cognitive impairment was rated mild if the score was 70%, moderate for score between 50% and 70% and sever for score 50%.

a. If a child played and learned like other children of a similar age, they were rated IQ= 70%
b. If a child had severe difficulty with learning in all aspects of development or only understand ideas at the level of younger children which were more than half of their age, they were rated IQ= 50%
c. Those children that fell in between a and b above were rate as IQ=50%-70%

Assessment of Speech and Hearing Impairments

All the children with confirmed diagnosis of speech or hearing impairments by the referring physician were captured initially. Where there was no physician diagnosis, the caregiver report of the child's inability to speak or comprehend spoken word was captured. Also, the child's ability to speak, follow verbal instructions and his ability to turn his head in the direction of voice or sound was assessed.

Assessment of Oropharyngeal Dysphagia (OPD)

All the children with confirmed diagnosis of OPD by the referring physician were captured initially. Where there was no physician diagnosis, the caregiver report of previous nasogastric tube feeding due to child's inability to swallow food or had external feeding tube surgically attach stomach, or where feeding of the child took more than 1 hour to complete or frequent chocking with food were captured as presence OPD case.

Data Analysis Procedure

Descriptive statistics of frequency, percentage, mean and standard deviation are used to summarize the data. Chi-square analysis was used to find association between gross motor function and all the associated disorders. All statistics were conducted at 0.05 Alpha level of significance.

Results

Fifty two children with CP participated in the study 17(32.7%) females and 35(67.3%) males. The mean age of the children was 2.0846 ± 1.76484 years. The mean age of the caregivers was 26.33±9.42years, age range 26-35. Twenty one of the caregivers (40.4%) had secondary education, and majority of the caregivers earned ₦18,000- ₦49,000 as monthly income as presented in Table 1. Furthermore, 42.3% (n=22) of the children have spastic type of cerebral palsy, 17 (32.7%) have spasticity grade 2/5 on the biceps muscles and 11 (21.1%) have spasticity grade 1/5 on their hamstring muscles. Thirty one children (59.6%) have GMFCS score of 4 and twenty one (40.4%) children have GMFCS score of 5 (Table 2).

Table 1: *Socio-demographic characteristic of the study participants*

Variables	**Frequency**
Age	Mean ±SD
Age of caregivers	26.33±9.42
Age of children	2.08 ± 1.76
	n(%)
Age category caregivers (years)	
16-25	16 (30.8)
26-35	26 (50.0)
36-45	6 (11.5)
Child age category (years)	
<1	12 (23.1)
1-5	37 (71.2)
6-10	3 (5.3)
Sex (children)	
Female	17 (32.7)
Male	35 (67.3)
Family income	
<₦18000	5 (9.6)
₦18000-₦49000	30 (57.7)
₦50000-₦100000	17 (32.7)
Level of education	
Non	8 (15.4)
Primary	20 (38.5)
Secondary	21 (40.4)
Tertiary	3 (5.8)

Key: n=frequency; %=percent; SD=standard deviation

Table 2: *Cerebral palsy types and spasticity level of children with CP*

Variables	**Frequency**
Spasticity SCORE	
Biceps	**N(%)**
0	27(51.9)
1	3(5.8)
2	17 (32.7)
3	5 (9.6)
Hamstring	
0	29 (55.8)
1	11 (21.2)
2	8 (15.4)
3	4 (7.7)
CP type	
Spastic	22(42.3)
Athetosis	22(42.3)
Mixed	8(15.4)
GMFCS scores	
4	31 (59.6)
5	21 (40.4)

Key: n=frequency; %=percent

In this study, significant association was found between GMF and each of speech ($P<0.05$) hearing impairments ($P<0.05$). There was however no significant association between GMF and each of seizure disorder, Oropharyngeal dysphagia, visual impairment and cognitive impairment ($P>0.05$) as presented in table 3. In addition, this study found no significant association between GMF and each of the type of cerebral palsy ($P>0.05$) and type of spastic cerebral palsy ($P>0.05$). Likewise, there was no significant association between GMF and each of spasticity of biceps ($P>0.05$) and hamstrings muscles ($P>0.05$) (table 4).

Table 3: *Association between functional status and associated impairments*

Functional status	**Associated impairments**			
	Seizure or epilepsy			
	Yes	No	X^2	P
Gmfcs 4	17	14	0.03	0.86
Gmfcs 5	11	10		
	Oropharyngeal dysphagia			
	Yes	No	X^2	P
Gmfcs 4	12	19	0.95	0.33
Gmfcs 5	11	10		
	Speech impairment			
	Yes	No	X^2	P
Gmfsc 4	18	13	0.004	0.003*
Gmfcs 5	20	I		
	Visual impairment			
	Yes	No	X^2	P
Gmfcs 4	2	29	0.38	0.32
Gmfcs 5	3	18		
	Hearing impairment			
	Yes	No	X^2	P
Gmfcs 4	1	30	0.013	0.013*
Gmfcs 5	6	15		
	Cognitive impairment			
	Moderate	Severe	X^2	P
Gmfcs 4	13	16	0.491	0.34
Gmfcs 5	15	8		

*Significant, X^2=Chisquare value, P=P-value

Table 4: *Relationship between children's level of function and each of spasticity and CP types*

Functional Status	**Spasticity and CP types**					
	Spastic types					
	hemiplegic	Diplegic	Double hemiplegic	quadriplegic	X^2	P
Gmfcs 4	3	1	0	7	6.98	0.072
Gmfcs 5	0	0	2	9		
	Cerebral palsy type					
		spastic	Athetoid	Mixed	X^2	P
Gmfcs 4		11	14	6	1.9	0.69
Gmfcs 5		11	8	2		
	Biceps spasticity					
	0	1	2	3	X^2	P
Gmfcs 4	18	1	8	2	1.93	0.68
Gmfcs 5	9	1	2	3		
	Hamstring spasticity					
	0	1	2	3	X^2	P
Gmfcs 4	18	9	3	1	5.7	0.12
Gmfcs 5	9	2	5	3		

*significant,X2=Chisquare value, P=P-value

Discussion

In this study majority of the children have predominantly spastic quadriplegia and athetoid CP types. This suggests that most of the children with severe forms of CP either have all four limbs and trunk involvement or have extra-pyramidal lesion. Furthermore, about 60% of these children have GMFCS score of 4. This implies that many of the children in this study have severe limitations with self-mobility; they are transported indoors or outdoors and in the community. In addition, this study found out that there was significant association between gross motor function (GMF) and each of hearing and speech impairments. This implies that impairment in the ability to speak well or understand spoken word could be significantly associated with the children who have severe deterioration physical function. In this study, many of the children have speech impairment. It is possible that inability to express their feelings or to understand instructions may slow their learning ability and especially practical exercises to improve their

movement function. It is also possible that early detection and treatment of speech and hearing disorders in addition to routine physiotherapy may improve the condition of these children. This finding is in consonance with that of Coleman et al, (2013) who observed that severe gross motor impairment is associated with delayed communication in children with CP.

This study found no significant association between GMF and each of Oropharyngeal dysphagia (OPD) and visual impairment. This implies that the presence of, Oropharyngeal dysphagia and visual impairment may not have any significant connection with the decreases in children's functional status. Although our study found that more than forty percent of children have OPD, this figure was lower than the 85% reported by Benfer et al, (2013), and was different from part of the report that OPD was significantly associated with severe CP types (Benfer et al, 2013).

The finding that impairment of vision was not significantly associated with gross motor function was different from the outcome of a research report (Salavati et al, 2014) where it was found that that children with visual impairment in CP lead to decrease in gross motor function and functional skills and increased caregiver assistance (Salavati et al, 2014). The possible reason for the difference in finding could be that very few (less than 10%) of the participants in this study suffered impairment in their vision. In addition, it was observed in this study that negligible association exist between gross motor function and each of seizure disorder and cognitive impairment. This means that the presence of impaired cognition and seizure disorder may be linked significantly with the severity of CP. The finding on impaired cognitive function was however in contrast to that of Enkelaar et al, (2008) who found that significant association existed between mental status and motor functioning in children with CP. More so, this study found that more than half of the study participants have either of seizure or epilepsy. This is similar to the report of Adding et al, (2006) that epilepsy is present in 20% – 40% of children with CP.

Additionally, this study found that there was no significant association between gross motor function and type of cerebral palsy. Though majority of the children in this study were predominantly spastic and athetoid types, there was homogeneous distribution of these CP types among categories VI and V the GMFCS. It is probably the reason why none of the cerebral palsy type was significantly associated any of the categories of the GMFCS. Our finding is similar to that of Muzaffar et al, (2012) who reported that weak association existed between gross motor function and topographical CP types. The result obtained in this study however differed from that of Pfeifer et al, (2009) and Obembe et al, (2013) who found that motor type and

topographical classification had significant association with gross motor function of children with cerebral palsy. In Pfeifer et al, (2009) spastic hemiplegia was found to be associated with better gross motor function. The possible reason for the difference between the finding in this study and that of Obembe et al (2013) could be because they recruited participants with across all the functional levels of GMFCS and this study recruited only children with severe mobility limitations (GMFCS 4 and 5). Furthermore, this study found no significant association between gross motor function and muscle spasticity. This implies that severity of CP may not be linked with increase in muscle spasticity. This finding agreed with that of Gorter et al, (2009) who reported that spasticity is marginally associated with gross motor function in children with CP.

The clinical implication of this study is that therapy should always include evaluation and treatment of associated impairments as part of comprehensive care for children with CP who are having problems with movement and posture. This study recommends that physiotherapists should actively engage other health professional to develop specific intervention algorithm for children with severe forms of CP who are experiencing many associated disorders in order to provide the optimum care that will improve their conditions. There is a need of thorough assessment and documentation of associated impairments in children with cerebral palsy especially hearing and speech impairment with prompt referral to the appropriate health personnel for further evaluation early treatment.

Conclusions

Impairment of ability to speak well or understand spoken word is significantly connected with severity of deterioration of physical function in children with CP. Children with severe forms of CP in Kano suffer speech and cognitive impairments more than other forms of associated impairments.

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