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Relationship between Motor Functioning, Eating and Drinking Ability and Communication Ability in Adolescents with Cerebral Palsy

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ABSTRACT

Background: There are limited studies in the literature which reflects the relationship between gross motor functioning, communication ability, feeding and swallowing problems in adolescents with cerebral palsy (CP). Since adolescence period is unique and distinct, a need was felt to understand the same in adolescents with CP.
Objective: To understand the relationship between various functions such as gross motor ability, communication functioning, eating and drinking ability in adolescents with CP.
Methods: A cross sectional study was conducted with a random sampling of 15 participants in the age range of 13 to 17.11 years with all the ethical standards met. Gross motor ability, communication functioning, eating and drinking ability were studied through various classifications systems such as Gross Motor Function Classification System Expanded and Revised(GMFCSE & R), Communication Function Classification System (CFCS), Eating and Drinking Ability Classification System (EDACS) respectively. Spearman correlation was done find the relationship between the classification systems.
Results: Results of the current study indicated a moderate correlation between GMFCS and CFCS scale (correlation coefficient, r = 0.67, p<0.00**) and between GMFCS and EDACS (correlation coefficient r = 0.67, p<0.00**). A strong correlation was found between EDACS and CFCS (r=0.72, p<0.05**).
Conclusions: There was a relationship between all the three classification systems in adolescents with CP in the current study. This implies that in adolescents with CP, various functions such as eating and drinking, gross motor functions, communication ability are interdependent and interrelated.

Keywords: Adolescents, Cerebral Palsy, Functional classification system, Gross motor functioning, Communication, Eating, drinking.

INTRODUCTION

Cerebral palsy (CP) is one of the frequent causes of physical disability that occurs during the early childhood period. [1] It is described as a non progressive permanent group of disorders of movement and posture, which causes activity limitation due to disturbances of brain structures in the developing fetus or infant. [2-3] The prevalence of CP varies between 3/1000 live births. [4] Children with CP exhibit several associated problems among which mobility, feeding and communication issues are very common in the developmental processes of individuals with CP, which affects their activities of daily living. [1,5, 6] In the recent past, the death rates of CP have reduced due to advancements in medical technology and many of them survive into adulthood and almost 90% of individuals with CP live beyond their eighteenth birthday of life. [7] Most of the associated problems persist through adulthood contributing to poor quality of life unless intensive intervention is initiated early and the deficits are mild. Feeding skills and mobility serves as the most important prognostic indicators for survival in individuals with CP. [8]

CP is a lifelong disability and even though it is a non-progressive condition, it is

superimposed by the dynamic process of development and aging. [9] The adolescence period can be particularly challenging for children with CP. During this period, there can be changes in the biological, social, and emotional domains. They also encounter problems during the transition period from childhood to adolescence due to their impairments. [10] The functional abilities of adolescents with CP can change as the transition occurs from childhood to adolescent period. The changes that occur in these domains in terms of communication, feeding and motor skills can be interrelated, for e.g., changes in upper limb abilities can lead to better self-feeding skills. Further, the motor alterations in adolescents with CP have an impact on their cognition, communication, perception and behavior. [11]

The studies in the past suggested that the motor functioning ability of individuals with CP vary according to the type and extent of lesion in the brain. [12] There are primary, secondary and tertiary motor impairments. [12] A few studies indicated that there could be a decline in the gross motor functioning ability, as children with CP moved into adolescence and young adulthood period except individuals with Gross motor functioning level (GMFCS) level I and II who remain almost in the same level even in adolescence period. [13] Study on adolescents and adults with CP revealed that the motor deficits are predominantly noticed in terms of muscle flexibility, reduction in the strength and endurance, increase in spasticity, arthritis, frequent falls and fractures, pain and fatigue, weight bearing difficulties and increased / decreased walking ability over time. [14] However, the stability of motor functioning may or may not occur during adolescent period in the CP population. [15] A retrospective cohort registry study in CP individuals revealed that in 74% of the participants, the last recorded GMFCS level was the same as that of first. Participants with GMFCS levels II and III during the first assessment had the lowest proportions returning to the same GMFCS level (56% and 49% respectively). 84 (11%) children and adolescents had a lower GMFCS (higher functional level) rating and 110 (15%) a higher GMFCS (lower functional level) than the level they were classified during first assessment. [16]

Another common associated problem is feeding deficits. Almost 50% to 80% of all individuals with CP experience oral-motor difficulties, which further results in feeding and swallowing problems referred to as dysphagia. Individuals with CP may have difficulty in all or any of the phases of swallowing. [17] They lack muscle coordination leading to problems in different eating processes such as sucking, biting, chewing, and drinking. They also exhibit food/fluid loss, drooling, sequencing and rhythmicity difficulties during feeding. [18] They are at risk for malnutrition lung problems, limited caloric intake, and poor growth. Also the presence of eating and drinking problems influence a person's dignity, self-esteem, and the quality of mealtime experiences. [19,20] A study was conducted in 10 spastic adolescents and adults with CP in the age range of 15-23 years to understand the consequences of eating and drinking difficulties. The study revealed that almost all the participants expressed that they had various eating and drinking problems. They expressed wide range of emotions such as shame, frustration, fear, and distress. Almost all the participants reported that they required devices or adaptations to help their eating and drinking abilities along with less social interaction during meal times. [20]

In addition to motor and feeding problems, communication impairment is also seen as one of the most common dysfunction associated with CP. Several studies have indicated the prevalence of communication impairment to be around 38% to 55% in children with CP. [21] Approximately 55% of communication difficulty was reported in 355 adolescents with CP. [22] The communication ability of individuals with CP can be of various levels

ranging from dysarthric speech to no speech or communicating using Augmentative and Alternative communication(AAC). [23] Individuals with bilateral CP were studied at the onset of CP and were reassessed at the age of 16–18 years in order to understand the speech problems and the factors influencing the same. The results revealed that around 63% of the participants had impaired speech, 23% were intelligible to unfamiliar people, 10% were mostly unintelligible to unfamiliar people, and 30% were mostly or wholly unintelligible even with the familiar adults. 32% participants were provided with one or more forms of AAC. The factors responsible for the results were described as the participant's level of GMFCS, their ability to do manipulation in the best hand, associated intellectual disability and epilepsy. [24] Further the studies also indicate that psychological problems in childhood period predict a significant restriction in adolescent participation in all domains of social roles, responsibilities and in the daily life activities of personal care and communication, finally leading to reduced quality of life. [25]

Hence it is very essential to conduct an ongoing assessment of the functioning ability in different domains in individuals with CP which could lead to initiation of appropriate rehabilitation related activities and implemented, so that the psychological issues can be reduced and their quality of life can be improved. There are various functional classification systems for individuals with CP which aids in prognostication, goal setting, and rehabilitation planning. [26] In the CP population, the instruments and classification systems are created using the International classification system (ICF). These Classification systems help professionals across different disciplines work together. [27] The various functional classification systems available are the Gross Motor Function Classification System Expanded and Revised (GMFCSE & R), [28] Manual Ability Classification System (MACS), [29] Eating and Drinking Ability Classification System (EDACS) [19] and the Communication Function Classification System (CFCS). [30] GMFCS is a method to grade the functional limitation, usage of assistive device, and quality of movement in persons with CP. CFCS attempts to classify the individuals with CP according to the ability to communicate consistent messages with other individuals and EDACS offers a system for classifying the eating and drinking ability of individuals with CP at a functional level. Each of these classification systems classifies the functioning ability of individuals with CP into five levels based on capacity and needs in each area, ranging from Level I indicating least affected by disability to Level V indicating most affected by disability. [31] Studies in the past also tried to assess the relationship between the gross motor functioning level and feeding difficulties. Children with CP (1-18 years) were studied with respect to GMFCS level and feeding and swallowing problems. Nearly all the children in the moderate (GMFCS E&R level III) and severe group (GMFCS E&R level IV or V) exhibited impairments in oral preparatory, oral, and pharyngeal phases of swallowing. During the oral phase, residue in the oral cavity and piecemeal deglutition was found in around 71.4% in moderate GMFCS level group and 83.3% in severe group. [32] A review study indicated that the severity of gross motor impairment is one of the factors which significantly contribute to the prevalence of feeding issues. Several studies mentioned in the review reflected that children with more severe gross motor involvement (GMFCS VI & V) had severe feeding problems. [18]

Some other studies assessed the relationship between GMFCS and CFCS in individuals with CP with various topographic distributions in the age range of 2 to 17 years. The results revealed a moderate correlation between GMFCS levels and CFCS levels in children with quadriplegia and no correlation in children with Diplegia. [33] Similarly another study reflected a strong correlation between

GMFCS-E&R, MACS and CFCS functional levels with intellectual functioning abilities in children with CP in the age group of 4 to 18 years. [34] Few studies indicate a moderate correlation between the GMFCS and CFCS levels. [31] Yet a few other cross sectional studies have assessed the relationship between motor, communication and feeding abilities. A study in 15-22 years young CP individuals indicated interrelationship between moderate to excellent interrelationship among the functional classification scales (GMFCS, MACS, CFCS, and EDACS). [26] Another cross-sectional revealed that EDACS had strong associations with MACS, CFCS and moderate association with GMFCS levels. Also increased levels in EDACS were associated with poor functioning in gross motor and communication functioning skills. [35]

A systematic review of the literature revealed that a few studies have been carried out to assess the relationship of the gross motor functioning level with feeding abilities, while a few other studies focused on the relationship of gross motor functioning with communication ability in individuals with CP. All these studies revealed a moderate to strong correlation between these aspects. Very few studies have studied the relationship between all the three classification systems (EDACS, GMFCS and CFCS).

Moreover the existing studies have included a wide age range i.e. either children and adolescents as a group or adolescents and adults as a group. It is a known fact that the adolescent period is unique and distinct from that of childhood period or adult period, consequent to the changes that take place internally in the body. The various changes during the adolescent period includes change in the neurological system, neuromuscular system, maturity in reproductive sexuality due to growth of the genital organs which reflect the hormonal changes, changes in the nutrition and diet, i.e., low caloric intake, which result in poor growth and decreased muscle mass at maturity. [36] Very few studies reflect the relationship between the EDACS, GMFCS and CFCS, especially in the adolescent group. Since feeding skills, communication and mobility serve as key contributors of quality of life in individuals with CP and are critical for social functioning, it is very essential to understand the relationship between these three aspects, which would inturn reflect the functioning and performance of individuals with CP as a whole. [16, 31] a need was felt to understand the holistic functioning ability in the adolescents with CP. Keeping this in view, the current study was planned with the aim of understanding the relationship between the gross motor functioning, communication functioning and feeding abilities in adolescents with CP.

METHOD

Participants: After an ethical clearance from ethical committee, a total of 15 participants in the age range of 13 to 17.11 years who were diagnosed as Cerebral Palsy by a qualified team of professionals were recruited for the study from SnehaKirana Spastic society of Mysuru and All India Institute of speech and hearing. There were 12 participants with spastic type of CP and 1 participant each with athetoid, mixed and ataxic type of CP with varying degrees of intellectual disability (ID) and topographic distribution. The details of the participants have been depicted in the Table 1.

Procedure: A prior consent was obtained from the caretakers/parents of the participants for participation in the study. The testing was carried out in a relatively noise free environment with minimum distractions and participants were comfortably seated. The demographic details of the participants were obtained and the assessment was carried out individually for each participant.

The level of gross motor impairment of the participants was assessed using GMFCS E & R. [28] In order to assess their

communication abilities, a general conversation was carried out with the participants, regarding their day today activities at school, home, hobbies etc. for 5-10 minutes and their mode of communication and their efficiency to communicate was noted. After the conversation, parents of the participants were also interviewed to understand the communication patterns with familiar & unfamiliar partners of the participants at home and in other social situations. CFCS, [30] was used to finally grade the level of communication functioning ability of the participants through the use of detailed conversation sample observation and with parental report.

In order to understand the feeding difficulties, the parents/caregivers were interviewed to obtain the relevant information. In addition, the participants were seated in their actual feeding position with additional equipments if any, and their feeding was observed. The bolus was provided in the following order: solid food (biscuit), thin liquid (water) and semisolid (jelly). Since this feeding assessment included the observation of the natural feeding by the participants themselves, there were no risks involved. A protocol by Rupela, developed to assess the oromotor deficits was used for the participants. [37] This includes the posture (11 items with so ring pattern'1'- Yes and '0'- No), oral structures at rest (8 items, scoring pattern: 2 for 'a', 1 for 'b' and '0' for 'c') and function of the oral mechanism for speech (6 items, scoring pattern:1 for 'adequate' and 0 for 'inadequate).The overall feeding and swallowing problems were graded using EDACS. [19] It is a valid measure to assess eating and drinking ability in children with CP from 3 years onwards.

Statistical analysis: On 40% of total population (4 participants) who were selected randomly after one week of the initial data collection, the protocols were read ministered to assess the test retest reliability. The scores obtained on each of the classification systems for each participant were statistically analyzed using the SPSS version 21.0 software. Cronbach's alpha was used to check the test-retest reliability. Mean, median and standard deviation was obtained using Descriptive statistics. Spearman correlation was done to find the relationship between the levels obtained on different protocols /classification systems.

RESULTS

Test-retest reliability: The Cronbach's alpha for all the classification systems varied from 0.90 to 0.99 which indicated high test-retest reliability.

Correlation between the gross motor functioning ability and communication functioning ability:

Descriptive statistics revealed the mean, median and SD of GMFCS score to be 3.20, 4.0 and 1.20 respectively. The overall GMFCS raw score levels varied from level 1 to level 5 (1 participant-*GMFCS level 1*, 4 participants-*GMFCS level 2*, 8 participants-*GMFCS level 4*, 2 participants-*GMFCS level 5).* These scores indicated that majority of the participants had level 4 of gross motor functioning. Similarly the descriptive statistics revealed the mean, median and SD of CFCS score to be 3.07, 3.0 and 0.88 respectively. The overall communication functioning ability of the participants varied from 2 to 5 (4 participants-*CFCS level 2*, 7 participants-*CFCS level 3*, 3 participants -*CFCS level 4*,1 participant-*CFCS level 5).* Among all participants, 7 participants had verbal mode of communication with sentence length varying from 3-4 sentences to 5-6 sentences. 8 participants were nonverbal among which 2 participants were AAC (communication book) users and 6 participants had only vocalization, head nod and eye gaze for communication purposes.

Spearman correlation was done to assess the relationship between the scores obtained on the GMFCS and CFCS scale. The results revealed a significant moderate correlation

between the two (correlation coefficient r = 0.67, p<0.00**).

Correlation between gross motor functioning ability and feeding ability: The common feeding problems observed in the participants were presence of drooling, poor lip closure, limited tongue movements, jaw movements, choking, and poor gag reflex. They had difficulty in drinking and sipping liquid and consuming solid food, jaw thrust while encountering a utensil, poor lip closure over the spoon, chewing not functional for swallowing, excess food and liquid loss and presence of cough. Mean, median and SD of EDACS scores were 2.66, 2.00 and 0.97 respectively. The overall levels varied between level 1 to level 4 (1 participant-*EDACSlevel 1*, 7 participants-*EDACS level 2*, 3 participants-*EDACS level 3*, 4 particpants- *EDACSlevel 4).* This indicated that most of the participants had difficulty in feeding and swallowing safely and efficiently. Spearman correlation between the scores obtained on the GMFCS and EDACS revealed that there was a significant moderate correlation between the two (correlation coefficient r = 0.67, p<0.00**).

Correlation between feeding ability and communication functioning ability: Descriptive statistics was done to find the mean, median and SD. This revealed that the mean percentage for oromotor functioning was 49.7, median was 46.87 and the standard deviation was 23.89. Spearman correlation between oromotor functioning (OMF) and CFCS, OMF and EDACS, EDACS and CFCS which indicated a significant strong correlation between OMF and CFCS (r=0.77, p<0.05**), OMF and EDACS (r=0.86, p<0.01**) and between the EDACS and CFCS (r=0.72, p<0.05**).

Table 1: Characteristics of Patients

Participant	Age/ Gender	Type of CP	Topographic distribution	Intellectual disability
1	15/Male	Spastic	Triplegic	Moderate
2	17.5/Female	Spastic	Quadriplegic	Moderate
3	15/ Female	Spastic	Quadriplegic	Moderate
4	15/ Female	Spastic	Triplegic	Mild
5	14.5/ Male	Athetoid	Quadriplegic	Moderate
6	16/ Male	Mixed(Spastic+Athetoid)	Quadriplegic	Mild
7	14/ Male	Spastic	Hemiplegic	Mild
8	17.8/ Male	Spastic	Quadriplegic	Severe
9	15/ Male	Spastic	Quadriplegic	Severe
10	13/ Female	Spastic	Quadriplegic	Moderate
11	16/ Male	Spastic	Triplegic	Moderate
12	14/ Male	Ataxic	Hemiplegic	Mild
13	15/ Female	Spastic	Quadriplegic	Severe
14	13.5/ Male	Spastic	Diplegic	Severe
15	15/Male	Spastic	Diplegic	Severe

DISCUSSION

The results obtained in the current study are in consonance with the literature. Relationship between GMFCS and CFCS is reflected in previous studies. [26,33,34] A significant correlation is reported between GMFCS-E&R and CFCS (rs =0.61, p=0.001) in 4- 18 years individuals with CP. [34] A study in individuals with dyskinetic CP in the age group of 15-22 years with CP suggested moderate correlation between GMFCS and CFCS. [26] Similarly a moderate to excellent correlation is also reported in 10 to 14 years individuals with CP. [31]

Although, the correlation reported between the GMFCS and CFCS in the age range of 2 to 17 years, the correlation was weak in children above 12 years(rs=0.31, p=0.029). Further, a moderate GMFCS–CFCS correlation was found in children with quadriplegia (rs=0.44, p<0.001). [33] Similarly, in the current study, most of the participants had quadriplegic distribution of CP and the correlation found between GMFCS and CFCS level was also moderate in nature.

In the current study, on visual inspection of the data, 4 participants had

better CFCS level when compared to their GMFCS levels. This result is also reflected in the literature. Even with greater GMFCS levels(GMFCS levels IV or V), participants have used some form of communication to communicate their needs to unfamiliar communication partners which lead to improved communication with CFCS levels I or II. Hence the authors suggested that when the individuals with CP have GMFCS level V, we should not assume that the individuals will exhibit severe limitations in communication. [33] Also CP individuals with increased severity of motor deficits can have good communication skills. [26] Most of the studies conducted in the literature also revealed that there was a significant correlation betweenseverity of feeding and swallowing impairments and gross motor functioning ability in individuals with CP. [2, 3, 18, 32] A fair relationship between CFCS and EDACS (r_s=0.49; $p<0.001$) in individuals with dyskinetic CP in the age range of 15 to 22 years is also reported. [26] EDACS had strong association with MACS, CFCS and moderate association with GMFCS level in children with CP. Most of the studies report that the oromotor deficits reflects the feeding functions depending on type of CP. Studies report that spastic quadriplegic CP individuals had more deficits in oromotor deficits reflects further leading to feeding and swallowing issues. [38, 39] Similarly in the current study, most of the participants had spastic type of CP and oromotor deficits which in turn reflected in feeding and swallowing skills.

To summarize, there was a correlation between all the three classification systems in adolescents with CP in the current study. This implies that in adolescents with CP, various functions such as eating and drinking, gross motor functions, communication ability are interdependent and interrelated, which indicates that one domain of functioning will probably have an influence on another domain due to the relationship they exhibit. Functional classification systems (FCS) play an important role in appropriate assessment and management of individuals with CP, since they assist in distinguishing the characteristics of functional abilities and aids prognostication, goal setting, and management planning. [27] The Current study helps the different professionals working with adolescents with CP in understanding the functioning ability of adolescents as a whole. However, caution has to be exercised before generalizing the results of the study. The study had limited number of participants and most of the participants in the current study had spastic type of CP. Future studies could include larger number of adolescents with different types of CP.

Implication and contribution: The study emphasizes the relationship between all the classification systems in adolescents with CP. Functional classification systems (FCS) play an important role in appropriate assessment and management of individuals with CP by various professionals.

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