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RESEARCH ARTICLE

ORAL-MOTOR FUNCTIONS AND GROSS MOTOR ABILITIES IN SPASTIC CEREBRAL PALSY

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ABSTRACT

Background: The oral- motor dysfunction in cerebral palsy(CP) has a wide base of importance as oropharyngeal dysphagia (OPD) which is a major risk factor for morbidity in this population. It leads to the inability to consume sufficient food and fluids safely and is associated with prolonged mealtimes, poor growth and nutrition and respiratory consequences from oropharyngeal aspiration. **Aim**: to determine relation between oral motor dysfunction and Gross motor development in children with spastic cerebral palsy. **Design**: Correlational study **Setting**: Outpatient clinic, National Institute of Neuromotor System, Giza, Egypt. **Materials and Methods**: One hundred children with different types of spastic CP participated in the study and their ages ranged from 1 year– 4 years. The oral motor functions and gross motor abilities were evaluated using Schedule for Oral motor assessment (SOMA) and gross motor functional measure scale (GMFM) respectively. **Results**: It was found a strong positive significant correlation between total score of SOMA and total score GMFM (r=0.51, p=0.0001).There were positive significant correlation between SOMA categories and GMFM, as between GMFM scale and puree there was (r=0.48; P<0.05), GMFM scale and semi-solids (r=0.44; P<0.05), GMFM scale and solid (r=0.40; P<0.05), GMFM scale and cracker (r=0.37; P<0.05), and GMFM scale and cup (r=0.21; P<0.05). While, no significant correlation between GMFM scale and bottle (r=0.11; P>0.05), GMFM scale and trainer-cup (r=0.15; P>0.05). **Conclusion**: There was a strong correlation between oral motor functions and gross motor abilities in children with spastic CP

INTRODUCTION

Children with CP is suffering from developmental disorders of movements and posture leading to activities limitation. Abnormalities of muscle tone, muscle weakness, muscle synergisms limited, contractures and altered biomechanics are common. Such disorders lead to developmental delay and can also affect the development of orofacial organs, which is important for proper eating (sucking, chewing, and swallowing), speech functions and respiratory changes (Cesa, 2004). Cerebral palsy is a common and significant disorder of motor abilities, with an incidence of 2–2.5 per 1000 live births (Cassiani et al., 2011). Children with CP cannot use the range of physical movement available to most of us. Difficulties may occur in the development of walking, speech and hand function. The movements involved in biting, chewing and swallowing are frequently affected. Children with CP may have problems eating enough food to grow and to stay healthy because it is challenging to move their mouths to eat and drink efficiently (Levitt, 2018). Strong extensor tone of the neck, shoulders, and even hips can affect oral mechanism and result in lip retraction and compensatory pursing, a jaw thrust and tongue thrust (Sellers, 2014).

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Oropharyngeal disorder (OPD) is present in 90% of children with CP and is a major risk factor for morbidity and mortality in this population. The risk of the OPD is that leads to the inability to consume sufficient food and fluids safely and is associated with prolonged mealtimes, poor growth and nutrition and respiratory consequences from oropharyngeal aspiration all of which contribute to lowered health outcomes (Sellers, 2014). The clinical examination is usually the first step in a comprehensive evaluation and is useful for determining the need for further instrumental evaluation (Benfer et al., 2015). Instrumental assessments usually focus on specific of swallowing such as identification of oropharyngeal aspiration that are less detected by clinical feeding assessment but not provide whole picture about child's feeding (Tesini, 2011). Techniques used for diagnosis and monitoring pediatric oral-motor disorders include clinical evaluation tools, quality of life measures and screening tests. For example, the SOMA and dysphagia disorder survey are two of the more commonly used standardized clinical assessment tools for evaluating and describing swallowing abilities in children with CP or neurodevelopmental disorder (Aruedson, 2013). The SOMA and the functional feeding assessment, modified, proved to be the strongest measures based on published psychometric properties of validity and reliability (Weir, 2009).

The SOMA provides a detailed scoring schedule to accompany standardized observations of eating and drinking, the outcome of the assessment is to distinguish infants with normal oral motor function from infants with oral motor dysfunction (Kent, 2015). The purpose of the study was to assess oral-motor functions and gross motor abilities in children with spastic CP and to detect the relation between oral motor functions and gross motor abilities in those children.

MATERIALS AND METHODS

Study Design: This study was a correlational study on 100 children with spastic CP aged from 1 year to 4 years. Ethical committee approval of the faculty of Physical Therapy, Cairo University as well as a written consent from children's parents was obtained before starting the study.

Study Location: National Institute of Neuro-motor System (NINMS) -Giza- Egypt

Study Duration: One year and half

Participants: Children with spastic CP from both sexes and aged from 1year to 4 years were eligible to be enrolled in this study if they had delay in gross motor development and had difficulty in feeding, drinking and swallowing. Children were excluded from this study if they had any operations in head or muscles affecting the feeding process or any congenital anomalies in the mouth e.g. cleft lips or cleft palate.

Outcome measures

Oral- motor functions: Oral motor functions in this study were assessed by using SOMA which is a standardized procedure for the assessment of oral motor skills during infancy. It was developed as a research tool for use with children who have oral motor dysfunction arising from a variety of etiologies, including neurological disorder. The SOMA has proved to be useful and reliable tool. It has six oral motor challenge (OMC) rating from liquid to dried fruit according to graded textures presented to the infant. The six OMC categories are: Liquids (OMC-1), Puree (OMC-2), Semi-solid (OMC-3), solid (OMC-4), Biscuits (OMC-5), and Dried fruit (OMC-6) (Kent, 2015).

Gross motor abilities: Gross motor abilities were assessed using GMFM. Gross motor functional measure scale is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with CP. It is a tool for physiotherapists that were commonly used in clinical practice, but in a more standardized format. The GMFM is a reliable scale to evaluate gross motor function and also useful for describing a child's current level of motor function, determining treatment goals. It can be used for children from birth to five years old (with normal motor abilities). It consists of 88 items (GMFM-88) grouped into five dimensions: (A) lying and rolling, (B) sitting, (C)crawling, kneeling, (D) standing and (E)walking, running, and jumping) (Ketelaar, 1998).

Procedures

Assessment of oral motor function

Preparation: The child sat on comfortable chair according to his age. The SOMA administered to each child approximately 1-2 hours after the child's main meal.

Application: The test took approximately 20 minutes to administer and was intended to be rated largely from a video recording of structured feeding session. A series of food stuffs of varying textures including liquids was presented to the child in a standardized manner. The SOMA used standard set of feeding utensils because using ordinary opaque plastic utensils is not ideal. The manner in which the food and liquids was presented should be standardized. Each family was met and data was collected during meeting. Evaluation procedure comprised three steps:

- Step (1): Semi structured feeding interview with child's primary caretaker, in the most cases the child's mother.
- Step (2): A video recording of the child's main meal of the day. The assessment procedures were filmed:
- The child's position was corrected so that the view of the child's head and neck taken from oblique angle.
- The examiner was in front of the child so that the food was presented in the mid line.
- The examiner administered three trials to each child, ensuring that a standardized approach was used and that the spoon is presented in a consistent manner.
- The child didn't receive any undue assistance. This was not always possible because some children refused to be fed by anyone other than a parent or may insist on feeding themselves. In such cases the examiner instructed the parents in how to present the food.
- Step (3): Scoring: Accepted or refused or omitted or not rateable (Kent, 2015).

Assessment of gross motor abilities: For evaluation of gross motor abilities, GMFM-88 test was used by the same examiner. All dimensions in the scale were evaluated. Each item of the test is scored on a 4-point scale and a percentage score is calculated for each dimension which evaluate the motor function. Scores for each dimension was expressed as a percentage of the maximum score for every dimension. The total score was obtained by averaging the percentage scores across the 5 dimensions.

Statistical Analysis: Quantitative data were statistically described in terms of mean ± standard deviation (±SD) and qualitative data are expressed as frequencies (number of cases) and percentages. Normality test of data using Shapiro-Wilk test was used that reflect the data was normally distributed. Levene's test for testing the homogeneity of variance revealed that there was no significant difference ($P>0.05$). So, the GMFM data is parametric and normally distributed. Spearman correlation (bi-variate correlation) to compute the relation between GMFM scale and SOMA scoring. All statistical analyses were accepted and significant at level of probability ($P \leq 0.05$). The statistical analysis was conducted by using statistical IBM SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL).

RESULTS

The current study was conducted to determine relation between oral motor dysfunction and gross motor abilities in children with spastic CP.

Clinical characteristics of the participants: Table (1) reveals mean, standard deviations (SD), minimum, maximum, and median of age and GMFM scale.

Table 1. Clinical characteristics of the participants

Items	Age (year)	GMFM scale (%)
Mean ±SD	2.17 ±0.70	34.25 ±15.19
Minimum	1.00	1.57
Maximum	3.90	89.49
Median	2.20	25.83

SD: Standard deviation GMFM**:** gross motor functional measure scale

Table 2. Frequency and percentage of gender, SOMA scoring, and diagnosis of the study sample

Variables	Items	Number (n=100)	Percentage (%)
Gender	Boy	64	64%
	Girl	36	36%
SOMA scoring	Bad	73	73%
	Good	27	27%
Diagnosis	Hemipleglia	30	30%
	Diaplegia	28	28%
	Quadriplegia	42	42%

SOMA: schedule for oral motor assessment

Table 3. Spearman correlation between Schedule for Oral Motor Assessment scale and Gross Motor Functional Measure scale

Correlation	R	P-value	Significance (P<0.05)
GMFM scale and puree	0.48	0.0001	S
GMFM scale and semi-solids	0.44	0.0001	S
GMFM scale and solid	0.40	0.0001	S
GMFM scale and cracker	0.37	0.0001	S
GMFM scale and bottle	0.11	0.527	NS
GMFM scale and trainer-cup	0.15	0.128	NS
GMFM scale and cup	0.21	0.037	S
GMFM scale and total SOMA scoring	0.51	0.0001	S

GMFM**:** Gross Motor Functional Measure scale r: correlation coefficient
P-value: probability value S: significant NS: no significant

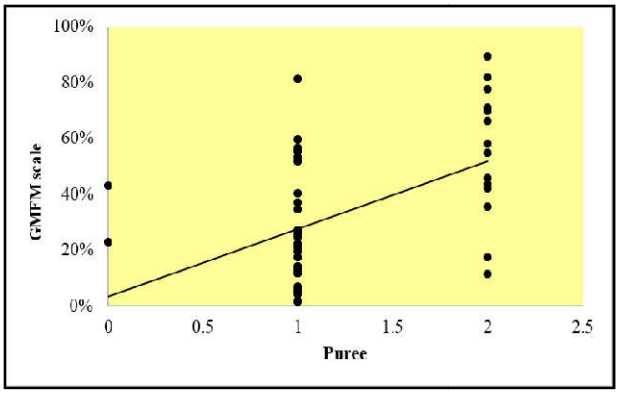

Figure 1. Correlation between puree category of SOMA scale and GMFM scale of the study sample

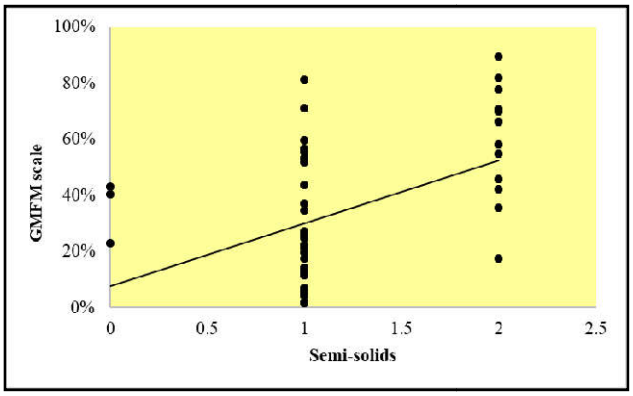

Figure 2. Correlation between semi-solids category of SOMA scale and GMFM scale of the study sample

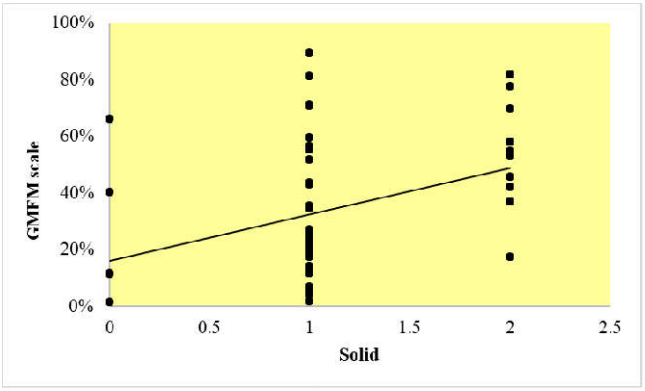

Figure 3. Correlation between solid category SOMA scale and GMFM scale of the study sample

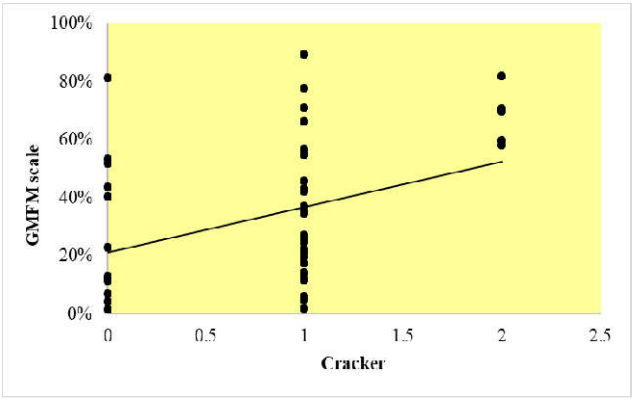

Figure 4. Correlation between cracker category of SOMA scale and GMFM scale of the study sample

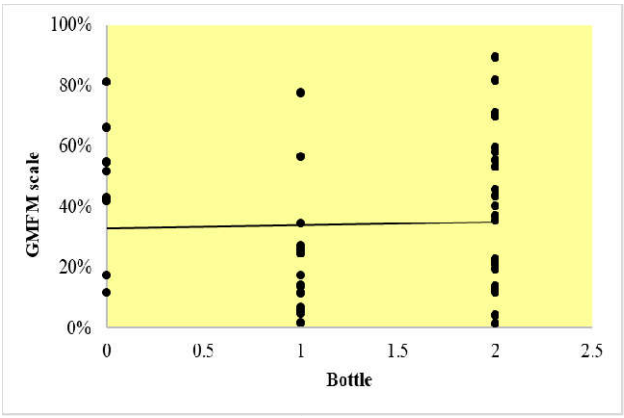

Figure 5. Correlation between bottle category of SOMA scale and GMFM scale of the study sample

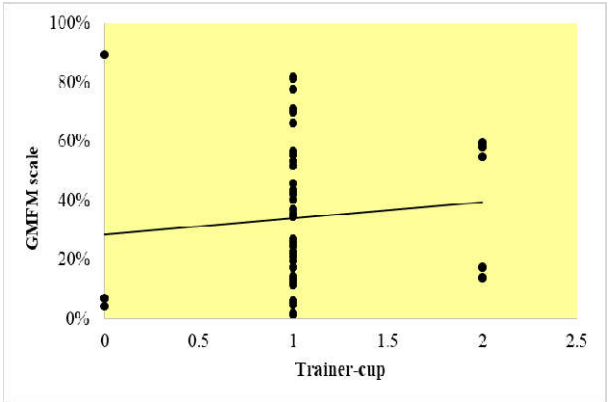

Figure 6. Correlation between trainer-cup category of SOMA scale and GMFM scale of the study sample

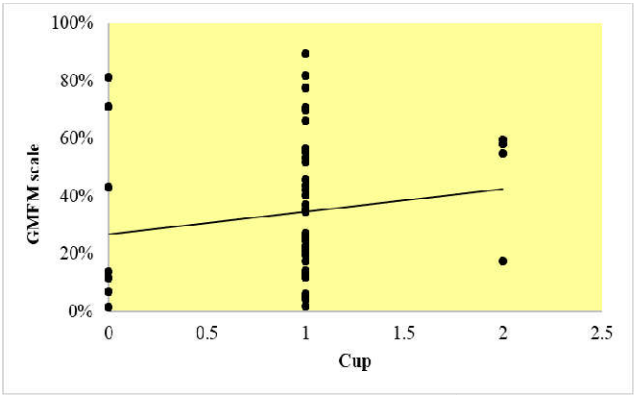

Figure 7. Correlation between cup category of SOMA scale and GMFM scale of the study sample

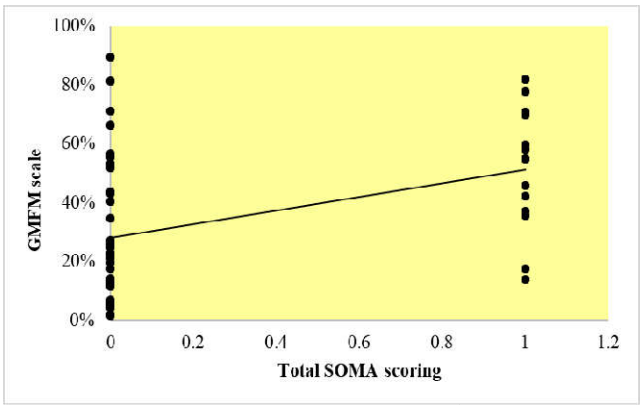

Figure 8. Correlation between total SOMA scale and GMFM scale of the study sample

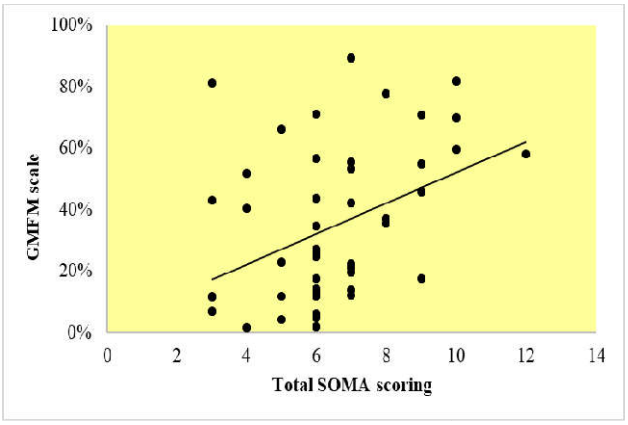

Figure 8. Correlation between total SOMA scale and GMFM scale of the study sample

Frequency and percentage of gender, scoring, and diagnosis were also calculated as shown in Table (2).

Correlation between GMFM scale and SOMA scoring: As shown in Table (3) and Figures (1, 2, 3, 4, 5, 6, 7 ,8), there was significant positive correlation between GMFM scale and total SOMA scoring ($r=0.51$; $P<0.05$). Significant positive correlation was found between GMFM scale and five OMC categories of SOMA; puree ($r=0.48$; $P<0.05$), semi-solids ($r=0.44$; $P<0.05$), solid ($r=0.40$; $P<0.05$), cracker ($r=0.37$; $P<0.05$), and cup ($r=0.21$; $P<0.05$). While, there was no significant correlation between GMFM scale and bottle ($r=0.11$; $P>0.05$), GMFM scale and trainer-cup($r=0.15$; $P>0.05$).

DISCUSSION

The main aim of the current study was to evaluate the oral motor function in children with spastic and the relation between the the dysfunction of oral motor and gross motor abilities in the same children. The results of this study revealed that there was positive significant correlation between oral motor functions and gross motor abilities. Cerebral palsy is a collection of disorders of movements, posture and communication problems. Oral motor impairments more common as difficulty in swallowing with excessive drooling (Reid, 2012). Schedule for Oral Motor Assessment scale is a reliable method for evaluation of oral-motor function in children with dysphagia. In particular, SOMA is recommended for children that were unable to complete the oral phase evaluation by VFSS due to poor cooperation (Benfer et al., 2015). Selection of SOMA scale to assess oral motor function in this study is supported by Benfer et al. (2015) who found in previous study that 85% of children with CP aged 18 to 36 months had OPD, based on impairment on 1 or more of the SOMA, DDS, or pharyngeal signs. The results of the current study agree with finding of Avredson et al. (2019) who found that the eating ability was significantly associated with gross motor functional abilities as rated on the gross motor functional classification system (GMFCS) in young children with CP. Children's ability to consume food textures with advancing complexity was best in those with GMFCS I and progressively decreased as GMFCS level increased (or gross motor functional ability decreased). Penagini et al. (2013) found that the specific nature and severity of swallowing problems may differ in relation to sensorimotor impairment, gross and fine motor limitations and cognitive communication deficits. These problems were seen in children with generalized sever motor impairment (for example spastic quadriplegia) are likely to experience greater swallowing deficits.

Arvedson et al. (2013) stated that children with CP have oral motor disorders including reduced lip closure, poor tongue function, tongue thrust, exaggerated bite reflex, tactile hypersensitivity, delayed swallow initiation and reduced pharyngeal motility. Moreover, Stipinovich (2010) reported that undernourished children with CP had significantly lower feeding competence scores in all areas of feeding (spoon able foods, biting, chewing, cup and straw drinking, and swallowing) than adequately nourished children with CP. The results of this study come in agreement with findings of Weir et al. (2013) who found that there is a significant association between reported capability on food textures assessed on the PEDI and gross motor functional abilities using the GMFCS in very young children with CP. They found that the capability on complex textures decreased as gross motor function decreased, and this was consistent across age bands from 1 year 6 months to 3 years corrected age. They predict that future studies investigating the prevalence of OPD using objective assessment of feeding skills, relationship with capability on food textures, and impact on nutritional status in young children across the full range of gross motor function abilities are required. These results highlight the need for early screening of oral-motor and feeding skills in young children with CP across all GMFCS levels, and particularly in those with lower gross motor functional abilities (levels IV and V). Dahlseng et al. (2012) reported that feeding difficulties, common among children with CP are mainly because of poor oral motor function but also are due to both poor motor

abilities and cognitive impairments. The findings of the present study come in line with Kim et al. (2013) who stated that dysphagia is closely related to gross motor function in children with CP. All swallowing abnormalities were more commonly observed as severity increased in children who classified as level III, IV, or V on GMFCS E&R. They had, to some extent, dysphagia and more than 90% of them had signs of pharyngeal phase involvement.

Conclusion

The study proved that there is strong relation between the oral motor dysfunction and gross motor abilities in children with spastic CP.

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Conflicts of interest: No potential conflict of interest relevant to this study was reported.

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