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Motor Functional Level and Quality of Life According to Feeding Types in Children With Cerebral Palsy

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ABSTRACT

Objective: The study aimed to compare motor functions and quality of life of children with cerebral palsy (CP), as well as anxiety and depression levels of caregivers according to the feeding types of the children.

Methods: The study included children with CP aged between 5-17 years. There were two groups: children with oral feeding (n=19) and children with non-oral feeding (n=16). Gross Motor Function Classification System (GMFCS) to classify children according to gross motor function, Gross Motor Function Measurement (GMFM) to evaluate gross motor functions, and parent-reported Pediatric Quality of Life Inventory to evaluate the quality of life of children were used. Beck Depression Inventory and Beck Anxiety Inventory were used to measuring caregivers' anxiety and depression levels.

Results: Significant differences were found between groups regarding the GMFCS, GMFM, and parent-reported Pediatric Quality of Life scores of children in favor of children with oral feeding ($p<0.05$). Depression levels of caregivers of children with non-oral feeding were higher than children with oral feeding ($p=0.006$).

Conclusion: It was concluded that children with CP who fed non-orally had lower motor functional levels and lower quality of life compared to children who fed orally, as well as their caregivers reported higher depression scores.

Keywords: Cerebral Palsy, Deglutition Disorders, Dysphagia, Enteral Nutrition, Motor Skills.

1. INTRODUCTION

Cerebral Palsy (CP) is defined as a condition that causes movement and postural impairment due to nonprogressive damage in the developing brain. Neurological damage in CP may affect muscle control, movement, posture, and balance (1). Children with CP are prone to experiencing various problems such as development and growth, mobility, cognitive speech, and respiratory issues (1, 2).

The oral motor and swallowing problems in children with CP include poor lip closure, inadequate tongue function, increased bite reflex, drooling, chewing disorders, delayed swallow initiation, decreased pharyngeal motility and inadequate airway closure (3). These symptoms may cause difficulties in providing adequate nutrition, growth and developmental problems in children with CP (4). In particular, children with CP who have problems with airway protection are at the greatest risk of experiencing significant nutritional problems and respiratory complications (5). It is also important to identify the children with CP who has swallowing dysfunction and determine the appropriate feeding method (6).

Swallowing evaluation of children with CP involves both clinical and instrumental approaches. In addition, several factors, such as their medical history, communication, and caregiver concerns should also be considered. This process can help determine the appropriate feeding method that will provide adequate nutrition and hydration (7). In addition to determine the appropriate feeding method, instrumental techniques such as the videofluoroscopic swallowing study and/or fiberoptic endoscopic evaluation of swallowing should be used (8, 9). If children with CP cannot swallow safely and efficiently and are having difficulty meeting nutritional requirements by mouth, enteral nutrition may be initiated (10). Enteral feeding strategies include intragastric (orogastric, nasogastric, gastrostomy tubes) or transpyloric (nasoduodenal, nasojejunal) types. The enteral feeding type is selected whether the enteral feeding requirement

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is short or long-term (11). Orogastric or nasogastric feeding types are used for children who are predicted to have a short-term need for enteral feeding. Gastrostomy tube feeding is chosen if long-term enteral feeding is required. In addition, texture modification might be selected for children with dysphagia risk or for those who experience only liquid aspiration (12).

Gross motor functions of children with CP who had feeding problems are discussed in the literature (13-16). A percentage of 85 of children with CP have been diagnosed with oropharyngeal dysphagia which is related to lower levels of the Gross Motor Function Classification System (GMFCS) (14). It was also reported that feeding problems are observed in children with various levels of the GMFCS, especially at the level of IV and V. According to these studies, the frequency, and severity of swallowing and feeding problems increase as GMFCS level increases (13-16). The literature, however, provides little information about the quality of life of children with CP who fed enterally. There is one study evaluating quality of life related to usage of gastrostomy (17). This study reported improvement in the quality of life scores after gastrostomy was performed in adults with severe CP, but the statistical significance was not tested due to the limited population. In another study conducted on children with neurological dysfunction, parent reports indicated no change in their children's quality of life at both 6 and 12 months post-G-tube insertion (18). There are also studies investigating the depression and anxiety levels of the caregivers of children with CP. However, there are no studies on the same issue regarding the caregivers of children with non-oral feeding.

Likewise, despite some studies on the relationship between gross motor function and feeding ability, there is no study investigating the motor functional level and quality of life children with CP, as well as anxiety and depression levels of caregivers according to their children's feeding types.

This current study aimed to compare (a) motor function levels of the children, (b) parent-reported quality of life of the children, and (c) anxiety and depression levels of caregivers according to the feeding types of children with CP. We hypothesized that children with CP who fed orally would be better in terms of motor skills and quality of life, and there would be low levels of anxiety and depression among their caregivers.

2. METHODS

2.1. Design

This prospective cross-sectional study included 35 children (19 males and 16 females) with CP aged between 5 to17 years. The study was carried out at Hacettepe University Faculty of Physical Therapy and Rehabilitation and Hacettepe University Swallowing Disorders Application and Research Center. Informed consent was obtained from the patients and their parents who agreed to participate in the study. The study did not include any intervention. Ethics committee approval was obtained from Hacettepe University Non-Invasive Ethics Committee (Approval number = GO18/265-06).

2.2. Participants

Children who were diagnosed with CP, aged between 5-17 years, fed by orally or non-orally and had sufficient cooperation to carry out the commands were included in the study. Children with having any other accompanying neurodegenerative diseases, and situations including having an acute respiratory tract infection and/or complications of enteral feeding such as malposition of the feeding tube, perforation of the intestinal tract, infection in the tube placement area, peritonitis that may affect the quality of life were excluded.

Children were divided into two groups as children with oral feeding (Group 1, n=19) and children with non-oral feeding (Group 2, n=16). Grouping of children was made according to the feeding type at the time of admission to the clinic.

2.3. Measures

Descriptive information including age, height, weight, gender, and CP subtype was noted. Observational evaluation of oral motor structures was performed. Open mouth refers to the chronic opening of the lip seal at rest. Open bite is a type of malocclusion, which means upper and lower incisor teeth do not meet properly when the jaws are closed. A high arched palate is high and narrow palate. Micrognathia is a condition in which the jaw is undersized (19).The presence of problems in oral structures, including the open mouth, open bite, high palate, and micrognathia was noted as 'present' or 'absent'.

The Gross Motor Function Classification System (GMFCS) was used to classify the level of gross motor functions in children with CP (20), and levels were based on child-initiated movement abilities, with emphasis on sitting, displacement, and mobility. The GMFCS uses a rating system of Level I to Level V. Level I shows the most independent functional motor level and Level V shows the most dependent functional motor level.

The Gross Motor Function Measurement (GMFM) is an observational clinical tool to evaluate the motor function of children with CP (21). It has five basic sections that evaluate motor function, including lying and rolling; sitting; crawling and kneeling; standing; and walking, running, and jumping, with a total of 88 items. Each evaluation is scored according to the level of achieving gross motor function without considering the quality of movement. While performing each task in the GMFM, a physical therapist scored each evaluation on a Likert scale between 0 to 3. 0 means 'Does not initiate' and 3 means 'Completes'.

Pediatric Quality of Life Inventory (PedsQL) was used to measure the parent-reported quality of life of children (22). The items of the PedsQL were scored between 0 to 100, of which 100 means "never", 75 means "almost never", 50

means “sometimes”, 25 means “often”, and 0 means “almost always”. Points are collected and divided by the number of items filled to obtain the total score. Higher scores indicate better health-related quality of life. Parent proxy-report versions of PedsQL were applied and recorded as physical health summary score (PHSS), psychosocial health summary score (PSHSS), and total scale score (TSS).

The Turkish version of the Beck Depression Inventory (BDI), and Beck Anxiety Inventory (BAI) were used to measure anxiety and depression levels of caregivers of children with CP (23, 24). The BDI scale is a tool that measures the symptoms of depression. It consists of 21 questions that are related to the emotional, cognitive, and motivation aspects of the disorder. The questions are scored between 0 and 3, and the highest score is 63. Areas evaluated in BDI are unhappiness, crying, self-blame, feeling of failure, irritability, social withdrawal, changes in body image, indecision, weight loss, fatigue, anorexia, insomnia, somatic efforts, and libido reduction. The scores of 17 and above could distinguish between depression with more than 90% accuracy. The BAI is a self-report measure of anxiety. It has 21 items and each one is scored on a Likert scale between 0 to 3. The total score ranges between 0 to 63. Higher scores indicate more severe anxiety in an individual.

Each evaluation was performed by a physical therapist with five years of experience in the field of dysphagia rehabilitation. All assessments were carried out in a silent and comfortable environment. Each evaluation session took 45 minutes for each child.

2.4. Data Analysis

Power of the study was calculated via G*Power version 3.1 as a total of 34 cases with 19 for oral feeding group and 16 for non-oral feeding group as a result of two-way post-hoc hypothesis testing with 5% type I error margin, and evaluated using PedsQL TSS mean scores and standart deviations of each group. Effect size was found 1.05 and the power of the study was found 85%.

The IBM-SPSS Statistics 20 for Windows was used for calculations. Mean (X), standard deviation (SD), minimum and maximum values are used for continuous variables, while number (n) and percentage (%) are used for categorical variables. The Shapiro-Wilk test (n <50) was used to determine whether the continuous variable averages were distributed normally, and the non-parametric tests were applied because the variables were not normally distributed. Mann-Whitney U test was used to compare the continuous variables according to the nutritional status of oral and enteral feeding groups. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS

A total of 35 children (19 males and 16 females) were included in the study. Group 1 consisted of children with full oral feeding (n = 11, 31.4%) and children with liquid-restricted oral feeding (n = 8, 42.1%). Group 2 included children with nasogastric tube feeding (n = 6, 17.1%) and children with g-tube feeding (n = 10, 28.6%). The mean duration of feeding with nasogastric tube in group 2 was 7.66 ± 3.26 months and the mean duration of feeding with g-tubes was 36.9 ± 30.8 months. Descriptive information is shown in Table 1. There was no difference in age, height, and weight between groups (p > .05).

Table 1. *Descriptive information of children*

	Group 1 Children with Oral Feeding (n = 19)		Group 2 Children with Non-oral Feeding (n = 16)		p
	X ± SD	min-max	X ± SD	min-max	
Age (year)	8.47 (3.63)	5-17	8.19 (3.19)	5-16	.947
Height (cm)	114.21 (22.60)	77-165	104.44 (20.20)	76-140	.389
Weight (kg)	20.29 (9.23)	8-48	20.75 (10.25)	6.5-43	.921

There was a significant difference between group 1 and group 2 in terms of sub-type of CP, GMFCS levels, and observational oral motor evaluation results (p < .05). The information regarding the sub-type of the CP, GMFCS levels and observational oral motor evaluation results are presented in Table 2.

Table 2. *Comparison of CP sub-type, GMFCS levels and oral structural evaluation.*

	Group 1 Children with Oral Feeding (n = 19)		Group 2 Children with Non-oral Feeding (n = 16)		p
CP sub-type	**n**	**%**	**n**	**%**	
Quadriparetic	4	21.1	13	81.3	.01*
Diparetic	3	15.8	1	6.3	
Hemiparetic	9	47.4	1	6.3	
Choreo-athetotic	2	10.5	1	6.3	
Dystonic	1	5.3	0	0.0	
GMFCS	**n**	**%**	**n**	**%**	.004*
Level I	7	36.8	1	6.3	
Level II	5	26.3	1	6.3	
Level III	2	10.5	1	6.3	
Level IV	2	10.5	0	0.0	
Level V	3	15.8	13	81.3	
Oral structural evaluation	**n**	**%**	**n**	**%**	
Open mouth	11	57.9	16	100	.003*
Open bite	9	47.4	16	100	.001*
High palate	2	10.5	7	43.8	.025*
Micrognathia	1	5.3	1	6.3	.900

** p<0.05; Abbreviations:CP: Cerebral Palsy, GMFCS: Gross Motor Functional Classification System.*

A significant difference was found between groups regarding the GMFM scores of children (p < .05). Children in group 2 had lower scores in all sub-scores and total scores of the GMFM compared to group 1 (Table 3). There was also a statistically significant difference in parent-reported quality

of life of children between groups (p < .05). The parent-reported PSHSS, PHSS, and TSS scores of group 1 were higher than group 2 (p < .05). No difference was found between groups in terms of the anxiety levels of the caregivers (p > .05). Depression levels of caregivers in group 2 were higher than in group 1 (p < .05).

Table 3. *Comparison of GMFM, PedsQL, BAI and BDI means.*

	Group 1 Children with Oral Feeding (n = 19)		Group 2 Children with Non-oral Feeding (n = 16)		p
	X ± SD	Min-Max	X ± SD	Min-Max	
GMFM					
Lying & rolling	87.72±25	0-100	46.32±28.47	13.73-100	.00**
Sitting	80.09±31.56	0-100	21.87±35.20	0-100	.00**
Crawling & kneeling	72.06±38.36	0-100	14.88±34.12	0-100	.00**
Standing	65.85±38.32	0-100	14.58±33.74	0-100	.00**
Walking, running & jumping	55.77±36.65	0-95.83	11.89±29.43	0-100	.001*
Total	72.30±32.64	0-99.17	21.91±31.05	2.75-100	.001*
PedsQL					
PHSS	62.99±28.74	12.5-100	27.54±23.34	0-84.38	.001*
PSHSS	72.81±18.47	21.67-93.33	60.52±19.77	0-83.33	.037*
TSS	69.39±19.81	18.48-93.48	49.05±18.85	0-80.43	.003*
BAI	9.63±7.78	0-28	14.25±10.86	0-41	.135
BDI	9.42±9.22	1-39	17.56±9.96	3-41	.006*

**p<0.05; **p<0.001; Abbreviations: GMFM: Gross Motor Function Measurement, PedsQL: Pediatric Quality of Life Inventory, PHSS: Physical Health Summary Score, PSHSS: Psychosocial Health Summary Score, TSS: Total Scale Score, BAI: Beck Anxiety Inventory, BDI: Beck Depression Inventory.*

4. DISCUSSION

The current study shows that children with CP who had non-oral feeding had lower motor functional levels and lower quality of life compared to children who had oral feeding, as well as their caregivers reported higher depression scores.

The demographics including age, height, and weight were similar in groups, which strengthens our study to be able to compare the groups. It was reported that malocclusion, open bite, and biting reflex were more commonly seen in children with CP (25), and the possible reasons were reported as neurological conditions of the children, head hyperextension at rest, atypical swallowing, using pacifiers, and thumb sucking habits (26, 27). Additionally, our study results showed that the prevalence of oral motor structural problems regarding the presence of open mouth, high palate and open mouth were higher in children with CP who had non-oral feeding. It may be explained by the increased neurological impairments of these children. Children with non-oral feeding in our study were mostly quadriparetic CP and children with oral feeding were mostly hemiparetic CP. When neurological impairment increased, optimal control of head, neck, and trunk muscles could not be maintained. Therefore, poor or inadequate control and accompanying kinetic problems of muscles may affect the development of the oral region and may cause inefficient feeding. Also oral structural problems seen more common on children with limited mobility and motor functional skills (28, 29).

Gross motor functional levels were lower in children with CP who had non-oral feeding compared to children with CP who had oral feeding. Children who fed non-orally were mostly in GMFCS level V although children fed orally were generally in GMFCS I and II. Oropharyngeal phase problems were seen in all children with CP at GMFCS levels II to V. In addition, it was found that the frequency and severity of nutritional and feeding disorders increase as the level of GMFCS increases as our study results (13-16, 30). Because children with lower motor functional ability need more support in functional activities including oropharyngeal swallowing and feeding. Similarly, the inability to provide an adequate head position for feeding and inappropriate head positions such as neck hyperextension may be increasing factors related to swallowing problems.

In terms of motor function of children in our study, the GMFM scores were better in children who fed orally compared to children fed non-orally as complementary to our results regarding the GMFCS levels. In a study (14), decreased sub-scores and total scores of GMFM are related to the presence of oropharyngeal dysphagia. It has been shown that approximately 70% of children with hemiparetic or diparetic CP had oropharyngeal dysphagia and their motor function scores were lower than children with hemiparetic/diparetic CP who did not have any feeding problems.

In our study, majority of the children fed non-orally were quadriparetic CP. In the current study, the highest achievement in both groups were seen in the lying and rolling section scores. However, children fed non-orally had lower scores in all sub-scores and total scores of the GMFM. In another study significant correlation was found between trunk control and oral motor functions in children with CP (31). Similarly, in our study, it was observed that the sitting subgroup scores of children fed orally were higher. Namely, the frequency of enteral feeding in other words severity of swallowing problems increased through motor function scores decreased. Therefore, children with poorer motor functional levels should be evaluated in terms of possible swallowing and feeding problems.

This study showed that children who fed non-orally had worse parent-reported quality of life scores compared to children fed orally. In a study on children with non-ambulant CP, factors affecting the health-related quality of life were reported as decreased motor functional levels and inefficient swallowing result in enteral feeding (32). Considering motor functional levels of children who fed non-orally, they have worse motor control and need more support on daily activities. They may be more dependent on their caregivers in terms of daily activities including walking, feeding, self-care, dressing, etc. In addition, they have worse swallowing and feeding difficulties. These factors may decrease the

quality of life in children with non-oral feeding. In addition, the need for hospitalization due to surgical intervention, economical costs, need for routine medical follow-up, risk of infection, the necessity to change at regular intervals, and usage of enteral feeding supplements instead of foods could also contribute to poorer quality of life in children fed non-orally (32). Therefore, more support should be given to children who are fed non-orally. This result does not mean that tube feeding in itself adversely affects quality of life for these children and their caregivers. Even though, there may be an improvement in quality of life after tube placement in children by eliminating the negative consequences of swallowing impairments (18, 33, 34). In the present study, there are different factors contributing to the quality of life including their neurological involvements, independency levels, etc. in our study groups. Therefore, the study design does not allow for interpret the findings in this way.

Anxiety and depression levels of caregivers were also measured. It is crucial to define the anxiety and depression levels of caregivers because caregiver compliance is important for the success of feeding and swallowing management. Despite no difference between anxiety levels of caregivers, depression levels of caregivers of children with non-oral feeding were higher than caregivers of children with oral feeding. Arslan et al. found a relationship between the feeding type of the children with CP and the anxiety levels of the parent's (35). Caregivers of children with feeding disorders spent more than half an hour and more than three hours a day for a single meal (16). Therefore, feeding sessions become dominant in the daily life of caregivers. In addition, children with CP need more care than healthy children due to complex health needs requiring multidirectional problems, hospital visits and follow-ups (36). Therefore, caregivers of children with CP had limited social life (37). In a study, it was reported that the dysphagia problem of children with neurological involvement negatively affects the main activities of daily life and health-related quality of life of caregivers (38). In addition, having children who are fed non-orally may increase the need of care for children with CP, thereby depression symptoms of caregivers of children with non-oral feeding may be higher.

There are also some limitations in the current study. The analysis could also be performed between subgroups if the number of participants will be increases. Thus, different groups including children fed by nasogastric tubes, gastrostomy tubes, etc. could be arranged and intergroup differences between parameters could be examined. Also in our study, the age range of children with CP was wide which may affect the of quality of life, perspective, and responses of parents depending on the age of the child. In future studies, different age groups can be formed, and the difference between feeding type and motor skills also quality of life of children and caregivers can be observed. Also, enteral feeding can be observed in certain time periods. Thus, differences and changes in motor functions and quality of life can be shown. Also, other conditions that could affect the anxiety and depression status of parents including parents' history of anxiety/depression, and medication use were not investigated in the present study.

5. CONCLUSION

The study concluded that children with CP who had non-oral feeding had lower motor functional levels and lower quality of life compared to children who had oral feeding, as well as their caregivers reported higher depression scores. Therefore, children with lower motor functional levels should be supported and followed closely by both theirselves and their caregivers.

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