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Original Article

An investigation of the relationship of drooling with nutrition and head control in individuals with quadriparetic cerebral palsy

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Abstract. [Purpose] The aim of the present study was to investigate the relationship of drooling, nutrition, and head control in individuals with quadriparetic cerebral palsy. [Subjects and Methods] Fifty-six individuals between the ages 2 and 15 diagnosed with spastic quadriparetic cerebral palsy and their families/caretakers were included in the study. Drooling severity and frequency of individuals was evaluated by using the scale developed by Thomas-Stonell and Greenberg (Drooling Severity and Frequency Scale). Individuals having a drooling severity value of 1 were included in the not drooling group (group 2) (n=27). Individuals having a drooling severity of 2, 3, 4, or 5 were included in the drooling group (group 1) (n=29). The evaluations were applied to both groups. [Results] There were significant differences between the two groups in terms of gestational age, nutrition behavior, eating abilities, head control, gagging, nutritional status (inadequate nutrition, normal nutrition, over weight-obese), and low weight. It was established that as head control increased, drooling severity diminished, and as drooling severity increased, BMI index decreased. Independence of eating ability was found to be greater in the group having better drooling control. [Conclusion] In the present study, it was determined that drooling control affected nutritional functions and that drooling control was affected by head control.
Key words: Drooling, Cerebral palsy, Dysphagia

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INTRODUCTION

Cerebral palsy (CP) is the term for a range of movement difficulties caused when the parts of the brain controlling the movements do not work properly[1)]. It is the commonest cause of significant physical and respiratory impairment in children[2–4)].

Nutritional problems observed in children with CP have an important place in the care of these children. If these nutritional problems are not treated, they lead to inadequate nutrition and growth-development retardation and affect morbidity and mortality unfavorably[5, 6)]. Nutrition and gastrointestinal system (GIS) problems in patients with CP depend on the interaction of several factors. Most of these patients cannot walk, reach their meals, or move food to their mouth due to motor impairment therefore, they depend on other people in their nutritional activities[6)].

Drooling is one of the most frequent problems seen in children with CP. We define drooling as the loss of saliva from the mouth. The prevalence of drooling in children with CP ranges from 37.4 to 58%. It is related to oral phase dysfunction in addition to insufficient lip closure generally and to tongue movements impaired due to diminished oral and perioral sensory perception, upside down posture, and diminished swallowing frequency and dysphagia. Drooling is a stressful situation for children as well as their parents and caretakers. Among the reported side effects are social rejection risk; continuously moist and wet outfits; unpleasant odor; chapped or softened facial skin; perioral and oral mouth infections, generally Candida albicans, dehydration; impaired chewing function; dependency in talking; book harming; impaired communication skills; and social isolation[7)]. Inability to swallow saliva can lead to aspiration pneumonia[8)]. In previous studies, it was observed that drooling of CP individuals with spastic quadriplegia was greater in CP individuals with than other functional capacities, and the prevalence of drooling was higher at younger ages[9)].

Based on this information, the primary purpose of the study was to evaluate drooling frequency and severity in children with quadriparetic cerebral palsy, to lead development of suitable treatment strategies, and to investigate the relationship of drooling frequency and severity with nutrition and head control. We believe that this study will shed light to necessity of rehabilitation programs composed of oral stimulation, exercises for improving oral motor abilities, speech and language therapy, appropriate feeding positions, family education for better sitting and feeding of the child, diet and feeding solutions.

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SUBJECTS AND METHODS

Fifty-six quadriparetic individuals were included in the present study, which investigated the effects of drooling on nutrition in individuals with quadriparetic CP. The individuals were evaluated between September 2013 and February 2014. Parents of individuals included in the study were informed about the study, and the required permit was obtained from the Abant Izzet Baysal University Clinical Research Ethics Committee (23625-050.01.04-194). Individuals diagnosed with quadriparetic spastic type cerebral palsy who were between the ages 2–15 were included in the study after obtaining approval from their parents, and individuals who had a diagnosis other than quadriparetic cerebral palsy or withdrew from the study on their own or due to the decision of their parents or caretakers were not included in the study.

Sixty-six individuals with a diagnosis of quadriparetic CP participated in the study. Ten individuals were not included in the study because they did not fulfill the age criterion among the inclusion criteria. Of the 56 individuals, 10 individuals (17.9%), 12 individuals (21.4%), and 34 individuals (60.7%) were classified as levels III, IV and V, respectively, according to the Gross Motor Function Classification System. Drooling control was evaluated by using the scale developed by Thomas-Stonell and Greenberg (Drooling Severity and Frequency Scale, DFSS). Individuals were divided into two groups: those who did not drool (group 2, n=27) and those who drooled (group 1, n=29). The evaluations were applied to both groups.

The subjects included in the study were evaluated according to an evaluation form. For determining characteristics of the subjects in the evaluation form, birth date, gender, height and body weight were recorded.

The episodes of the subjects were considered under these headings: birth weight (grams (gr)) and gestational age (weeks), and diagnosed gastrointestinal system problem "yes" or "no". Questions were asked about the eating period of the subjects (20 min, 20–40 min, or 40 min and above), meal interval (2 hours, 3 hours, 4 hours, or more than 4 hours), kind of food that could be consumed from a diet list (liquid, solid, mash), presence of gastronomy, independent eating skill (independent, semi-independent, fully dependent), and materials used in consuming meals (nursing bottle, glass, spoon, finger, straw). Moreover, appetite status of the children was as also queried (good, inconsistent, and weak).

Skill to hold the head in an upright position for 10 seconds (sec) in a supported sitting position was evaluated[10]. Head control was determined as "yes" or "no".

Drooling severity and frequency was determined based on the method of observation determined in meetings with the parents or caretakers and related physiotherapists. Drooling status of the individuals during the last two weeks was determined numerically by using the scale developed by Thomas-Stonell and Greenberg (DFSS)[7]. According to the scale developed by Thomas-Stonell and Greenberg, drooling severity was evaluated as follows: 1 dry (no drooling); 2, mild (moist lips); 3, moderate (wet lips and chin); 4, severe (moist outfits); and 5, profuse (wet outfits, hands, and objects). Drooling frequency was evaluated as follows: 1, none; 2, sometimes (not every day); 3, sometimes (part of the day); and 4, continuously. Individuals who had a score of 1 for drooling severity formed the not drooling group (group 2), and individuals who had scores of 2, 3, 4 or 5 for drooling severity formed the drooling group (group 1). The evaluations were applied to both groups.

The heights of the subjects were measured and recorded in meters, their body weights were measured and recorded in kilograms, and their body mass indexes (kg/m^2) was estimated by dividing their body weights (in kilograms) by the square of their heights (in meters). Furthermore, body mass indexes (BMIs) were determined numerically based on age. BMIs based on age were categorized as suggested by the World Health Organization (WHO): below the 5th percentile, "inadequate nutrition"; 6th to 15th percentile, "weak"; 16th to 85th percentile, "normal", 86th to 95th percentile, "increased risk for overweight"; and over the 95th percentile, "overweight" (obese). A group was formed by combining the individuals from the 86th to 95th percentiles, "increased risk for overweight", and individuals from the over 95th percentile, "overweight" (obese). As a result, individuals from below the 5th percentile made up the "inadequate nutrition" group, individuals from the 16th to 85th percentile made up the "normal nutrition" group, and individuals from the 86th percentile and above made up the "overweight-obese" group. "Growth curves" made over normal limits were used in kilogram index based on age and children remaining under 3 percentile were named as "low weight". Weight indexes based on age were grouped according to the distribution interval in the population and indicated numerically.

Statistical analyses were performed by using the SPSS Statistics software (version 11.5, SPSS Inc., Chicago, IL, USA). For the significance of differences between averages, the Student's t test was used, and in the analysis of categorical variables, χ^2 (Fisher's exact) test was used. A $p<0.05$ was accepted as significant in the tests.

RESULTS

Statistically significant differences were found between the groups in terms of weight (p=0.017) and BMI (p=0.018) values (Table 1). A statistically significant difference was found between the groups in terms of age values (p=0.032) (Table 2). The drooling severity and frequency scores of drooling individuals were 3.06±0.79 and 3.00±0.84, respectively. Presence/absence of gastrointestinal system problems, nutrition periods, meal intervals, presence/absence of feeding with a tube, and a comparison of solid and mashed food eating skills are shown in Table 3. A significant difference was found between the groups in terms of meal eating skill (p=0.001). It was observed that the not drooling group was more independent (Table 4). There was no significant difference between the groups in terms of chewing and drinking with a straw skill (Table 5). A significant difference was found between head control (p=0.038) and drooling. The drooling severity was higher in individuals having no head control (Table 6). There was no significant difference between the groups in terms of BMI index values based on age (p=0.169) (Table 7).

Table 1. Physical characteristics of the individuals

Physical characteristics	Group 1 (n= 29) X±SD	Group 2 (n= 27) X±SD
Age (years)	7.86±3.89	8.59±4.09
Weight (kg)	18.10±8.44	24.53±10.89
Height (cm)	115.48±17.38	115.81±23.56
BMI (kg/m^2)	13.77±4.14	17.15±6.00

Table 2. Birth weights and gestational ages of the individuals

	Group 1 (n= 29) X±SD	Group 2 (n= 27) X±SD
Birth weight (g)	2772.8±975.8	2497.2±901.8
Gestational age (weeks)	36.79±4.46	33.96±5.10

Table 3. Comparison of the presence/absence of gastrointestinal system problems, eating periods, meal intervals, presence/absence of feeding with a tube, and solid and mash food eating skills of the individuals

		Group 1 n (%)	Group 2 n (%)	Total n (%)
Gastrointestinal system problem	Yes	10 (17.9%)	10 (17.9%)	20 (35.7%)
	No	19 (33.9%)	17 (30.4%)	36 (64.3%)
Eating period	20 min	15 (26.8%)	14 (25.0%)	29 (51.8%)
	30–40 min	8 (14.3%)	11 (19.6%)	19 (33.9%)
	45 min and above	6 (10.7%)	2 (3.6%)	8 (14.3%)
Meal interval	2 h	10 (17.9%)	5 (8.9%)	15 (26.8%)
	3 h	10 (17.9%)	8 (14.3%)	18 (32.1%)
	4 h	7 (12.5%)	12 (21.4%)	19 (33.9%)
	Over 4 h	2 (3.6%)	2 (3.6%)	4 (7.1%)
Feeding with tube	Yes	1 (1.8%)	2 (3.6%)	3 (5.4%)
	No	28 (50%)	25 (44.6%)	53 (94.6%)
Feeding with mash	Yes	27 (48.2%)	25 (44.6%)	52 (92.9%)
	No	2 (3.6%)	2 (3.6%)	4 (7.1%)
Feeding with solid food	Yes	14 (25%)	18 (32.1%)	32 (57.1%)
	No	15 (26.8%)	9 (16.1%)	24 (42.9%)

Table 4. Comparison of eating, use of a nursing bottle, drinking from a glass, eating with a spoon, and eating with the hands skills of individuals

		Group 1 n (%)	Group 2 n (%)	Total n (%)
Eating skill	Independent	0 (0%)	6 (10.7%)	6 (10.7%)
	Semi-dependent	4 (7.1%)	9 (16.1%)	13 (23.2%)
	Fully dependent	25 (44.6%)	12 (21.4%)	37 (66.1%)
Use of a nursing bottle	Yes	11 (19.6%)	9 (16.1%)	20 (35.7%)
	No	18 (32.1%)	18 (32.1%)	36 (64.3%)
Drinking from a glass	Yes	21 (37.5%)	21 (37.5%)	42 (75%)
	No	8 (14.3%)	6 (10.7%)	14 (25%)
Eating with a spoon	Yes	28 (50%)	22 (39.3%)	50 (89.3%)
	No	1 (1.8%)	5 (8.9%)	6 (10.7%)
Eating with the hands	Yes	8 (14.3%)	11 (19.6%)	19 (33.9%)
	No	21 (37.5%)	16 (28.6%)	37 (66.1%)

Table 5. Comparison of chewing and drinking with a straw skills among groups

		Group 1 n (%)	Group 2 n (%)	Total n (%)
Chewing	Yes	17 (30.4%)	19 (33.9%)	36 (64.3%)
	No	12 (21.4%)	8 (14.3%)	20 (35.7%)
Drinking with a straw	Yes	8 (14.3%)	12 (21.4%)	20 (35.7%)
	No	21 (37.5%)	15 (26.8%)	36 (64.3%)

Table 6. Comparison of head control of the individuals

		Group 1 n (%)	Group 2 n (%)	Total n (%)
Head control	Yes	15 (26.8%)	21 (37.5%)	36 (64.3%)
	No	14 (25%)	6 (10.7%)	20 (35.7%)

Table 7. Comparisons of BMI values based on age between the groups

		Group 1 n (%)	Group 2 n (%)	Total n (%)
BMI based on age	0–5 (inadequate nourishment)	20 (35.7%)	8 (14.3%)	28 (50%)
	6–15 (poor nourishment)	-	-	-
	16–85 (normal nourishment)	7 (12.5%)	11 (19.6%)	18 (32.1%)
	86–95 (increased risk for overweight)	2 (3.6%)	3 (5.4%)	5 (8.9%)
	95 and above (obese)	0 (0%)	5 (8.9%)	5 (8.9%)

Table 8. Comparison of BMIvalues between groups based on ages of the individuals

	Group 1 n (%)	Group 2 n (%)	Total n (%)
Inadequate nourishment (<5)	20 (35.7%)	8 (14.3%)	28 (50%)
Normal (16–85)	7 (12.5%)	11 (19.6%)	18 (32.1%)
Overweight/ obese (>86)	2 (3.6%)	8 (14.3%)	10 (17.9%)

Table 9. Grouping and comparison of the weight percentile values of the individuals based on age

	Group 1 n (%)	Group 2 n (%)	Total n (%)
<3 (low weight)	17 (30.4%)	5 (8.9%)	22 (39.3%)
>3	12 (21.4%)	22 (39.3%)	34 (60.7%)

The BMI indexes of individuals who did not drool were found to be greater based on age. In other words, the nutrition levels of individuals who had saliva control were better. There was quadratic regression between the BMI index and drooling severity based on age. Until the drooling severity score reached 2 (mild), there was negative linear regression with BMI based on age, and after the drooling severity score reached 2, regression did not change significantly. Weight indexes in individuals who had no head control based on age were found to be lower. In other words, the growth levels of individuals who had no head control were lower.

The overweight and obese groups were combined. As a result, inadequate nutrition, normal nutrition, and overweight/obese groups were formed. There were significant differences between the inadequate nutrition, normal nutrition, and overweight/obese groups (p=0.008) (Table 8). There were significant differences between the groups having low weights and the groups that did not have low weights according to weight index based on age (p=0.002) (Table 9).

DISCUSSION

In the present study, there was a significant difference between the drooling and not drooling groups in terms of eating skills. It was observed that as the eating skill diminished, drooling prevalence increased. It was found that 44.6% of individuals having saliva control were able to eat mash and that 48.2% of individuals who drooled were able to eat mash. There were no significant differences between the groups in terms of meal content (solid, mash, liquid), nutrition periods, and presence/absence of feeding with a tube. In other words, it was found that uncontrolled drooling did not affect diet content. We think that the factors determining diet content are oral health (teeth situation, etc.) and oral motor dysfunction.

For drinking with a straw, it is necessary to reach to the straw and then it is necessary to grab it without biting and to draw fluid into the mouth. This is a rather difficult skill for quadriparetic CP individuals. Individuals with middle and severe nutrition disorder have problems drawing liquid into the mouth with a straw and with grabbing a straw with their lips. Yılmaz et al.[10] found that the drinking with a straw skill

of younger individuals was worse than that of older individuals because of lack of experience. Reid et al.[11] reported that there was no drooling in 80.1% of individuals with CP who could use straw and that the other 19.9% drooled. In our study, it was found that 35.7% of the subjects could drink with a straw. Drooling was found in 14.3% of these subjects, and whereas the other 21.4% did not drool. We think that in our study, having considerably high drinking skills with a straw was related to the mental situation of the individuals. We think that having a good mental situation, good oral muscle strength, and good coordination affects drinking with a straw positively in individuals.

Senner et al.[12] found a positive correlation between drooling severity and dysphagia. Siktberg and Bantz[13] reported that physical growth and nutrition level of children with swallowing impairment were affected by social interaction. Nutrition has significant social effect not only for sustaining life but also for the establishment of intrafamilial relationships and out of home independence[14]. In an epidemiologic study by Erasmus et al.[15] conducted in Northern Ireland during 1992–2009 at a CP center, dysphagia was found in 43% of 1,357 children with CP. Nutrition and swallowing problems caused malnutrition and dehydration and may affect physical and cognitive growth and development of children[13]. Arvedson[16] reported that the prevelance of nutrition impairment was greater in spastic quadriplegic children (50–75%). Early detection of dysphagia and diagnosis by an interdisciplinary team may correct the nutritional situation and physical, cognitive, and psychological growth and development of children and their interaction with other children and their families[13]. Growth analyses and follow-up with developmental evaluations are important for determining nutrition and swallowing impairments[16]. In the present study, we wanted to draw attention to nutrition problems and the nutrition behavior of quadriparetic CP children. Snider et al.[14] reported that prevalence studies indicating nutrition difficulties of CP children are scarce. In study by Erkin et al.[17], nutrition problems were detected in 86% of quadriplegic CP children and 37% of hemiplegic or diplegic children. Liquid and food loss is prevalent during swallowing in individuals who have severe nutritional dysfunction[10]. Hou et al.[18] reported that oral motor dysfunction and nutritional problems in children with CP were seen at early ages and that they affected growth and the nutrition level.

It was reported that 27% of CP children who had a swallowing problem experienced a suction problem in the past. No relationship was found between the severity of swallowing difficulty and suction skill in the present study. In full-term newborn children, complex delayed swallowing problems have been observed[19]. In our study, there was no significant difference between drooling and suction functions in the postnatal term. Reid et al.[11] observed that 77.5% of children with CP experiencing difficulty in eating did not drool and that the other 22.5% did drool. In the present study, 66.7% of the children with a drooling problem experienced difficulty in eating solid food, and 39.3% of children without a drooling did not experience difficulty in eating solid food. When mash food eating skills were evaluated, it was seen that 65.7% of children who did not drool could eat mash and that 34.5% of children who drooled could eat mash. Drooling was found in 97.6% of children who fed with a tube, and no drooling was found in 2.4% of the children.

Food content affects growth and nutrition impairment and oral health, especially at early ages[20, 21]. Santos et al.[20] reported that there was significant difference between tooth health and diet content. In our study, the health of the subjects' teeth was not evaluated, and therefore it could not be determined, whether oral motor dysfunction or tooth problems influenced preferences regarding diet content. By conducting a multidisciplinary study with dentists, the conditions of the teeth of the individuals could be evaluated, and it could be determined whether the health of the teeth plays a role in determination of diet content.

In the present study, the incidence of assisted nutrition (by a caretaker) with a spoon was found to be 89.3%. When the functional levels of individuals with quadriparetic CP are considered, it is clear that acquiring the skill to eat independently with a spoon is rather difficult. There was no significant difference between the drooling and not drooling groups in nursing bottle usage, drinking from a glass, eat with a spoon and eating with the hands skills. These skills are affected by the functional level and mental status. It was observed that drooling did not affect these skills. We think that the reason for it is the sufficiency of functional levels and mental status of the individuals. Sığan et al.[22] reported in a study that evaluated children with CP that 79.3% of them could not eat with spoon, 83.45% could not bite, 66.33% could not chew, 91.61% could not drink, and 74.73% could not swallow. Santos et al.[20] reported difficulty in eating with a spoon, biting, chewing, drinking from a glass, drinking with a straw, and swallowing skills. Gisel and Patrick[23] found that the chewing and swallowing periods were longer in individuals with severe CP.

Lack of facial tone and head control affect drooling[17]. In children who bend forward, drooling is greater[24]. Head posture and position affect chair sitting manner and drooling[11, 24, 25]. Lack of postural control increases nutrition and swallowing disorders[26]. In a study conducted by Yilmaz et al.[10], head control was evaluated by physiotherapists, and individuals who could hold their head in a sitting position for less than 10 sec were categorized as having weak head holding skill. In another study, it was established that 4.4% of the children with CP did not have head control but had saliva control, and drooling was found in 95.6% of the children[11]. In the present study, the ratio of individuals who did not have head control was 35.7%. Drooling was found in 25% of the subjects, whereas no drooling was found in the other 10.7%. Less drooling was found as the head control of the subjects improved. There was a significant difference between head control and drooling. As we stated previously, head control affects drooling control. In treatment programs applied for drooling control development, attention must be paid to ensure that the head position is in a neutral position[27]. In quadriparetic children, allowing them to lie down all day long combined with swallowing impairment, it could lead to aspiration and lung infection. This is a life-threatening situation in individuals with CP, and it illusrates the importance of drooling control.

Individuals with weak postural control experience nutrition and swallowing problems frequently. Right postural

arrangement plays a vital role in the normal nutrition and swallowing process[26]. It was previously observed that positional programs result in recovery of eating and swallowing skills[14]. Effective oral nutrition starts with the correction of head stability and chin control. Chin stability affects tongue control and lip movements. Head control is affected by body arrangement, and the body depends on pelvis stability. Along with techniques such as therapeutic sitting and oral control, right postural arrangement corrects oral functions and enables food intake safely[26].

It is considered that investigations are needed regarding development of head control within the physiotherapy programs and this will contribute to the development of saliva control and nutrition and swallowing functions. In children who are not able to develop head control, it is important that proper sitting and eating positions are developed by training their family members.

In individuals with drooling, weight and BMI were found to be lower, the incidence of low weight, was higher, and BMI based on age decreased as drooling severity increased.

It was determined that saliva control affected nutrition level, and when the eating skills of the groups with and without drooling control were compared, it was observed that the individuals having saliva control were more independent.

The limitations of the study are as follows: The epilepsy episodes of the subjects of the study were not questioned. Epilepsy is a factor that affects drooling. Furthermore, tooth problems are vital factors influencing the nutrition levels and diet content of individuals. In the present study, tooth problems were not evaluated. Finally, only the individuals with quadriparetic cerebral palsy were included in our study. Therefore, an investigation should be conducted that includes all cerebral palsy types.

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