

ABSTRACT

The objective of this study was to evaluate the influence of the type of cerebral palsy (CP) and oral motor function (OMF) on the oral health status of children and adolescents with CP in Teresina, Piauí, Brazil. The sample consisted of 52 children with CP, aged 7 to 18 years. The data were statistically analyzed using chi-square tests. In 73.1% of the sample, the subjects' caregivers carried out the daily oral care. There was a significant association between the frequency of daily care and the subject's level of oral hygiene ($p = .037$). A diagnosis of Class II malocclusion was made for 55.8% of the sample, and defects of enamel formation were found in 38.5% of the subjects. There was no significant correlation between DMFT (decayed, missing, filled teeth) ($\bar{x} = 1.09 \pm 1.64$) and socioeconomic status of the subjects ($r = .254$, $p = .069$). A significant association was found between quadriplegia and OMF ($\chi^2 = 7.88$, $p = .019$). The type of CP and OMF did not influence the levels of plaque and caries indices in the children with CP, but increased frequency of toothbrushing did result in an improved oral hygiene index.

KEY WORDS: cerebral palsy, oral health, oral motor function, children

Oral health and oral motor function in children with cerebral palsy

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Introduction

Cerebral palsy (CP) is a chronic, nonprogressive, disabling condition of the neuromuscular system, a result of early brain damage in the pre-, peri-, or postnatal periods, when the nervous system is still maturing.¹ In the United States, the incidence is estimated to be between 2 and 2.5 for every 1,000 live births, according to Sankar and Mundkur.¹ In England and Scandinavia, the prevalence varies between 1.0 and 2.1 per 1,000 schoolchildren.² It was estimated that the incidence in Brazil could range from 1.5 to 2.5 for every 1,000 live births.²

The etiology of this disease is still being researched; however, it has been suggested that CP is a multifactorial disease.³ The factors most studied in the literature are perinatal hypoxia-ischemia, low weight at birth, intrauterine infection, prematurity, and genetic disorders, among others. There is also evidence that multiple gestation could be a risk factor.^{3,4}

Patients who have CP are more prone to developing oral diseases such as caries and periodontal disease because they have difficulty controlling plaque, have a high intake of sugary foods, use sugary medications, have xerostomia, and have abnormal tension of facial muscles, with poor control of the lips and tongue.⁵ They also have chewing and swallowing dysfunction, with a prolonged delay between the time of intake of food and swallowing.⁵ They are more likely to be mouth-breathers, as well as having malocclusions.⁵

This paper describes a cross-sectional study aimed at evaluating the oral health of children and adolescents with CP in Teresina, Piauí, Brazil. The study assessed the correlation between the type of CP and the subjects' degree of oral motor impairment. The variables evaluated were dental caries and plaque indices, oral hygiene habits, defects in tooth enamel formation, occlusion, food consistency, and degree of oral motor dysfunction.

Materials and methods

The sample consisted of 52 children with CP (26 boys and 26 girls) whose ages ranged from 7 to 18 years ($\bar{x} = 10$ years ± 2.36). The study was conducted in the state of Piauí, Brazil, at the Integrated Center for Special Education (CIES) and the Integrated Rehabilitation Center (CEIR), which are centers of referral for rehabilitative care of patients with special needs in the state of Piauí.

The rules governing research on human subjects were respected and the Ethics Committee of the Federal University of Piauí approved the study (protocol 0178.0.045.000–08). The caregivers for the research subjects who participated in the study signed an informed consent before the data was collected. Caregivers completed a form to provide data regarding the age, gender, social class, dietary habits, and oral hygiene of the children. They also reported on whether the subjects had any degree of mental disability.

Subjects carried out supervised toothbrushing and their caregivers were instructed in oral hygiene. The clinical examination was carried out under artificial lighting at the institutions' dental practice facility. A single examiner (previously trained and calibrated) used a dental mirror, probe, and cotton-roll isolation for the oral examination. The variables evaluated were: caries experience, dental plaque index, the classification of dental occlusion, the presence of defects in the formation of enamel, altered tooth morphology, tooth agenesis, the presence of open bite, and fissured tongue. The degree of oral motor dysfunction, diet consistency, and the presence of nonnutritive oral habits were also assessed.

Dental caries experience was scored by DMFT, using the standard methodology of the World Health Organization (WHO, 1997).⁶ The presence of dental plaque was scored using the Simplified Oral Hygiene Index (SOHI) modified by Greene and Vermillion (1964).⁷ We assessed the buccal surfaces of the maxillary right first molar, left first molar, maxillary right central incisor and left central incisor, and the lingual surfaces of the right first molar and mandibular left first molar, for the presence of dental plaque bacteria after disclosure with basic fuchsin (10% Eviplac™ Biodinâmica, Paraná, Brazil).

The following scores were assigned according to the amount of plaque (debris) and calculus found: 0 = surfaces that were plaque- and calculus-free; 1 = surfaces with dental plaque or calculus covering not more than one-third; 2 =

surfaces with dental plaque or calculus covering more than one-third but not more than two-thirds; and 3 = surfaces with dental plaque or calculus covering more than two-thirds of the tooth. Subsequently, the rates of debris and calculus were calculated by dividing the sum of the scores assigned to each area by the number of teeth examined. SOHI is the sum of debris and calculus scores, respectively.

The occlusion was classified according to Angle's criteria (1899):⁸ normal molar relationship or neutral occlusion (mesio-lingual cusp of first maxillary molar occluding into the central fossa of the first mandibular molar and the incisors almost vertically positioned); Class I (antero-posterior relationship between the mandible and maxilla, but differences between dental and alveolar size causing dental crowding, among other irregularities); Class II (mandibular arch placed distally to the maxilla); and Class III (the mandibular teeth protruding in front of the maxillary teeth).

Defects in tooth enamel formation were classified according to the index proposed by the Commission on Oral Health Research and Epidemiology (1982),⁹ in three categories: hypoplasia (quantitative defect where there is loss of tooth tissue), opacity (qualitative defect in the enamel identified as a loss of light transmission), or combination of defects, when opacity and hypoplasia are found on the same tooth.

The 24-hour diet recall method was used, where the caregiver records and describes all foods and beverages consumed by the subject during the previous 24 hours. The consistency of the diet was classified as liquid, pasty, or solid according to the dietary report of foods that were most often consumed by the children.

The degree of oral motor dysfunction was assessed using a Rating Scale of Oral Motor Function for Patients with Cerebral Palsy.¹⁰ The research protocol consisted of observing 13 behaviors related to oral motor function (OMF), as well as assessing voluntary movements (response to verbal commands) and involuntary movements (oral reflexes).

Scores from 0 (immature movements or inability to perform the movements) to 2 (mature and symmetrical movements) were given for each OMF behavior. The final score was the sum of the scores of 21 items, so the scores ranged from 0 to ≥ 42 points. The closer the score was to 42, the more normal the child's OMF was considered to be. Autistic subjects did not have their OMF assessed due to their inability to follow commands.

Statistical analysis

The data collected for the sample population were recorded on forms and processed using SPSS (Statistics Package for Social Science, version 15.0 for Windows, 2007, Cary, NC, USA). The measures of central tendency (mean) and dispersion (standard deviation) were used for continuous variables. We assessed the association between the degree of motor impairment and the caries experience, plaque index, and toothbrushing frequency by using the chi-square test. The level of significance was set at 5% ($p < .05$) and the confidence interval was 95%. To determine the study's intraexaminer accuracy, the examination was repeated for 21 randomly selected subjects (0.88 kappa was recorded for the caries index).

Results

The sample population consisted of 52 subjects (65.4% with mixed dentition and 34.6% with permanent dentition) aged 7 to 18 years ($\bar{x} = 10$ years old ± 2.36). Some degree of mental disability was reported in 40.4% of the sample. Table 1 shows the number of patients according to the classification of CP. There was a higher incidence of quadriplegia (46.2%) in this sample.

The mother was the primary caregiver for 80.8% of the subjects, and her mean age was 37.5 years (± 11.26). The caregiver's schooling ranged from 0 to 17 years ($\bar{x} = 9$ years), which represents the first year of U.S. high school. The mean monthly family income was 2.6 times the minimum wage; 40.4% of the sample received a monthly pension, and

Table 1. Distribution of patients according to type of cerebral palsy.

CP type	N	%
Diplegic	17	32.7
Hemiplegic	11	21.2
Quadriplegic	24	46.2
Total	52	100

Source: Direct research, CIES/CEIR, Teresina, 2009.

Table 2. Distribution of patients according to type of occlusion.

Occlusion	N	%
Normal relationship	13	25.0
Class I	9	17.3
Class II	29	55.8
Class III	1	1.9
Total	52	100

Source: Direct research, CIES/CEIR, Teresina, 2009.

17.3% were registered in the Social Assistance Programs of the Federal Government (Bolsa Familia).

Forty-seven subjects had received some previous dental treatment and 78.8% were cared for in the public health service. During the study, 75% of subjects were receiving a mean of 5.6 months of dental treatment. The last visit to the dentist for 75% of subjects was less than 6 months; for 9.6% it was between 6 months and 1 year and for 7.7% it was more than 1 year.

In order to find out the caregivers' knowledge regarding oral hygiene, they were asked about the frequency of daily toothbrushing of the children; 61.5% reported that brushing was done upon waking, 69.2% after meals, and 71.2% before bedtime. However, a caregiver carried out this oral hygiene in 73.1% of the children and there was no significant association between the type of CP and the frequency of toothbrushing ($p > .05$). All the caregivers reported using a

Table 3. Correlation between OHI and frequency of toothbrushing.

IHO	Brushing frequency			
	≤2 times	≥3 times	χ^2	p value
Good	3	10		
Mediocre	22	17	4.34	0.037

IC = 95%; $\chi^2 = 4.34$; $p < .05$.
Source: Direct research, CIES/CEIR, Teresina, 2009.

Table 4. Association between type of CP and oral motor function.

	Monoplegia	Paraplegia	Diplegia	Hemiplegia	Quadriplegia
Mild	2	2	1	4	2
Moderate	1	2	4	3	4
Severe	0	0	3	4	11
p value	.564	–	.417	.132	.019
χ^2	0.333	–	1.750	2.273	7.88

Source: Direct research, CIES/CEIR, Teresina, 2009.

toothbrush and toothpaste, however only 3.8% used dental floss frequently, while 15.4% reported using it when they felt some discomfort, and 80.8% of subjects never flossed. Almost 33% of subjects had the oral habit of sucking their fingers. A solid diet was reported by 61.5%, whereas 38.5% ate a nonsolid diet (liquid or paste).

Microdontia, crossbite, fissured tongue, and supernumerary teeth were found in 1.9% of subjects; open bite was seen in 5.8%, and anodontia was found in 13.5% of the sample. Dental enamel defects occurred in 38.5% of the subjects and the most affected teeth were the central incisors, lateral, canines, and first premolars. The distribution by type of occlusion of the subjects is shown in Table 2.

The mean DMFT was 1.09 (± 1.64), with a predominance of decayed teeth. The mean and maximum SOHI scores were 1.67 and 3, respectively. No positive association was found between the DMFT index and socioeconomic status of the subjects ($r = 0.254$, $p = .069$).

Patients who brushed up to twice daily were more likely to be classified as

mediocre in the index of oral hygiene while those who brushed three times were more likely to have a good oral hygiene measurement in the index (Table 3).

The subjects' OMF was moderately to severely impaired in most cases (61.5%). It was not possible to assess the oral motor performance in subjects with autism (9%) or those children with an advanced degree of mental disability (17.3%). Often, subjects who were diplegic had OMF impairment that ranged from moderate to mild, and quadriplegics ranged from moderate to severely impaired. The subjects who were quadriplegic had severely compromised OMF ($p < .05$, Table 4). There was no significant difference between the DMFT of subjects with different impairment in OMF ($p = .532$), including those who were quadriplegic ($p = .263$).

Discussion

The clinical manifestations of CP depend on the individual's chronological age, gestational age, and location of cerebral damage.² In addition to motor loss, there

is intellectual, auditory, visual, or sensory damage.² In the subjects with some degree of mental disability (40.4%), it was not possible to assess OMF because they were not able to follow verbal commands.

The mean education level of the caregivers was 9 years. The average monthly family income was 2.6 times the minimum wage and 40.4% of the sample received a monthly pension. A similar study by Subasi *et al.*¹¹ in Turkey reported that 60% of mothers were aged 31 to 40 years and married, 54.3% had completed primary education, and 45.7% were receiving a social benefit. Their study suggested that poor toothbrushing habits and irregular follow-up visits were associated with a low educational level of the mothers and were considered risk factors for poor oral health of children with CP.

Seventy-five percent of the subjects in our study were receiving dental treatment for a mean time of 5.6 months. The institutions that were surveyed have multidisciplinary teams to care for the children, and in one of them, the CIES, students, and teachers of the Federal University of Piauí take part on an extension project designed to restore and maintain patients' and caregivers' oral health. Some studies^{12,13,20} found a low number of clinics that provide dental care for special needs patients and the care provided is usually surgical or restorative procedures. It is important to provide adequate dental care for special patients in order to improve their quality of life.¹²

It was found that 75% of subjects had visited a dentist less than 6 months ago, 9.6% between 6 months and a year, and 7.7% had not been for more than a year. According to Subasi *et al.*,¹¹ 40% of children and 20.1% of mothers had visited a dentist during the previous year, although 91.4% reported it had been for an emergency treatment only. This suggests that there are social cultural differences influencing caregivers and parents and impacting how they perceive the need for care, which affect the oral health of children and adolescents with CP.^{11,13}

There was no significant association between the type of CP and the toothbrushing frequency, because oral hygiene, in most cases, was carried out by the subjects' caregivers, which corroborates a study by Camargo and Antunes.¹³ In subjects with CP, oral hygiene was carried out by a caregiver in 73.1% of the subjects. People with CP have disabled manual dexterity, and therefore assistance in performing toothbrushing is essential.¹⁴ Only 3.8% of subjects used dental floss frequently, 15.4% used it when they felt some discomfort, and 80.8% of subjects never used it at all.¹¹ Camargo and Antunes¹³ found that oral hygiene was carried out by caregivers fewer than three times a day and 85% did not clean the child's teeth at night. These findings emphasize the importance of professional dental care in institutions for people with special needs.

Dental enamel defects occurred in 38.5% of subjects, most often affecting the central and lateral incisors, canines, and first premolars, findings which are similar to those in a previous study by Bhat and Nelson.¹⁵ Enamel defects may be caused by systemic diseases, which can disrupt calcium balance or disturb the ameloblasts and affect the formation of the enamel matrix.¹⁵ CP itself is not a risk factor for defects in enamel formation.¹⁵

According to Winter *et al.*,¹⁶ on a meta-analysis of studies carried out in the United States, UK, Korea, Russia, and Brazil, the head and tongue posture, as well as a poor tonus of the orbicularis oris muscle, may be associated with the high prevalence of malocclusion in patients with CP. Most of the study sample (55.8%) had a Class II malocclusion and a low percentage (1.9%) had a Class III malocclusion. Similar results were found in a previous study¹⁶ where individuals with CP had a high prevalence of malocclusion (between 59% and 92%) and a high proportion had Class II malocclusion (between 38.8% and 75.8%), whereas very few had a Class III malocclusion.

The mean DMFT found among the subjects was 1.09, a rate that is within

the WHO's goals for the year 2000 (DMFT lower than 3 at 12 years of age, SB Brazil Project, 2003).¹⁷ The predominant component of the DMFT score was decayed teeth. These results show a lower frequency of caries, when compared to those found in an epidemiological survey in Brazil,¹⁷ in the general population of the Northeast, where for 12 year olds the DMFT was 3.19 and for 15 to 19 year olds it was 6.34. However, Camargo and Antunes¹³ reported a high rate of untreated caries among patients with CP in their study. There was no positive correlation between the DMFT index and socioeconomic status of subjects in our study ($r = .254$, $p = .069$), compared to that of Peres *et al.*¹⁸ and Subasi *et al.*¹¹

In our study, the mean and maximum OHI found were 1.67 and 3, respectively, while Santos *et al.*¹⁹ found high levels of bacterial plaque and caries among subjects with CP, when compared to a control group of subjects without CP.

OMF was found to be moderately to severely impaired in the majority of our subjects (61.5%). For subjects with diplegia, OMF often was moderately to mildly compromised, and for those with quadriplegia, the impairment was moderate to severe. These results are similar to those reported by Reilly *et al.*²⁰ and Santos *et al.*¹⁰ Oral motor ability is frequently altered in patients with CP. Lingual dysfunction was often observed in our study, as were prolonged and exaggerated bite reflexes. Chewing was limited to opening and closing movements without lateral movements of the jaw. The inadequate functioning of lip and cheek muscles can prevent proper lip sealing during feeding, which can lead to food loss and inhibition of distal propulsion of the bolus. The persistence of these abnormal responses may severely limit the ability of persons with CP to chew, swallow, and position the food bolus, thereby impairing nutrition.²¹ There was a significant correlation between the OMF and quadriplegia, which confirmed the results previously reported by Santos *et al.*¹⁰

These results highlight the importance of including a dentist in the

multidisciplinary care team for patients who have CP. Programs must be implemented to promote oral health and disseminate information on how to prevent oral diseases in this population.

Conclusions

Most subjects had moderate to severe oral motor dysfunction and subjects who were quadriplegic had more severe oral motor dysfunction. The level of oral motor impairment did not correlate with the level of oral health in patients with CP, probably because their oral hygiene was carried out by their caregivers. Most children with CP in this study had a DMFT lower than 2 and had access to regular OHI. The greater the frequency of oral hygiene, the better was their oral hygiene index. The type of CP was not related to differences in caries or plaque indices, diet type, or frequency of tooth-brushing. Among the defects in formation of enamel, opacity was more common among patients with CP, although the prevalence was not high and there was no relationship between the prevalence of dental enamel defects and the degree of general motor impairment or the type of CP.

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