Descriptive Study of Oral Health, Dental Care and Nutritional Habits of Children with Cerebral Palsy during Conductive Education

Orsós M [*] / Antal D [**] / Veres DS[***] / Nagy K[****] / Németh O[*****]

Objective: *Regarding the 2011 census in Hungary, the number of children with movement deficiences can be around 7,000. These children with special health care needs are considered to be a vulnerable group even from a dental point of view. In our dental program, we gain comprehensive information about patients' oral health, health behavior, and monitor dental care.* ***Study design:*** *A total of 199 children went through a full pediatric dental examination, children with cerebral palsy were categorized into five different levels (GMFCS) and children without motor disfunction into two groups. We analyzed the df-t and DMF-T values. Oral hygiene routine, dental care, gingivitis, demographic characteristics, nutritional habits odds ratio to df-t and DMF-T were surveyed.* ***Results:*** *The mean df-t and DMF-T was 1.87 and 1.15 out of a total of 199, and the group that scored worse was the GMFCS II. The mean RI (restorative index) was 18.12% and 27% for decidous and permanent teeth, respectively. The prevalence of gingivitis was 66.7%.* ***Conclusion:*** *The results of our research point to the fact that children with cerebral palsy have difficulties in developing and maintaining proper oral health due to their disadvantages and therefore require special care and attention.*

Key words: *Oral hygiene, Epidemology, Cerebral palsy, Children with disabilities*

INTRODUCTION

Patients with special needs are defined by the Commission on Dental Accreditation (CODA) as any individual with a medical, psychological and / or social condition that requires individualization of the dental treatment.[1] In practice, this phenomenon can be divided into subgroups, cerebral palsy belongs to neurological motor disorders.

Regarding the 2013 Yearbook of Health Statistics in Hungary (2011 population census), the number of children (aged 0-19 years) living with deficiencies can be around 35,100, out of which the number of movement deficiences is around 7,000.[2] Depending on the severity of their condition, these children have varying degrees of disadvantage in maintaing their and their families' daily routine. Children with special health care needs are considered as an underserved and vulnerable group even from a pediatric dental point of view.[3] A US survey suggests that the dental care for special-need patients is not sufficient, and lack of access to oral healthcare contributes to oral health disparities.[3,4] The dentist must adapt the appropriate psychological approach and surgical techniques as well as consider different dental materials for every individual and every need. In this context, the identification of dental problems and the implementation of the treatment plan may change for each case dramatically, as the patient's general health status will influence this behavior.[5] Cerebral palsy (hereinafter abbreviated as CP) patients also present a reduced self-cleaning function of the oral cavity, due to drooling and the abnormal movements of the tongue and facial muscles.[6]

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Conductive education is an educational approach for children and adults with motor disabilities caused by CP, founded by and named after Professor András Pető. CP was described as characterized by delayed gross motor function and many other possible co-existing conditions, such as epilepsy, learning difficulties and behavioral challenges.[7] All conductive education-based programs consist of a structured program of tasks related to functional mobility, self-care skills cognitive and social skill development, and the specific design of the equipment promotes independence and self-efficacy in the child.[7]

CP describes a group of permanent disorders involving movement and posture development causing activity limitations. Perinatal asphyxia is found to be the cause of the disease in only 6-8% of the cases, whereas prenatal risk factors account for approximately 75% of CP cases. Genetic factors play a role in the genesis of CP, and genetically determined causes are identified in 40% of CP patients.[6] Children suffering from CP have motor dysfunctions which are often accompanied by disturbances of sensation, perception, cognition, communication and behavior. These are attributed to nonprogressive disturbances occurring in the developing fetal or infant brain. These neuromuscular problems inherent in CP can affect oral health significantly, thereby acting as a barrier to oral care access, thus increasing caries susceptibility.[8] Spastic CP refers to patients presenting stiffness of muscles and awkward movement. Nonspastic CP comprised ataxic (lack of motor coordination), athetoid (ceaseless involuntary writhing movements) and mixed conditions. Damage to brain tissue may result in the partial or generalized paralysis of CP patients. Tetraparesis refers to the paralysis of all four limbs, hemiparesis refers to the reduced movement of one side of the body and diparesis of two corresponding limbs.[6] In the dental office, children with spastic CP have difficulties cooperating, due to their high sensitivity to physical contact and neuromotor response to an unusual stimulus such as noise, artifical light, and position in the dental chair; but the nonplastic disease form also represents a further level of physical limitation in dental care.[6]

There are no policies and protocols in place regarding prevention for such issues, since there is no available data in Hungary on the oral hygiene or the dental status of children with CP. In our dental program, we gain comprehensive information about patients' oral health, health behavior, and monitor dental care. We study how dental care could be specified for children with CP, how their dental treatment can be optimalized, and how the severity of movement deficiences influence their oral hygiene and dental status.

MATERIALS AND METHOD

This study was conducted in Budapest, Hungary in the dental office of András Pető Institute and in the medical office of a school center. A total of 199 children (149 children at Pető Institute / Practice Kindergarten, Conductive Practice School and Dorm/ and 50 children at a school center as a healthy control group) went through a full pediatric dental examination. All children were categorized into seven different groups. Children without motor disfunction were in two groups; the healthy group took part in normal education method (labeled in the tables with 0), and the other group had normal motor skills within the conductive education method (labeled as 1 in the tables).

Children with motor disabilities caused by CP were categorized into five different levels (Figure 1), using a tool called the Gross Motor Function Classification System (hereinafter abbreviated as GMFCS).[9] GMFCS is helpful because it provides families and clinicians with a clear description of a child's current motor function, and an idea of what equipment or mobility-aids a child may need in the future, e.g. crutches, walking frames or wheelchairs.[9]

The consent of the appropriate ethical committee (Medical Research Council, Hungary, ETT TUKEB 4913/ 2016/ EKU) was acquired prior to the start of the dental program which this study is a part of. The participants' parents or legal guardians had given written consent. Participants over 14 provided their consent, too (the age of limited legal capacity in Hungarian law is 14). Vulnerability was no issue of concern because there was no possible risk to the subjects of this study during the data collection. However, subjects were given full freedom to decide whether to participate or not, without their

Figure 1. Gross Motor Function Classification System[9]

GMFCS level I. (labeled as 2 in the tables)	Children are able to walk home, to school, outdoors and within the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance, and coordination are limited.
GMFCS level II. (labeled as 3 in the tables)	Children are able to walk within most settings and climb stairs holding onto a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas or confined spaces. Children may walk with physical assistance, a hand-held mobility device or usewheeled mobility over long distances. Children have only minimal ability to perform gross motor skills such as running and jumping.
GMFCS level III. (labeled as 4 in the tables)	Children are able to walk using a hand-held mobility device within most indoor settings. They may climb stairs holding onto a railing with supervision or assistance. Children use wheeled mobility when traveling long distances and may be self-propelled for shorter distances.
GMFCS level IV. (labeled as 5 in the tables)	Children use methods of mobility that require physical assistance or powered mobility within most settings. They may walk for short distances at home with physical assistance or use powered mobility or a body support walker when positioned. At school, outdoors and within the community, children are transported in a manual wheelchair or use powered mobility.
GMFCS level V. (labeled as 6 in the tables)	Children are transported in a manual wheelchair within all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements.[7]

decision affecting their medical condition, management, and care. The confidentiality of all data was strictly maintained by only the researchers who had access to the data.

Dental examinations and questionnaires were carried out by a pediatric dentist (Figure 2). The standardized dental examination was performed according to WHO standards. WHO criteria were used to record teeth as sound, decayed, missing or filled and Gingival Bleeding Scores to measure gingivitis. The clinical examitation and the questionnaire (Figure 3) for the health behaviour and dental care were done in accordance with WHO recommendation.[10] The instruments for the oral examination to gain information on oral health were a plane mouth mirror and dental probe, using artifical light in the dental office. The restorative care of the given population was measured with the Restorative Index formula (RI=F/(D+F)*100). Clinical data of CP, GMFCS classification and the underlying diseases were derived from patients' files. We used a survey of 20 questions to ask about oral hygiene practices, tooth brushing frequency, toothbrushing performance (independent or helped), last visit to a dentist, eating habits, addictions/ bad oral habits and social background (Figure 3). The response options were dichotomous or asked about frequency.

Demographic variables consisted of age, gender, and permanent address. Dental care and oral health were measured by some important questions like frequency and independence of tooth brushing, using adjuncts, bad oral habits, parafunctions, last dental visit, toothache, and oral problems (for example when biting, or chewing) in the last year. In the case of dysphagia, aphasia or severe mental disability parents, legal caregivers (guardians) and conductive education teachers helped us. Demographic characteristics, dental care, drinking and eating habits related median df-t, and DMF-T were surveyed. As 49.3% of the participants had a mixed dentition, the Decayed and Filled Teeth index for the deciduous dentition (df-t) and the DMF-T index for the permanent dentition were used to estimate dental caries. We did not consider the "m" component for the missing teeth in the deciduous dentition, as it is difficult to distinguish between the exfoliation of a primary tooth and a missing tooth due to caries. High tendency to delayed eruption of permanent dentition was observed in children with CP, which could be related to general growth retardation.[11]

Statistical analysis was performed using the R software (Version 3.6.0, R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.). We checked the validity of data-entry by randomly selecting observations and checking their entries against the original questionnaries. The descriptive data are presented as frequency, mean, standard deviation (SD) and median.

Figure 2. Study management and patient pathway (created by Orsós M)

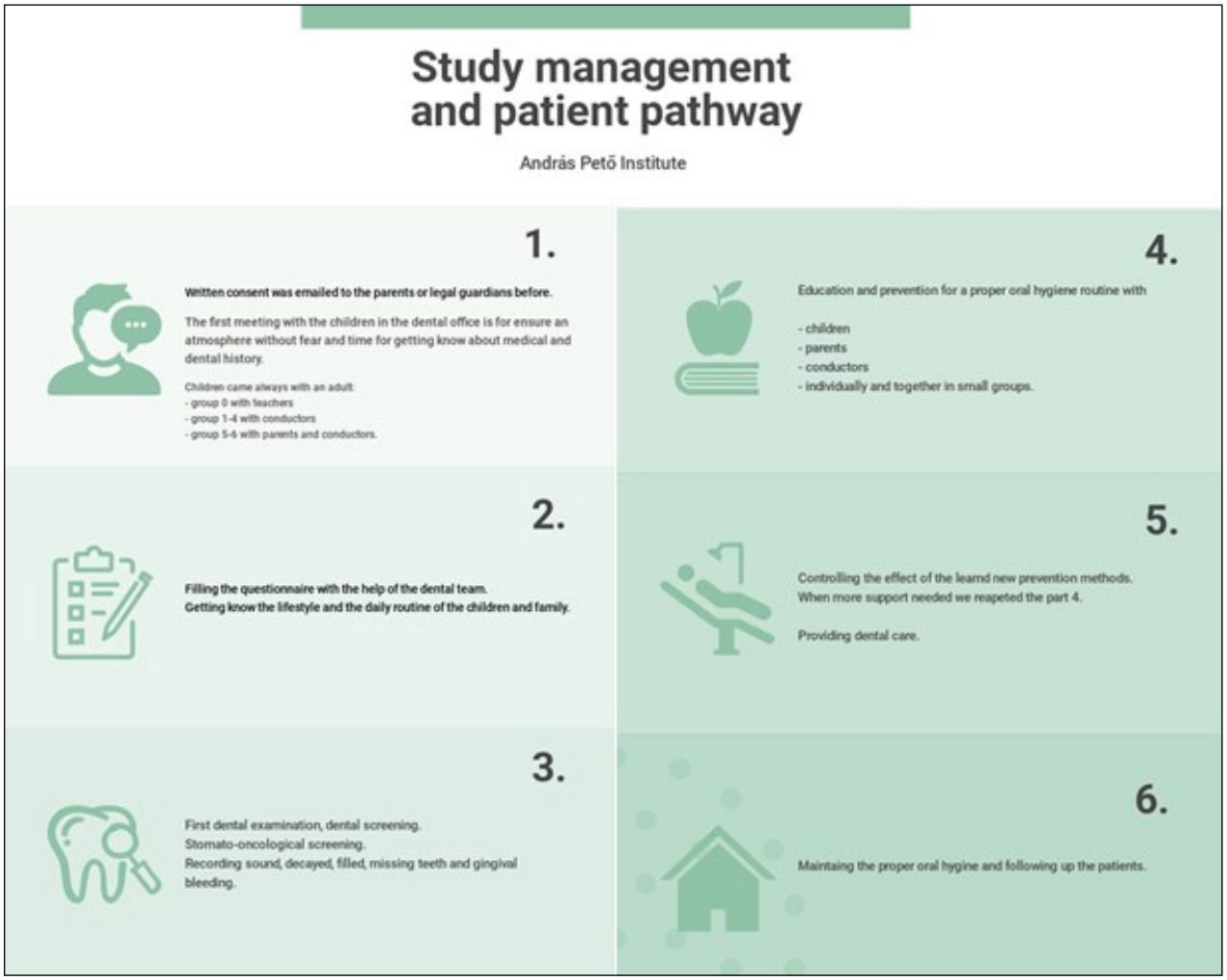


Figure 3. Questionnaires applied, based on WHO recommendation[10]

First, we would like you to answer some questions concerning yourself and your teeth

1. Personal data:

Identification number:
Sex:
Location:

2. Health condition:

ICD-10 code[1]:
ICD-10 code[2]:
ICD-10 code[3]:
ICD-10 code[4]:

3. Movement deficiences:

None
GMFCS I.
GMFCS II.
GMFCS III.
GMFCS IV.
GMFCS V.

4.How old are you today? (Years) _____

5. How would you describe the health of your teeth and gums? (Read each item)

6. How often during the past 12 months did you have toothache or feel discomfort due to your teeth?

Now please answer some questions about the care of your teeth

7. How often did you go to the dentist during the past 12 months? (Put a tick/cross in one only)

8. What was the reason for your last visit to the dentist? (Put a tick/cross in one box only)

Pain or trouble with teeth, gums or mouth
Treatment/follow-up treatment
Routine check-up of teeth/treatment
I don't know/don't remember

9. Are you in an orthodontic treatment?

10. How often do you clean your teeth? (Put a tick/cross in one box only)

11. Who cleans your teeth? (the toothbrushing performance)

12. Do you use any of the following to clean your teeth or gums? (Read each item)

Toothbrush
Wooden toothpicks
Plastic toothpicks
Thread (dental floss)
Charcoal
Chewstick/miswak
Other: _____

13. Do you use…

a) … toothpaste to clean your teeth?
b) … toothpaste that contains fluoride?

14. Because of the state of your teeth and mouth, did you experience any of the following problems during the past year?

a) I am not satisfied with the appearance of my teeth
b) I often avoid smiling and laughing because of my teeth
c) Other children make fun of my teeth
d) Toothache or discomfort caused by my teeth forced me to miss classes at school or miss school for whole days
e) I have difficulty biting hard foods
f) I have difficulty in chewing

15. How often do you eat or drink any of the following foods, even in small quantities? (Read each item)

Fresh fruits
Biscuits, cakes, cream cakes, sweet pies, buns etc.
Lemonade, Coca Cola or other soft drinks
Jam/honey
Chewing gum containing sugar
Sweets/candy
Milk with sugar
Tea with sugar
Tea
Tea with sweetener
Coffee with sugar
Coffee
Coffee with sweetener

16. How often do you use any of the following types of tobacco? (Read each item)

Cigarettes
Pipe
Cigars
Chewing tobacco or snuff
Other: _____

17. What level of education has your father completed (or your stepfather, guardian or other male adult living with you)?

18. What is your father manpower status now (or your stepfather, guardian or other male adult living with you)? Is it permanent, or occasional?

19. What level of education has your mother completed?

20. What is your mother manpower status now? Is it permanent, or occasional?

That completes our questionnaire.

Thank you very much for your cooperation.

RESULTS

All of the examinated children were Hungarians with a mean (SD) age of 9.06 (±3.69) years, and boys n_b=101 (50.75%) outnumbered girls n_g=98 (49.25%).

The mean df-t and DMF-T were 1.87 and 1.15, respectively, in the total of 199 (Table 1.). The worse groups were the GMFCS level II and III classification of children with CP, with df-t scores 3.00 and 2.42, and DMF-T scores 2.00 and 1.68. The restorative index was 18.12% for decidous and 27% for permanent teeth (Table 2.). As the patient's answers 68.7% of the last dental visit was only a consultation, and 46.2% was urgent or total dental care. Caries experiences among children with CP were dominantly untreated dental caries, which was likewise highest in the GMFCS classification groups I and IV. The proportion of CP / healthy children with caries that never received dental restorative treatment was higher in younger children with primary dentition than in older children with permanent dentition.

As recommended, 76.9% of children clean their teeth twice a day, 29.65% brush with help, and the teeth of 19.6% are brushed by parents and caregivers or conductive teachers. In our study the toothbrushing performance had a significant effect on DMF-T scores (Table 3). We found that gingivitis prevalence was 66.7% in the groups (mostly in GMFCS groups IV and V) in which toothbrushing was performed by other people: parents, caregivers or conductive teachers. The prevalence of gingivitis was the highest (above 31%) around all the upper and lower incisors and the lower canines in the whole group. In the interferential statistics, $p \leq 0.05$ significance level was used. The logistic regression model was used for estimating the effect of the toothbrushing performance and using electric toothbrush on gingivitis while controlling for age and gender. After variable selection of disinteresting and insignificant interactions; the effect of electric toothbrush was not significant in the Anova table. The interaction of toothbrushing performance and shows that age has a significant effect on gingivitis (p=0.3072). Based on the results between groups brushing alone and brushing with help has a significantly different effect on changing the effect of age on gingivitis.

The negative binomial generalized linear model was used for estimating the effect of the toothbrushing performance on DMF-T controlled for age and gender. The results show that the age and the toothbrushing performance has a significant effect on DMF-T (p-value was 0.2384). Figure 4. shows the outstanding effect of age: the predicted values of DMF-T are higher when we increase the age in different toothbrushing performance groups.

DISCUSSION

Children are just one of the many vulnerable and underserved populations that face persistent, systemic barriers limiting their access to oral health care.[3] DMF-T and df-t score is a good indicator of children's oral health. In Ahmad et al.'s study, caries prevalence was 81.7% and the median DMF-T was 0.5, df-t scores were 3.0.[12] It is a lower DMF-T score than our result. As for the df-t and DMF-T distribution by GMFCS group, children with more and most severe gross motor function losses have the lowest value, which can be explained by the loss of lifestyle self-sufficiency, which was confirmed by toothbrushing put into effect by parents/caregivers/conductive teachers in GMFCS groups IV and V. If we look at the df-t and DMF-T values for the average (Hungarian) healthy population; DMF-T: 1.84; def-t: 2.39 [13], one can see that our results are mostly in the lower range. Also, in the study of Somani et al. (2019), upon the evaluation of the dental caries status, it was found that the caries experience of children with CP was higher than that of normal caries-active and caries-free children.[8] In our study, the caries experience of children with CP might depend on the grading of the motor disabilities.

There is no protocol or professional recommendation in Hungary for preventing dental disease in children with special needs. Many of these children suffer from associated mental, sensory, learning disablities, spasm or dystonia and incontinence. They may also have deficiences due to a deterioration of manual function; cleaning their teeth is more difficult, the gross motor function is delayed, and the development of fine motor skills is late.[14,15] Using an electric toothbrush can be a good solution due to their better plaque removal efficiency.[16] In our study, we could not find significantly better scores for gingivitis and df-t, DMF-t when using an electric toothbrush, which may be explained by the lack of education about using electric toothbrushes. Further studies are required to find out whether the oral health educational level of helpers or other anatomical and functional disfunctions might cause the high level of gingivitis.

With regards to the many high-risk foods, it can be observed that the more patients consume them, the worse their df-t and DMF-T values become. This is explained by the high risk of caries prevalence when consuming fermentable carbohydrates.[17] Monitoring cariogenic food/drink intake is crucial to prevent dental caries without compromising the daily nutrient intakes for the optimum growth of children with CP.[12] Just as in the study of Ahmed et al., our present study group consumed sugary drinks the most frequently, as compared to other types of cariogenic foods/drinks.[12] In our descriptive study it is visible that among those who did not have a high sugar intake nor bad oral hygiene, enamel erosion is less frequent (4.2%) than for those whose sugar intake and bad oral habits are registered (20.7%). We found better DMF-T scores in the GMFCS groups IV and V which might be explained by the lack of self-sufficiency in eating and oral healthcare. It is proven that children with CP who consumed high levels of sugar demonstrated higher caries prevalence than those with low sugar intake, as in de Camargo's study.[6]

CP is a common pediatric disorder that sets on during childhood. The inadequate functioning of the masticatory system in these children results in problems with mastication, which requires the constant consumption of mushy food and leads to decreased self-cleansing ability, thus to poor oral hygiene, which, in turn, leads to an increased susceptibility of dental caries. Moreover, these carious lesions keep on progressing, as providing treatment is all the more difficult in these children.[8]

Oral diseases and disorders in general affect health and well-being through life.[4] Designing a comprehensive method and providing physical medicine requires interdisciplinary teamwork, and dental professionals have to be a part of it. Oral healthcare and oral education have to be components of the specific pedagogical program of children with CP.

Table 1. The d, f, df-t, D, M, F and DMF-T (mean (SD)) scores in the groups

	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
d								
Mean (SD)	1.56 (±2.28)	1.32 (±2.69)	1.23 (±2.70)	2.69 (±5.36)	2.00 (±3.80)	1.41 (±2.04)	1.13 (±1.36)	1.55 (±2.91)
Missing	23 (46.0%)	0 (0%)	4 (11.8%)	6 (31.6%)	10 (34.5%)	8 (26.7%)	2 (11.1%)	53 (26.6%)
	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
f								
Mean (SD)	0.22 (±0.641)	0.53 (±1.17)	0.07 (±0.365)	0.31 (±0.630)	0.42 (±1.02)	0.59 (±1.40)	0.25 (±1.00)	0.32 (±0.924)
Missing	23 (46.0%)	0 (0%)	4 (11.8%)	6 (31.6%)	10 (34.5%)	8 (26.7%)	2 (11.1%)	53 (26.6%)
	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
df-t								
Mean (SD)	1.78 (±2.52)	1.84 (±3.45)	1.30 (±2.74)	3.00 (±5.28)	2.42 (±3.83)	2.00 (±2.29)	1.38 (±2.09)	1.87 (±3.12)
Missing	23 (46.0%)	0 (0%)	4 (11.8%)	6 (31.6%)	10 (34.5%)	8 (26.7%)	2 (11.1%)	53 (26.6%)
	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
D								
Mean (SD)	0.78 (±1.84)	0.75 (±1.54)	0.94 (±2.17)	1.08 (±1.73)	0.86 (±1.17)	0.78 (±1.57)	0.623 (±1.54)	0.81 (±1.66)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)
	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
M								
Mean (SD)	0.02 (±0.143)	0.00 (±0.00)	0.00 (±0.00)	0.167 (±0.577)	0.00 (±0.00)	0.00 (±0.00)	0.00 (±0.00)	0.02 (±0.182)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)
	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
F								
Mean (SD)	0.25 (±0.693)	0.00 (±0.00)	0.13 (±0.500)	0.75 (±1.36)	0.82 (±1.40)	0.087 (±0.288)	0.25 (±0.683)	0.31 (±0.852)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)
	0	1	2	3	4	5	6	Overall
(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)	
DMF-T								
Mean (SD)	1.04 (±2.26)	0.75 (±1.54)	1.06 (±2.41)	2.00 (±3.05)	1.68 (±1.78)	0.87 (±1.58)	0.88 (±1.59)	1.15 (±2.07)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)

0: healthy children in normal educational method

1: normal motor function in conductive education

2: GMFCS I.

3: GMFCS II.

4: GMFCS III.

5: GMFCS IV.

6: GMFCS V.

Table 2. Restorative index (RI)

	0	1	2	3	4	5	6	Overall
	(n=50)	(n=19)	(n=34)	(n=19)	(n=29)	(n=30)	(n=18)	(n=199)
RI $_{decidous}$								
Mean	9.43	37.95	5.00	20.37	23.33	25.64	6.25	18.12
RI $_{permanent}$								
Mean	30.48	0.00	8.33	29.17	38.89	16.67	33.33	27.00

0: healthy children in normal educational method

1: normal motor function in conductive education

2: GMFCS I.

3: GMFCS II.

4: GMFCS III.

5: GMFCS IV.

6: GMFCS V.

Table 3. DMF-T according to toothbrushing performance (data reported as Mean (SD), median and missing data)

	0 (n=101)	1 (n=59)	2 (n=39)	Overall (n=199)
DMF-T				
Mean (SD)	1.34 (±2.22)	1.13 (±2.15)	0.33 (±0.658)	1.15 (±2.07)
Median (Q1, Q3)	0.00 (0.00, 2.00)	0.00 (0.00, 1.00)	0.00 (0.00, 0.00)	0.00 (0.00, 2.00)
Missing	10 (9.9%)	21 (35.6%)	18 (46.2%)	49 (24.6%)

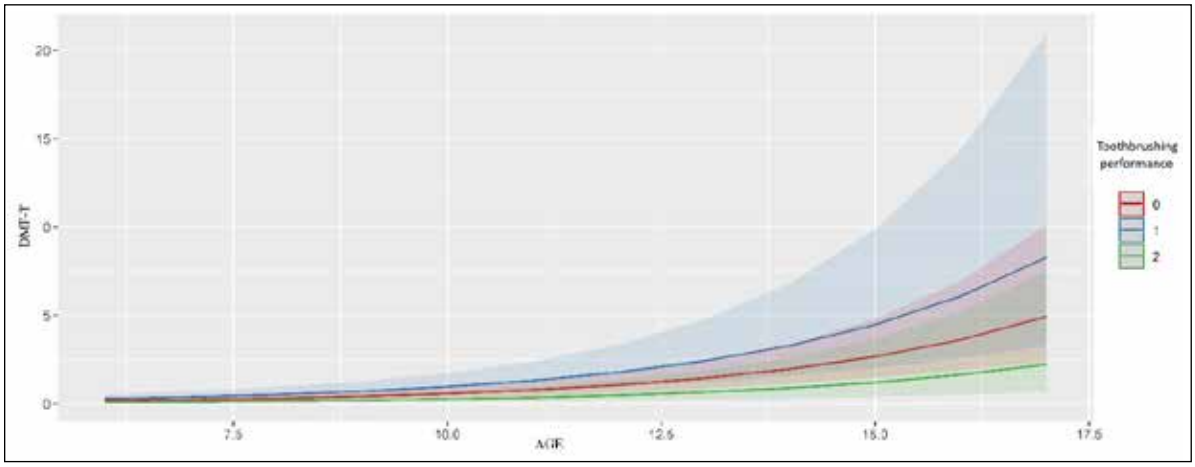
The toothbrushing performance scores:

0: toothbrushing alone

1: toothbrushing with help of parents/ caregivers/ conductive teachers

2: totally toothbrushing by parents/ caregivers/ conductive teachers

Figure 4. DMF-T in association with toothbrushing performance and age



The toothbrushing performance scores:

0: toothbrushing alone

1: toothbrushing with help of parents/ caregivers/ conductive teachers

2: totally toothbrushing by parents/ caregivers/ conductive teachers

CONCLUSION

Our study demonstrated the correspondence between the df-t, DMF-T values, the toothbrushing performance and the health behavior among GMFCS classification. The results of our research highlight the fact that children with CP have difficulties developing and maintaining proper oral health due to their disabilities, and therefore require special care and attention. Conductive education-based programs consist of a structured program to improve children's self-care skills, and the specific design of the equipment promotes independence and self-efficacy in the child, however, these self-care skills might be counterproductive from a dental perspective. With the help of our results and by extending our study, new dental prevention models can be created that help children with special needs adapt to their changed circumstances.

Conflict of interest

The authors declare no conflict of interest.

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