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Oral health in preschool children with cerebral palsy: a case–control community-based study

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Objectives. To assess and compare the oral health status of preschool children with and without cerebral palsy (CP).

Methods. Preschool children with CP (72) were recruited from 23 Special Child Care Centers in Hong Kong. An age (±3 months) and gender matched sample of preschool children from mainstream preschools were recruited as the control group. Dental caries status, gingival health status, tooth wear, developmental defect of enamel, malocclusion, dental trauma and oral mucosal health were assessed and compared between the two groups.

Results. Significant differences in gingival health status were found between children with and without CP (mean plaque index scores, $P = 0.001$ and mean gingival index scores, $P < 0.05$). Tooth wear involving dentine was more prevalent among CP children ($P < 0.001$), as were evidence of anterior open-bite ($P < 0.001$) and oral mucosal lesions ($P < 0.05$). Children with and without CP had similar caries experiences ($P > 0.05$), prevalence of enamel defects ($P > 0.05$) and dental trauma ($P > 0.05$).

Conclusions. Differences of oral health status exist among preschool children with and without CP. Preschool children fare worse in terms of gingival health, tooth wear, oral mucosal health and malocclusion.

Introduction

Cerebral palsy (CP) is a range of non-progressive syndromes of postural and motor impairments that result from an insult to the developing central nervous system in early childhood[1]. The worldwide prevalence of CP among live births is estimated to be between 1.9 and 3.6 per 1000[2–5]. CP is associated with numerous health problems, including disorders of the development of movement and posture, neuromuscular disorders, gastrointestinal problems and disturbances to the central nervous system resulting in intellectual disability, visual and hearing impairments as well as seizures in many cases[6,7].

It is also recognized that CP can have direct and indirect effects on oral health status. Neuromuscular problems inherent in CP can result in changes in the structure of the orofacial region and the development of parafunctional habits such that malocclusions and tooth wear are common[6,8]. Experience of dental trauma is also highly prevalent due to instability as a result of neuromuscular defects and/or seizures[9,10]. There are conflicting reports with respect to overall dental caries experience among children with CP; with some reports suggesting a high level dental caries, or at least a high level of untreated decay[11–13]. Gingival health is often reported to be poor due to difficulties in maintaining oral hygiene as a result of poor neuromuscular control and/or other health priorities[14,15]. However, reports on the oral health status of children affected by CP have for the most part been limited to clinical samples, have lacked control comparison groups and have been very selective in terms of oral health aspects studied.

The objectives of this study were to conduct a community based oral health survey among preschool children with CP and to compare

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the findings with a gender and age matched sample from mainstream preschools. The oral health survey aimed to determine differences in the dental caries experience, gingival health, and prevalence of dental trauma, tooth wear, malocclusion, enamel defects and oral mucosal lesions among preschool children with and without CP in the Hong Kong community.

Materials and methods

Sample

The sampling frame for this study was the complete list of Special Child Care Centers as identified from the Government Social Welfare Department in Hong Kong Special Administrative Region (HKSAR), China. Of the 33 centers identified, 23 centers had preschool children diagnosed with CP (five in Hong Kong Island, five in Kowloon, 13 in New Territories of HKSAR). In total, 94 children with CP were identified from the 23 centers and their parent(s)/primary care-givers were invited to participate in the study. As a control group an age (±3 months) and gender-matched sample of preschool children from mainstream preschools in the geographical areas were recruited. Approval to conduct the study was sought and obtained from the local Institutional Review Board of Ethics (IRB HKU: UW 08-448).

Data collection

All the recruited children received clinical examinations by a single trained and calibrated examiner. The clinical examinations took place on a table at preschools with the children in a supine position. The visual examination was conducted by one examiner using an intra-oral examination mirror with a built in LED light source. The examination procedures and diagnostic criteria were those recommended in the World Health Organization Oral Health Survey Basic Methods and included assessment of dental caries experience as indicated by the number of sound, decayed, missing (due to caries) and filled surfaces (dmfs)[16].

Six index teeth: the maxillary right second primary molar (55), maxillary right central primary incisor (51), maxillary left first primary molar (64), mandibular left second primary molar (75), mandibular left central primary incisor (71), mandibular right first primary molar (84) were chosen for the assessment of gingival health, tooth wear and developmental defects of enamel. Gingival health was assessed by the Simplified Debris Index[17] and the Gingival Index[18]. Thepresence/absence of gingival hyperplasia was assessed by the Angeolopoulos and Goaz measurement[19]. Tooth wear experience was assessed as being present/absent of 'loss of enamel involving dentine' on index teeth based on the Tooth Wear Index (TWI)[20]. Presence of developmental defects of enamel was also recorded as being present/absent on index teeth based on the Development Defects of Enamel Index criteria[21].

Trauma was assessed in accordance with the criteria of Andreasen[22], using the maxillary incisors as the index teeth and classified as being present or absent. In assessing malocclusion, the presence or absence of anterior open-bite and over-jet was recorded. In addition, presence or absence of oral mucosal lesions were also recorded[23].

Prior to commencing the clinical examination, the examiner was trained and calibrated on the clinical assessments at a local preschool by conducting repeat assessments on 25 children. Agreement of clinical assessments was established to be good (Kappa values >0.70).

Data analysis

Data were analysed using the statistical package SPSS for Windows 16.0. Differences in mean caries experience (at surface level), plaque index and gingival index scores between those with and without CP were compared using Mann–Whitney *U*-test (a non-parametric equivalent of the *t*-test for independent samples). A comparison of the prevalence of gingival hyperplasia, prevalence of dental trauma experience, prevalence of tooth wear involving dentine, prevalence of developmental defects of enamel, prevalence of oral

mucosal lesions and prevalence of open-bite and over-jet between those with and without CP was assessed using chi-square tests.

Results

Response rate and profile

It was possible to conduct oral examinations for 76.6% (72/94) of the preschool children with CP (twenty primary care givers declined to participate in the study and it was not possible to conduct a comprehensive assessment on two children). The mean age of the children was 56 ± 12 months (range from 30 to 77 months), of whom 54% were males. The characteristics of the 72 preschool children with CP evaluated in this study are shown in Table 1. An age (±3 months) and gender match sample of 72 preschool children attending mainstream preschools acted as the control group for the study.

Among the children with CP, 42.5% (31/72) had dental caries experience (dmfs>0), and 35.6% (26/72) had evidence of untreated decay. The mean dmfs was 4.81, the mean ds was 3.22, while the mean ms was 1.14 and the mean fs was 0.45 for these children. There was no significant difference in the dental caries experience of the preschool children with and without CP ($P > 0.05$), see Table 2.

In terms of gingival health of children with CP, the mean plaque index score was 0.89 and the mean gingival index score was 0.81 for the index teeth. Children with CP had higher plaque index scores ($P < 0.001$) and higher gingival index scores ($P = 0.02$) than the children without CP. Approximately one-in-five of children with CP, had evidence of gingival hyperplasia (19.2%, 14/72). In contrast, children without CP did not have evidence of gingival hyperplasia.

Preschool children with CP more frequently had evidence of tooth wear involving dentine than children without CP, 63.0% versus 32.9%, $P < 0.001$ (Table 3). Presence of an anterior open-bite and over-jet was more common among children with CP, when compared to those without CP, 26.0% versus 2.7% respectively ($P < 0.001$). In addition, children with CP more frequently had an oral mucosal lesion present (ulcers,coated tongue,candidiasis,) than children without CP, 20.6% versus 8.2% respectively, ($P = 0.03$). There was no significant difference ($P > 0.05$) in the prevalence of development defects involving enamel, or the prevalence of dental trauma among children with and without CP.

Table 1. The characteristics of the 72 preschool children with cerebral palsy.

Characteristic	Classification	*n*	%
Type of motor impairment	Spastic	44	61.1
	Nonspastic	28	38.9
Topographic classification	Monoplegia	1	1.4
	Hemiplegia	10	13.9
	Diplegia	15	20.8
	Quadriplegia	40	55.6
	Unclassified	6	8.3
Gross Motor Function Classification System (GMFCS)	Level I	7	9.7
	Level II	12	16.7
	Level III	8	11.1
	Level IV	10	13.9
	Level V	33	45.8
	Unclassified	2	2.8

Table 2. A comparison of the dental caries experience and periodontal condition of preschool children with and without cerebral palsy.

	CP	Non-CP	*P*-value*
Periodontal status	**Mean (SD)**	**Mean (SD)**	
plaque index score	0.89 (0.28)	0.71 (0.35)	0.001*
gingival score	0.81 (0.19)	0.73 (0.22)	0.024*
Dental caries status	**Mean (SD)**	**Mean (SD)**	
dmfs	4.81 (11.24)	4.41 (8.71)	0.630
ds	3.22 (9.90)	3.22 (6.45)	0.176
ms	1.14 (5.31)	0.86 (3.66)	0.332
fs	0.45 (2.42)	0.33 (2.81)	0.589
Caries experience	***n* (%)**	***n* (%)**	
dmfs >0	31 (42.5)	35 (47.9)	0.506
ds >0	26 (35.6)	34 (46.6)	0.178

**P* values obtained by Mann–Whitney *U*-test.

Discussion

This study was an epidemiological study of the oral health of preschool children with CP in Hong Kong. The sampling frame was the complete list of 33 Special Child Care Centers in Hong Kong, but it is acknowledged that some children with CP may attend other preschools. A sample of 23 preschool centers with CP was identified and among them over 70 children were examined. Although this was time

Table 3. A comparison of the prevalence of tooth wear, developmental defects of enamel, trauma, malocclusion and oral mucosal health among children with and without cerebral palsy.

		CP group *n* (%)	Non-CP group *n* (%)	*P*-value
Tooth wear*	Present	45 (63.0)	23 (32.9)	< 0.001**
	Absent	27 (37.0)	49 (67.1)	
Developmental defect of enamel†	No defect	8 (12.3)	14 (20.5)	0.387
	Opacity	55 (75.4)	51 (69.9)	
	Enamel hypoplasia	9 (12.3)	7 (9.6)	
Trauma to teeth††	Present	26 (37.0)	18 (26.0)	0.154
	Absent	46 (63.0)	54 (74.0)	
Malocclusion				
Anterior open-bite	Present	19 (26.0)	2 (2.7)	< 0.001**
Increased overjet	Present	23 (31.5)	10 (13.7)	0.021*
Oral mucosal lesions	Present	15 (20.5)	6 (8.2)	0.034*
	Absent	57 (79.5)	66 (91.8)	

*$P < 0.05$, **$P < 0.001$.
†Index teeth: 55,51,64,75,71,84; ††Upper incisors.

consuming and had significant resource implications, it enabled a reasonably large and representative sample to be obtained. The age (within ±3 months) and gender-matched sample of preschool children attending mainstream preschools was a powerful control group.

In the oral health examination a large number of oral health factors were considered, including dental caries experience, gingival health, tooth wear, dental trauma, developmental defects of enamel and oral mucosal condition, so as to provide a comprehensive view of the oral health status of children with CP. Balancing the requirement for a comprehensive assessment with consideration of the children's limited levels of cooperation, index teeth were used for a number of assessments (i.e., partial sampling). Such an approach is commonly adapted by clinicians who frequently examine and treat young children and special needs patients[24].

In terms of the key indicators of oral health, namely dental caries and periodontal condition, children with CP fared in a similar manner to their counterparts without CP with respect to dental caries, but less favourably with respect to periodontal health. Evidence of caries differences among CP populations is conflicting, but there are many reports of a similar or lower caries experience among CP children[11,25]. The gingival health of the children with CP was poorer than that of children from mainstream preschools. This concurs with numerous reports in the literature[14,15]. This may be related to the poor neuromuscular control of children, preventing that from being able to maintain good oral hygiene (especially for older children). Moreover, the increased prevalence of gingival hyperplasia among the CP group is likely to be related to their use of anticonvulsive effects which are known to induce gingival hyperplasia[14].

The presence of tooth wear was markedly more common (almost twice as common) among children with CP, which is likely to reflect parafunctional habits such as bruxism[26]. Classification of tooth wear was made using the TWI on index teeth and simply categorized based on loss of enamel involving dentine or not. Further studies involving more sophisticated epidemiological assessments among CP groups are warranted particularly as it may be of important in the clinical management to distinguish between tooth substance loss due to erosion and other forms of tooth surface loss[25]. Interestingly, the observations that oral mucosal lesions were more commonly evident in children with CP, with most lesions being ulcers, which again, is most likely to be related to parafunctional habits.

In assessing malocclusion two attributes were considered. The presence or absence of an anterior open-bite and increased over-jet were found more common among children with CP, as has previously been reported[11,14]. This could possibly be related to aberrant tongue movement or positioning, a poor swallow reflex and frequent mouth breathing.

Instability and seizures may give rise to dental trauma[9] and developmental defects of

enamel (which may also arise from hypoxic and metabolic upset)[27,28]. They are common among special needs children because of premature birth or severe early childhood diseases. However, no significant difference in the prevalence of developmental defects of enamel or dental trauma among the children with and without CP was identified. This in part may be related to the relatively low prevalence of these conditions among the study populations and/or to the method that was employed for assessing them in this study. In addition, the high prevalence of tooth wear among CP children may have masked the features of DDE resulting in underscoring its true prevalence.

Conclusions

In this community study, conducted in Hong Kong, differences of oral health status exist among preschool children with and without CP. Children with CP tend to fare worse in terms of gingival health, tooth wear, malocclusion and oral mucosal health than normal preschool children. These findings have implication in advocation for oral health care for children with CP.

Bullet points

- A community based oral health survey among preschool children with CP.
- Compare the oral health findings between children with and without (gender and age matched) CP.
- Differences of oral health status exist among preschool children with and without CP.

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