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Original Article

Investigation and analysis of the prevalence of oral diseases and oral health-related quality of life in children with cerebral palsy, and associated factors

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Abstract: Objective: To assess the prevalence of oral diseases and oral health-related quality of life (OHRQoL) in children with cerebral palsy (CP) and identify associated factors. Methods: This retrospective study included 192 children with CP who were admitted to Zhujiang Hospital, Southern Medical University between March 2023 and May 2024. The prevalence of oral diseases, such as dental caries, pulp diseases, malocclusion, and dental trauma, was statistically analyzed. The 5-item Oral Health Impact Profile (OHIP-5) was used to assess OHRQoL. OHIP-5 scores were compared across different degrees of CP severity, and factors influencing OHRQoL were evaluated. Results: Among the 192 children, 50.00% had dental caries, 22.40% had pulp diseases, 16.15% had malocclusion, and 11.46% had dental trauma, with only 14.06% being disease-free. The mean OHIP-5 score was 9.24 ± 1.87. Severe CP was associated with a higher prevalence of oral diseases and higher OHIP-5 scores compared to mild and moderate CP ($P < 0.05$). Poorer OHRQoL was associated with parental education (vocational school or below), low family income (≤ 5000 RMB/month), infrequent tooth brushing (< 2 times/day), short brushing duration (< 3 minutes), and irregular toothbrush replacement ($P < 0.05$). Multivariate analysis identified severe CP (OR = 2.050), low family income (OR = 1.923), infrequent brushing (OR = 1.960), short brushing duration (OR = 1.929), and irregular toothbrush replacement (OR = 1.895) as significant risk factors for reduced OHRQoL ($P < 0.05$). Conclusion: Children with CP have a high prevalence of oral diseases, which significantly impact their OHRQoL. Severe CP and modifiable risk factors, such as oral hygiene practices and socioeconomic status, are critical contributors. Interventions targeting these factors could improve oral health outcomes in this population.

Keywords: Cerebral palsy, children, oral diseases, quality of life, associated factors

Introduction

Cerebral palsy (CP) is a syndrome primarily characterized by motor disorders, abnormal posture, and limited mobility, resulting from non-progressive brain injury during the fetal or infant stages [1, 2]. The prevalence of CP is approximately 0.3%, making it a common cause of motor disorders in childhood [3]. Studies [4] have shown that children with CP are at high risk for dental diseases, which can significantly impact their oral health-related quality of life (OHRQoL). Compared to the general population, children with CP tend to have poorer oral hygiene, a higher prevalence of periodontal issues and bruxism, and more severe malocclusion [5]. Congenital CP can lead to structural changes in the oral-facial region, occlusal dysfunction, and feeding difficulties, all of which severely affect the growth and development of children with CP. Furthermore, many children with CP suffer from chewing disorders, which exacerbate the severity of dental caries [6]. Despite the significance of these oral health issues, they have long been overlooked clinically, leaving children with CP as a marginalized group. Improving their oral hygiene is essential. Understanding the oral health status of children with CP is crucial for enhancing their rehabilitation and quality of life. Currently, there is limited research on the oral health of children with CP. Therefore, this study aims to investigate the prevalence of oral diseases and OHRQoL in children with CP, and to analyze the associated

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influencing factors. The results are presented as follows.

Materials and methods

Clinical data

This retrospective study included 192 children with CP admitted to Zhujiang Hospital, Southern Medical University between March 2023 and May 2024. The participants consisted of 99 boys and 93 girls, aged 5 to 14 years, with a mean age of 9.62 ± 1.95 years. This study has obtained approval from Zhujiang Hospital, Southern Medical University.

Inclusion criteria: The diagnostic criteria for CP include four essential and two reference conditions [7].

Essential Conditions: (1) Persistent central motor dysfunction; (2) Abnormal development of movement and posture; (3) Abnormal development of reflexes; (4) Abnormal muscle tone and strength.

Reference Conditions: (1) Etiological basis for the cause of CP; (2) Neuroimaging evidence (MRI, CT, ultrasound).

Additional inclusion criteria: Age 5-14 years; guardians without mental illness and able to read the questionnaire independently; Exclusion criteria: Severe organ diseases such as congenital heart disease; incomplete eruption of the first permanent molars; inability to cooperate with examinations or surveys; severe intellectual disability.

Survey methods

A questionnaire, referencing the Chinese version of the short-form Health Literacy Dental scale (HeLD 14) and a condition assessment form for children with CP, was used to gather basic information from the study participants. This included gender, age, CP severity, place of residence, parents' marital status, father's education level, mother's education level, household income, daily brushing frequency, brushing time, brushing method, regularity of toothbrush replacement, and oral disease status [8]. The questionnaires were distributed and collected on-site. A total of 200 questionnaires were distributed, with 192 successfully collected, yielding a response rate of 96.00%.

Assessment of OHRQoL in children with CP

The oral health-related quality of life (OHRQoL) of children with CP was assessed using the 5-item Oral Health Impact Profile (OHIP-5) scale [9]. This scale included five items, each scored from 0 to 4, resulting in a total score ranging from 0 to 20. Higher scores indicated poorer OHRQoL. The Cronbach's α coefficient of the OHIP-5 scale was 0.868, and the test-retest reliability was 0.831, indicating good internal consistency and reliability.

Severity assessment of CP in children

The severity of CP in children was assessed using the Gross Motor Function Classification System (GMFCS) [10]. Based on the GMFCS, levels I-II were classified as mild, level III as moderate, and levels IV-V as severe.

Inflammatory factors

3-5 mL of peripheral venous blood was routinely collected from patients. After centrifugation, the supernatant was obtained. Enzyme-linked immunosorbent assay (ELISA) was used to measure the levels of CRP (CRP-H5226), IL-6 (GMP-L06H27), and IL-6 (GMP-L06H27) in the peripheral blood of patients in both groups (Beijing Biosys Biotechnology Co., Ltd.). The procedure was strictly followed according to the operating guidelines. The expression of WBC in peripheral blood was analyzed by flow cytometry.

Statistical analysis

Statistical analysis was performed using SPSS 21.0 software. Measurement data were expressed as mean ± standard deviation (x ± sd) and analyzed using t-tests or analysis of variance (ANOVA). Pairwise comparisons were conducted using the LSD-t method. Categorical data were presented as composition ratios or percentages (%) and analyzed using the χ^2-test. Logistic multiple regression analysis was used to identify risk factors affecting the OHRQoL of children with CP. A *P*-value of less than 0.05 was considered statistically significant.

Table 1. Clinical data and oral disease prevalence in CP children

Clinical Data	Cases	Proportion (%)
Gender		
Male	99	51.56
Female	93	48.44
Age		
5-7 years	82	42.71
8-10 years	65	33.85
11-14 years	45	23.44
CP Severity		
Mild/Moderate	123	64.06
Severe	69	35.94
Place of Residence		
Urban	77	40.10
Rural	115	59.90
Parental Marital Relationship		
Harmonious	84	43.75
Quarrelsome	108	56.25
Father's Educational Level		
Vocational School or Below	97	50.52
College or Above	95	49.48
Mother's Educational Level		
Vocational School or Below	103	53.65
College or Above	89	46.35
Primary Caregiver's Educational Level		
Vocational School or Below	118	61.46
College or Above	74	38.54
Family Income		
≤ 5000 RMB/month	103	53.65
> 5000 RMB/month	89	46.35
Daily Tooth Brushing Frequency		
≥ 2 times	80	41.67
< 2 times	112	58.33
Brushing Duration		
≥ 3 minutes	78	40.63
< 3 minutes	114	59.38
Brushing Method		
Horizontal Brushing	63	32.81
Vertical Brushing	58	30.21
Mixed Horizontal & Vertical Brushing	71	36.98
Regular Toothbrush Replacement		
Yes	85	44.27
No	107	55.73
Oral Disease Prevalence		
No Disease	27	14.06
Dental Caries	96	50.00
Pulp Disease	43	22.40
Malocclusion	31	16.15
Dental Trauma	22	11.46

CP, cerebral palsy.

Results

Clinical data and oral disease prevalence in CP children

In this study, 192 children with cerebral palsy (CP) were included, consisting of 99 boys (51.56%) and 93 girls (48.44%). The age distribution was as follows: 82 children aged 5-7 years (42.71%), 65 children aged 8-10 years (33.85%), and 45 children aged 11-14 years (23.44%). Regarding CP severity, 123 children (64.06%) were classified as mild/moderate, and 69 children (35.94%) were classified as severe.

Among the participants, 27 children (14.06%) had no oral diseases, 96 children (50.00%) had dental caries, 43 children (22.40%) had pulp diseases, 31 children (16.15%) had malocclusion, and 22 children (11.46%) had dental trauma. Additional clinical information is provided in **Table 1**.

Comparison of baseline data between CP children with and without oral diseases

The study found no statistically significant differences between CP children with and without oral diseases in terms of gender, age, or place of residence. However, significant differences were observed in disease severity and brushing habits (all $P < 0.05$). Detailed data are presented in **Table 2**.

Comparison of peripheral blood inflammatory markers between CP children with and without oral diseases

No statistically significant differences in white blood cell count (WBC), interleukin-6 (IL-6), or C-reactive protein (CRP)

Table 2. Comparison of baseline data between CP children with and without oral diseases

Item	CP Without Oral Diseases (n = 27)	CP With Oral Diseases (n = 165)	Statistic	*P*-Value
Gender (Male/Female)	17/10	80/85	1.410	0.235
Age (years)	15.6±8.7	16.0±7.9	0.532	0.661
CP Severity (Mild/Moderate/Severe)	20/4/3	40/89/36	27.080	< 0.001
Place of Residence (Rural/Urban)	14/13	88/77	0.642	0.431
Brushing Frequency (≥ 2 times/< 2 times)	20/7	45/120	16.774	< 0.001
Brushing Duration (≥ 3 min/< 3 min)	22/5	75/90	12.366	< 0.001
Brushing Method (Horizontal/Vertical/Mixed)	9/9/9	70/55/40	0.356	0.654
Regular Toothbrush Replacement (Yes/No)	21/6	55/110	18.773	< 0.001

CP: cerebral palsy.

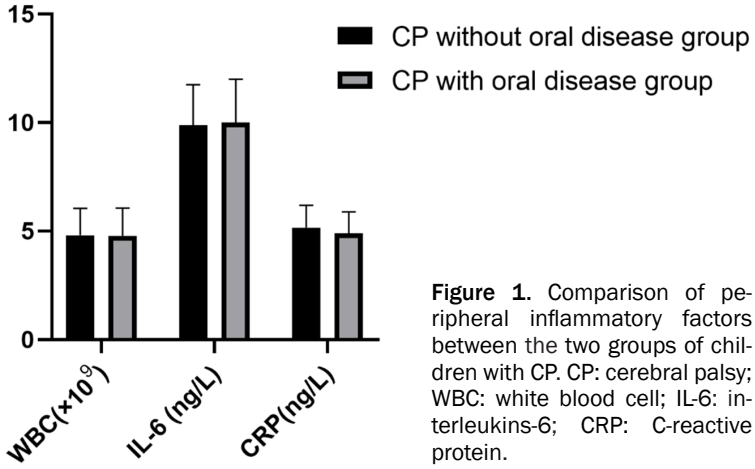

Figure 1. Comparison of peripheral inflammatory factors between the two groups of children with CP. CP: cerebral palsy; WBC: white blood cell; IL-6: interleukins-6; CRP: C-reactive protein.

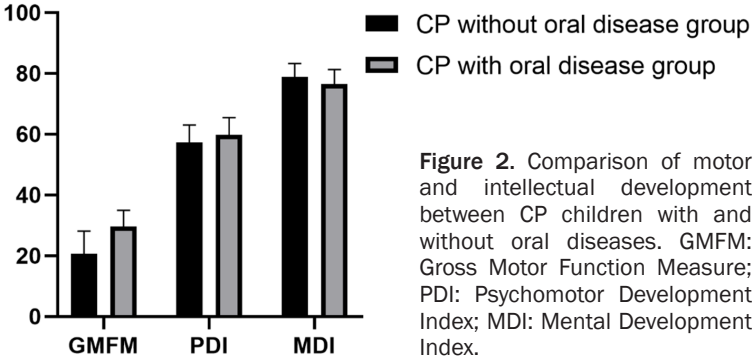

Figure 2. Comparison of motor and intellectual development between CP children with and without oral diseases. GMFM: Gross Motor Function Measure; PDI: Psychomotor Development Index; MDI: Mental Development Index.

levels were found between CP children with oral diseases and those without oral diseases (P > 0.05). Details are shown in **Figure 1**.

Comparison of motor and intellectual development between CP children with and without oral diseases

No statistically significant differences were observed between CP children with and without oral diseases regarding Gross Motor Function Measure (GMFM), Psychomotor Development Index (PDI), or Mental Development Index (MDI) (all P > 0.05). Detailed data are presented in **Figure 2**.

Multivariate logistic analysis of CP with oral diseases

Multivariate logistic regression analysis revealed that after considering univariate factors, disease severity, brushing duration, and brushing habits were identified as independent factors influencing oral diseases in CP children. Detailed results are presented in **Table 3**.

Comparison of oral disease prevalence and OHIP-5 scores among CP children with different severity levels

The mean OHIP-5 score of the 192 CP children was 9.24 ± 1.87. A comparison of oral disease prevalence and OHIP-5 scores across different CP severity levels showed statistically significant differences (P < 0.05). The severe CP group had a higher prevalence of oral diseases compared to the mild and moderate groups (χ^2 = 11.864, 5.751; P = 0.001, 0.016). Similarly, the OHIP-5 scores were higher in the severe group compared to the mild and moderate groups (t = 6.961, 2.243; P = 0.000, 0.027), and the OHIP-5 score in the moderate group

Table 3. Multivariate Logistic analysis of influencing factors for CP with oral diseases

Factor	β	*P*-Value	OR	95% CI
Severe CP Severity	0.906	0.001	4.568	1.004-5.765
Brushing Duration < 3 min	0.738	0.012	1.929	1.042-3.571
Irregular Toothbrush Replacement	0.712	0.043	2.773	1.432-3.908
Brushing Frequency < 2 times/day	1.442	0.041	1.023	1.001-2.334

CP: cerebral palsy.

Table 4. Comparison of oral disease prevalence and OHIP-5 scores among CP children with different severity levels

Group	n	Oral Disease Prevalence (%)	OHIP-5 Score (Mean ± SD)	χ^2/F Value	*P*-Value
Mild Group	92	72 (78.29)	8.15±1.73		
Moderate Group	31	26 (83.97)[a]	9.40±1.82[a]	χ^2 = 11.712	0.003
Severe Group	69	67 (97.10)[a,b]	10.61±2.74[a,b]	F = 25.665	< 0.001

Notes: a: compared to mild group, P < 0.05; b: compared to moderate group, P < 0.05. OHIP-5: Oral Health Impact Profile.

was higher than that in the mild group (t = 3.474; P = 0.001). Detailed data are shown in **Table 4**.

Univariate analysis of factors affecting OHRQoL in CP children

No statistically significant differences were found in OHIP-5 scores based on gender, age, place of residence, parental marital status, or brushing method (P > 0.05). However, CP children with severe CP, fathers with an education level of vocational school or below, mothers with an education level of vocational school or below, primary caregivers with an education level of vocational school or below, family income ≤ 5000 RMB/month, less frequent brushing (fewer than 2 times per day), brushing duration < 3 minutes, and irregular toothbrush replacement had higher OHIP-5 scores compared to those with mild/moderate CP, fathers with a college-level education or above, mothers with a college-level education or above, primary caregivers with a college-level education or above, family income > 5000 RMB/month, brushing ≥ 2 times per day, brushing duration ≥ 3 minutes, and regular toothbrush replacement (P < 0.05). Details are presented in **Table 5**.

Multivariate analysis of factors affecting OHRQoL in CP children

A binary logistic regression analysis was conducted to identify factors influencing OHRQoL scores. Independent variables included CP severity (severe = 1, mild/moderate = 0), family income (≤ 5000 RMB/month = 1, > 5000 RMB/month = 0), brushing frequency (≥ 2 times = 1, < 2 times = 0), brushing duration (< 3 minutes = 1, ≥ 3 minutes = 0), and regular toothbrush replacement (no = 1, yes = 0). The OHRQoL scores were the dependent variable. The entry level for the model was 0.05, and the exclusion level was 0.10.

The results indicated that severe CP (OR = 2.050, 95% CI: 1.107-3.796), family income ≤ 5000 RMB/month (OR = 1.923, 95% CI: 1.039-3.561), brushing frequency < 2 times per day (OR = 1.960, 95% CI: 1.059-3.629), brushing duration < 3 minutes (OR = 1.929, 95% CI: 1.042-3.571), and irregular toothbrush replacement (OR = 1.895, 95% CI: 1.023-3.508) were identified as significant risk factors for poorer OHRQoL in CP children (P < 0.05). Detailed results are presented in **Table 6**.

Discussion

CP is frequently associated with sensory, communication, and behavioral abnormalities, as well as issues such as epilepsy and secondary skeletal problems, all of which can impair daily activities and oral health [11, 12]. The pathogenesis of CP remains unclear, though it may be linked to intrauterine infections, placental abnormalities, and other factors [13]. Compared to the general population, children with CP often struggle with oral hygiene practices such as rinsing and brushing their teeth due to motor coordination difficulties, making them more prone to oral diseases like dental caries [14]. Oral health is one of the most neglected aspects of overall health in children, particularly those with special needs [15]. Assessing OHRQoL is crucial for understanding the oral health status of children with CP and for facilitating appropriate planning and management of their oral health in clinical practice.

Table 5. Univariate analysis of factors affecting OHRQoL in CP children

Clinical Data	Cases (n)	OHIP-5 Score (Mean ± SD)	t-value	*P*-value
Gender				
Male	99	9.07±1.75	1.305	0.193
Female	93	9.41±1.86		
Age				
5-7 years	82	9.21±1.86	0.150	0.861
8-10 years	65	9.33±1.82		
11-14 years	45	9.14±1.95		
CP Severity				
Mild/Moderate	123	8.47±1.79	6.532	< 0.001
Severe	69	10.61±2.74		
Place of Residence				
Urban	77	9.14±1.81	0.619	0.537
Rural	115	9.30±1.72		
Parental Marital Relationship				
Harmonious	84	9.45±1.64	1.518	0.131
Quarrelsome	108	9.07±1.78		
Father's Educational Level				
Vocational School or Below	97	9.54±1.82	2.399	0.017
College or Above	95	8.92±1.76		
Mother's Educational Level				
Vocational School or Below	103	9.48±1.85	2.030	0.044
College or Above	89	8.95±1.75		
Primary Caregiver's Educational Level				
Vocational School or Below	118	9.45±1.93	2.051	0.042
College or Above	74	8.89±1.69		
Family Income				
≤ 5000 RMB/month	103	9.56±1.84	2.709	0.007
> 5000 RMB/month	89	8.86±1.72		
Daily Brushing Frequency				
≥ 2 times	80	8.72±1.54	3.530	0.001
< 2 times	112	9.60±1.81		
Brushing Duration				
≥ 3 minutes	78	8.83±1.63	2.748	0.007
< 3 minutes	114	9.51±1.72		
Brushing Method				
Horizontal	63	9.31±1.76	0.153	0.858
Vertical	58	9.26±1.72		
Mixed	71	9.15±1.68		
Regular Toothbrush Replacement				
Yes	85	8.89±1.54	2.570	0.011
No	107	9.51±1.75		

CP: cerebral palsy.

Previous studies have shown that the incidence of oral diseases in children with CP is higher than that in non-CP children [16]. In this study, among the 192 CP patients, 27 (14.06%) had no oral diseases, 96 (50.00%) had dental caries, 43 (22.40%) had pulp diseases, 31 (16.15%) had malocclusion, and 22 (11.46%) had dental trauma. This indicates a higher inci-

Table 6. Logistic regression analysis of factors affecting OHRQoL in CP children

Factor	β	SE	Wald χ^2	*P*	OR	95% CI
Severe CP Severity	0.718	0.227	10.005	0.000	2.050	1.107-3.796
Father's Educational Level	0.283	0.441	0.412	0.528	1.327	0.717-2.457
Mother's Educational Level	0.372	0.535	0.483	0.506	1.451	0.783-2.686
Primary Caregiver's Education	0.381	0.528	0.521	0.413	1.464	0.791-2.710
Family Income ≤ 5000 RMB/month	0.624	0.261	6.279	0.015	1.923	1.039-3.561
Daily Brushing Frequency < 2 times	0.643	0.236	8.132	0.003	1.960	1.059-3.629
Brushing Duration < 3 minutes	0.627	0.258	6.485	0.012	1.929	1.042-3.571
Irregular Toothbrush Replacement	0.609	0.275	5.399	0.028	1.895	1.023-3.508

CP: cerebral palsy.

dence of oral diseases in CP children, consistent with previous research by Chen et al. The reasons for this include difficulties in swallowing and oral muscle weakness during feeding, which can lead to an inability to chew and swallow food normally, increasing food residue in the mouth and promoting oral diseases. Additionally, due to limitations in motor function, children with CP face challenges in self-care, especially in maintaining oral hygiene. They may struggle to brush their teeth effectively or undergo regular oral check-ups, creating an environment conducive to oral bacteria, as reported in similar studies [16].

Many studies use the OHIP-5 score to assess the oral health condition of children, making it clinically significant to investigate the OHIP-5 score and its influencing factors. In this study, the OHIP-5 score for the 192 CP patients was 9.24 ± 1.87. The prevalence of oral diseases in the severe group was higher than that in the mild and moderate groups, and the OHIP-5 score was also higher in the severe group compared to the mild and moderate groups. Additionally, the OHIP-5 score in the moderate group was higher than that in the mild group, indicating that as the severity of oral diseases in CP children increases, the OHIP-5 score also increases. Factors such as severe CP, father's education level (vocational school or below), mother's education level (vocational school or below), caregiver's education level (vocational school or below), family income ≤ 5000 yuan/month, brushing less than twice a day, brushing duration < 3 minutes, and irregular toothbrush replacement were associated with higher OHIP-5 scores in CP children. Multivariate analysis identified severe CP, low family income, infrequent brushing, short brushing duration, and irregular toothbrush replacement as risk factors affecting the OHRQoL of CP children. The underlying reasons may include poor oral hygiene and chewing difficulties, which contribute to the occurrence of dental caries and other oral diseases. Severely affected CP children often experience more severe swallowing and oral movement disorders, and those with intellectual disabilities typically rely on family members to maintain their oral hygiene, leading to a higher incidence of oral diseases, which in turn affects OHRQoL, corroborating previous research findings [17].

Furthermore, Akhter et al. [18] reported that the incidence of dental caries in CP children in low-resource environments is high, which negatively impacts their OHRQoL. Brushing teeth is the primary method for removing dental plaque and maintaining oral cleanliness, and it should be a daily hygiene habit for everyone. Relevant studies [19] indicate that to control dental plaque, maintain oral hygiene, and prevent bad breath, brushing teeth at least twice a day is recommended. Brushing less than twice a day may increase the risk of oral-related diseases, thereby negatively affecting the OHRQoL of CP children. Each tooth surface should be brushed 5-10 times, and each brushing session should last at least 3 minutes. Insufficient brushing time can reduce the effectiveness of oral cleanliness and plaque removal [20]. Most children with CP do not master the correct brushing technique and brush for a short duration, which prevents them from effectively removing plaque, thus impacting their OHRQoL. Prolonged use of the same toothbrush can lead to bacterial growth, increasing the risk of oral infections and diseases. Experts recommend changing toothbrushes every 3 months. Using a tooth-

brush for too long or with improper force can cause the bristles to fall out or deform. If toothbrushes are not changed regularly, they cannot adequately clean the teeth and ensure oral hygiene [22], which increases the risk of dental caries, pulp diseases, and other oral diseases, subsequently affecting OHRQoL. Therefore, attention should be paid to these factors in clinical practice to reduce the risk of oral diseases in children with CP and improve their OHRQoL. Similar findings have been reported in a previous research [21].

The results of this study showed no significant difference in the expression levels of inflammatory factors in peripheral blood between the two groups. This may be related to the following mechanisms: inflammation is an important part of the immune response and is closely associated with the occurrence of cerebral palsy, while IL-6 and CRP levels may be central to the regulatory mechanism of inflammatory cytokines in CP. Although inflammation is closely linked to the development of oral diseases, these are local lesions and do not significantly increase the systemic inflammatory response, supporting the findings of previous studies [23].

This study has several limitations. First, as a retrospective study, it relied on existing data, which may be subject to incomplete or inaccurate reporting. Additionally, the study's cross-sectional nature limits the ability to establish causal relationships. The single-center design may also restrict the generalizability of the findings to a broader population. Future studies should consider conducting prospective or longitudinal research to better understand the causal links between oral health factors and OHRQoL in children with CP. Expanding the study to multiple centers and incorporating interventions such as oral health education could provide more comprehensive insights and improve outcomes for children with CP.

In conclusion, the prevalence of oral diseases in children with CP is relatively high. Factors such as severe CP, low family income, brushing frequency, brushing duration, and irregular toothbrush replacement are significant risk factors affecting the OHRQoL of CP children. This underscores the importance of raising awareness across society, particularly among healthcare professionals, about the need for oral care education for children with CP to improve their OHRQoL.

Disclosure of conflict of interest

None.

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