

# Comparative Evaluation of Association Between Dietary Patterns and Early Childhood Caries Among Children with Autism Spectrum Disorder and Cerebral Palsy: A Cross-Sectional Study

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**Abstract:** ***Purpose:** Early Childhood Caries (ECC) poses a significant oral health challenge among children with special health care needs, particularly those with Autism Spectrum Disorder (ASD) and Cerebral Palsy (CP). This study aimed to evaluate and compare the association between dietary patterns and the prevalence of ECC in children with ASD and CP aged 3–6 years. **Materials and Methods:** A cross-sectional study was conducted among 18 children (9 per group) aged 3–6 years diagnosed with ASD or CP, attending early intervention centres in Dakshina Kannada district, Karnataka. A validated 15-item self-structured questionnaire assessed dietary patterns and oral hygiene habits. Caries experience was recorded using the dmfs index. Statistical analyses included unpaired t-test, Fisher's exact test, and Spearman's correlation (SPSS). A p-value <0.05 was considered significant. **Results:** Caries prevalence was high in both groups (ASD: 88.9%; CP: 100%). Mean dmfs scores were 11.55±8.66 and 14.33±9.16, respectively (p=0.518). Significant intergroup differences were observed in type of feeding (p=0.002), swallowing difficulty (p=0.029), diet consistency (p=0.011), and presence of oromotor dysfunction (p<0.001). In the ASD group, food pouching (r=0.904, p=0.001) and diet consistency (r=-0.866, p=0.003) were strongly correlated with dmfs scores. In the CP group, food pouching (r=0.935, p<0.001) and brushing frequency (r=-0.722, p=0.028) showed significant associations. **Conclusions:** Although ECC prevalence was similarly elevated in both groups, dietary and feeding profiles differed significantly. Food pouching was a critical shared caries risk factor. Condition-specific preventive strategies and caregiver counselling are essential to improve oral health outcomes in children with ASD and CP.*

**Keywords:** Autism Spectrum Disorder; Cerebral Palsy; Dietary Patterns; dmfs index; Early Childhood Caries; Food Pouching; Special Health Care Needs

## 1. Introduction

Early Childhood Caries (ECC) is defined by the American Academy of Pediatric Dentistry as the presence of one or more decayed, missing, or filled tooth surfaces in any primary tooth in a child under 6 years of age.<sup>1</sup> It remains among the most prevalent chronic conditions globally, affecting approximately 48% of preschool children.<sup>2</sup> ECC is associated with significant morbidity including pain, impaired chewing, nutritional deficiencies, and reduced quality of life.<sup>3</sup> Among children with special health care needs (SHCN), its burden is disproportionately elevated, driven by condition-specific barriers to oral hygiene, altered dietary practices, and limited access to preventive dental care.<sup>4</sup>

Children with Autism Spectrum Disorder (ASD) frequently exhibit marked food selectivity influenced by sensory sensitivities.<sup>5</sup> Caregivers often employ food-based rewards- commonly sugary snacks or beverages- as behavioural reinforcers, inadvertently increasing cariogenic exposure.<sup>6</sup> Children with ASD have been found to consume significantly more sugar-sweetened beverages and snack foods compared to typically developing peers.<sup>7</sup> A meta-analysis reported a pooled dental caries prevalence of 60.6% among children with ASD.<sup>8</sup>

Children with Cerebral Palsy (CP) commonly present with

oromotor dysfunction, dysphagia, and dependence on modified-consistency diets.<sup>9</sup> Factors such as food consistency, snacking between meals, and associated oromotor dysfunction have been reported to contribute to the high incidence of caries in children with CP.<sup>10</sup> Santos et al. demonstrated that dietary consistency and oromotor dysfunction significantly influenced caries experience in CP, with those receiving liquid diets showing the highest DMF values.<sup>11</sup> Dependence on caregivers for feeding and oral hygiene further modifies caries risk in this group.<sup>12</sup>

Prolonged food retention due to pouching or delayed swallowing has been specifically implicated in accelerating enamel erosion and decay in children with ASD and CP.<sup>13</sup> Despite the well-recognised vulnerability of both populations, comparative studies directly examining dietary determinants of ECC in children with ASD versus CP remain scarce.<sup>14</sup> The present study was therefore designed to evaluate and compare the association between dietary patterns and ECC in children with ASD and CP aged 3–6 years.

## 2. Aim and Objectives

### *Aim*

To evaluate and compare the association between dietary patterns and the prevalence of ECC in children with ASD and CP aged 3–6 years.

**Objectives**

- Assess dietary patterns (frequency, type, consistency) in children with ASD and CP aged 3–6 years.
- Assess the prevalence and severity of ECC using the dmfs index.
- Analyse the association between dietary patterns and ECC within each group.
- Compare dietary factors and ECC prevalence between groups.
- Provide caregiver awareness regarding diet and oral health in these children.

**3. Material and Methods****Study Design**

A cross-sectional comparative study design was employed.

**Study Setting and Sample Selection**

The study was conducted at early intervention centres in Dakshina Kannada district, Karnataka, India. Two centres were randomly selected. Ethical clearance and institutional permissions were obtained prior to the study. Written informed consent was obtained from all caregivers.

**Sample Size Estimation**

Sample size was calculated using the two-group comparison formula:  $n = 2(SD)^2(Z_{1-\alpha/2} + Z\beta)^2/d^2$ . With  $SD=2.718$ , mean difference=3.63, 95% CI, and 80% power, the estimated sample size was 8.79 per group, rounded to 9. A total of 18 children were enrolled (9 ASD, 9 CP).

**Inclusion Criteria**

- Children aged 3–6 years diagnosed with ASD or CP, primarily orally fed.
- Consistent dietary form for at least 6 months prior to enrolment.
- Primary caregiver involved in daily feeding and oral hygiene, willing to participate.

**Exclusion Criteria**

- Children with dual diagnoses (ASD and CP).
- Mixed or changing dietary consistencies over 6 months.
- Medical conditions reducing salivary flow, or enteral (tube) feeding.
- Children uncooperative for oral examination despite routine behaviour management.
- Children with acute medical emergencies.

**Data Collection**

A validated 15-item self-structured questionnaire with closed-ended multiple-response options was administered to caregivers. The questionnaire was developed in English and translated into regional languages. Content validity was established by a panel of five experts (paediatric dentists, paediatricians, public health dentistry specialists). It captured information on: type of feeding, chewing and swallowing difficulties, diet consistency, meal frequency, sugar drink intake, food pouching, snack consumption, dietary modifications, and oral hygiene practices.

**Oral Examination**

Clinical oral examination was performed on all children to assess caries using the dmfs (decayed-missing-filled

surfaces) index, in accordance with WHO diagnostic criteria, under standardised conditions.

**Statistical Analysis**

All analyses were performed using IBM SPSS Statistics software. Shapiro–Wilk test assessed normality. Unpaired t-test compared continuous variables; Fisher's exact test compared categorical variables; Spearman's rank correlation assessed associations between dmfs scores and dietary parameters. A p-value <0.05 was considered statistically significant.

**4. Results**

A total of 18 children were enrolled (9 ASD, 9 CP). Comparisons were made across demographic characteristics, caries prevalence and severity, dietary habits, oral hygiene practices, and association between dietary factors and caries experience.

**Table 1:** Comparison of age between the two groups (Unpaired t-test)

Parameter	ASD	CP	p-value
Age (years)	5.44±0.52	5.55±0.72	0.716 NS

NS = Not significant

The mean age in the ASD group was 5.44±0.52 years and in the CP group was 5.55±0.72 years. The difference was not statistically significant (p=0.716), confirming comparable age distribution.

**Table 2:** Comparison of gender distribution (Fisher's exact test)

Parameter	Category	ASD	CP	p-value
Gender	Male	7 (77.8%)	4 (44.4%)	0.335
	Female	2 (22.2%)	5 (55.6%)	NS

NS = Not significant

Males constituted 77.8% in the ASD group and 44.4% in the CP group. The gender distribution did not differ significantly (p=0.335).

**Table 3:** Comparison of caries prevalence (Fisher's exact test)

Parameter	Category	ASD	CP	p-value
Caries prevalence	Yes	8 (88.9%)	9 (100%)	0.909
	No	1 (11.1%)	0	NS

NS = Not significant

ECC prevalence was 88.9% in the ASD group and 100% in the CP group. The intergroup difference was not statistically significant (p=0.909).

**Table 4:** Comparison of dmfs scores (Unpaired t-test)

Parameter	ASD	CP	p-value
Mean dmfs score	11.55±8.66	14.33±9.16	0.518 NS

NS = Not significant

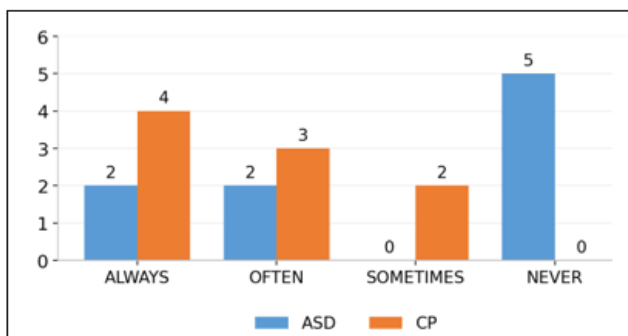
Mean dmfs scores were 11.55±8.66 (ASD) and 14.33±9.16 (CP). Although the CP group showed higher caries severity, the difference was not statistically significant (p=0.518).

**Table 6:** Comparison of oral hygiene practices (Fisher's exact test)

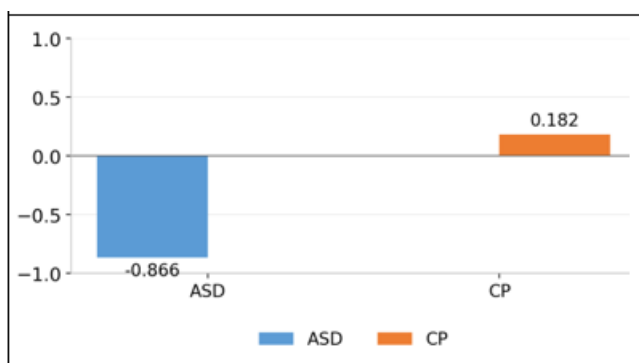
Parameter	Category	ASD	CP	p-value
Brushing frequency	Once/day	6 (66.7%)	4 (44.4%)	0.813 NS
	Twice/day	1 (11.1%)	3 (33.3%)	
	Irregular	2 (22.2%)	2 (22.2%)	
Brushing by	Caregiver	9 (100%)	8 (88.9%)	0.988 NS
	Child	0	1 (11.1%)	

NS = Not significant

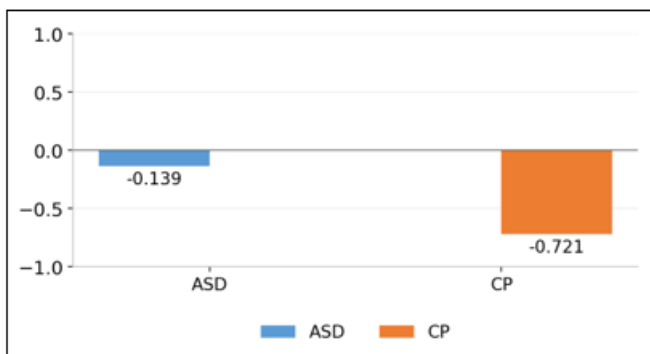
Once-daily brushing was predominant in both groups (ASD: 66.7%; CP: 44.4%). Caregiver-assisted brushing was reported for all ASD children (100%) and 88.9% of CP children. No significant differences were observed for brushing frequency (p=0.813) or brushing personnel (p=0.988).



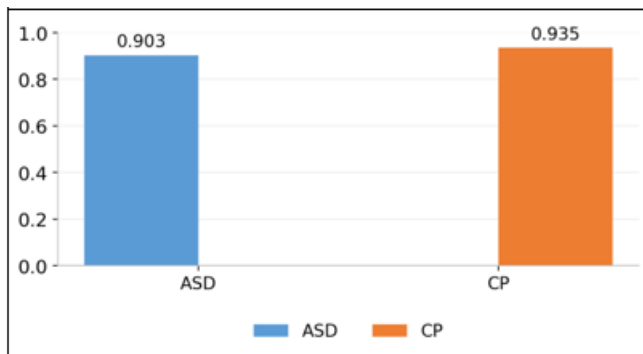
**Figure 1:** Comparison of food pouching during meals between the ASD and CP groups.



**Figure 2:** Spearman's correlation between caries status and diet consistency in the ASD and CP groups (r = -0.866 and 0.182, respectively).



**Figure 3:** Spearman's correlation between caries status and brushing frequency in the ASD and CP groups (r = -0.139 and -0.721, respectively)



**Figure 4:** Spearman's correlation between caries status and food pouching during meals in the ASD and CP groups (r = 0.903 and 0.935, respectively).

**Table 5:** Statistically significant dietary and feeding parameters between groups (Fisher's exact test)

Parameter	Category	ASD	CP	p-value
Type of feeding	Self-fed	7 (77.8%)	0 (0%)	0.002*
	Assisted	2 (22.2%)	9 (100%)	
Swallowing difficulty	Yes	4 (44.4%)	9 (100%)	0.029*
	No	5 (55.6%)	0 (0%)	
Diet consistency	Regular solid	5 (55.6%)	0 (0%)	0.011*
	Soft/Mashed	4 (44.4%)	8 (88.9%)	
	Pureed+ Mashed	0 (0%)	1 (11.1%)	
Associated diagnosis	Oromotor dysfn. only	0 (0%)	7 (77.8%)	<0.001*
	Feeding/ swallowing diff.	4 (44.4%)	1 (11.1%)	
	None	5 (55.6%)	0 (0%)	

\*Statistically significant (p < 0.05)

Significant intergroup differences emerged for four dietary/feeding parameters. All CP children were caregiver-assisted during feeding, whereas the majority of ASD children (77.8%) were self-fed (p=0.002). Swallowing difficulty was reported in all CP children compared with 44.4% of ASD children (p=0.029). Diet consistency differed markedly (p=0.011): most ASD children consumed regular solid food (55.6%), while the majority of CP children received soft or mashed diets (88.9%). The distribution of associated feeding diagnoses also differed significantly (p<0.001), with oromotor dysfunction alone present in 77.8% of CP children but in none of the ASD children, while feeding/swallowing difficulty alone was more common in the ASD group (44.4%). Remaining dietary parameters-chewing difficulty, meal frequency, sugar drink intake, food pouching frequency, between-meal snacking, and provider-recommended dietary modification- did not differ significantly between groups (p>0.05 for all).

**Table 7:** Statistically significant Spearman's correlations between dmfs score and dietary/oral hygiene parameters

Grp	Correlate of dmfs	r	p-value	Strength
ASD	Diet consistency	-0.866	0.003	Very strong negative
ASD	Food pouching	0.904	0.001	Very strong positive
CP	Brushing frequency	-0.722	0.028	Fairly strong negative
CP	Food pouching	0.935	<0.001	Very strong positive

All other correlations (meal frequency, sugar drink frequency, snack consumption, and the cross-group correlations not listed) were not statistically significant ( $p > 0.05$ ).

In the ASD group, two parameters showed significant correlations with dmfs score: diet consistency ( $r=-0.866$ ,  $p=0.003$ ), a very strong negative correlation, and food pouching ( $r=0.904$ ,  $p=0.001$ ), a very strong positive correlation. In the CP group, two parameters showed significant correlations: brushing frequency ( $r=-0.722$ ,  $p=0.028$ ), a fairly strong negative correlation, and food pouching ( $r=0.935$ ,  $p<0.001$ ), a very strong positive correlation. Brushing frequency and food pouching were not significantly correlated with caries severity in the ASD group, and diet consistency was not significantly correlated with caries severity in the CP group.

## 5. Discussion

Both groups demonstrated notably high caries prevalence (ASD: 88.9%; CP: 100%) and elevated mean dmfs scores, consistent with previously reported literature on SHCN populations.<sup>4, 9</sup> The comparable prevalence and severity ( $p>0.05$ ) underscore the shared vulnerability of both populations to ECC, albeit through distinct pathophysiological pathways.

All CP children required assisted feeding compared to the majority of self-fed ASD children ( $p=0.002$ ), reflecting the well-documented oromotor dysfunction and dysphagia associated with CP.<sup>10, 11</sup> This dependence on caregivers extends beyond feeding to oral hygiene, and may explain why caregiver-assisted brushing was near-universal in the CP group as well.<sup>12</sup>

Swallowing difficulty was reported in all CP children compared with less than half of the ASD group ( $p=0.029$ ), consistent with the high burden of dysphagia documented in CP.<sup>9, 11</sup> Impaired swallowing prolongs the residence time of food and fermentable carbohydrates within the oral cavity, independent of diet consistency, and may compound the caries risk associated with modified diets in this group.

Diet consistency differed significantly between groups ( $p=0.011$ ), with regular solid food predominating in ASD and soft or mashed diets predominating in CP. The predominance of modified-consistency diets in the CP group represents a critical difference in cariogenic exposure, as soft-consistency diets are inherently more adhesive, are retained longer on occlusal and interproximal surfaces, and provide reduced mechanical self-cleansing compared to firmer foods.<sup>11</sup>

The distribution of associated feeding diagnoses differed sharply between groups ( $p<0.001$ ): oromotor dysfunction alone was present in over three-quarters of CP children but in none of the ASD children, whereas feeding or swallowing difficulty alone was more characteristic of the ASD group. This reflects the distinct underlying aetiologies of feeding impairment in the two conditions- a primarily neuromuscular basis in CP versus a primarily sensory/behavioural basis in ASD.<sup>5, 9</sup> and suggests that

preventive dietary counselling should be tailored to the specific feeding profile of each condition rather than applied uniformly.

Food pouching during meals (Figure 1) emerged as the strongest correlate of caries severity in both groups (ASD:  $r=0.904$ ,  $p=0.001$ ; CP:  $r=0.935$ ,  $p<0.001$ ; Figure 4).

Pouching prolongs fermentable carbohydrate contact with tooth surfaces, facilitating sustained acid production by cariogenic microflora.<sup>13</sup> The fact that this association held with similar strength and direction in both groups- despite their differing feeding profiles- suggests that pouching behaviour is a universal, modifiable risk factor that should be specifically assessed and addressed during caregiver counselling for any child with feeding difficulties, regardless of the underlying diagnosis.

In the ASD group, diet consistency showed a significant inverse association with caries severity ( $r=-0.866$ ,  $p=0.003$ ; Figure 2)- children consuming softer diets had higher dmfs scores. This finding is somewhat counterintuitive, since softer diets are generally assumed to be less abrasive but also less cariogenic when nutritionally appropriate. A plausible explanation is that children with ASD who accept only softer textures due to sensory sensitivities are often restricted to a narrow range of frequently sweetened, processed, or packaged foods, which are both texturally soft and highly cariogenic.<sup>5, 6</sup> Food selectivity in ASD commonly favours sweet or processed items, increasing overall sugar exposure and, consequently, caries risk, even though the diet itself appears 'softer'.<sup>7</sup>

In the CP group, brushing frequency was inversely correlated with dmfs scores ( $r=-0.722$ ,  $p=0.028$ ; Figure 3)- children brushed more frequently had lower caries severity. This reinforces the protective role of regular mechanical plaque removal even in children whose diet consistency and oromotor function predispose them to higher caries risk.<sup>12</sup> Since caregiver-assisted brushing is near-universal in CP (Table 6), increasing brushing frequency from once to twice daily represents a readily achievable, low-cost preventive intervention that does not require behavioural desensitisation, unlike in ASD where brushing resistance is often a barrier.<sup>5</sup>

Notably, brushing frequency was not significantly correlated with caries severity in the ASD group ( $r=-0.139$ ,  $p=0.721$ ), and diet consistency was not significantly correlated with caries severity in the CP group ( $r=0.183$ ,  $p=0.638$ ). This divergence suggests that the dominant modifiable risk factor differs by condition: dietary texture and selectivity appear to be the primary drivers of caries risk in ASD, whereas oral hygiene frequency appears to be the primary modifiable driver in CP, with diet consistency in CP being more a consequence of oromotor impairment than an independent risk factor once pouching is accounted for.<sup>10, 11</sup>

Both groups demonstrated suboptimal brushing practices overall, with once-daily brushing predominant and twice-daily brushing achieved by only a minority (Table 6), consistent with earlier SHCN reports and highlighting a significant gap in caregiver knowledge and practice.<sup>4, 8, 12</sup>

Limitations include the small sample size (9 per group), a consequence of the short study design, limiting statistical power and generalisability. The cross-sectional design precludes causal inference. Future longitudinal studies with larger samples would strengthen the evidence base for condition-specific preventive interventions.

## 6. Conclusion

Despite comparable ECC prevalence and severity, children with ASD and CP exhibit distinctly different dietary and feeding profiles influencing caries risk through different mechanisms. Food pouching was a critical shared risk factor in both populations. Diet consistency was the primary dietary predictor in ASD, while brushing frequency was the key protective factor in CP. Condition-specific, targeted preventive strategies encompassing caregiver education, dietary counselling, and early dental visits are strongly recommended for both populations.

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## Conflict of Interest

The authors declare no conflict of interest.

## References

- [1] American Academy of Pediatric Dentistry. Policy on Early Childhood Caries (ECC): Classifications, Consequences, and Preventive Strategies. *Pediatr Dent*. 2020;42(6):49–51.
- [2] Uribe SE, Innes N, Maldupa I. The global prevalence of early childhood caries: a systematic review with meta-analysis using the WHO diagnostic criteria. *Int J Paediatr Dent*. 2021;31(6):817–830.
- [3] Anil S, Anand PS. Early Childhood Caries: Prevalence, Risk Factors, and Prevention. *Front Pediatr*. 2017; 5: 157.
- [4] Chi DL, Rossitch KC, Beeles EM. Developmental delays and dental caries in low-income preschoolers in the USA. *BMC Oral Health*. 2013; 13: 53.
- [5] Stein LI, Polido JC, Mailloux Z, Coleman GG, Cermak SA. Oral care and sensory sensitivities in children with autism spectrum disorders. *Spec Care Dentist*. 2011;31(3):102–110.
- [6] Hernandez P, Ikkanda Z. Applied behavior analysis: behavior management of children with autism spectrum disorders in dental environments. *J Am Dent Assoc*. 2011;142(3):281–287.
- [7] Evans EW, Must A, Anderson SE, et al. Dietary patterns and body mass index in children with autism and typically developing children. *Res Autism Spectr Disord*. 2012;6(1):399–405.
- [8] Fakroon S, Arheiam A, Omar S. Oral hygiene and caries experience in children with down syndrome and autism spectrum disorder: a systematic review and meta-analysis. *Front Oral Health*. 2025; 6: 1522548.
- [9] Zemene MA, Dessie AM, Anley DT, et al. Dental

caries and mean values of DMFT among children with cerebral palsy: a systematic review and meta-analysis. *BMC Oral Health*. 2024;24(1):241.

- [10] Reid N, Johnstone M. Oral health in children with cerebral palsy. In: Panteliadis CP, ed. *Cerebral Palsy: A Multidisciplinary Approach*. IntechOpen; 2018.
- [11] Santos MTBR, Guare RO, Celiberti P, Siqueira WL. Caries experience in individuals with cerebral palsy in relation to oromotor dysfunction and dietary consistency. *Spec Care Dentist*. 2009;29(5):198–203.
- [12] Carvalho RB, Mendes RF, Prado RR Jr, Moita Neto JM. Oral health and oral motor function in children with cerebral palsy. *Spec Care Dentist*. 2011;31(2):58–62.
- [13] Rathore A, Bhatt S, Saxena V. Challenges and solutions in managing dental problems in children with autism. *Front Oral Health*. 2025; PMC12305087.
- [14] Akhter R, Hassan NMM, Martin EF, et al. Caries experience and oral health-related quality of life of children and adolescents with cerebral palsy in a low-resource setting. *BMC Oral Health*. 2019;19(1):15.