

Prevalence and Pattern of Dental Anomalies Among Schoolchildren in Aden, Yemen

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Abstract

Background: Dental anomalies (DAs) are clinically relevant developmental anomalies that impact oral health and overall quality of life.

Objectives: Our study aimed to determine the prevalence of dental anomalies among schoolchildren in Aden, Yemen.

Methods: A cross-sectional study was performed involving 1,026 schoolchildren aged 8–13 years in Aden, Yemen. The DAs were evaluated by clinical examinations and the nutritional status was checked using BMI z-scores. The data was entered and then analyzed using SPSS.

Results: Out of 1,026 schoolchildren, the overall prevalence of DA was showed in 304 (29.6%). The DA was significantly higher among children in age group less than 10 years, males and those children who had low BMI (34.1%, 40.9% and 69.4%), respectively and ($P = 0.0001$), each. tongue tie was the most frequent anomaly that found in 11.6% of children and it was significantly higher in males (68.1%, $P = 0.001$). the significant highest rates for impacted teeth, Supernumerary teeth and Tongue Tie were noticed in children aged below 10 years, (90.9%, 72.7%, 52.1; $p=0.0001, 0.01, 0.005$), respectively. all cases had supernumerary teeth had low BMI ($P = 0.034$). the two anomalies talon cusp and tongue tie also were correlated with low BMI ($P = 0.024$ and 0.007), respectively.

Conclusion: The prevalence of dental anomalies in Aden, Yemen was relatively high comparing to most global studies. The DA was associated with children aged less than 10 years old, males and the low BMI. The tongue tie is the most frequent anomaly among the children and it significantly associated with the males and children aged below 10 years.

Introduction

Dental anomalies (DAs) are clinical deviations from normal odontogenesis and include differences in number, size, shape, position and structure of the teeth (1). These conditions are not only aesthetic concerns; they are often associated with malocclusion (2), increased caries susceptibility (3), periodontal disease(4), and significant impacts on oral health-related quality of life (OHRQoL) in pediatric populations (5). The prevalence of DAs varies markedly between different ethnic groups across the world, from 10% to over 30% which is the consequence of a complex interaction between genetic predisposition and environmental triggers (6).

Recent meta-analyses have shown a wide variation in the overall prevalence in the Middle East of between 2.6% and 45.1% with different patterns seen in some subpopulations (7). But Yemen is a different epidemiological story. Because of the specific genetic lineage of the region and the severe and long-lasting environmental stressors with a malnutrition prevalence > 45%, the clinical reality of the Yemeni situation may not be well reflected by the standard international dental benchmarks (8, 9).

There is limited evidence in the literature for the association of dental developmental stability with these systemic stressors, in particular Body Mass Index (BMI) as a proxy for nutritional status (10). Research has suggested that environmental insults may lead to enamel defects and eruption delays (11). However, the theory of 'genetic canalization' suggests that dental development may be highly mixed from nutritional stress from external sources (12). Furthermore, the capacity to prioritize clinical cases is crucial in healthcare systems with limited resources or those affected by conflict, such as Yemen's. To optimize specialist referral pathways, there are currently no validated, data-driven models that can stratify dental anomalies by clinical urgency. By offering a comprehensive analytical map of dental anomalies among schoolchildren in Aden, the current study aimed to determine the prevalence of dental anomalies and to identify the contributions of age, sex, and BMI to the occurrence of these anomalies.

Subjects and Methods

Yemeni primary school students in the Aden Governorate participated in this cross-sectional epidemiological study. To capture the varied socioeconomic landscape of the post-conflict urban environment, data were collected between January and May 2025 at different representative schools. Children aged 8–13 years who were enrolled in participating schools and had signed consent forms from their parents were eligible for inclusion. Children with a history of extensive orthodontic treatment, those with systemic syndromes (such as Down syndrome or ectodermal dysplasia), or those who were uncooperative during the clinical examination were excluded.

Sample size

Based on a previous study and using Stephen Thompson's formula, the minimum required sample size was 528, calculated using a 95% confidence level, a 5% margin of error, and an estimated DA prevalence of 20.1% from previous regional studies (13). The final sample was increased to 1,026 schoolchildren after adjusting for a non-response rate (20%) and a design effect associated with multistage cluster sampling to account for district-level variation and to boost the power of multivariate analysis.

Clinical Examination and Diagnostic Criteria

Two trained pediatric dentists performed the examinations, using portable light sources and disposable mirrors and periodontal probes. No radiographs were taken in the field due to logistical limitations, so hypodontia and impactions were identified by tooth absence beyond the normal eruption window (± 2 years). Anomalies were grouped as: (1) high-priority anomalies with possible functional impact with a need for referral to a specialist (e.g. tongue-tie affecting speech/feeding and impacted permanent teeth); and (2) low-priority anomalies including morphological variations requiring monitoring only (e.g. peg laterals, minor talon cusps).

Anthropometric measurements were carried out for all participants. Height was measured to the nearest 0.1cm and weight to the nearest 0.1kg. Children were classified according to age- and sex-specific z-scores based on WHO growth references, and Body Mass Index (BMI) was calculated (kg/m²) (14).

Statistical Analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS®) software (Version 26). Children's ages were normally distributed; therefore, mean and standard deviation (SD) values were determined. Qualitative data were presented as frequencies and percentages. Significant associations between different variables were determined by calculating p-values using the chi-square (χ^2) test, where a p-value ≤ 0.05 indicated statistical significance. Multivariable logistic regression was used to assess the impact of independent variables and to control for confounders.

Results

A total of 1,026 schoolchildren who met the inclusion criteria were included in the study, consisting of equal numbers of male and female children (513 each, 50%). The mean $\pm$ SD age was 10.54 $\pm$ 1.44 years, with most participants (399, 38.9%) falling below the age of 10 years. The majority (755, 73.6%) had low BMI (Table 1).

Table 1
General characteristics of schoolchildren in
Aden, Yemen (n = 1026)

Category	Frequency	Percentage (%)
Age group years		
< 10	399	38.9
10–11	323	31.5
> 11	304	29.6
Mean ± SD	10.54 ± 1.44	
Sex		
Male	513	50.0
Female	513	50.0
BMI		
Normal	213	20.8
Low	755	73.6
High	58	5.7

The overall prevalence of dental anomalies among children was 304 (29.6%) (Fig. 1). The highest rates were 136 (34.1%) in age group less than 10 years, 210 (40.9%) among male children, and 211 (69.4%) among those children who had low BMI. All these results were highly statistically significant ($P = 0.0001$), each (Table 2).

Table 2
Prevalence of dental anomalies among
schoolchildren by their demographic characteristics
(n = 1026)

Category	Dental Anomalies		P value
	No	%	
Age group years			
< 10 (n = 399)	136	34.1	0.0001
10–11(n = 323)	104	32.2	
> 11(n = 304)	64	21.1	
Sex			
Male (n = 513)	210	40.9	0.0001
Female (n = 513)	94	18.3	
BMI			
Normal (n = 213)	85	28.0	0.0001
Low (n = 755)	211	69.4	
High (n = 58)	8	2.6	

$P < 0.05$ is considered significant.

The most frequent anomaly among schoolchildren was tongue tie, found in 119 (11.6%) children, followed by macrodontia in 51 (5.0%) children (Fig. 2). Tongue tie occurred significantly more often in males (68.1%, $P = 0.001$) (Table 3).

Table 3
The prevalence specific dental anomalies among schoolchildren by
their sex in Aden, Yemen (n = 1026)

Dental Anomaly	Male		Female		P value
	No	%	No	%	
Hypodontia (n = 11)	3		8	72.7	0.112
Impacted Teeth (n = 33)	12	36.4	21	63.6	0.078
Macrodonia (n = 51)	21	41.2	30	58.8	0.125
Peg-shaped Laterals (n = 39)	19	48.7	20	51.3	0.500
Supernumerary (n = 11)	5	45.5	6	54.5	0.500
Talon Cusp (n = 40)	16	40.0	24	60.0	0.129
Tongue Tie (n = 119)	81	68.1	38	31.9	0.001

P < 0.05 is considered significant.

According to age, the results indicated a significantly higher prevalence of impacted teeth, supernumerary teeth, and tongue tie in the youngest age group (children aged below 10 years): 90.9%, 72.7%, and 52.1%, respectively (p = 0.0001, 0.01, and 0.005, respectively). Conversely, hypodontia, macrodonia, and talon cusp were significantly associated with children in the age group 10–11 years: 90.9%, 62.7%, and 57.5%, respectively (p = 0.0001, 0.0001, and 0.001, respectively) (Table 4).

Table 4
The prevalence specific dental anomalies among schoolchildren by their age group in Aden, Yemen (n = 1026)

Dental Anomaly	Age group years						P value
	Less than 10		10–11		More than 11		
No	%	No	%	No	%		
Hypodontia (n = 11)	0	0.0	10	90.9	1	9.1	0.0001
Impacted Teeth (n = 33)	30	90.9	2	6.1	1	3.0	0.0001
Macrodonia (n = 51)	14	27.5	32	62.7	5	9.8	0.0001
Peg-shaped Laterals (n = 39)	20	51.3	10	25.6	9	23.1	0.269
Supernumerary (n = 11)	8	72.7	3	27.3	0	0.0	0.01
Talon Cusp (n = 40)	12	30.0	23	57.5	5	12.5	0.001
Tongue Tie (n = 119)	62	52.1	26	21.8	31	26.1	0.005

P < 0.05 is considered significant.

Regarding the BMI of children, our data noticed that all eleven children (100%) who has Supernumerary teeth had low BMI (P = 0.034). the talon cusp and tongue tie were correlated with low BMI (P = 0.024 and 0.007), respectively (Table 5).

Table 5
The prevalence specific dental anomalies among schoolchildren by their BMI in Aden, Yemen (n = 1026)

Dental Anomaly	BMI						P value
	Normal		Low		High		
No	%	No	%	No	%		
Hypodontia (n = 11)	2	18.2	9	81.8	0	0.0	0.500
Impacted Teeth (n = 33)	3	9.1	29	87.9	1	3.0	0.122
Macrodonia (n = 51)	10	19.6	39	76.5	2	3.9	0.827
Peg-shaped Laterals (n = 39)	10	25.6	26	66.7	3	7.7	0.614
Supernumerary (n = 11)	0	0.0	11	100.0	0	0.0	0.034
Talon Cusp (n = 40)	3	7.5	32	80.0	5	12.5	0.024
Tongue Tie (n = 119)	17	14.3	100	84.0	2	1.7	0.007

Multivariate regression analysis showed that children aged above 11 years had 60% decreased odds of experiencing dental anomalies compared to younger children (AOR = 0.404; p = 0.0001; 95% CI: 0.300–0.645). Female sex was a significant protective factor against dental anomalies (AOR = 0.319; p = 0.0001; 95% CI: 0.238–0.427). Low BMI was strongly associated with the development of DA, with more than four times the risk (AOR = 4.13; p = 0.001; 95% CI: 1.8–9.5) (Table 6).

Table 6
Multivariate analysis of factors associated with presence of dental anomalies among children (n = 1026),

Anomaly	AOR	SE	P value	95% CL
Age group years				
< 10	1.00	-	-	-
10–11	0.795	0.174	0.188	0.565 – 0.112
> 11	0.404	0.195	0.0001	0.300-0.645
Sex				
Male	1.00	-	-	-
Female	0.319	0.149	0.0001	0.238–0.427
BMI				
Normal	1.00	-	-	-
Low	4.13	0.425	0.001	1.8–9.5
High	1.73	0.411	0.182	0.77–3.9

AOR; Adjusted Odds Ratio, SE; Standard Error, 95% CI; 95% Confidence Interval

Discussion

This is the first epidemiological study on dental anomalies among schoolchildren from Aden, Yemen, reporting an occurrence of 29.6%, which is among the highest recorded in the literature. This rate is significantly higher than that found in other population groups, such as 26.6% in a Nigerian schoolchildren (15), 25.8% in an Indian school children (16), 25.4% among Saudi children (17), 39.9% in a Brazilian schoolchildren (18), 20.1% in a Kuwaiti children (19), 16.7% in a Slovenian population (20), and 5.2% in an Australian children (21). A study conducted among Nigerian schoolchildren revealed one of the lowest rates at 4.2% (22). This introduced burden defines the “Yemen Paradox”—where high nutritional stress is associated with some, but not all, dental anomalies—a special epidemiological phenomenon demanding further investigation.

For the current study, the highest significantly high prevalence was recorded for the children under the age of 10 years ($p = 0.0001$). There were conflicting results in studies conducted in Kuwait (19). For this particular study, there was a significant strong inverse association between the age of the children and dental anomalies. The 10-11-year-old children showed a non-significantly high risk of developing dental anomalies compared to children below 10 years (AOR = 0.795; $p = 0.188$). The 11-years-and-above category showed a 60% decrease in the odds of having anomalies compared to their counterparts (AOR = 0.404; $p = 0.0001$; 95% CI = 0.300–0.645). Children under the age of 10, who participated in our study,

grew up amidst the most challenging periods of the war in Yemen, characterized by widespread maternal malnutrition and stress. On the other hand, children aged over 11 were already past the most important period of tooth formation when the conflict escalated into its most difficult stages, which is why the frequency of anomalies among them was relatively low.

In terms of sexual distribution, the prevalence rate of DA that was statistically significant was 40.9% in males. Multivariate analysis indicated that being female was significantly associated with protection against dental abnormalities (AOR = 0.319; $p = 0.0001$; 95% CI: 0.238–0.427). In contradiction to previous studies conducted in Kuwait and Nigeria that found higher DA prevalence in females (19, 22), our results indicate that environmental factors have different effects on odontogenesis in females and males in Yemen. Males have been described as more biologically vulnerable during certain developmental periods according to the concept of “male fragility”(23) .

Our research revealed that low BMI subjects exhibited the highest DA prevalence rate (69.4%). Our multivariate analysis (see Table 6) indicated that low BMI was found to be a very significant independent predictor of having dental anomalies, with four times higher chances for having such abnormalities compared to those with normal body weight (AOR = 4.13; $p = 0.001$; 95% CI: 1.8–9.5). This is one of the first empirical studies to provide evidence for this finding.

Tongue tie was the most common DA (11.6%), while macrodontia was the second most common (5.0%). According to research conducted by Olatosi et al., hypoplasia was the most common DA, followed by the retention of primary tooth (24). According to Alanzi et al., tooth number anomaly and taurodontism were the most common anomalies, respectively (19). A Saudi Arabian study found that the most common DA was hypodontia, followed by hyperdontia (25). The reason for this difference can be related to diagnostic criteria, genetic predisposition, and types and number of anomalies detected.

Concerning a relation between anomalies and sex, ankyloglossia (tongue tie) is the only DA that had a statistical difference between male and female children, with twice more males (68.1%) than females (31.9%, $p = 0.001$). This is highly consistent with findings from Saudi Arabia, where a systematic review demonstrated a male-to-female ratio of approximately 2:1 for ankyloglossia (25). The physiological explanation for increased risk among males may be associated with their greater vulnerability to prenatal and perinatal stress.

The anomaly-specific analysis (Table 4) indicated a significantly higher prevalence of impacted teeth, supernumerary teeth, and tongue tie among children aged below 10 years (90.9%, 72.7%, and 52.1%, respectively; $p = 0.0001$, 0.01, and 0.005, respectively), while hypodontia, macrodontia, and talon cusp were significantly associated with children in the age group 10–11 years (90.9%, 62.7%, and 57.5%, respectively; $p = 0.0001$, 0.0001, and 0.001, respectively). These results differ from those reported in Nigeria (24). These age-specific patterns indicate that the developmental timing of dental anomalies may be affected by population-specific genetic, nutritional, and environmental factors.

The data obtained in our study indicate strong correlations between underweight (low BMI) and certain dental anomalies (Table 5). The prevalence of supernumerary teeth was limited to low-BMI subjects only (100.0%, $n = 11$; $p = 0.034$). The prevalence of talon cusp was also high among low-BMI children (80.0%, $n = 32$; $p = 0.024$). The strongest correlation between low BMI and dental anomaly was identified for tongue tie (84.0%, $n = 100$; $p = 0.007$). Shrestha, et al. noted that dental developmental anomalies may be associated with nutrition during odontogenesis due to delays in tooth eruption in the low-BMI group (26). Talon cusp occurs in higher prevalence among children with low growth percentiles, and ankyloglossia causes feeding difficulties, which can lead to nutritional disorders and result in low BMI (27).

The normal prevalence of hypodontia (0.49%) in the presence of extensive malnutrition (73.6% low BMI) indicates that the development of tooth number is genetically determined and resistant to nutritional stress—termed the "Yemen Paradox" for the first time in this setting.

Strengths and Limitations

One of the major strengths of this study is its relatively large sample size ($n = 1,026$) and the equal division of the participants between males and females (50% each). The thorough examination of seven types of anomalies in connection with the variables such as age, sex, and BMI provides a multi-faceted approach to studying the epidemiology of dental anomalies among people in conflict zones.

However, there are certain drawbacks that should be highlighted. The absence of OPGs, for example, means that conditions such as hypodontia, extra teeth, and impacted teeth may not have been well reported because they are commonly identified using radiography. Second, although BMI was chosen as a nutritional marker, actual nutritional status is not fully assessed because BMI fails to account for micronutrient deficiencies (e.g., vitamins D and A, iron, zinc, folic acid, and calcium), which can be essential for tooth formation. Third, the cross-sectional study design cannot prove causative relationships; longitudinal studies are needed to establish temporal relationships. Furthermore, using samples from a single city limits generalizability, as other cities in Yemen may not be equally affected by conflict or nutritional deficiencies.

Conclusions

The prevalence of dental anomalies in Aden, Yemen, was relatively high compared to most global studies. The development of DAs is associated with age less than 10 years, male sex, and low BMI. The most frequent anomalies among schoolchildren were tongue tie and macrodontia. Tongue tie was significantly associated with male sex and children aged below 10 years. Furthermore, impacted teeth and supernumerary teeth were associated with children aged below 10 years, while hypodontia, macrodontia, and talon cusp were significantly associated with children in the age group 10–11 years. Low BMI was strongly correlated with supernumerary teeth, talon cusp, and tongue tie. High rates of tongue-tie and impacted teeth, especially among malnourished and younger patients, indicate severe

developmental problems due to nutritional stress caused by prolonged warfare. Future investigations with radiographic diagnosis and genetic evaluation are needed.

Declarations

Acknowledgments

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Ethics declarations

Ethics approval and consent form:

Ethical approval for this study was obtained from the Ethics Committee of the College of Medicine and Health Sciences at the University of Science and Technology (MEC No. MEC/AD0105). The study was based on the standards of the Helsinki Declaration. Written consent forms were obtained from parents before performing any procedures.

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Data availability and materials

All data was presented in the manuscript, no further data available and it will be available at any time.

Competing interests: The authors declare no conflict of interest.

Authors' contributions

O. A. R. formulated the initial draft, conceived the key idea, wrote the introduction and methodology, and analyzed the data; A. N. M. G. oversaw the work, revised the manuscript, and edited the manuscript finally; A. N. Y. carried out the literature review and revised the manuscript; N. O. J. gathered the data and assisted with statistics; G. A. A. gathered the data and undertook anthropometric measures; A. A. G. gathered the data and assisted with the clinical examination; and A. M. A., A. B. A., T. N. A., and F. R. A. conducted the clinical examinations.

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Figures

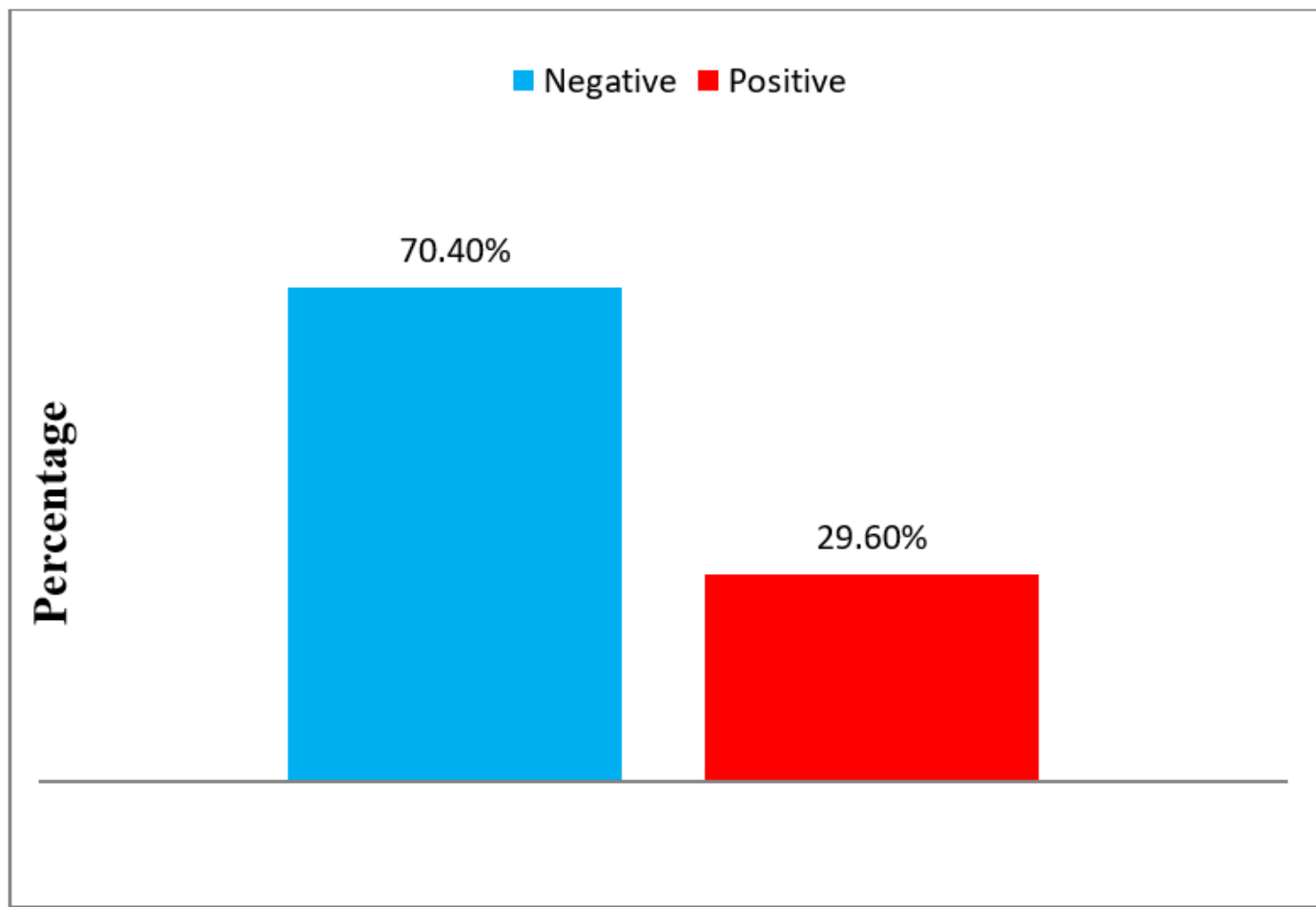


Figure 1

Prevalence of dental anomalies among schoolchildren in Aden, Yemen (n=1026)

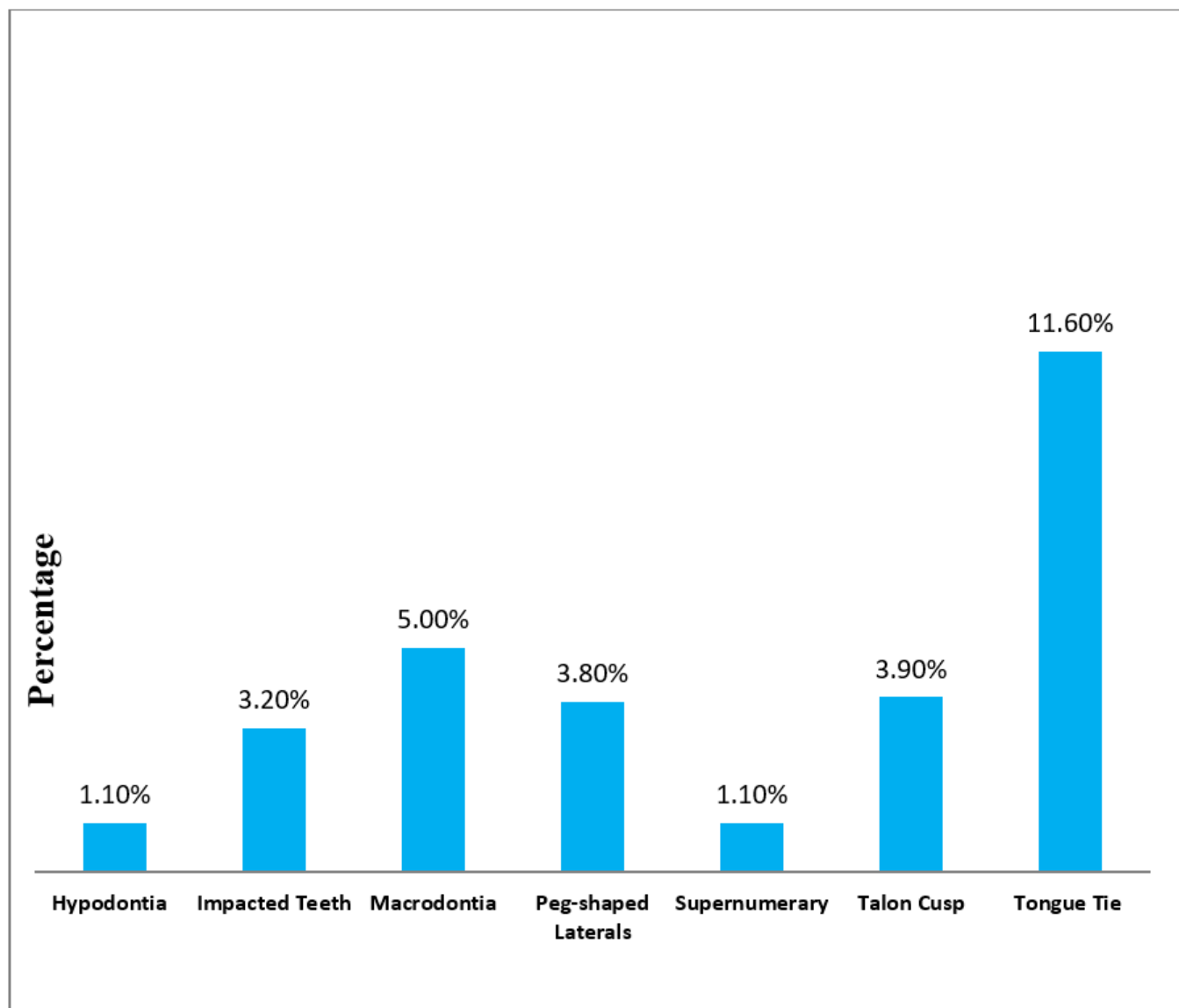


Figure 2

The prevalence of specific dental anomalies among schoolchildren in Aden, Yemen (n=1026)