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RELATIONSHIP BETWEEN THUMB SUCKING AND THE ANTERIOR OPEN BITE IN CHILDREN'S PRESCHOOL

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Abstract

Background: The non-nutritive habit of thumb sucking, which is common in youngsters, has drawn attention to orthodontics and pediatric dentistry because of its possible effects on dental occlusion and the formation of an anterior open bite in preschool-aged children. When the back teeth come into contact with the upper and lower front teeth, there is no vertical overlap, a condition known as an anterior open bite. Various nations, including Hilla City, Dhaka, Bangladesh, and Saveetha, have conducted numerous studies. The purpose of these studies is to evaluate thumb sucking on the anterior open bite in children's preschool.
Methods: This cross-sectional survey was carried out in Saudi Arabia from July to November 2024. The purpose of this study was to assess the prevalence of anterior open bite in children between the ages of three and five, as well as its association with harmful oral practices. Males and females in the Saudi population between the ages of three and five were the inclusion criteria, while men and females older than six were the exclusion criteria.
Results: The study involved 722 children, revealing a mean age of 4.9 years and a slight male predominance (54.6%). A significant 64.8% of participants exhibited thumb sucking habits, potentially affecting their dental and psychological health. Most children began thumb sucking between ages 1 to 3, with 41.5% sustained this habit for over six months, which correlated with dental misalignments, as nearly equal proportions of maxillary anterior proclination (49.1%) and mandibular anterior retroclination (51.7%) were observed. Notably, only 42.3% sought dental advice, indicating a gap in preventive care. Additionally, significant relationships were found between maxillary anterior tooth proclination and factors such as gender, age, parental age, and socioeconomic status, with p-values indicating strong statistical significance (all $p < 0.01$).
Conclusion: the study revealed the significant prevalence of thumb sucking, observed in 64.8% of the 722 preschool-aged children assessed, indicating a prominent behavioral trend that warrants attention from dental professionals. The findings revealed a clear correlation between prolonged thumb sucking and the development of anterior open bite, with a notable 49.1% of children showing maxillary anterior

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proclination and 51.7% demonstrating mandibular anterior retroclination, both of which are recognized dental misalignments. Given that 41.5% of participants sustained the thumb sucking habit for over six months, the risk of malocclusion is amplified, underscoring the importance of early intervention and parental awareness. Moreover, only 42.3% of the children sought dental advice, signalling a critical gap in preventive care that could mitigate long-term dental complications.
Keywords: thumb sucking, anterior open bite, children's preschool.

Introduction:

Thumb sucking, a prevalent non-nutritive behavior in children, has sparked interest in orthodontic and pediatric dentistry for its potential impact on dental occlusion and the development of an anterior open bite in preschool-aged children [1]. Non-Nutritive Sucking Behavior: A non-nutritive sucking behavior is any type of sucking that does not involve the consumption of food or liquid [2]. Thumb sucking is a common example of a non-nutritive sucking behavior in children [3]. Anterior open bite is a type of malocclusion in which the upper and lower front teeth do not overlap vertically when the back teeth come into contact [4]. An open bite is one of the most prevalent malocclusions and requires the most difficult orthodontic treatment [5]. One of the malocclusions with the greatest potential to affect the mixed dentition is the open bite [6]. Girls tend to thumb-suck more frequently than boys, and the habit typically starts early in life but is often outgrown by the age of 3 or 4 [7]. In 2023, a study conducted in Lisbon, Portugal, with 89 children as a sample showed that 83.9% of children had malocclusion, with crowding (44.8%) and disocclusion (41.4%) being the most common types. Using a pacifier was the most common non-nutritive sucking habit among the children (68.2%), accounting for 81.6% of all cases [8]. A study in Bagh College Dentistry in Hilla city, conducted in 2019, showed a highly significant difference ($p>0.01$) in the occurrence of anterior open bite and increased over jet between study and controls. in addition, thumb sucking habit increased the likelihood of development of anterior open bite and increased overjet and posterior cross bite by 39 folds, 40 folds and 3 folds respectively [9]. Based on a 2023 study conducted at the Dental College in Dhaka, Bangladesh, 41.9% of parents and 77.4% of children aged 5 to 6 reported that their child had a thumb-sucking habit. A start of age thumb sucking 77.4% of children aged 5–6 years) and approximately 41.9% of parents reported that their child had a thumb sucking habit were found to be statistically significant indicators of thumb sucking habit. The habit of sucking thumb was found to be statistically significant when it came to the start of the habit at a young age ($p= 0.001$), the length of the habit ($p= 0.001$), the clarity with which words were pronounced ($p= 0.001$), the proclination of the maxillary anterior teeth ($P= 0.002$), the asymmetry of the face ($P= 0.002$), and the seeking of dental advice or treatment ($p= 0.002$). Thumb sucking begins in the majority of children (21.8%) between the ages of 6-7. Merely 8.1% of the kids had trouble pronouncing words correctly, while only 5.6% had facial asymmetry, proclined maxillary anterior teeth, and sought dental guidance or care [10]. According to research done in 2023 at the Saveetha Institute of Medical and Technical Sciences (SIMATS), the majority of 13 to 17-year-olds have open bites in 106 (48.18%) of the study population. Open bite is observed in 108 (49.09%) female patients and 112 (50.91%) male patients, suggesting that open bite is equally common in both sexes. The majority of patients (33.7%) sucked their thumbs excessively [11]. One important behavioral trait in a newborn is thumb sucking. It manifests in two ways: nutritional and non-nutritive. The former provides sustenance, while the latter offers safety and comfort. Up until the age of four or five years, thumb sucking is said to be innocuous in youngsters and is a frequent practice. The oral habits that might lead to the emergence of malocclusion greatly impede the growth and development of the jaws. Between the ages of one and three and a half years, thumb sucking may stop. It is typically linked to the infant's need to satisfy the urge for contact. Malocclusion must be taken seriously, as evidenced by the

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rise in cross-bite and open bite, the increased risk of developing Class II malocclusion, and crowding. Strength The intensity, duration, and length of malocclusion vary. Thumb-sucking habit that children repeat. This research aims to establish the prevalence of thumb sucking habits and it's associated with anterior open bites or not.

Materials and Methods:

Study design:
This is a cross-sectional study conducted in the Kingdom of Saudi Arabia between July 2024 and December 2024. This research aimed to evaluate the presence of anterior open bite in children aged three to five years from public schools and its relation with deleterious oral habits.

Sample size:
The sample size was calculated to determine the minimum number of respondents required to ensure the survey results are representative of the entire population. The Raosoft sample size calculator was used for this purpose, with the following parameters:
n = sample size
z = z-score for the desired confidence level (1.96 for 95% confidence)
p = expected proportion (0.50)
e = margin of error (0.05)

Inclusion and Exclusion Criteria:
The inclusion criteria were the Saudi population, males and females, ages ranging from pre-school children aged between 3-5 years. The exclusion criteria are males and females older than 6 years old.

Method for data collection and instrument (*Data collection Technique and Tools)*:
A structured questionnaire was employed as a measurement tool to assess the prevalence of the relationship between thumb sucking and the anterior open bite in children's preschool [10]. Google Forms were utilized to create the questionnaire and collect data. To assess the appropriateness, relevance, clarity, and adequacy of the questions, the questionnaire was reviewed by orthodontists. To gauge the appropriateness, relevance, clarity, and adequacy of the Arabic version, it was evaluated by experts who were native Arabic speakers and volunteers from the general population. Necessary modifications to the Arabic questionnaire were implemented based on the feedback provided by the experts and volunteers. The final version of the questionnaire comprised 19 questions categorized into three main sections.

Pilot test:
The questionnaire was provided to twenty individuals, who were instructed to fill it out. This was done to evaluate the feasibility of the study and the questionnaire's usability. The final analysis of the study did not incorporate the findings from the pilot study.

Analyzes and entry method:
Data was entered into the computer system through the use of the "Microsoft Office Excel Software" program (2016) for Windows. After that, the data was moved to the Statistical Package of Social Science Software (SPSS) program, version 20 (IBM SPSS Statistics for Windows, Version 20.0; Armonk, NY: IBM Corp.), for statistical analysis.

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Results:

Table (1) displays various demographic parameters of the participants with a total number of (722). Notably, the mean age of children was 4.9 years, with a well-distributed representation across different age groups, indicating that a significant portion of participants (approximately 51% combined) were aged 3 or 4 years old. The gender distribution leans slightly male, with 54.6% being male and 45.4% female. The prevalence of thumb sucking habits is striking, with 64.8% of the children exhibiting this behavior, potentially impacting future dental and psychological assessments. Parental involvement also merits attention, as 62.4% of the relationship figures indicate mothers as primary caregivers. The educational background of parents shows a predominance of higher education attainment, with 62% holding bachelor's degrees. Additionally, marital stability is evident, with 85.5% of participants being married, while family income and childbearing patterns suggest a demographic largely managing economically favorable households.

Table (1): Sociodemographic characteristics of participants (n=722)

Parameter		***No.***	***Percent (%)***
Age of child (Mean: 4.9, STD:2.6)	3 years old or less	182	25.2
	4 years old	186	25.8
	5 years old	142	19.7
	6 years old	68	9.4
	7 years old or more	144	19.9
Gender	Female	328	45.4
	Male	394	54.6
Thumb sucking habit	No	254	35.2
	Yes	468	64.8
Relationship to the child (n=468)	Father	176	37.6
	Mother	292	62.4
Age of the parent (n=468)	30 years or less	182	38.9
	30 to 35	150	32.1
	more than 35	136	29.1
Occupational status (n=468)	Student	8	1.7
	Healthcare professional	104	22.2
	Employee	206	44.0
	Freelancer	24	5.1
	Unemployed	108	23.1
	Retired	18	3.8
Educational level (n=468)	Primary school	6	1.3
	Middle school	4	.9
	High school	100	21.4
	Diploma	46	9.8
	Bachelor’s degree	290	62.0
	Postgraduate degree	20	4.3
	Uneducated	2	.4
Marital status (n=468)	Married	400	85.5

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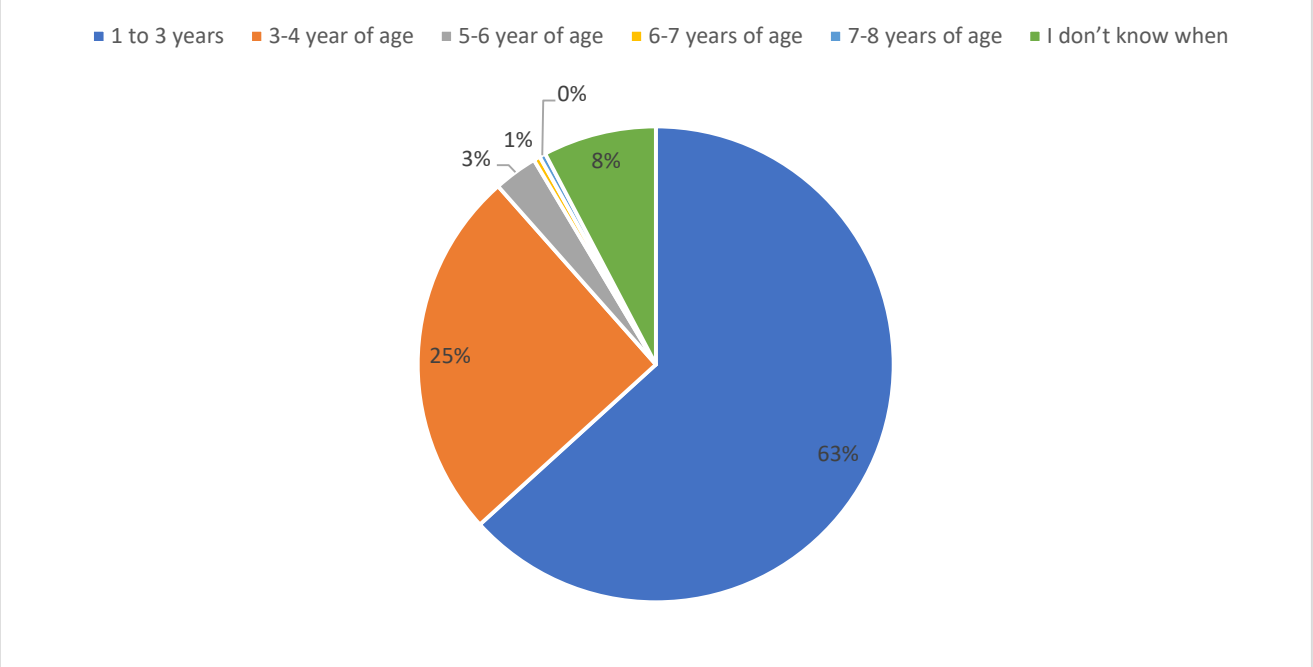
	Divorced	66	14.1
	Widowed	2	.4
Monthly family income (n=468)	Less than 5000	18	3.8
	5000 to 10000	226	48.3
	More than 10000	224	47.9
Number of children (n=468)	1-2	202	43.2
	3-4	198	42.3
	5-6	60	12.8
	More than 7	8	1.7

As shown in figure 1, The data presented regarding the onset of thumb sucking behavior highlights significant trends across various age groups. Notably, the majority of participants, representing approximately 72.8% (296 out of 408), indicate that thumb sucking begins between the ages of 1 to 3 years. This early onset is followed by a substantial decline, with only 28.9% (118) reporting initiation between ages 3 to 4. The numbers diminish dramatically for older age groups, with merely 3.4% (14) starting between 5 to 6 years, and an even smaller representation of 0.5% (2 each) for those aged 6 to 8 years. Additionally, 8.8% (36) of the respondents were uncertain about the commencement of this behavior.

Figure (1): Illustrates the start of age of thumb sucking among participants.



As illustrated in table (2), The data presented delineates the parameters concerning the association between thumb sucking habits and the prevalence of open bite among a sample of 468 individuals. Notably, a significant proportion (63.2%) commenced thumb sucking between the ages of 1 to 3 years, highlighting an early onset that could predispose this group to dental and orthodontic complications. In terms of duration, it is concerning that 41.5% of participants engaged in thumb sucking for more than

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six months, a factor potentially linked to dental misalignments, as evidenced by the nearly even distribution of maxillary anterior proclination (49.1%) and mandibular anterior retroclination (51.7%). Strikingly, only 42.3% of individuals reported visiting a dentist for advice or treatment, underscoring a gap in preventive dental care.

Table (2): Parameters related to association between thumb sucking habit and open bite. (n=468).

Parameter		***No.***	***Percent (%)***
Start of age of thumb sucking:	1 to 3 years	296	63.2
	3-4 year of age	118	25.2
	5-6 year of age	14	3.0
	6-7 years of age	2	.4
	7-8 years of age	2	.4
	I don't know when	36	7.7
Duration of thumb sucking:	No duration	94	20.1
	Less than one month	114	24.4
	1-6 months	116	24.8
	6-12 months	64	13.7
	More than one year	80	17.1
Pronunciation of word clearly:	No	174	37.2
	Yes	294	62.8
Breathing through nose:	No	154	32.9
	Yes	244	52.1
	I don't know	70	15.0
Pattern of disfigurement of thumb:	No	378	80.8
	Yes	90	19.2
Development Fungal lesion develop:	No	400	85.5
	Yes	68	14.5
Proclination of maxillary anterior teeth:	No	238	50.9
	Yes	230	49.1
Retroclination of mandibular anterior teeth:	No	226	48.3
	Yes	242	51.7
Asymmetry of face:	No	396	84.6
	Yes	72	15.4
Complete closure of lip:	No	94	20.1
	Yes	374	79.9
Visit to dentist for advice or treatment:	No	270	57.7
	Yes	198	42.3

As shown in figure (2), The data presented on the duration of thumb sucking reveals several noteworthy trends. A significant majority, comprising 39.2%, demonstrates no recorded duration of thumb sucking, with 94 individuals falling into this category. Conversely, the less than one month segment encompasses 114 participants, accounting for approximately 45.5% of the total. Within the 1-6 months duration, there are 116 individuals, which corresponds to 46.1%, indicating that a considerable number of children engage in this behavior for a relatively limited period. However, those sucking their thumbs for 6-12

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months represent 25.2%, with 64 individuals, and 80 participants, or 31.4%, have continued this habit for over one year.

Figure (2): Illustrates duration of thumb sucking among participants.

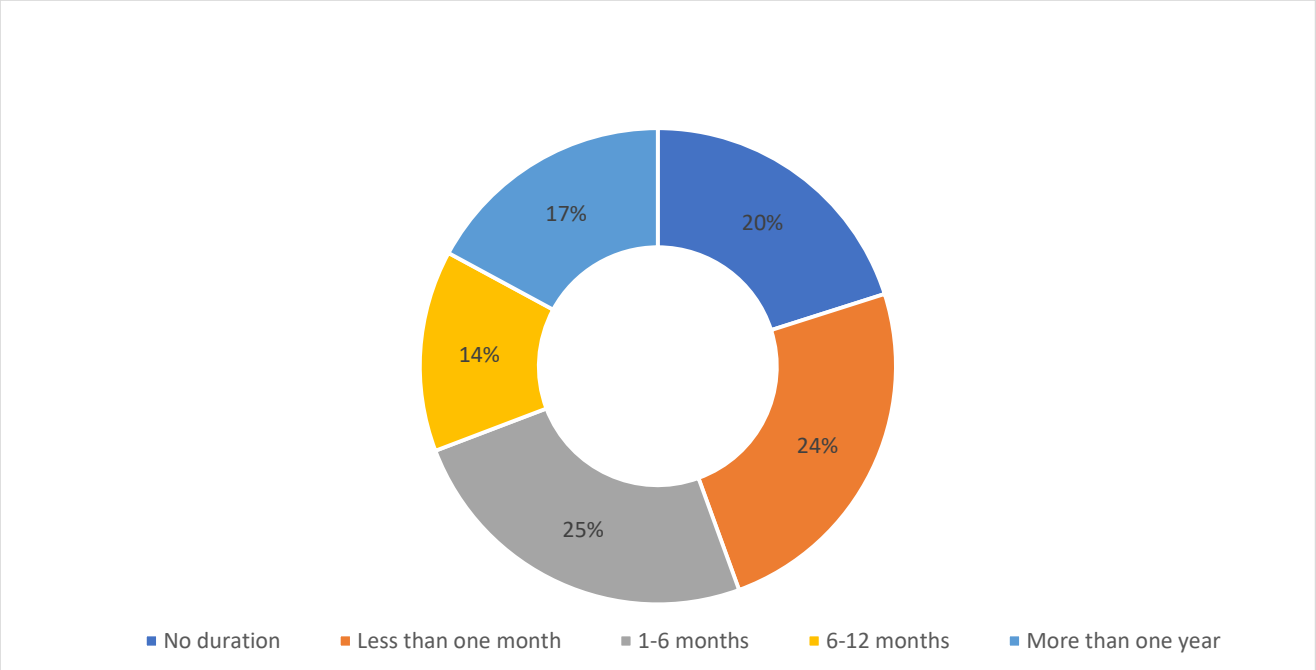

Table (3) shows that thumb sucking habit among children has statistically significant relation to gender (P value=0.001), and age (P value=0.0001).

Table (3): Relation between thumb sucking habit and sociodemographic characteristics.

Parameters		***Thumb sucking habit***		***Total (N=722)***	***P value ****
		No	Yes		
Gender	Female	136	192	328	0.001
		53.5%	41.0%	45.4%	
	Male	118	276	394	
		46.5%	59.0%	54.6%	
Age	3 years old or less	82	100	182	0.0001
		32.3%	21.4%	25.2%	
	4 years old	38	148	186	
		15.0%	31.6%	25.8%	
	5 years old	48	94	142	
		18.9%	20.1%	19.7%	
	6 years old	20	48	68	
		7.9%	10.3%	9.4%	
	7 years old or more	66	78	144	
		26.0%	16.7%	19.9%	

****P value was considered significant if ≤ 0.05.***

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Table (4) shows that proclination of maxillary anterior teeth has statistically significant relation to gender (P value=0.0001), age (P value=0.0001), age of parent (P value=0.002), occupational status (P value=0.0001), educational level (P value=0.0001), marital status (P value=0.0001), family monthly income (P value=0.001), and number of children (P value=0.006).

Table (4): Proclination of maxillary anterior teeth in association with sociodemographic characteristics.

Parameters		***Proclination of maxillary anterior teeth***		***Total (N=468)***	***P value****
		No	**Yes**		
Gender	Female	74	118	192	0.0001
		31.1%	51.3%	41.0%	
	Male	164	112	276	
		68.9%	48.7%	59.0%	
Age	3 years old or less	56	44	100	0.0001
		23.5%	19.1%	21.4%	
	4 years old	120	28	148	
		50.4%	12.2%	31.6%	
	5 years old	20	74	94	
		8.4%	32.2%	20.1%	
	6 years old	10	38	48	
		4.2%	16.5%	10.3%	
	7 years old or more	32	46	78	
		13.4%	20.0%	16.7%	
Age of parent	30 years or less	110	72	182	0.002
		46.2%	31.3%	38.9%	
	30 to 35	72	78	150	
		30.3%	33.9%	32.1%	
	more than 35	56	80	136	
		23.5%	34.8%	29.1%	
Occupational status	Student	4	4	8	0.0001
		1.7%	1.7%	1.7%	
	Healthcare professional	78	26	104	
		32.8%	11.3%	22.2%	
	Employee	92	114	206	
		38.7%	49.6%	44.0%	
	Freelancer	8	16	24	
		3.4%	7.0%	5.1%	
	Unemployed	52	56	108	
		21.8%	24.3%	23.1%	
	Retired	4	14	18	
		1.7%	6.1%	3.8%	
Educational level	Primary school	4	2	6	0.0001
		1.7%	0.9%	1.3%	

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	Middle school	4	0	4	
		1.7%	0.0%	0.9%	
	High school	36	64	100	
		15.1%	27.8%	21.4%	
	Diploma	18	28	46	
		7.6%	12.2%	9.8%	
	Bachelor's degree	168	122	290	
		70.6%	53.0%	62.0%	
	Postgraduate degree	8	12	20	
		3.4%	5.2%	4.3%	
	Uneducated	0	2	2	
		0.0%	0.9%	0.4%	
Marital status	Married	174	226	400	0.0001
		73.1%	98.3%	85.5%	
	Divorced	62	4	66	
		26.1%	1.7%	14.1%	
	Widowed	2	0	2	
		0.8%	0.0%	0.4%	
Family monthly income	Less than 5000	14	4	18	0.001
		5.9%	1.7%	3.8%	
	5000 to 10000	128	98	226	
		53.8%	42.6%	48.3%	
	More than 10000	96	128	224	
		40.3%	55.7%	47.9%	
Number of children	1-2	120	82	202	0.006
		50.4%	35.7%	43.2%	
	3-4	92	106	198	
		38.7%	46.1%	42.3%	
	5-6	24	36	60	
		10.1%	15.7%	12.8%	
	More than 7	2	6	8	
		0.8%	2.6%	1.7%	

P value was considered significant if ≤ 0.05.

Discussion:

Anterior open bite is characterized by an observable vertical space between the upper and lower incisors when the teeth are in centric occlusion [12]. According to Subtelny and Sakuda [13], anterior open bite refers to the abnormal vertical alignment between the maxillary and mandibular arches, resulting in a distinct absence of vertical contact between opposing tooth segments. McSherry also defined it as an occlusal anomaly in which there is no vertical overlap between the upper and lower incisors. Additionally, anterior open bite is recognized as a situation wherein the crowns of the upper incisors do not cover the incisal third of the lower incisors when the mandible is fully occluded. Digit sucking in childhood serves an adaptive purpose for children up to the age of four. Typically, about two-thirds of these habits are self-limiting by ages four to five with no lasting effects. Nonetheless, if sucking persists

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beyond five years of age, it can result in various malocclusions, including open bite, crossbite (both unilateral and bilateral), increased overjet, crowding, and an increased likelihood of developing Class II malocclusion. Prolonged thumb sucking disrupts the functional balance between the tongue and orofacial muscles [14], resulting in the narrowing of the maxillary arch, the development of posterior crossbite, and may also contribute to a simple anterior open bite. In three-year-old children who continue to suck their thumbs, anterior open bite is particularly prevalent [15]. Extended thumb and finger sucking frequently results in anterior open bite and disrupts the dentofacial development in the anteroposterior, vertical, and transverse dimensions, with the most significant effects on the positioning of the anterior teeth. Other habits, such as finger or digit sucking, have been associated with the development of anterior open bite [16]; however, finger sucking has been found to be more significant in contributing to the formation of anterior open bite. Thus, we aimed in this study to assess the effect of thumb sucking on the anterior open bite in children's preschool.

In contrast to our findings of a 64.8% prevalence of thumb sucking among 722 children, previous studies in Nigeria reflected a significantly lower prevalence of oral habits, reported at 13.14% among school children aged 11 to 16 years [17,18]. This suggests a regional variation in the prevalence of thumb sucking habits, which may be influenced by cultural or environmental factors. Notably, previous research has highlighted thumb sucking as a principal factor in the development of dental anomalies, such as anterior open bite, with rates observed at 2.1% and 4.1% [19,20]. Our data aligns with earlier studies [21,22,23] indicating that thumb and finger sucking are the most significant contributors to anterior open bite formation, emphasizing the detrimental impact of these habits on dental alignment. Furthermore, the systematic review by Doğramacı and Rossi-Fedele [24] complements our findings by noting that digital sucking results in more severe dental protrusion compared to pacifier use, particularly during mixed dentition, which is associated with anterior open bite and posterior crossbites. This reinforces our results wherein thumb sucking was linked to significant dental misalignments, characterized by similar proportions of maxillary anterior proclination (49.1%) and mandibular anterior retroclination (51.7%). The link between oral habits and anterior open bite aligns with findings from I N Ize-Iyamu et al. (2012) [25], which reported that thumb sucking was a primary etiological factor for anterior open bite, with a prevalence of 33%. This finding resonates with Larsson's report [26] of a 30% prevalence, further reinforcing the role of thumb sucking in introducing or exacerbating occlusal irregularities. Conversely, Onyeaso and Sote's [27] finding of a 10.7% prevalence suggests variability in prevalence rates, emphasizing possible regional differences or methodological disparities. Previous work by Ngan and Fields [28], Burford and Noar [29], and Isiekwe [30] further corroborate the association of asymmetric open bite with thumb sucking habits, thereby highlighting a critical area for preventive dental intervention in young populations.

Conclusion:

In conclusion, this study reveals a significant prevalence of thumb sucking habits among preschool children in Saudi Arabia, with important implications for dental health and development. With 64.8% of children exhibiting this behavior, particularly those starting between ages 1 and 3, there is a clear correlation between prolonged thumb sucking and the incidence of dental misalignments, including anterior open bite. The findings emphasize the need for early intervention and parental awareness to mitigate the potential long-term effects on oral health. As demonstrated, thumb sucking not only influences dental alignment but also highlights a critical area for pediatric dental care initiatives. Consequently, integrating preventive measures and educational programs for parents may help reduce the prevalence of thumb sucking and its associated dental complications in young children.

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Ethical approval

An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.

Funding

There was no external funding for this study.

Conflict of interests

The authors declare no conflict of interest.

Informed consent:

Written informed consent was acquired from each individual study participant.

Data and materials availability

All data associated with this study are present in the paper.

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