






Online ISSN (2789-3219)

Research Article

Prevalence of Dental Developmental Anomalies Among Iraqi Cohorts: A Hospital-Based Cross-Sectional Study

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Received: 1 July 2025; Revised: 5 August 2025; Accepted: 7 August 2025

Abstract

Background: Developmental anomalies affect oral hard and soft tissues, arising from genetic, prenatal, postnatal, environmental, and pathogenic influences. Environmental factors for dentists, updated on the epidemiology of developmental anomalies, would enhance the overall dental care provided by optimizing accurate diagnosis and personalizing the treatment. **Objective:** To investigate the prevalence and distribution of diverse developmental anomalies in a sample of the Iraqi population. **Methods:** A cross-sectional study was conducted by clinical examination of 745 systemically healthy Iraqi individuals (11-40 years) seeking dental treatment at teaching dental hospitals affiliated with Iraqi universities in Baghdad, Iraq. **Results:** Developmental abnormalities were found in 413(55%) of the cases, 67% of which were in males and 33% in females. Across all age groups examined, the most common developmental anomalies for both sexes were those related to the teeth. The most common dental anomaly, impaction, was found in 40% of males and 54% of females. The existence of a cusp of Carabelli (16% in males and 8% in females) was one of the other noteworthy anomalies. Anomalies relating to the bones were very rare; just 3% of males had torus mandibularis. Soft tissue anomalies were also uncommon; just 3% of females had Fordyce granules, and one male (0.4%) and one female (0.7%) had cleft lip and/or palate. **Conclusions:** The Iraqi population had a high prevalence of dental anomalies, among other developmental anomalies. These epidemiological findings emphasize the importance of early meticulous diagnosis of dental anomalies in patients pursuing dental treatment.

Keywords: Dental anomalies, Developmental anomalies, Iraq, Prevalence, Stomatognathic diseases.

انتشار تشوهات الأسنان النمائية بين الأفراد العراقيين: دراسة مقطعية في المستشفى

الخلاصة

الخلفية: تؤثر تشوهات النمو على الأنسجة الصلبة والرخوة للفم، والتي تنشأ عن التأثيرات الوراثية وقبل الولادة وما بعد الولادة والبيئية والمرضية. العوامل البيئية المحدثة لأطباء الأسنان حول وبائيات التشوهات التنموية من شأنها أن تعزز رعاية الأسنان الشاملة المقدمة من خلال تحسين التشخيص الدقيق وتخصيص العلاج. **الهدف:** التحقيق في انتشار وتوزيع شذوذ النمو المتنوع في عينة من السكان العراقيين. **الطرائق:** أجريت دراسة مقطعية عن طريق الفحص السريري لـ 745 من الأفراد العراقيين الأصحاء جهازيا (11-40 سنة) يسعون لعلاج الأسنان في مستشفيات الأسنان التعليمية التابعة للجامعات العراقية في بغداد، العراق. **النتائج:** تم العثور على تشوهات في النمو في 413 (55%) من الحالات، 67% منها في الذكور و 33% في الإناث. في جميع الفئات العمرية التي تم فحصها، كانت أكثر حالات تشوهات النمو شيوعا لكلا الجنسين هي تلك المتعلقة بالأسنان. تم العثور على شذوذ نمو الأسنان الأكثر شيوعا وهو انحشار في 40% من الذكور و 54% من الإناث. كان وجود نبت كارابيلي (16%) عند الذكور و 8% عند الإناث) أحد الحالات الشاذة الأخرى الجديرة بالملاحظة. كانت الحالات الشاذة المتعلقة بالعظام نادرة جدا. فقط 3% من الذكور لديهم torus mandibularis. كانت تشوهات الأنسجة الرخوة غير شائعة أيضا. 3% فقط من الإناث كان لديهن حبيبات فورديس، وذكر واحد (0.4%) وأنثى واحدة (0.7%) لديهن شفة مشقوقة و/أو حنك. **الاستنتاجات:** كان لدى السكان العراقيين معدل انتشار مرتفع لتشوهات الأسنان، من بين شذوذ نمو آخر. تؤكد هذه النتائج الوبائية على أهمية التشخيص الدقيق المبكر لتشوهات الأسنان لدى المرضى الذين يتابعون علاج الأسنان.

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INTRODUCTION

“Developmental anomalies” is a broad term used to describe stomatognathic diseases or conditions present at birth that involve deviation from normal structure and development of the mouth and associated tissue [1]. Developmental anomalies may stem from genetic factors and events occurring during

prenatal and postnatal development, in addition to environmental and pathogenic influences. Among all, environmental factors, including trauma, infections, radiation, pharmaceuticals, and hormonal influences, have been proposed as serious risk factors resulting in disruptions of oral development during embryonic development [2]. Diagnosing developmental anomalies requires a comprehensive assessment of the

patient, encompassing medical, dental, familial, and clinical histories. Clinical examination, radiographic assessment, and, in certain instances, specific laboratory testing is also required [1]. Developmental anomalies necessitate meticulous evaluation and treatment strategizing; when one anomaly is detected, medical professionals should consider the possibility of more anomalies being present [3]. Developmental anomalies may affect oral hard tissue, including teeth and jaws, and oral soft tissue, like the tongue, lips, and palate. Dental anomalies are a group of conditions characterized by the deviation of the form, function, or position of one or more teeth from the norm [4], presenting considerable aesthetic, functional, and dental treatment challenges. The presence of dental anomalies jeopardizes overall oral health by enhancing both the development of dental caries and periodontal tissue deterioration. Unfortunately, dental anomalies are usually being overlooked during routine dental examinations, which compromises the accuracy of dental diagnosis and treatment planning [5]. Bone anomalies are structural defects in the alveolar bone, such as torus palatinus and torus mandibularis. Conversely, soft tissue anomalies include irregularities in the oral mucosa, gingiva, or supporting periodontal structures [6]. Developmental defects together have a significant impact on oral health and function, often leading to delayed and difficult eruption, tooth attrition, poor aesthetics, crowding, malocclusions, and problems in speech, mastication, and breath. Developmental anomalies present issues in the dental management of patients across all disciplines, including periodontics, orthodontics, conservative dentistry, surgery, and prosthetics [7]. Numerous Iraqi studies have documented the prevalence of dental anomalies across diverse study populations; nevertheless, the findings were inconsistent [8-10]. The inconsistencies are ascribed to variation in participants' age group, sampling methodologies, and diagnostic standards. Early identification of developmental anomalies is essential, as it can minimize the need for complex dental interventions and reduce the risk of future complications. Delivering current, detailed data on the prevalence of these anomalies—along with their distribution by age and sex—can significantly enhance clinical decision-making and individualized patient care. To the best of our knowledge, up-to-date epidemiological Iraqi data regarding the prevalence of developmental anomalies are scarce. Hence, the aim of this cross-sectional study is to assess the prevalence of developmental anomalies encompassing dental, bony, and soft tissue anomalies among a sample of the Iraqi population aged 11 to 40 years, thereby providing both dentists and oral health researchers with updated foundational data for their practice.

METHODS

Study design and setting

This epidemiological study was authorized by the Ethical Committee of the Department of Dentistry,

Al-Rafidain University College (Certificate no. 29 on 23-6-2025). Study data was obtained through clinical examination of a total of 745 (381 females and 364 males) dental patients aged 11-40 years old who attended three dental teaching hospitals affiliated with Iraqi universities (Ibn Sina University, Al-Rafidain University College, and Al-Essra University). All participants provided informed consent prior to their enrollment.

Inclusion and exclusion criteria

The inclusion criteria for participants were Iraqi dental patients of both sexes aged between 11 and 40 years. Patients were excluded from the study if they had systemic disorders affecting dental development, prior orthodontic treatment or invasive dental procedures that could influence the study's outcome, incomplete medical records or insufficient data regarding their developmental anomalies, or if they declined to participate in the study.

Data collection and outcome measurement

In order to collect demographic information, a standardized, multi-sectional questionnaire was utilized. The clinical examiners documented developmental abnormalities data from the research participants after conducting a comprehensive clinical examination of the participants. All types of developmental anomalies were evaluated in this study. These included bone anomalies, such as bony exostosis or tori (torus palatinus and torus mandibularis); soft tissue anomalies, such as cleft lip, tongue tie, and Fordyce granules; and dental anomalies defined as variations in number, size, shape, structure, and eruption patterns within the teeth. During the clinical examination, each anomaly that was noticed was classified according to its particular type and position within the dental arch and documented.

Statistical analysis

GraphPad Prism software (version 9.0, La Jolla, CA, United States) was used to process participants' responses. Descriptive statistics calculating the total number of participants with each developmental anomaly were provided alongside demographic information and the distribution of participants within each type of anomaly. Sex, age category, and types of anomalies (further subclassified as follows: tooth-related anomalies, bone-related anomalies, and soft tissue-related anomalies) were managed as categorical variables, and their values were expressed in frequencies and percentages. Sex-based Comparisons of the prevalence of developmental anomalies were analyzed using chi-square for dental anomalies, and Fisher's exact test for bone and soft tissue anomalies. Significance was set at a two-tailed *p*-value of <0.05.

RESULTS

The study sample consisted of 745 participants, comprising 364 males (49%) and 381 females (51%). The majority of participants were within the age group of 21–30 years ($n = 541$; 73%), followed by those aged 11–20 years ($n = 190$; 25%), while only 14 participants (2%) were between 31 and 40 years (Table 1).

Table 1: Descriptive characteristics of the study population.

Variable	n(%)
Sex	
Male	364(49)
Female	381(51)
Total	745(100)
Age group (year)	
10-20	190(25)
21-30	541(73)
31-40	14 (2)
Total	745(100)

A total of 413 (55%) developmental anomalies were identified, with 277 (67%) anomalies recorded in males and 136 (33%) in females. Tooth-related anomalies were the most prevalent developmental anomalies for both sexes and across all age groups analyzed. Detailed sex-related and age-related distributions of developmental anomalies were illustrated in Figures 1 and 2, respectively.

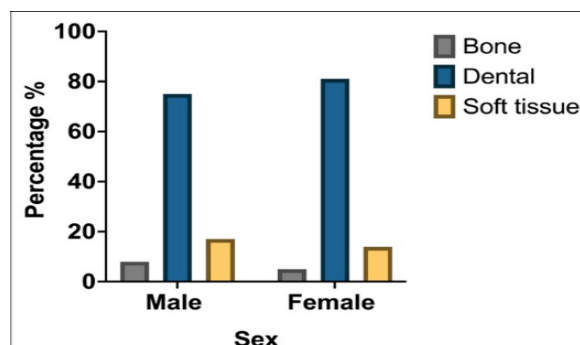


Figure 1: Developmental anomalies distribution according to sex.

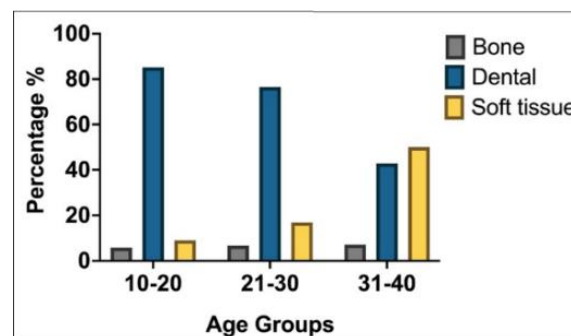


Figure 2: Developmental anomalies distribution according to age groups.

Table 2 showed that for both male & female participants, impaction was the most prevalent tooth-related anomaly, identified in 40% of males and 54% of females. Other notable anomalies included the presence of a cusp of Carabelli (16% in males, 8% in females), midline diastema (8% in males, 6% in females), talon cusp (6% in males, 4% in females), and hypodontia (6% in both sexes). Less frequent anomalies recorded were dens invaginatus, enamel hypoplasia, peg-shaped lateral incisors, and supernumerary teeth. Bone-related anomalies were less commonly identified when compared to tooth-related anomalies, as torus mandibularis and torus palatinus were observed exclusively in males (3% and 0.4%), respectively. In a similar trend to bone-related anomalies, soft tissue anomalies were also rare. Cleft lip and/or palate was identified in one male (0.4%) and one female (0.7%), and Fordyce granules were reported in 3% of females only. Intergroup comparison revealed no association between sex and presence of dental and bone related anomalies ($p > 0.05$ for both), while a p value of 0.003 revealed a significant association between sex and presence of soft tissue related anomalies. (Table 2).

Table 2: Intergroup comparison of developmental anomalies according to the sex

Class	Developmental Anomalies	Male	Female	<i>p</i> -value
Dental	Amelogenesis Imperfecta	1(0.4)	0(0.0)	0.413
	Dens invaginatus	12(4)	3(2)	
	Cusp of carabelli	44(16)	11(8)	
	Ectopic position of the tooth	7(3)	3(2)	
	Enamel hypoplasia	2(0.8)	3(2)	
	Fusion	1(0.4)	0(0.0)	
	Gementaion	1(0.4)	0(0.0)	
	Hypodontia	16(6)	8(6)	
	Impaction	110(40)	74(54)	
	Microdontia	3(1.0)	1(0.7)	
	Macrodontia	1(0.4)	1(0.7)	
	Midline diasthema	22(8)	8(6)	
	Peg shaped lateral	15(5)	6(4)	
	Supernumerary teeth	9(3.6)	3(2)	
	Talon cusp	17(6)	5(4)	
	Transposition of tooth	3(1.0)	2(1.0)	
Bone	Torus platinus	1(0.4)	0(0.0)	0.999
	Torus Mandibularis	9(3)	0(0.0)	
	Tongue Tie	2(0.8)	0(0.0)	
Soft Tissue	Cleft lip/Palate	1(0.4)	1(0.7)	0.003
	Fordyes granules	0(0.0)	5(3)	
Total		277(100)	136(100)	

Values were expressed as frequency and percentage. p -value significant at <0.05 according to chi-square test for dental anomalies and Fisher's exact test for bone and soft tissue anomalies.

DISCUSSION

This hospital-based cross-sectional study investigated the prevalence and types of developmental anomalies in an Iraqi population aged 11–30 years. The overall prevalence of developmental anomalies was high, with more than half of the study population presenting at least one anomaly. According to their anatomical location, tooth-related anomalies were the most common, followed by bone and soft tissue anomalies. Sex-wise, developmental abnormalities exhibited a greater occurrence in males compared to females; nevertheless, sex-related difference did not attain statistical significance for dental and bone related anomalies. This aligns with a relatable study conducted in Saudi Arabia indicating that sex does not significantly influence the overall occurrence of dental malformations [11]. In terms of age, participants aged 21–30 years accounted for the majority of observed anomalies (73%), suggesting that many anomalies are identified later due to delayed diagnosis, supporting the need for better screening during childhood and adolescence [4,12]. Among tooth-related anomalies, impaction was the most prevalent anomaly (47% of total anomalies), consistent with findings from a previous Iraqi study by Najm *et al.* [8] reporting impaction as the most frequent anomaly among dental students in Baghdad. In accordance, radiograph-based studies highlighted the high frequency of tooth impaction and its possible deleterious effects on adjacent structures [10,13]. The cusp of Carabelli was the second most frequent dental anomaly (16% males and 8% females), aligning with a systematic review that reported accessory cusps are one of the most common dental anomalies, with a higher prevalence in the first maxillary molar (59%), followed by 10% for the third molar and 8% for the second molar [14]. Midline diastema and talon cusp were also reported with moderate frequencies, similar to the results of Abd Al-Aaloosi *et al.* [9], who observed a notable occurrence of enamel and morphological anomalies in Badra. Contrary to the literature, some anomalies such as gemination, fusion, hypodontia, and transposition appeared less frequently in line with observations of several population-based studies [4,15]. Bone-related anomalies were documented in low frequencies, exclusively in males. This is in accordance with the literature that supports genetic predilection and possibly a sex-linked component [16]. In a related manner, soft tissue anomaly findings were rare in this study, with Fordyce granules noted in 3% of females and cleft lip/palate observed in only two individuals. The low prevalence of cleft anomalies is expected in our selected age group, since such defects may be underrepresented in adults due to early surgical interventions. Related cross-sectional studies reported a cleft lip and palate incidence of 2:1000 and 2.94:1000 births in the Erbil and Al-Ramadi governorates in Iraq, respectively [17,18].

Study limitations

The study was constrained by a number of factors, including the following: the targeted population consisted of hospital attendees, potentially restricting generalizability of the findings; the exclusion criteria may have led to an underestimation of actual prevalence; reliance solely on clinical diagnosis resulted in undetected anomalies requiring radiographic assessment; and the selection of a teenage-adult demographic could influence the prevalence of anomalies with specific age predilections.

Conclusions

Despite its limitations, this cross-sectional study documented that the Iraqi population had a high prevalence of dental anomalies, among other developmental anomalies. These epidemiological findings emphasize how crucial it is to carefully diagnose and investigate dental anomalies in patients pursuing dental treatment. Epidemiological data regarding the prevalence of developmental anomalies within certain populations, sexes, and age groups is of paramount importance to the dentist to enhance the overall diagnosis and personalize the treatment plan.

Conflict of interests

The authors declared no conflict of interest.

Funding source

The authors did not receive any source of funds.

Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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