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Original article

Prevalence of Intrinsic Stains in Libyan Adults and Clinical Measurement of Tooth Color and Stain

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Abstract
Intrinsic tooth stains (IS) are discolorations incorporated within enamel or dentin during or after tooth formation, with common causes including dental fluorosis, tetracycline use, and developmental enamel defects. Such discoloration can have significant aesthetic and psychosocial impacts. While the prevalence of IS has been investigated globally, data on Libyan adults remain scarce. Determine the prevalence of ISs in a random sample of consecutive patients attending the Oral Diagnosis Clinic, to describe the general characteristics and clinical presentation of ISs such as the extent of involvement, the type of stain, and the surfaces mostly involved, and to measure tooth colour and stain by visual shade matching method. A cross-sectional clinical study comprised Libyan adults attending the Faculty of Dentistry, University of Benghazi, and the target number was 200 patients. Participants were examined under standardized lighting using visual inspection and a 3D Master VITA shade guide for color assessment. Data were analyzed using descriptive statistics. All the obtained information was tabulated in a Microsoft Excel spreadsheet, and the validated data were exported to SPSS for statistical analysis. The obtained information was analyzed by descriptive analysis for the mean, median, mode, SD & range of the general information. The intra-examiner and inter-examiner reliability tests were done by the Cohen kappa test of a pilot study consisting of 50 cases. Intrinsic stains were detected in females, n=111 (55%), and males, n=89 (45%). The number of females was more than the number of males except for the age group over 70 years. The highest concentration of participants was observed in the 20–30 years age group comprising a total of 65 participants (32.5%). This was followed by the age group 41–50 years, which comprises 43 participants (21.5%). The most prevalent cause of intrinsic stains is necrotic pulp, accounting for 83 (41.5%) of cases, followed by demarcated enamel opacity 20 (10.0%), and generalized severe dental fluorosis19 (9.5%), while generalized moderate fluorosis was17 (8.5%). Other notable diagnoses included localized moderate fluorosis 17 (8.5%) and staining associated with restorative fillings15 (7.5%). Conditions such as diffuse enamel opacity13 (6.5%), generalized mild fluorosis5 (2.5%), and localized enamel hypoplasia 4 (2.0%) are less frequent. Rare diagnoses included amelogenesis imperfecta (hypoplastic type) and localized mild fluorosis (3, each 1.5%), while internal resorption was the least common, comprising 1(0.5%) of cases. Stains were more common in the Localized region, 158 (79.0%). Generalized fluorosis affected 40 patients (65.6%) of the patients while localized fluorosis was observed in 21 (34.4%). Moderate degree of fluorosis severity 34 patients (55.7%), whereas severe fluorosis was noticed in 19 patients (31.1%). Coexistence of external dental stains was observed in 131 (65.5%) of the patients with intrinsic stains. More than half of the patients, 105 (52.5%), had non-vital teeth, 44 fractured teeth (22.0%), 22 filled teeth (11.0%), and 7 mobile teeth (3.5%). The labial surface was the most commonly affected by fluorosis, accounting for 99 (29.7%) of stained surfaces. The majority of patients (52.0%) had staining confined to a single tooth or 2 to 6 teeth (25.5%). The most recorded shade of stained teeth was 5M1 (37.5%), followed by 5M3 (22.0%), and the most common stain color was white (35.5%), yellow (33.5%), and brown (30.0%). Statistically significant associations were found between stain type and both age and sex of the participant p-value (<0.05). Intrinsic tooth stains are prevalent among Libyan adults, with pulp necrosis and fluorosis as the most common causes. Findings highlight the role of environmental fluoride exposure, trauma, and systemic factors in their occurrence.
Keywords. Intrinsic Stains, Tooth Color, Clinical Study, Libyan Patients, Cross-Sectional Study.

Introduction

Most dental stains encountered in dental practice are extrinsic in nature, acquired over time in adulthood, mainly due to habits like smoking or the use of beverages or oral hygiene neglect. Such ES are predominantly caused by the buildup of substances like bacteria, foodstuffs, or metallic compounds on the tooth surface [1]. On the other hand, the intrinsic stains (IS) are mostly congenital or acquired early in life. These are usually incorporated into the tooth substance. The most common ISs are dental fluorosis, tetracycline (which has become rare nowadays), and enamel hypoplasia. Intrinsic discolorations are attributable to chromogenic materials incorporated into the structure of either enamel or dentine and can be present in one tooth or be generalized throughout the dentition [2]. Intrinsic tooth discoloration can be of significant aesthetic and, in some instances, functional concerns.

Dental fluorosis, tetracycline staining, localized and chronological hypoplasia, amelogenesis and dentinogenesis imperfecta (DGI), and alkaptonuria can all produce a cosmetically unsatisfactorily looking dentition. The aetiology of intrinsic discoloration of enamel may sometimes be deduced from the patient's history[3]. A comprehensive study of ISs was published in 2004 by Koleoso and co-associates, which addressed different aspects of this problem in 600 Nigerian

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children where the prevalence of intrinsic tooth discoloration was 36.0% (110) for the boys and 39.5% (116) for the girls. The commonest types of intrinsic tooth discoloration were enamel opacities (23.0%), tetracycline staining (9.2%), and enamel hypoplasia (7.3%). Other intrinsic tooth discolorations were those due to dental caries (4.3%), pulp necrosis/ hemorrhage (0.8%), tooth wear (0.3%), and discolored restorations (0.3%)[2]. Dental fluorosis (DF) is caused by overingestion of fluoride, resulting in disturbances in enamel mineralization. The result is intrinsic discolorations in the maxillary and mandibular teeth with a poor esthetic appearance (Slaska et al., 2015).

Optimal use of topical fluorides leads to a decrease in caries prevalence but may show an increase in the prevalence of fluorosis staining because of metabolic alterations in the ameloblasts, causing defective matrix formation and improper calcification [3]. The most popular method of assessing tooth color clinically is visual shade matching, as this approach is quick and simple to use. However, variation in results can occur due to the subjective nature of this method. The instrumental approaches, including quantitative light-induced fluorescence, remove or significantly reduce the subjective component. Image analysis appears to be the most suitable method for tooth color measurement. Therefore, digital image analysis systems have proved a reliable objective method for quantifying tooth color, including stain and whiteness. The advantages of this approach include: a decrease in subjectivity and improved reliability; a permanent database of images which can be analyzed and re-investigated at a later date; quick and simple training and operation; does not require a clinician; and no contact with the tooth surface but does assess the whole tooth surface[1].

This research on the prevalence of ISs in Libyan adults involves investigating the frequency and characteristics of intrinsic tooth stains within this specific demographic. The originality lies in exploring the unique factors contributing to tooth discoloration in Libyan adults, as well as developing clinical methods to accurately measure tooth color and stain severity in this population. The current study investigates the prevalence of ISs in Libyan adults and the clinical measurement of tooth color and stain by the use of standardized methods to measure tooth color and stain severity. This could involve visual examination, imaging techniques, and a visual shade guide. These findings are hoped to 3 provide valuable insights into the prevalence of ISs in this population and help in understanding the clinical characteristics of tooth discoloration among Libyan adults. Teeth are formed via the process of odontogenesis. Human dentition is diphyodont, meaning there are two generations of functional teeth during life: deciduous teeth and permanent teeth. Humans have 20 deciduous teeth that get replaced by 32 succedaneous, or permanent adult, teeth. Around the sixth to eighth weeks of embryonic development, the odontogenesis of deciduous teeth begins. In the twentieth week of embryonic development, the odontogenesis of permanent teeth begins. Every tooth develops from the ectoderm and the ectomesenchyme. The enamel arises from the ectoderm. The dentin, cementum, periodontal ligament, and pulp arise from the ectomesenchyme, which comprises the transformation of neural crest cells into developing maxillary and mandibular arches[4].

Tooth formation initiates via the localized thickening of dental epithelium invaginating into the underlying mesenchyme to form the dental lamina. This process forms ten placodes, or focal thickenings of oral epithelium, each on the mandibular and the maxillary arches. The placodes develop into tooth buds, which eventually develop into teeth. During deciduous teeth development, teeth form starting from the anterior part of the maxilla and mandible and continue posteriorly. Given human dentition is heterodont, meaning there are four different tooth classes, different teeth erupt at different times, but they follow the same pattern of odontogenesis. Lingual to the deciduous teeth are tooth buds of permanent teeth positioned in a horseshoe-shaped arch. Every tooth, with the exception of the second and third permanent molars, is present and have started development prior to birth. Most of the activity of the dental lamina occurs over five 6 years, but the activity of the dental lamina near the third molars continues until about 15 years of age [5].

Material and methods

Study Design

This descriptive cross-sectional observational study was designed to assess the prevalence, type, distribution, and severity of intrinsic tooth stains among Libyan adults. The study also aimed to record and evaluate tooth color using a standardized visual shade guide system. All examinations were conducted during a defined study period under standardized clinical conditions. The time frame is 6 months, and the target number is 200 patients with ISs. 4.1.2. Study population and location Participants were recruited from routine dental patients of the oral diagnosis department of Benghazi University and any appropriate dental center in the town that volunteered for this study. The sample included both male and female adults aged 15 years and above, representing various social and occupational backgrounds. Recruitment continued until the predetermined sample size was achieved to ensure adequate statistical power.

Study registration and ethical considerations

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The present study was registered at Higher studies office of the dental faculty and got ethical approval No: 079. All the ethical and safety protocols were followed when the study was conducted. All data kept confidential and to be get purge safely after the completion of the study.

Materials and Tools

Tools used in clinical examination: i. Dental diagnostic set including disposable dental mirror, dental probe, gauze piece, condescend chair light, gauze, cotton roll and tweezers. ii. iii. Magnifying lens. Digital camera. 4.1.8. Clinical data 1. The attached clinical form to be used for recording. 2. The Information to be recorded in a specially designed clinical form, and then tabulated in a Microsoft excel spreadsheet (appendix 1). 4.1.9. Statistical analysis All obtained information will be tabulated in a Microsoft excel spreadsheet and the validated data will be exported into an SPSS format for statistical analysis. The obtained information will be analyzed by descriptive analysis for the mean, median, mode, SD & range of the general information. Results were listed in percentage of patients affected by a particular condition, to the sum of the examined patients. The intra-examiner and inter examiner reliability test was done by Cohen kappa test of a pilot study consisting of 50 cases. However, results can be compared with same international peers.

Result

Sex of the participants

This study comprised a total of 200 participants, 89 (45%) males and 111 (55%) females. In all age groups the number of females surpass the number of males except for those over 70 years groups as shown in (Figure 1).

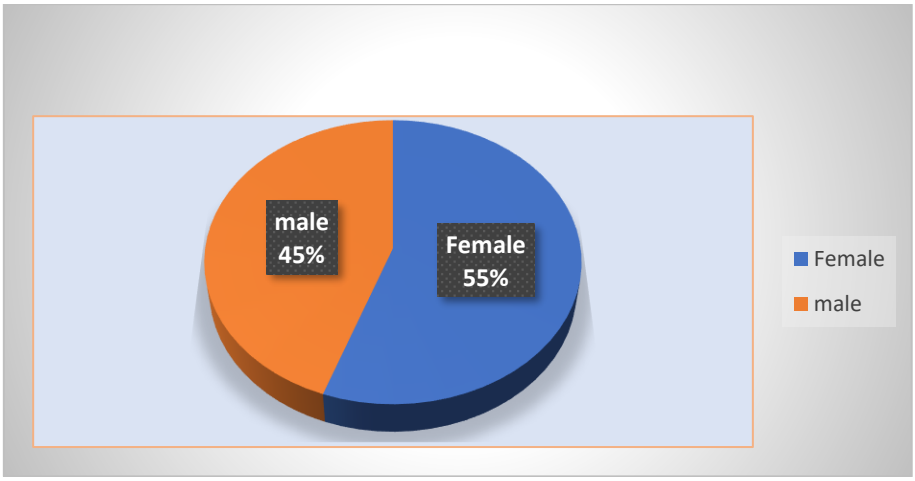

Figure 1. Sex of the study group

Age group

Dental stains were found in all age groups of adults over 17 years. The highest concentration of participants was observed in the 20–30 years age group, comprising a total of 65 participants (32.5%). This was followed by the age group 41–50 years, which comprises 43 participants (21.5%) and the patients aged between 18 ND 20 years, comprising 29 participants (14.5%). The least number of participants lies in the group70 years and above, which included only one male and no female participants, as shown in (Table 1).

Table 1: Age groups of the study sample

Age group (years)	Frequency	Percent
<20	29	14.5
20-30	65	32.5
31-40	36	18.0
41-50	43	21.5
51-60	18	9.0
61-70	8	4.0
>70	1	0.5
Total	200	100.0

Diagnosis of the intrinsic stains in the current sample

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The most prevalent cause of intrinsic stains is necrotic pulp, accounting for 41.5% of cases. This indicates significant burden of pulpal pathology associated with internal discoloration. The second most common condition was demarcated enamel opacity (10.0%), followed closely by generalized severe dental fluorosis (9.5%) and generalized moderate fluorosis (8.5%). Other notable diagnoses included localized moderate fluorosis (8.0%) and staining associated with restorative fillings (7.5%). Conditions such as diffuse enamel opacity (6.5%), generalized mild fluorosis (2.5%), and localized enamel hypoplasia (2.0%) are less frequent. Rare diagnoses included amelogenesis imperfecta (hypoplastic type) and localized mild fluorosis (each 1.5%), while internal resorption and localized moderate fluorosis were the least common, each comprising 0.5% of cases, as shown in (Table 2).

Table 2: Diagnosis of the intrinsic stains in the current sample

Diagnosis	Frequency	Percent
Necrotic pulp	83	41.5
Demarcated Enamel Opacity	20	10.0
Generalized severe dental fluorosis	19	9.5
Generalized Moderate dental fluorosis	17	8.5
Localized moderate dental fluorosis	17	8.5
Stain-related filling	15	7.5
Diffuse Enamel opacity	13	6.5
Generalized mild dental fluorosis	5	2.5
Localized enamel hypoplasia	4	2.0
Amelogenesis imperfecta hypoplastic type	3	1.5
Localized mild dental fluorosis	3	1.5
Internal resorption	1	0.5
Total	200	100.0

Extent of stain in the participants

The majority (158) patients (79.0%) had localized tooth staining, while only 42 (21.0%) exhibited generalized staining. In other words, in most cases, discoloration is confined to specific teeth or a region rather than affecting the whole dentition. This is explained in (Table 3).

Table 3:Extent of stain in the participants

Extent of stain	Frequency	Percent
Localized stain	158	79.0
Generalized stain	42	21.0
Total	200	100.0

Discussion

Dental stains remain a relentless problem when thinking about improving oral and dental health, as they adversely affect the individual's appearance, esthetics, and well-being. The presence and extent of dental stains negatively affect the quality of life of the patient, as these stains ruin the esthetics of the individual and decrease the feeling of well-being (Goulart, Condessa, Hilgert, Hugo, & Celeste, 2018). The main concerns with regard to dental staining as a global problem were how to identify their potential causes, understand their patterns, and plan for the best management options [6]. Dental stains can be extrinsic or intrinsic. Extrinsic stains are due to deposition of materials on the surfaces of dentition, mostly due to insufficient oral hygiene efforts to clear them, which can be managed through oral hygiene measures, whereas intrinsic stains usually result from incorporation of stains into tooth substance and may need different ways for management (Meeral & I, 2023). The study of the prevalence of intrinsic stains is significant for better understanding of the challenges facing oral healthcare providers (OHCP) in their non-stop efforts for setting up a holistic approach for identification and management of various oral health problems [7].

Intrinsic staining tends to be more noticeable in early adulthood, as per the findings of this study and many previous studies [8,9]. There is a natural change in the color of dentition which is due to age-related thinning of enamel and dentin changes; as people age, the enamel naturally wears down, becoming thinner and more translucent. This exposes the underlying dentin, which yellows over time due to physiological changes in its structure. Dentin deposition increases with age, leading to a darker, more opaque appearance. Other factors that possibly lead to intrinsic stains are tetracycline antibiotics (used in the past, leading to permanent gray/brown stains if taken during tooth development), fluorosis (excessive fluoride intake during childhood, causing white/brown mottling), and trauma-induced discoloration (e.g., from falls, accidents, or dental

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procedures causing pulp necrosis and darkening). Higher likelihood of dental trauma and pathology. Older individuals are more likely to have experienced tooth fractures, deep decay, or failed root canals, which can lead to pulp necrosis (dead tooth nerve). This causes gray or black intrinsic staining due to blood breakdown products infiltrating dentin. Restorative materials (e.g., metal amalgam fillings) can also stain teeth over decades, contributing to discoloration. In the present study, intrinsic stains were more common among females. This observation is in line with the findings of D. C. Umesi Koleoso and co-associates, who found an overall intrinsic tooth discoloration prevalence slightly higher in girls compared to boys [2]. This female predilection is perhaps due to hormonal differences between the two genders (e.g., females have higher estrogen levels), which may influence tooth development and mineralization, and in turn potentially increase susceptibility to discoloration. The other possibility is the genetic or developmental variations in enamel formation between the two sexes; as such, dietary and behavioral factors may have an influence, as girls may have higher exposure to staining substances (e.g., certain medications, iron supplements, or dietary habits). The differences in oral hygiene practices (though this could go either way) may also affect the prevalence of intrinsic staining. Finally, a diagnostic bias may play a role, as girls are more likely to seek dental care or have their teeth examined closely, so slight discolorations might have been detected more frequently.

Interestingly, a study carried out in 2018 by Aswin, Hegde et al. showed a higher prevalence of tooth discoloration in males in comparison with females. This might be caused by the fact that this particular study had relied on the introduction of smoke as a factor influencing the formation of tooth stains, and therefore the number of men smokers was more susceptible to tooth staining as compared to a smaller number of women smokers [10]. Intrinsic staining in the present study was particularly prevalent in both government employees and students. As the government employees formed the main bulk of participants, these results revealed a higher incidence of intrinsic staining in this sector of the population, which is particularly linked to dental caries and subsequent pulp necrosis. This raises doubts about their ability to afford to pay for the costs or even get access to the available dental health care services. It seems that delayed dental treatment is possibly related to lack of medical insurance or tight work schedules that incur delays or make them reluctant to seek dental treatment before serious consequences like pulp necrosis or further progress to more serious consequences. A similar situation in India was addressed previously by [11], who highlighted the role of occupational exposure in the development of extrinsic dental staining, especially in industrial settings where contact with acids, metals, or airborne particles is common.

Although the majority of participants in the current study do not face such circumstances, the general principle remains relevant: occupation can influence both direct exposures to staining agents and the likelihood of timely dental care. On the other hand, students (usually leading an active lifestyle) and substantial participation in various sports may increase the risk of dental trauma in this sector of the population, a known cause of pulpal damage and internal discoloration. This may raise concerns about compliance with safety instructions while they are practicing their sports. Previous literature indicated that only a small fraction of cases of intrinsic stains are actually linked to specific systemic diseases. Some systemic diseases have the ability to affect tooth structure and induce alterations in teeth during tooth formation. Certain blood disorders and metabolic conditions like erythroblastosis fetalis, thalassemia, and sickle-cell anemia can induce deposited pigments within the tooth structure before its eruption, resulting in permanent intrinsic stain color [12]. In the present study, all the measures were taken to obtain a thorough medical history and conduct a comprehensive clinical examination; nonetheless, no single case of intrinsic stains was found attributed to such systemic diseases. However, it is advisable that during dental examinations involving assessment of intrinsic staining, every effort should be made not to overlook the possibility of systemic causes of those stains.

Anti-diabetic medications, particularly metformin and insulin alongside antihypertensives, were the most common types of medication used by many patients with DM and HTN. A study by [13] reviewed various medications that can be linked to tooth discoloration and suggested precautionary measures that can be taken to avoid or minimize their effects on tooth structure. In the present study, although no cases were related to the use of medication, the importance of taking a detailed case history should not be overlooked; the patient should be asked about the type and duration of their medication. Dental fluorosis, by and large, was the third cause of intrinsic stains in this sample of Libyan patients, which is in line with the findings of previous studies [14]. However, only a few studies found that other causes may contribute to fluorosis as the main cause of intrinsic stains, as in the study of [9]. The relatively high prevalence of fluorosis in the present study may reflect environmental or systemic fluoride exposure in the population.

Dental pulp necrosis as the first cause of tooth discoloration commonly caused extension of dental decay to the pulp according to many previous studies. However, in the present study, pulp necrosis was mainly a consequence of trauma to dentition. This high percentage of necrotic pulp due to trauma is widely affecting the anterior teeth of young adults due to trauma during sports activityy. Nigerian study by (Koleoso et al., 2004) found that the commonest causes of intrinsic tooth discoloration there were enamel opacities and enamel hypoplasia, discolored restorations and high prevalence of tetracycline staining, and noticeably low prevalence of pulp necrosis, in contrast to the present study findings which show

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low prevalence of enamel hypoplasia, as compared with high percentage of pulp necrosis and fluorosis and no cases tetracycline stains. It is of note that most Libyan women avoid the use of tetracycline during their gestation and lactation times, which reflected the absence of cases of staining due to tetracycline. Other factors besides enamel hypoplasia and tetracycline stains reported by the study of Koleoso et al in Nigeria were the association with childhood malnutrition, preventable childhood diseases, and the irrational use of drugs (tetracyclines). In this regard, they stressed the need to intensify child immunization efforts in the community as well as health education and promotion activities geared toward proper nutrition and the rational use of drugs [2]. In a study carried out by [15] and another study by [16], the investigators demonstrated the importance of color in the identification of the type of intrinsic stain of the tooth. Their findings are consistent with those of the present study, as the white, yellow, and brown colors are most often associated with fluorosis and enamel hypomineralization, while pink color is usually an indication of internal resorption of the tooth, and grey color usually results in cases of necrotic pulp.

In the present study, clinical examination stains can usually be seen at almost all surfaces of the involved teeth; nonetheless, the labial surface was the most commonly involved surface, followed by the occlusal/incisal surface. proximal surfaces, though they are difficult to inspect, some stains can be seen over there. The palatal surface was rarely affected, and no stains were noticed at the lingual surface. These findings indicate that the occlusal and labial surfaces are more prone to reflect staining, potentially due to their easy visibility. The high incidence of generalized involvement of all surfaces corresponds with the involvement of large parts of tooth structure in the case of generalized causes like fluorosis or dental enamel developmental defects. It is of note that in the case of pulp necrosis, the intrinsic stains are visible through all the surfaces of the affected tooth. In the present study, the predominance of darker VITA shades 5M1 and 5M3 suggests a significant portion of the tooth has been involved, and the stained teeth had a moderate to severe degree of discoloration, which may have both aesthetic and clinical implications. These findings are consistent with the high prevalence of cases with necrotic pulp and fluorosis-related stains; both of them are known to alter the tooth color beyond the lighter shades. Intrinsic discoloration can be due to many reasons; however, the exact cause of discoloration can only be known through history and clinical examination.

Besides dental fluorosis and enamel opacities, and to a lesser extent tetracycline staining, enamel hypoplasia, and dental caries, pulp necrosis/hemorrhage, and tooth wear are the most commonly reported causes [2]. Fluorosis is a worldwide public health problem depending largely on the type of water consumed, such as groundwater. High fluoride concentration in groundwater may be due to contamination from local industries. Since fluoride and arsenic are the main pollutants of groundwater, some studies correlate groundwater consumption with a high prevalence of fluorosis [17]. As there is no single source of drinking water for all the participants in the present study, many of them are still drinking well water, which contains high fluoride. This is anticipated as the main cause of fluorosis in these cases; this matter is out of scope of this study and needs intricate investigation. The contamination of drinking water with fluoride poses a substantial threat to health and survival not only to humans but also to other creatures as well. [18] in their recent study, they emphasized the susceptibility of wildlife to the detrimental effects of prolonged fluoride exposure. The integrity of forest ecosystems-including national parks, wildlife sanctuaries, biosphere reserves, and protected forests-remains at significant risk due to potential disturbances in the population equilibrium between herbivores and carnivores. Such disruptions can have profound negative consequences for the stability of vulnerable forest ecosystems, according to them. In the present study, pulpal necrosis was a major cause of tooth discoloration and one of the complications that follow traumatic dental injury, and is usually evident by grayish-black discoloration of the crown of the tooth. The high percentage of tooth discoloration from pulpal necrosis in this study may be supported by the study by [9], where the prevalence of trauma to anterior teeth was higher in permanent teeth.

Trauma is usually from road traffic accidents, falls, home and other forms of accidents to the tooth. Also, with a high percentage of children leaving traumatized teeth untreated, as reported by studies done in Nigeria, it is not surprising to see pulpal necrosis as the utmost cause of intrinsic tooth discoloration. Pulpal necrosis with or without pain can also be a sequela of untreated traumatized teeth whose neurovascular supply has been destroyed. The figures in the present study, however, are contrary to those of [2], who found a lower prevalence of pulpal necrosis amongst other intrinsic discolorations. This low prevalence could be due to the fact that the study was on school children, translating to a younger age group in whom traumatized teeth may not have stayed long enough to result in discoloration. In the present study, the prevalence of demarcated enamel opacity was in a few patients and much fewer cases with diffuse enamel opacity and enamel hypoplasia. These findings are inconsistent with those in an Australian study by Seow and co-workers who reported a prevalence of DDE enamel opacities three times more prevalent than enamel hypoplasia [19]. In contrast with a longitudinal study of human development and health in a birth cohort comprising 1037 children born in Dunedin, New Zealand, the prevalence of enamel hypoplasia was high, particularly the mild type of enamel hypoplasia. This wide variation in the prevalence of enamel defects may be due to varied genetic susceptibility to enamel defects, or differences in dietary habits or nutritional deficiencies, particularly in calcium and vitamin D, or other factors such as study design, age of the

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participants, or diagnosis criteria, or differences in training and interpretation by dentists of the condition [20]. No cases of DI were recorded in this sample of Libyan patients. They might be underdiagnosed or unreported due either to diagnostic and reporting limitations or the lack of local epidemiological data.

No published studies specifically address DI prevalence in Libya's general or adult populations, as the existing Libyan dental research focuses on more common anomalies like hypodontia, supernumerary teeth, or molar incisor hypomineralization (MIH). For example, a study of 1,219 Libyans found dental anomalies in 4.67% of participants but did not report DI cases. In the present study, the prevalence of internal resorption was very low, in contrast to the study by [21]where the incidence of internal root resorption was slightly higher. According to the study by [22] the high proportion of incidental findings of internal resorption detected by CBCT suggests that resorption is not recognized/detected by conventional radiography and therefore remains underdiagnosed. The prevalence of tetracycline and minocycline staining in a Nigerian study by [2] was higher than that in the present study. Tetracycline staining occurs primarily when the antibiotic is administered during critical periods of tooth development (pregnancy, infancy, and childhood up to age 8). By the late 1970s–1980s, global guidelines restricted tetracycline use in these groups due to well-documented staining risks. Libya adopted these guidelines early and limited access to tetracycline at those ages, while in some regions of the world tetracycline remains available over the counter, leading to ongoing cases (e.g., rural Nigeria). Stricter pharmaceutical regulations in Libya can allow for the use of tetracyclines in some conditions like acne or respiratory infections, but good alternatives are available, so no case of tetracycline stained recorded in the present study.

This study is trying to unveil an important aspect of dental staining, particularly in adults of a Libyan sample, and measure the color of the stained tooth clinically in the hope of providing valuable insights into oral health trends, treatment needs, and preventive care strategies specific to this population. It is well known that the clinical measurement of tooth color and stains helps in assessing oral health status, guiding treatment decisions, and improving aesthetic outcomes. This research can contribute to tailored interventions, preventive strategies, and enhanced dental care for the population [23].

Conclusion

This study provides a comprehensive overview of the prevalence and distribution of intrinsic tooth stains among a sample of Libyan adult patients, highlighting their gender, age, occupation, systemic health, and environmental exposure as important determinants to be considered in such a study. The findings of this study clearly show that ISs are more frequent among females and young adults, with pulp necrosis and fluorosis being the most common causes. Environmental factors, notably high fluoride levels in well water, play a significant role in fluorosis prevalence and severity. Although some developmental and genetic dental anomalies such as AMI and dentinogenesis imperfecta exist in Libya, they remain rare or underreported, likely due to diagnostic, genetic testing, and healthcare limitations. The predominance of localized staining, especially on labial surfaces, coupled with darker VITA shades, underscores both the aesthetic and functional burden of tooth discoloration. This research emphasizes the need for early diagnosis, preventive interventions, and tailored treatment strategies to improve oral health and aesthetics in the Libyan population.

Conflict of interest. Nil

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