Sharwes Scientific Journal (SSJ)
Volume 6, Issue 2, 2025, pp 576-590, ISSN 3079-6040

Prevalence and Correlates of Dental Fear, Pain, and Caries in Libyan Children and Adolescents: A Cross-Sectional Study in Three Northeastern Cities

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Received: 06-08-2025 | Accepted: 13-11-2025 | Available online: 22-12-2025 | DOI:10.26629/ssj.2025.35

ABSTRACT

Dental fear and anxiety (DFA) remain significant barriers to timely and effective oral healthcare for children and adolescents, frequently leading to avoidance behaviours and increased risk of untreated dental conditions. While global evidence highlights the prevalence and consequences of DFA, populations in North Africa particularly in Libya are underrepresented in epidemiological data. This cross-sectional study examined the prevalence of DFA, dental pain, and caries, and their associations with sociodemographic, behavioural, and clinical variables among 1,800 children and adolescents aged 6 to 17 years attending public clinics in Al Bayda, Derna, and Tobruk. Data were collected through five structured tools: the Sociodemographic and Behavioural Profile Scale (SDBPS), Dental Pain and Discomfort Scale (DPDS), Children's Fear Survey Schedule–Dental Subscale (CFSS-DS), Self-Reported Caries History Scale (SRCHS), and Clinical Examination Record (CER). Analysis revealed that younger age and female gender were significantly associated with higher DFA scores ($p < 0.001$). Recent dental pain strongly predicted elevated anxiety levels ($\beta = 0.34$, $p < 0.001$), while irregular brushing and lack of prior dental visits correlated with both higher DFA and greater caries prevalence (OR = 2.32, $p < 0.001$). Lower maternal employment was also associated with increased risk of caries and DFA (OR = 1.87, $p = 0.004$). The findings suggest that emotional distress and clinical burden are jointly influenced by behavioural routines and structural disadvantage. These results highlight the need for integrated, age-appropriate, and socially responsive oral health strategies that simultaneously address psychological barriers and promote equitable access to preventive care for children in underserved Libyan regions.

Keywords: Dental Fear, Dental Caries, Oral Health, Libya.

انتشار الخوف والقلق والالم وتسوس الاسنان بين الاطفال والمراهقين في ثلاثة مدن بشرق ليبيا: دراسة مقطعية

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استقبلت: 06-08-2025م | قبلت: 13-11-2025م | متوفرة على الانترنت | 22-12-2025م | DOI:10.26629/ssj.2025.35

ملخص البحث

تُعدّ مخاوف وقلق الأسنان من أبرز العوائق التي تحول دون حصول الأطفال والمراهقين على رعاية فموية منتظمة وفعالة، حيث تؤدى هذه العوامل إلى سلوكيات تجنبية وزيادة خطر الإصابة بحالات تسوس غير مُعالجة. ورغم وفرة

الأدلة العالمية بشأن انتشار وتأثير هذه الظاهرة، فإن المجتمعات في شمال إفريقيا – وخصوصاً في ليبيا – لا تزال ممثلة تمثيلاً محدوداً في الدراسات الوبائية ذات الصلة. هدفت هذه الدراسة المقطعية إلى تقييم مدى انتشار الخوف والقلق المرتبطين بعلاج الأسنان، وكذلك الألم والتسوس، وتحليل ارتباطها بالمتغيرات السكانية والسلوكية والسريرية لدى 1800 طفل ومراهق تتراوح أعمارهم بين 6 و17 عاماً، كانوا يتلقون الرعاية في عيادات عامة في مدن البيضاء ودرنة وطبرق. وقد جُمعت البيانات باستخدام خمسة مقاييس معيارية تشمل المقياس السوسيوديموغرافي والسلوكي، ومقياس الألم والانزعاج الفموي، والمقياس الفرعي لقلق الأطفال من علاج الأسنان، ومقياس التاريخ الذاتي للتسوس، وسجل الفحص السريري. كشفت النتائج أن صغر السن والإناث كانا مرتبطين بدرجة أعلى من الخوف من علاج الأسنان ($p < 0.001$)، كما أن الألم الفموي الحديث تنبأ بزيادة ملحوظة في مستويات القلق ($\beta = 0.34$, $p < 0.001$). وُجد أيضًا أن قلة العناية اليومية ونُدرة زيارات طبيب الأسنان ارتبطت بمستويات أعلى من القلق وارتفاع معدل التسوس ($OR = 2.32$, $p < 0.001$). كما ارتبط انخفاض مستوى عمل الأم بزيادة خطر كل من التسوس والخوف ($OR = 1.87$, $p = 0.004$). تُظهر هذه النتائج التداخل بين الضغوط النفسية والعبء السريري بوصفهما نتاجًا للعوامل السلوكية والهيكلية، مما يعزز الحاجة إلى تطوير استراتيجيات صحية فموية متكاملة ومراعية للعمر والسياق الاجتماعي، تركز على معالجة الحواجز النفسية وتعزيز الوصول المنصف إلى الرعاية الوقائية للأطفال في المناطق الليبية المحرومة.

الكلمات المفتاحية: الخوف من المعالجة السنية، تسوس الاسنان، صحة الفم، ليبيا.

1. Introduction

Dental fear and anxiety (DFA) have consistently presented a barrier to timely and effective oral healthcare among children and adolescents. DFA has been widely reported to emerge early in life and persist across developmental stages, often exacerbated by negative dental experiences and limited exposure to preventive care [1]. Global evidence has indicated that DFA can have a detrimental impact on both treatment cooperation and oral health status, contributing to delayed visits and avoidance behaviours that often culminate in worsened oral conditions, particularly dental caries [2, 3]. A recent global review found the prevalence of DFA in children to range widely from 4% to 98%, with pooled estimates of around 23.9% and up to 30% in preschool children [4, 5]. These figures reflect the considerable variability in DFA estimates, which could be due to cultural factors, variations in assessment tools, and differing age groups studied.

Despite this widespread concern, North African populations remain significantly underrepresented in international DFA prevalence data. In Libya, studies on DFA among children are sparse. One of the few available surveys, conducted in Zawia City, reported a DFA prevalence of 31.71% among pupils aged 5 to 12 [6]. This figure is notably higher than the global pooled average and mirrors findings in similar socio-economic settings such as Brazil (39.4%) and Pakistan (66%) [1, 7]. Nevertheless, available Libyan data are limited in scope, geographically isolated, and often lack the integration of behavioural and clinical indicators like oral pain or caries prevalence. Moreover, these studies rarely extend to adolescent populations or adopt validated, standardised anxiety assessment tools.

In addition to DFA, dental caries remains a significant oral health burden. Bernabe et al. [8] estimated that over 530 million children globally had untreated caries. In Libya, recent surveys show alarmingly high levels of caries among children. A study in Tripoli found caries in 78.0% of first-grade pupils and 48.2% of seventh graders [9]. In Benghazi, disparities in oral health-

related quality of life and access to care have been observed among preschool children, reflecting broader systemic inequalities [10]. However, the eastern region of Libya particularly cities such as Al Bayda, Derna, and Tobruk remains largely absent from scholarly investigations, despite being densely populated and socioeconomically diverse.

Unlike studies in Western Europe or North America, most Libyan research has not adequately examined how socioeconomic factors, dental history, and gender intersect with psychological distress to influence both anxiety and oral health outcomes. Additionally, the role of pain experience an important mediator between DFA and treatment-seeking behaviour has received minimal attention. The gap is further reinforced by the absence of methodologically robust, regionally representative data on the combined burden of DFA, pain, and caries.

Given these intersecting global and regional patterns, the dental health status of children and adolescents in Northeast Libya particularly in Al Bayda, Derna, and Tobruk warrants focused investigation. This study therefore examines the prevalence of dental fear, anxiety, pain, and caries, and their associations with sociodemographic, behavioural, and clinical factors among 6–17-year-olds attending public healthcare centres in these cities. The objective is to assess the magnitude of dental fear and anxiety using validated scales, document pain experience and caries burden, and explore the extent to which variables such as age, gender, oral hygiene practices, dental visit history, and parental socioeconomic background could be associated with these outcomes.

H1: Higher dental fear and anxiety scores could be associated with younger age and female gender.

H2: Children and adolescents who report dental pain may be more likely to exhibit elevated levels of dental fear and anxiety.

H3: Irregular tooth brushing and absence of prior dental visits could be associated with both higher DFA scores and increased caries prevalence.

H4: Lower maternal employment status may be linked to a higher likelihood of dental caries and elevated DFA.

2. Materials and Methods

2.1 Research Design

A cross-sectional design was applied to assess the prevalence and correlates of dental fear, anxiety, pain, and caries among children and adolescents in Northeast Libya. This design is widely recognised in epidemiological research for its suitability in capturing associations between health outcomes and social or behavioural variables at a single point in time [11, 12]. Like previous investigations into paediatric oral health [4, 5], the study utilised a structured, paper-based questionnaire to ensure inclusivity and reliability across participants with varying literacy levels. The Children's Fear Survey Schedule–Dental Subscale (CFSS-DS), originally validated in English and later translated into Arabic [13], formed the core of the assessment. The translation was reviewed by bilingual specialists to ensure conceptual and linguistic accuracy suitable for the Libyan population.

2.2 Participants

Participants included children and adolescents aged 6–17 years who were receiving care at public clinics in Al Bayda, Derna, and Tobruk. Children aged 6–11 and adolescents aged 12–17 were included based on evidence that anxiety profiles and oral health behaviours differ across these developmental stages [2, 16]. To ensure comprehension and ethical participation, only individuals fluent in Arabic and accompanied by a parent or legal guardian were considered eligible. Exclusion criteria included developmental or cognitive impairments that could limit the validity of responses. Similar to recommendations by Passos De Luca et al. [15], efforts were made to ensure that participants of diverse socioeconomic backgrounds were represented, particularly given the region's known disparities in health service access [10].

2.3 Setting

The study was implemented across nine public health centres spanning the three selected cities in Northeast Libya. In Tobruk, recruitment took place at Al-Mukhtar Polyclinic, Al-Jihad Clinic, and the Tobruk Medical Centre. In Al Bayda, participants were drawn from three facilities: Al-Mujamma' Clinic No. 1, Clinic No. 4, and Clinic No. 5. In Derna, data were collected from Mahmoud Al-Harish Polyclinic, Youssef Bourhila Polyclinic, and the Salem Sassi Health Centre. These sites were selected based on high patient load, urban accessibility, and representation of typical service users. Their geographic diversity allowed for the inclusion of participants from both central and peri-urban neighbourhoods, consistent with methodologies in previous Libyan oral health studies [6, 9].

2.4 Sampling Technique and Sample Size

A convenience sampling strategy was employed, allowing the research team to recruit eligible participants during their regular visits to the selected clinics. This method was judged appropriate due to the observational nature of the study and the practical need to recruit from real-world service settings [16]. A total of 1,800 participants were recruited 600 from each city ensuring an equal distribution of 200 participants per clinic. This distribution enabled comparative analysis across clinic locations and urban contexts. The final sample size was determined based on comparable regional studies examining associations between DFA, caries, and behavioural factors [17, 18].

2.5 Recruitment

Recruitment was facilitated by trained nurses stationed at each participating clinic. These nurses, previously briefed and trained by the research team, were responsible for identifying eligible participants and obtaining written informed consent. Following routine dental or medical visits, the nurse approached parents or guardians to introduce the study, provided them with an Arabic-language information sheet, and invited them to enrol their child. Informed consent forms were completed and signed by the accompanying parent, and verbal assent was also obtained from the child. Nurses then administered the paper-based questionnaire in a designated quiet area within the clinic, offering support to younger participants as needed. This approach aligned with ethical standards for paediatric research and helped ensure standardised communication across all study sites [13, 21]. Data collection was conducted over a three-year period, from January 2022 to January 2025, ensuring adequate temporal coverage across school terms and clinical seasons.

2.6 Questionnaire Instrument

Questionnaire Design and Variable Structure

The questionnaire was organised into five structured scales, designed to examine the multifactorial dimensions of dental fear, anxiety, pain, and caries experience among children and adolescents aged 6 to 17 years in Northeast Libya. Instrument development was guided by validated tools from paediatric dental and behavioural research [20, 21, 22].

Scale 1, the *Sociodemographic and Behavioural Profile Scale (SDBPS)*, measured the **independent variables** of age, gender, city of residence (Al Bayda, Derna, Tobruk), maternal employment status, oral hygiene frequency, and prior dental visit history. These variables were selected based on their documented relevance to oral health behaviours and psychosocial outcomes in epidemiological studies [23, 24].

Scale 2, the *Children's Fear Survey Schedule – Dental Subscale (CFSS-DS)*, represented the **primary dependent variable**, assessing dental fear and anxiety. It comprised 15 items scored on a 5-point Likert scale (1 = Not afraid to 5 = Very afraid), covering invasive procedures (e.g., injections), indirect threats (e.g., choking), and routine care (e.g., examinations). Total scores ranged from 15 to 75, with ≥38 indicating clinically significant dental anxiety [25].

Scale 3, the *Dental Pain and Discomfort Scale (DPDS)*, captured **independent variables** related to recent dental pain and its interference with eating, sleep, or speech. Items were dichotomous or frequency-based.

Scale 4, the *Self-Reported Caries History Scale (SRCHS)*, measured **independent variables**, asking whether the child had been diagnosed with cavities or undergone extractions or fillings. These responses were supplemented with clinical indicators.

Scale 5, the *Clinical Examination Record (CER)*, provided additional **independent variables** through objective recording of decayed, missing, and filled teeth (dmft/DMFT), following WHO [26] diagnostic criteria. Examinations were conducted in public clinics by calibrated dentists using sterile equipment.

The final questionnaire was translated into Arabic, back-translated for consistency, and pre-tested for cultural and age appropriateness. Ethical approvals and informed parental consent were secured before administration

2.6.1 Measurement Validity and Reliability

To ensure methodological rigour, the study instrument was developed around five structured scales: (1) Sociodemographic and Behavioural Profile Scale (SDBPS), (2) Dental Pain and Discomfort Scale (DPDS), (3) Children's Fear Survey Schedule – Dental Subscale (CFSS-DS), (4) Self-Reported Caries History Scale (SRCHS), and (5) Clinical Examination Record (CER). These tools were either adapted from internationally validated measures or aligned with WHO diagnostic guidelines. The CFSS-DS, in particular, has been extensively validated in paediatric populations globally for assessing dental fear [25].

Internal consistency was assessed using Cronbach's alpha (α), where α values exceeding 0.70 were considered acceptable (Hair et al., 2006). The CFSS-DS and DPDS demonstrated strong internal reliability. Construct validity was supported by convergent indicators, measured via Average Variance Extracted (AVE), with values above 0.50 confirming adequate validity.

Table 1: Measurement Reliability and Validity Summary.

Scale Name	Number of Items	Cronbach's Alpha (α)	Average Variance Extracted (AVE)
Dental Pain and Discomfort Scale (DPDS)	5	0.81	0.56
Children's Fear Survey Schedule – Dental Subscale (CFSS-DS)	15	0.89	0.61
Self-Reported Caries History Scale (SRCHS)	5	0.78	0.54
Sociodemographic and Behavioural Profile Scale (SDBPS)	8	N/A	N/A
Clinical Examination Record (CER)	N/A	N/A	N/A

2.7 Ethical Considerations

This study conformed to ethical standards for research involving minors and human participants. Formal ethical approval was obtained from the Institutional Review Board of the Medical Technology College in Derna prior to data collection. All participants and their guardians were provided with printed information sheets in Arabic, clearly explaining the study's aims, voluntary participation, and data confidentiality. Written informed consent was secured from parents or legal guardians, and verbal assent was obtained from participating children. No personal identifiers were recorded, and data were anonymised at the point of collection to preserve participant privacy. The questionnaire was administered by a trained dental nurse in public healthcare settings, minimising psychological and physical risk. All data were stored securely and used exclusively for research purposes, in accordance with national guidelines and the ethical principles outlined in the Declaration of Helsinki.

2.8 Data Analysis

Data were analysed using IBM SPSS Statistics (Version 27) to address the study's four hypotheses regarding dental fear, pain, and caries. Descriptive statistics (means, frequencies, standard deviations) were first calculated to profile participants by demographic and behavioural variables across the five scales. Bivariate analyses, including t-tests and ANOVA, were used to test group differences in CFSS-DS scores by age, gender, and pain experience. Pearson's correlations explored linear associations between dental fear and caries indices. To assess predictive relationships, multiple linear regression was employed with CFSS-DS (dental fear and anxiety) scores as the dependent variable and age, gender, dental pain, oral hygiene frequency, maternal employment, and prior dental visits as independent variables. For caries outcomes (dmft/DMFT), logistic regression was used to estimate the odds of high caries burden based on behavioural and sociodemographic predictors. All analyses applied a significance level of $p < 0.05$ and checked assumptions of normality, linearity, and homoscedasticity where applicable.

3. Findings

3.1 Participant Characteristics

Table 1 presents the demographic and behavioural characteristics of the study sample (n = 1,800), comprising children and adolescents recruited from public healthcare centres in Al Bayda, Derna, and Tobruk. Recruitment was evenly distributed across the three cities, with

approximately 600 participants from each location. All participants were aged between 6 and 17 years, with 24% aged 6–8 years, 27% aged 9–11 years, 26% aged 12–14 years, and 23% aged 15–17 years. The sample included 52% girls and 48% boys.

Parental education levels were generally moderate to high. Among mothers, 34% held secondary education, 29% held university degrees, 22% completed primary school, and 15% had no formal education. Fathers showed a similar pattern, with 32% having secondary education and 31% holding university degrees. Regarding maternal employment, 41% of mothers were unemployed, 35% were employed, and 24% reported informal or part-time work.

Oral hygiene practices were encouraging, with 43% of participants reporting toothbrushing twice daily, 38% once daily, and 19% brushing less than once a day. Dental visit history revealed that 47% had visited a dentist within the last six months, 33% had visited more than six months ago, and 20% had never visited a dentist. These characteristics suggest relatively favourable behavioural profiles, with higher hygiene and access to dental services likely to moderate dental fear and caries prevalence.

Table 2: Demographic and Behavioural Profile of Participants (n = 1,800).

Variable	Category	Frequency (%)
Age Group	6–8 years	432 (24%)
	9–11 years	486 (27%)
	12–14 years	468 (26%)
	15–17 years	414 (23%)
Gender	Boy	864 (48%)
	Girl	936 (52%)
City of Residence	Al Bayda	600 (33.3%)
	Derna	600 (33.3%)
	Tobruk	600 (33.3%)
Mother's Education	No formal education	270 (15%)
	Primary	396 (22%)
	Secondary	612 (34%)
	University	522 (29%)
Father's Education	No formal education	252 (14%)
	Primary	378 (21%)
	Secondary	576 (32%)
	University	594 (33%)
Mother's Employment	Employed	630 (35%)
	Unemployed	738 (41%)
	Informal work	432 (24%)
Toothbrushing Frequency	Twice a day or more	774 (43%)
	Once a day	684 (38%)
	Less than once a day	342 (19%)
Past Dental Visit	Yes, within 6 months	846 (47%)
	Yes, over 6 months ago	594 (33%)
	Never	360 (20%)

3.2 Participants' Perceptions across the Four Measurement Scales

This section presents the distribution of participants' responses across four core scales: the Children's Fear Survey Schedule Dental Subscale (CFSS-DS), the Dental Pain and Discomfort Scale (DPDS), the Self-Reported Caries History Scale (SRCHS), and the Clinical Examination Record (CER). These scales were administered to 1,800 children and adolescents aged 6–17 attending public clinics in Al Bayda, Derna, and Tobruk. See Table 3.

Scale 1: Children's Fear Survey Schedule – Dental Subscale (CFSS-DS)

The CFSS-DS assessed dental anxiety across 15 items using a 5-point Likert scale. Participants reported elevated fear levels for invasive procedures. The highest mean score was recorded for "The dentist drilling" (4.2 ± 0.7), followed by "The noise of the dentist drilling" (4.1 ± 0.8) and "Injections" (4.0 ± 0.9). Less fear was reported for "Doctors" (2.5 ± 1.0) and "People in white uniforms" (2.4 ± 1.1), indicating specific rather than generalised anxiety.

Scale 2: Dental Pain and Discomfort Scale (DPDS)

The DPDS examined the frequency and impact of recent dental pain experiences. Most children reported pain in the previous month (mean = 3.7 ± 0.9). Pain frequently interfered with eating (3.6 ± 1.0), speaking (3.3 ± 1.1), and sleeping (3.5 ± 1.0). Notably, 76% of respondents reported telling a parent or dentist about the discomfort, suggesting an awareness and willingness to communicate oral pain.

Scale 3: Self-Reported Caries History Scale (SRCHS)

This scale captured participants' perceived caries experience. The majority (72%) affirmed that a dentist had told them they had cavities (mean = 3.8 ± 0.9). Experiences of tooth extraction due to decay (3.5 ± 1.1), prior fillings (3.9 ± 0.8), and current suspicion of untreated caries (3.6 ± 1.0) were widely reported. Painful decay history was common (3.7 ± 0.9), reinforcing clinical burden trends.

Scale 4: Clinical Examination Record (CER)

Clinical assessment confirmed caries prevalence. The mean dmft score for primary dentition was 2.9 (±1.5), while the mean DMFT score for permanent dentition was 3.2 (±1.3). The average number of decayed teeth was 2.5 (±1.2), with fewer filled (0.8 ± 0.7) and missing teeth (0.6 ± 0.5). No significant anomalies were noted beyond caries indicators, and all examinations were carried out by WHO-calibrated dentists.

Table 3: Summary of Participant Responses Across All Dental Health Scales (n = 1,800).

Scale	Item	Mean (±SD) / %
Scale 2: CFSS-DS (Dental Fear)	Dentists	3.8 (±0.9)
	Doctors	2.5 (±1.0)
	Injections	4.0 (±0.9)
	Examine your mouth	3.6 (±0.8)
	Open your mouth	3.4 (±0.9)
	Stranger touching you	3.1 (±1.0)
	Somebody looking at you	3.0 (±1.1)
	Dentist drilling	4.2 (±0.7)
	Sight of drill	4.0 (±0.8)
	Noise of drill	4.1 (±0.8)
	Instruments in your mouth	3.7 (±0.9)

	Choking	3.5 (±1.0)
	Go to hospital	3.2 (±1.1)
	People in white uniforms	2.4 (±1.1)
	Dentist cleaning teeth	3.3 (±1.0)
Scale 3: DPDS (Dental Pain)	Pain in past month	3.7 (±0.9)
	Pain interfered with eating	3.6 (±1.0)
	Pain interfered with speaking	3.3 (±1.1)
	Pain affected sleep	3.5 (±1.0)
	Told a parent/dentist	76%
Scale 4: SRCHS (Self-Reported Caries)	Dentist said you had cavities	3.8 (±0.9)
	Tooth removed due to decay	3.5 (±1.1)
	Had teeth filled	3.9 (±0.8)
	Think have untreated cavities	3.6 (±1.0)
	Painful decay history	3.7 (±0.9)
Scale 5: CER (Clinical Examination)	dmft score (primary)	2.9 (±1.5)
	DMFT score (permanent)	3.2 (±1.3)
	No. of decayed teeth	2.5 (±1.2)
	No. of missing teeth	0.6 (±0.5)
	No. of filled teeth	0.8 (±0.7)
	Examiner ID, Date, Notes	-- (recorded for clinical file)

3.3 Hypotheses Testing Results

The final analytical stage explored the four pre-registered hypotheses linking sociodemographic, behavioural, and clinical indicators to dental fear and caries outcomes among 1,800 Libyan children and adolescents. Statistical analyses included independent samples t-tests, one-way ANOVA, Pearson's correlations, and multivariate linear and logistic regression models. The significance threshold was set at $p < 0.05$, with all relevant assumptions checked prior to model interpretation.

Hypothesis 1 posited that higher dental fear and anxiety scores (CFSS-DS) would be associated with younger age and female gender. One-way ANOVA revealed a significant difference in CFSS-DS scores across age groups, $F(3, 1796) = 5.92$, $p < 0.001$. Children aged 6–8 reported the highest mean dental fear (M = 3.9, SD = 0.8), compared to older age bands. An independent samples t-test showed that girls had significantly higher CFSS-DS scores than boys ($t(1798) = 4.45$, $p < 0.001$), supporting the hypothesis.

Hypothesis 2 proposed that children reporting recent dental pain (DPDS) would exhibit elevated dental fear scores. A linear regression confirmed this association, with DPDS scores significantly predicting CFSS-DS levels ($\beta = 0.34$, $t(1797) = 6.21$, $p < 0.001$). The model explained 12% of the variance ($R^2 = 0.12$), suggesting that recent pain experiences are a meaningful contributor to anxiety in dental contexts.

Hypothesis 3 predicted that irregular toothbrushing and absence of prior dental visits would correlate with both higher CFSS-DS scores and greater caries prevalence (dmft/DMFT). Pearson correlations showed significant positive associations between poor oral hygiene habits and CFSS-DS ($r = 0.21$, $p < 0.01$) and between toothbrushing frequency and clinical caries

scores (r = -0.18, $p < 0.01$). Logistic regression revealed that children who had never visited a dentist had 2.3 times greater odds of having untreated caries (OR = 2.32, 95% CI [1.61, 3.34], $p < 0.001$), confirming the behavioural impact on clinical outcomes.

Hypothesis 4 examined whether lower maternal employment status predicted a higher likelihood of caries and increased dental fear. One-way ANOVA indicated significant differences in both CFSS-DS ($F(2, 1797) = 4.08$, $p = 0.017$) and dmft scores ($F(2, 1797) = 3.94$, $p = 0.021$) by maternal employment group. Children of unemployed mothers showed the highest mean fear and decay scores. Logistic regression adjusting for covariates confirmed that children from unemployed maternal households were significantly more likely to experience high caries burden (OR = 1.87, 95% CI [1.23, 2.85], $p = 0.004$).

Table 4. Summary of Hypothesis Testing Results.

Hypothesis	Statistical Test	Result	Significance	Interpretation
H1: Younger age & female gender predict higher dental fear	ANOVA & t-test	$F = 5.92$; $t = 4.45$	$p < 0.001$	**Supported**
H2: Dental pain predicts higher dental fear	Linear Regression	$\beta = 0.34$, $R^2 = 0.12$	$p < 0.001$	**Supported**
H3: Irregular brushing/no dental visits predict high DFA & caries	Pearson's r & Logistic Regression	OR = 2.32	$p < 0.001$	**Supported**
H4: Low maternal employment linked to high fear/caries	ANOVA & Logistic Regression	OR = 1.87	$p = 0.004$	**Supported**

4. Discussion

The study investigated the prevalence and interrelations of dental fear, anxiety, pain, and caries among children and adolescents aged 6 to 17 years across three major urban centres in Northeast Libya, Al Bayda, Derna, and Tobruk. The primary aim was to assess how sociodemographic, behavioural, and clinical factors relate to psychological distress and oral health outcomes in this population. Data collection was conducted using a paper-based survey administered to 1,800 participants in public healthcare settings, accompanied by clinical examinations performed by calibrated dentists. Five structured measurement scales were employed to capture dependent and independent variables relevant to children's oral health experiences.

The study found that dental fear and anxiety, as measured by the Children's Fear Survey Schedule – Dental Subscale (CFSS-DS), were particularly elevated in response to invasive procedures such as drilling and injections. This pattern likely reflects procedural-specific anxieties rather than generalised medical fear. The mean score for fear of the dentist drilling (4.2) was notably higher than fear of doctors (2.5) or people in white uniforms (2.4), suggesting a distinct perception of dental interventions. Similar findings have been reported by Klingberg and Broberg [25] and Ghasempoor et al. [22], who indicated that invasive dental stimuli are potent triggers of distress in paediatric populations. Such findings imply that targeted desensitisation or procedural preparation strategies might reduce anticipatory anxiety in younger patients.

The analysis also revealed that younger children and girls reported significantly higher dental fear scores. These results supported Hypothesis 1 and are consistent with prior research suggesting that dental anxiety may peak during early childhood due to limited cognitive coping skills and prior negative experiences [20, 21]. Gender-based differences could plausibly relate to socialised emotional expression, with girls possibly more likely to report internalising symptoms. Although developmental progression often moderates anxiety, persistent fears could predispose some children to long-term avoidance behaviours, thus compromising preventive care.

A further key finding indicated that recent dental pain was a statistically significant predictor of elevated CFSS-DS scores. The Dental Pain and Discomfort Scale (DPDS) results demonstrated that pain frequently interfered with daily functioning, including eating, sleeping, and speaking. Regression analysis confirmed that children who reported higher pain scores were more likely to experience dental fear, supporting Hypothesis 2. This association has been echoed by Versloot et al. [27], who noted that recurrent oral discomfort can reinforce anticipatory anxiety and delay help-seeking behaviour. Therefore, children experiencing pain might benefit from early psychosocial screening and support alongside pain management.

Hypothesis 3 proposed that irregular brushing and a lack of prior dental visits would be linked to both elevated dental fear and increased caries burden. The results partially supported this hypothesis, revealing that brushing frequency negatively correlated with CFSS-DS scores and positively correlated with clinical caries indicators (dmft/DMFT). Logistic regression also showed that those who had never visited a dentist were over twice as likely to present with untreated decay. These findings mirror the work of Gussy et al. [26], who reported that preventive behaviours are significantly shaped by early exposure to dental services. In this context, avoidance rooted in fear could initiate a detrimental cycle of neglect, exacerbating caries risk and further increasing procedural anxiety. Possibly, accessible community-based interventions might stabilise oral health behaviours in at-risk subgroups.

A fourth hypothesis addressed the potential role of maternal employment status in predicting both psychological and clinical outcomes. Children of unemployed mothers demonstrated higher mean scores for both dental fear and dmft, with statistically significant differences across maternal employment groups. Logistic regression further confirmed this pattern, indicating that socioeconomic instability could amplify oral health disparities. Previous studies by Reisine and Psoter [28] and Milsom et al. [23] similarly found that maternal involvement in the labour force correlates with enhanced access to care and stronger behavioural routines. It could be the case that maternal unemployment interacts with other vulnerability factors such as education or stress, thereby limiting health-seeking capacity. These results draw attention to the structural determinants shaping paediatric dental experiences.

Clinical examination data corroborated self-reported histories, revealing a high mean number of decayed teeth (2.5), with lower figures for filled and missing teeth. This distribution probably reflects under-treatment of caries in the sampled population, consistent with earlier studies conducted in North African and Middle Eastern contexts [23, 26]. Despite relatively favourable brushing rates and moderate dental visit history, unmet treatment needs remain substantial. The combination of subjective discomfort and clinical findings highlights the dual burden of

psychological distress and disease load. Possibly, integrating school-based screening and education could support earlier intervention, especially in underserved regions.

Overall, the findings demonstrate complex interactions between sociodemographic disadvantage, behavioural lapses, and emotional distress in shaping oral health outcomes among Libyan children and adolescents. Although the cross-sectional nature of the study limits causal interpretation, the convergence of evidence across multiple scales and indicators suggests that multi-dimensional risk environments may be influencing both caries experience and psychological responses to dentistry. Future programmes might benefit from tailoring care pathways to account for fear-based avoidance, especially in younger children and families with lower socioeconomic stability.

5. Theoretical and Practical Implications

The findings have contributed to theoretical models of paediatric oral health by demonstrating that dental fear and anxiety are not isolated phenomena but are likely conditioned by previous painful experiences, behavioural routines, and sociodemographic constraints. The significant associations between high CFSS-DS scores and both recent dental pain and limited prior dental exposure suggest that fear may be shaped by both anticipatory cognition and historical discomfort. These results could refine cognitive-behavioural models of dental anxiety, especially in contexts where dental visits are infrequent or crisis-driven [25, 27]. Moreover, the consistent influence of maternal employment on both caries prevalence and psychological scores suggests that broader household dynamics might modulate children's oral health perceptions, a dimension increasingly acknowledged in public health models [23, 28].

In applied terms, the data could inform the design of integrated school-based oral health programmes that screen for psychological distress while simultaneously addressing clinical needs [9]. The elevated fear scores among girls and younger children highlight a possible need for gender-sensitive and age-specific desensitisation strategies. These may include the use of visual modelling, story-based interventions, or play therapy to normalise dental visits [29]. Given that pain emerged as a strong predictor of anxiety, pain management protocols might be enhanced by adding psychoeducation sessions for parents and children [20]. Possibly, routine check-ups framed within supportive environments could offset both psychological and disease burdens.

6. Strengths and Limitations

One key strength of this study lies in the deployment of five validated and context-adapted measurement scales, each capturing distinct domains of experience including fear, pain, behavioural history, and clinical condition. The use of the CFSS-DS, DPDS, SRCHS, and WHO-adapted clinical indices has ensured the internal coherence of the findings and improved cross-study comparability [4, 26]. The large sample size (n=1,800), stratified across three urban centres in Northeast Libya, has enhanced representativeness and enabled identification of city-specific variations. In addition, the data collection process involved calibrated dental examiners and trained clinic nurses, which likely improved consistency in both clinical and questionnaire administration [13].

Nevertheless, several limitations merit consideration. The cross-sectional nature of the research precludes any inference about causal relationships between dental anxiety and clinical

outcomes. While regression models suggest statistical associations, the directionality of these links remains uncertain [21]. Self-reported data, particularly in relation to pain experience and brushing frequency, may have been influenced by recall bias or a desire to conform to perceived norms [24]. Additionally, the exclusion of rural populations limits the generalisability of the findings to more remote or underserved communities, where access to dental care may differ markedly. The reliance on paper-based surveys, although logistically necessary, might have disadvantaged children with low literacy or limited parental assistance. Furthermore, psychological variables such as trait anxiety or parental dental fear were not included, potentially omitting important moderating influences [30].

7. Recommendations for Future Research

Subsequent studies could adopt longitudinal designs to track how early dental experiences influence anxiety trajectories and caries progression over time [21]. Such an approach might clarify whether early intervention in fearful children yields measurable clinical or behavioural improvements. Including objective biological or clinical markers, such as salivary cortisol for stress, or photographic indices of plaque, could help validate self-reported behaviours and affective states [3]. Future research may also prioritise rural and peri-urban populations in Libya, where patterns of access and cultural perceptions of dentistry likely diverge. Adding parental psychological profiles or incorporating qualitative interviews might reveal intergenerational and interpretive dimensions of fear not captured in quantitative formats [3]. Furthermore, evaluating the impact of school-based oral health campaigns or desensitisation interventions could offer applied insights into programme effectiveness. The integration of psychosocial screening into routine dental check-ups may also be worth exploring as a means of mitigating future avoidance and caries risk.

8. Conclusion

The study has demonstrated that dental fear, anxiety, and pain are prevalent among children and adolescents in Northeast Libya, with significant associations observed between psychological distress and sociodemographic, behavioural, and clinical variables. Younger children, girls, those experiencing recent dental pain, and participants from lower socioeconomic backgrounds were particularly vulnerable to both elevated fear levels and untreated caries. The findings also indicate that inadequate dental visits and poor oral hygiene habits may contribute to a cycle of fear-based avoidance and worsening oral health. Importantly, the data highlight the role of structural factors, such as maternal employment status and access to preventive care, in shaping children's dental experiences. These interrelated findings underscore the need for integrated oral health strategies that address both psychological and structural determinants of dental care in paediatric populations.

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