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Prevalence and Clinical Risk Factors of Dental Caries among Syrian Children Aged 6–12 Years (A Cross-Sectional Study)

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Abstract:

Objectives: The purpose of this study aimed to determine the prevalence of dental caries and the potential Risk factors among schoolchildren aged 6–12 years in Damascus, Syria.

Materials and Methods: The study was cross-sectional and was conducted between September 2023 and June 2024; the sample consisted of 872 children selected using the multi-stage cluster sampling method. The *DMFT/dmft* index was used to determine dental caries,while additional information on socioeconomic status and oral health practices was collected throu gh a structured questionnaire.

Results : Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS). The overall prevalence of dental caries was (84%), and males had a slightly higher prevalence rate (85%) compared to females (83%), and the mean DMFT/dmft score was 2.04 ±1.64/3.03 ±2.47, respectively. Caries prevalence was significantly associated with the type of school attended, socioeconomic status, and parental education،additionally, the frequency of tooth brushing. It was found that caries experience remains high in the children in Damascus, with many associated factors including their sociodemographic factors and oral behaviors.

Conclusion: The prevalence of dental caries was significantly associated with the type of school attended, socioeconomic status, parental employment, and tooth brushing practices. The findings indicate that dental caries remains highly prevalent among children in Damascus, with multiple contributing factors, including socio demographic characteristics and oral health behaviors.

Key Words: Caries, Children, Prevalence, Oral Hygiene, Risk Factors.

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دراسة نسبة انتشار وعوامل الخطر السريرية للنخور السنية عند الأطفال السوريين بعمر 6–12 سنة (دراسة مقطعية –عرضية)

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الملخص:

هدف البحث: هدفت هذه الدراسة الى تحديد معدل انتشار النخر السني وعوامل الخطر المحتملة بين أطفال المدارس بعمر 6–12 سنة في دمشق، سوريا.

المواد والطرائق: كانت الدراسة مقطعية وتم إجراءها بين أيلول 2023 وحزيران 2024، بلغ عدد أطفال العينة 872 طفلاً تم اختيارهم باستخدام أسلوب العينة العنقودية متعدد المراحل. وتم استخدام مشعر dmft/DMFT لتحري انتشار النخور السنية.
بينما تم جمع معلومات إضافية عن الحالة الاجتماعية –الاقتصادية والعناية الفموية عبر استبيان منظم.

النتائج: أجريت تحليلات البيانات باستخدام الحزمة الاقتصادية للعلوم الاجتماعية وبلغت نسبة انتشار النخر السني الكلي (84%) وكان الذكور/ الإناث يتمتعون بنسبة انتشار أعلى قليلا (85 %) مقارنة بالإناث (83 %). وبلغ متوسط مشعرات DMFT/dmft 2.04 ±1.64/3.03 ±2.47 . ارتبط انتشار النخر السني ارتباطاً وثيقا بنوع المدرسة التي يرتادها الطفل والوضع الاجتماعي والاقتصادي ،والمستوى التعليمي للوالدين، وتكرار عملية التفريش السني.
وقد وجد أن معدل الإصابة بالنخور السنية لايزال مرتفعاً بين أطفال مدينة دمشق، مع وجود العديد من العوامل المرتبطة بذلك، بما في ذلك عواملهم الاجتماعية والديموغرافية وسلوكياتهم الفموية.

الاستنتاج: ارتبط انتشار النخر السني بشكل معنوي بنوع المدرسة التي يرتادها الطفل والحالة الاقتصادية والاجتماعية وعمل الوالدين بالإضافة إلى عملية تفريش الأسنان.
وقد وجد أن معدل الإصابة بالنخر السني لايزال مرتفعا بين أطفال دمشق مع وجود العديد من العوامل المرتبطة بما في ذلك عواملهم الاجتماعية والديموغرافية وسلوكياتهم الفموية.

الكلمات المفتاحية: النخور، الأطفال، انتشار، عناية فموية، عوامل خطورة.

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Introduction:

Oral health is considered an essential part of overall health owing to its reciprocal influence on the individual's general health; and given the impact of oral and dental diseases on quality of life and daily activities, the World Health Organization (WHO) has classified it among the most prominent priorities of global public health (Moradi et al., 2019).

caries has been defined as a chemical dissolution resulting from the metabolic activity of bacteria in the dental plaque, which disrupts the balance of the two processes of demineralization and remineralization of mineral salts in the teeth (pitts et al.,2017) ,(Mehta,2017). Dental caries is considered a multifactorial disease, as biological, behavioral, and environmental elements interact in its onset and development (Skrivel et al.,2013).

The development of dental caries is attributed to the interaction of 4 main elements that include the tooth surface, which is influenced by genetic factors related to the structure of enamel and dentin; in addition to saliva characteristics from the quantitative and compositional aspect (Baelum and Fejerskov,2015) ,(Pitts et al.,2017), (Choi,2020), and the dental plaque, which is considered a fertile environment for the growth of caries-causing bacteria such as Streptococcus mutans and Lactobacilli (Mathur and Dhillon,2018) and finally, the time factor.Dental caries is considered one of the most prevalent chronic diseases globally, and its rates differ between developed and developing countries(Liu et al.,2024) ,(Pitts et al.,2017),as developing countries have witnessed an increase in dental caries prevalence rates as a result of the deterioration of social and economic conditions and the change of life patterns, in addition to other factors such as consumption of sugar-rich foods, poor oral care, and difficulty accessing healthcare services(Almutairi et al.,2024),(Pitts et al.,2017),(Gathecha et al.,2012).In recent years, Syria has faced significant challenges due to the ongoing conflict, which severely affected its healthcare system including dental care services. This situation led to an increase in dental problems including dental caries, periodontal inflammation, and tooth loss, which made oral health an urgent public health issue for children in Syria (Alshayeb et al.,2025). In 2011, Dashash and Blinkhorn (Dashash et al2012), reported a 61% prevalence of dental caries among five-year-old children. By 2016, the rate for children aged 8-12 was 79.1%(Ballouk et al2019) , while in 2019, the prevalence among 12-year-old children escalated to 86% (ALhaffar et al 2019). By 2023, the prevalence of dental caries in children aged 10-13 years reached 90.4% (Misrabi et al 2023).Understanding the prevalence rate of dental caries and its associated risk factors is a matter of great importance; however, data relating to these factors among children in Syria remain limited. Despite the conduct of a limited survey on the prevalence of oral diseases, the specific risk factors that contribute to dental caries among children remain unclear.Therefore, this study aims to estimate the prevalence rate of dental caries and identify its associated risk factors among children in Damascus, Syria

Materials and Methods:

Study design and setting

This cross-sectional descriptive study aimed to determine the prevalence rate of dental caries among children aged 6–12 years during the period between September 2023 and April 2024, then selecting the children participating in the study from randomly selected public and private primary schools in Damascus. All procedures adhered to the relevant guiding principles. Ethical approval was obtained from the Research Ethics Committee at Damascus University, with additional written approval from the Directorate of Education and Teaching. Informed consent was obtained from the guardians of all participating children prior to data collection, and *STROBE* guidelines were followed in this cross-sectional study.

Population sampling.

The multi-stage cluster sampling method was used in this study to minimize selection bias. This method involved dividing the population into

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clusters and selecting random samples. The sample included children selected from public and private primary schools aged between 6–12 years in the city of Damascus. The first stage of cluster sampling involved dividing Damascus into nine districts based on the health sector map provided by the Ministry of Health. In the next stage, schools were randomly selected from these districts, resulting in 17 schools.In the third stage, the systematic random sampling method was used to select every fifth child from the attendance lists, based on the total number of students in the school. School principals in the selected areas were contacted, and those who agreed to participate were included in the study.Children's parents/guardians received an informational booklet explaining the objective and methodology of this study, in addition to a consent form.

The sample size was determined using the formula [equation (1): $z^2 p \frac{1-p}{d^2}$], which is recommended for descriptive cross-sectional studies(pourhoseingholi et al.,2013). A standard normal variate of 1.96 was used for a 5% type I error with a level of confidence of 95%, and the population percentage was set at 79.1% based on the results of the Ballouk and Dashash study (Ballouk et al 2019).

The desired margin of error (d) was established at 3%. This calculation indicated a need for 702 participants, however, in the end, 872 children were enrolled in this study.

Inclusion and Exclusion Criteria

Participants were selected based on written informed consent signed by parents/guardians. Inclusion was restricted to male and female children aged 6–12 years of Syrian origin. Children who were uncooperative, or who had medical problems or chronic diseases, or had orthodontic appliances, or those with special needs were excluded

Study Protocol and data collection

Strict sterilization protocols were observed during dental examinations. Clinical examination of each child was conducted individually using sterilized oral mirrors and WHO ball-ended probes of 0.5 mm, and gauze, gloves, and oral masks.The child was seated with the head tilted at a horizontal angle of 45 degrees. Examinations were conducted in a designated room in each school using natural light supported by a handheld lamp.Structured questionnaires were used to collect sociodemographic information including age – sex – parental education level – father's occupation – sugar consumption – practice of oral care; and it also included the number of tooth-brushing episodes. Parents/guardians were asked to fill in this form with the specified information.Dental examinations were performed for all selected children in accordance with WHO guidelines for the diagnosis of dental caries. To minimize inter-examiner variability, the assessment was conducted by a single examiner only.

Outcome Assessment

In epidemiological studies, multiple indices were developed for the diagnosis of dental caries, its causes, and associated risk factors. The primary objective of these indices was to standardize all data in order to compare the prevalence rate of dental caries among different populations (Altas et al.,2023) .The condition of permanent and primary teeth was assessed using the *DMFT* index (Decayed, Missing, and Filled permanent Teeth) and *dmft* (decayed, missing, and filled primary teeth).These indices have constituted the primary tool for assessing oral health globally for more than 70 years, and they provide a comprehensive measure of dental caries and its outcomes, making them necessary for monitoring community oral health interventions and formulating related policies(Moradi et al.,2019),(WHO,2013).According to WHO guidelines(WHO,2013), *DMFT* is the sum of the number of permanently decayed, missing, and filled teeth, where the component *D* represents all teeth affected by dental caries, or affected by secondary caries, or remaining root fragments, or temporary fillings.The *M* component represents the teeth lost due to untreated dental caries, while *F* represents the restored teeth. For primary teeth, the index was used and was calculated in a similar manner. The Plaque Index (*PI*) was measured according to *Loe & Silness*, with plaque presence recorded and its severity clinically classified as follows: 1-mild, 2-moderate, 3-severe(Loe et al.,1967).

Statistical Analysis:

The obtained data were analyzed using the *SPSS* program, Version 23.Descriptive statistics were presented as means, standard deviations, medians, counts, and percentages%.The Kolmogorov–Smirnov test indicated that the data follow a normal distribution.Therefore, the independent-samples *T*-test was used to compare two groups, while *ANOVA* was used to compare more than two groups. Categorical data were analyzed using the Pearson chi-square test, and logistic regression analysis was performed for multivariate analysis.

Results:

This study included 872 students, aged 6 to 12 years, with a nearly balanced gender distribution. The demographic characteristics of the participants are presented in Table 1. The overall prevalence of dental caries was 84%, with mean scores of 2.04 ±1.645 and 3.03 ±2.468, respectively The associations between sociodemographic factors and caries prevalence.The data revealed no significant gender differences in caries prevalence, as both male (85%) and female (83%) students had similar rates of caries, with a P-value of 0.329. Age groups also did not show significant variation in caries prevalence, with all age categories displaying caries rates ranging from 77% to 86%, and a P-value of 0.125. However, a statistically significant association was found between school type and caries prevalence (P-value = 0.010), with students attending public schools exhibiting a higher prevalence (86%) compared to those attending private schools (79%).Further analysis of parental education levels indicated no significant effect on caries prevalence. The P-values for father's education level (0.278) and mother's education level (0.395) suggest that these factors do not significantly influence caries rates. Additionally, no significant association was found between maternal occupation and caries prevalence (P-value = 0.574).Regarding socioeconomic status (SES), a significant difference was observed (P-value = 0.012). Students from lower SES backgrounds had a higher prevalence of caries (84%) compared to those from moderate (89%) and high (78%) SES backgrounds .

Discussion

This study aimed to evaluate the prevalence of dental caries and its associated factors among children in Syria.The study relied on a cross-sectional design, where the study sample included 872 children selected by the multi-stage cluster sampling method from multiple areas within the city, which reflected a wide diversity in social, economic, demographic, and cultural characteristics. Considering Damascus as the capital and largest urban city in Syria, it represents a social and demographic hub that attracts residents from various regions, including large numbers of internally displaced persons as a result of the conflict in rural areas.

The ongoing Syrian revolution drove millions of families to relocate to major cities such as Damascus in search of greater safety and security and access to basic services(UNHCR,2024) As a result, Damascus became a miniature model that reflected the Syrian demographic composition, as it brought together local residents and displaced persons from diverse geographic and cultural backgrounds. When comparing the results with international dental health standards (WHO,2022), a notable prevalence of dental caries of approximately 85% was evident, which represented a concerning indicator for public health.This study provided important insights into the influence of social, demographic, and environmental factors on oral health among Syrian children, which was exacerbated as a result of the ongoing war that led to a notable deterioration in the healthcare infrastructure.Dental caries is considered one of the most prevalent chronic diseases globally, having affected approximately 60–90% of children, and still represents an ongoing global health challenge(Petersen et al.,2005)This study highlighted that more than 84% of children suffer from dental caries, where the percentage of the two *DMFT/dmft* indices2.04 ±1.645 and 3.03 ±2.468, respectively. These results were comparable with other studies also conducted in Damascus; where it reached 85.7% among children aged 13–16 years in the year 2020 (Al-

Ladhqani, 2020), and 86% among children aged 12 years in the year 2019 (Alhaffar et al., 2019b). In contrast, higher prevalence rates for caries were recorded in other studies, where it reached approximately 90% among children aged 9–14 years in the year 2024 (Al-Shayeb and Dashash, 2025), and in the year 2023 where it reached 90.4% among children aged 10–13 years (Misrabi et al., 2023).In contrast, lower prevalence rates for caries were recorded in other studies also conducted in Damascus; 79.1% in the year 2016 among children aged 6–12 years (Ballouk and Dashash, 2019), and 74% in the year 2012, a rate of 74% among children aged 6–12 years (Jaghasi et al., 2012a).Also, a study in the city of Latakia in the year 2014 showed that the prevalence rate of caries reached 67.1% among children aged 13–15 years (Salman, 2014);as for the Eastern Region in the year 2009, the prevalence rate of dental caries was 80.4% (Al-Hindawi, 2009).This may be attributed to the difference in the age group in addition to the time gap between the conduct of these studies, as cultural and social differences and dietary pattern also play a role among the study populations.Lower prevalence rates were recorded in some other countries, such as Ethiopia 46.9% (Shitie et al., 2021), Egypt was 74% (Abbass et al., 2019), Qatar 71.4% (Al-Thani et al., 2018), Dubai 59.2% (Al Mashhadani et al., 2017), India 74.7% (Liu et al., 2016), and Brazil 55.5% (Martins et al., 2016).This disparity between the prevalence rate of caries in this study and other countries may also be attributed to the reality of the Syrian crisis that has extended for a long period in the country. The war-related disruptions severely affected public health services, which limited access to dental care centers and exacerbated social and economic challenges. Restricting access to health and educational services was an important consequence of the Syrian crisis (Alhaffar et al., 2018). Hundreds of dental clinics were closed, and many specialists emigrated during the crisis (Alhaffar and Janos, 2021b), (Saltaji, 2015). Alhaffar and colleagues reported notable neglect of oral health during this period, with increasing rates of dental caries (Alhaffar et al., 2019b). Similarly, Saltaji highlighted the negative effects of the war on refugees, including reduced oral care and increased prevalence of periodontal diseases such as chronic gingivitis and periodontitis (Saltaji, 2015). The difficult economic situation exacerbated these matters, which forced many Syrians to prioritize basic necessities such as food over oral care products such as toothbrushes and toothpaste (Alhaffar et al., 2019b), (Saltaji, 2015).These findings highlighted the importance of developing targeted health interventions that are compatible with these complex environments.The study showed that the prevalence rate of caries was slightly higher among males (85%) compared to females (83%), without statistically significant differences. This may be attributed to the fact that females are more attentive and committed to their oral care.This finding was consistent with other results (Al-Shayeb and Dashash, 2025), where the data indicate that access to dental healthcare and parental supervision may have a greater influence than behavioral differences related to sex in this context.The study also revealed comparable caries prevalence rates among the age groups; the youngest age group (6–7 years) had a low value for the *DMFT* index (0.52) and a high value for the *dmft* index (3.21), while the older age group had a high value for the *DMFT* index (2.51) and the lowest value for the *dmft* index (2.04), which indicated that early adolescence may be a critical period for the development of dental caries. We agreed in that with the study of (Al-Shayeb and Dashash, 2025) and the study of (Al-Jaghasi and Dashash, 2010).It is notable that with advancing age, *dmft* scale scores tend to decrease while *DMFT* scale scores rise. This is most likely due to a lack of awareness regarding the importance of maintaining primary teeth and the misconception that they are of less importance as they will be replaced by permanent teeth. The early loss of primary teeth may lead to early eruption of permanent teeth, making them more susceptible to caries, and this is consistent with previous studies conducted in Egypt, India, and Iran (Youssefi and Afroughi, 2020), (Abbass et al., 2019), (Joshi et al., 2013).Children from families with low socioeconomic status showed a higher prevalence of dental caries. These findings are consistent

with studies that link low economic and social status with increased risk of dental caries (Al-Shayeb and Dashash, 2025) (Youssefi and Afroughi, 2020), (Abbass et al., 2019), (Alhaffar et al., 2019b), (Al-Jaghasi and Dashash, 2010). The study showed that children in public schools have a significantly higher rate compared to their peers in private schools. This disparity confirms the influence of the social and economic status on oral and dental health outcomes. Children in public schools — who mostly belong to families with low income — may face difficulty in obtaining dental care, reduced awareness of oral and dental hygiene, and weak parental participation in tracking their children's oral health. In contrast, private schools devote greater attention to health aspects in general. On the contrary, other studies reported a higher prevalence of caries among children from families with a higher social and economic status, and it is likely that this is due to increased consumption of sugars and snacks (Amudha et al., 2021), (Popoola et al., 2013). On the other hand, (Ghandour, 1992) found no statistically significant differences in the prevalence of caries among socioeconomic groups, which may be attributed to the difference of economic contexts and the availability of healthcare services and the level of access to them in different countries.The study findings showed that the highest prevalence rates of dental caries were recorded among children whose mothers were not working. These findings are consistent with what previous studies concluded (Al-Shayeb and Dashash, 2025), (Kato et al., 2017), (Tanaka et al., 2013).However, other studies showed the presence of a statistically significant relationship, where it was found that children of working mothers suffer from higher rates of dental caries (Pereira et al., 2020).This discrepancy is attributed to the multidimensional influence of the mother's work on oral health among children; as the mother's preoccupation with work may lead to a reduced level of daily supervision and follow-up, which negatively reflects on the dietary patterns and oral care practices among them.

The study findings indicate the presence of a clear and statistically significant association between the tooth-brushing rate and the prevalence level of dental caries and periodontal inflammation. It was found that children who do not follow a regular brushing routine or clean their teeth infrequently were the most susceptible to caries and periodontal inflammation. These findings confirm the decisive role of regular tooth brushing in preventing caries and periodontal inflammation, and that in line with the findings of previous research (Martignon et al., 2021), (Abbass et al., 2019), (Plaka et al., 2017).

Finally, dental plaque accumulation was common among 93% of children, and this was directly associated with caries and periodontal inflammation. Children who suffered from severe plaque accumulation recorded caries rates of 90 %.This is consistent with the recommendations of the American Academy of Pediatric Dentistry (AAPD, 2020), which emphasizes that plaque accumulation is considered an important indicator for increased risk of developing caries and periodontal inflammation, especially in early childhood (AAPD, 2020).The findings of this study, which revealed a rise in the rate of dental caries, indicated important implications for policymakers and oral health service providers, where the urgent need to implement targeted interventions in the field of public health is highlighted, particularly in conflict-affected areas such as Damascus. The collapse of healthcare infrastructure, economic instability, and displacement resulting from the conflict contribute to the aggravation of disparities in oral health, which requires adopting sustainable, low-cost, community-based strategies.

Conclusion:

This study provides valuable scientific insights into the prevalence rate of dental caries and the influence of the social–demographic factors and oral care associated with it among children.The results showed a continued rise in the prevalence rate of dental caries among schoolchildren in Damascus, Syria, reaching approximately 84%.This study also identified the factors significantly associated with increased prevalence of dental caries, which included both: low socioeconomic status, low parental educational level, enrollment in public schools, and poor oral care.

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LEGENDS:

Table 1: Characteristics of students' caries prevalence according to their demographic variables.

Variables	Categories	N (%)	Caries prevalenc (%)
Total	—	872 (100%)	734(84%)
Gender	Male	425 (49)%	363 (85)%
	Female	447 (51)%	371 (83)%
P-value			P=0.329
Age	7-6	160 (18)%	137 (86)%
	8-7	148 (17)%	126 (85)%
	9-8	154 (18)%	132 (86)%
	10-9	137 (16)%	117 (85)%
	11-10	129 (15)%	100 (77)%
	12-11	144 (16)%	122 (85)%
P-value			P=0.125
School Type	Public	605 (69.4)%	522 (86)%
	Private	267 (30.6)%	212 (79)%
***P*-value**			***P*= .010***
Father's Education Level	Primary and below	154 (18.4)%	133 (86)%
	Middle or Secondary school	374 (44.7)%	317 (85)%
	University and above	308 (36.8)%	250 (81)%
P-value			0.278=P
Mother's Education Level	Primary and below	146 (17)%	127 (87)%
	Middle or Secondary school	387 (44)%	328 (85)%
	University and above	339 (39)%	279 (82)%
P-value			P=0.395
Mother's occupation	Worker	354 41)%(	295 (83)%
	Not Worker	518 (59) %	439 (85)%
P-value			P=0.574
SES	Low	548 (63)%	467 (84)%
	Moderate	136 (15)%	121 (89)%
	High	188 (22)%	146 (78)%
P-value			P=0.012*

a significant coefficient.*

Table 2: Oral health-related behaviors of children based on caries prevalence and severity.

Variables	Categories	N (%)	Caries prevalence (%)a
Total	—	872 (100%)	734 (84%)
Frequency of teeth cleaning	No "never"	127 (14.5%)	125(89%)
	Twice or more daily	545(62.5%)	414(76%)
	Not every day or seldom	200(23%)	195(97.5%)
P-value			P<0.001*
Plaque Prevalence	PI = 0	61(7%)	68(65%)
	PI > 0	811 (93%)	693(85%)
Visible plaque index (VPI)	Low	349(40%)	279(80%)
	Mild	314(36%)	280(89%)
	Sever	148(17%)	134(90%)
P-value			P=0.001*

***: a significant coefficient.**