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Prevalence and clinical risk factors of dental caries in Syrian children: a cross-sectional study

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This study aimed to estimate dental caries' prevalence and potential risk factors among schoolchildren aged 8–12 in Damascus, Syria. The study was cross-sectional and conducted between February 2023 and April 2024, the target population was 1,052 children selected using multi-stage cluster sampling. Dental caries were determined using the DMFT/dmft index, while additional information on sociodemographic status, and attitude towards oral hygiene practices, were collected via a structured questionnaire. Data analyses were conducted using the Statistical Package for Social Sciences (SPSS). The overall prevalence of dental caries was 90.8%. Males had a slightly higher prevalence (91.9%) than girls (89.8%). Children aged [10–12] years showed the highest caries prevalence (91.7%). The mean DMFT/dmft score was 2.07 ± 1.91/3.74 ± 2.25, respectively. Caries prevalence was significantly associated with the type of school attended, family size, socioeconomic status, and parental education. Additionally, the frequency of tooth brushing, dental flossing, and irregular dental visits were significantly linked to higher caries incidence. It was found that caries experience remains high in the children in Damascus, with many associated factors including their sociodemographic factors and oral behaviors. We confirm that visiting the dentist regularly, using dental floss, and brushing regularly decreased the prevalence of dental caries among children.

Keywords Caries, Children, Prevalence, Oral hygiene, Risk factors

Abbreviations

WHO	World Health Organization
DMFT	Decayed, missing, and filled teeth in the permanent teeth
dmft	Decayed, missing, and filled teeth in the primary teeth
PI	Plaque Index
SES	Socio economic status
SPSS	Statistical Package for Social Sciences
AAPD	American Academy of Pediatric Dentistry

Dental caries, also known as tooth decay, is a global issue and ranks as one of the most prevalent chronic diseases[1,2]. It arises from the interactions between tooth structure, microbial biofilm, sugars, and various genetic and salivary factors[2]. According to the World Health Organization (WHO), between 60 and 90% of schoolchildren and nearly 100% of adults in many countries have experienced caries[3]. Unlike previous studies that showed stable rates, the global prevalence of dental caries is currently on the rise[4].

Several risk factors contribute to the development of caries including physical, biological, environmental, and lifestyle influences. These encompass high levels of cariogenic pathogens, reduced salivary flow, insufficient fluoride exposure, poor oral hygiene, low socioeconomic status (SES) of the population, inappropriate infant feeding practices, and poverty[5,6]. Studies show that inadequate oral hygiene practices significantly increase the risk of developing dental caries[7]. In children, factors such as high sugar consumption, and mothers' poor oral health perceptions are strongly associated with the occurrence of caries[8].

Untreated dental caries and infections can pose serious health threats, leading to pain, restricted food intake, and a detrimental impact on children's quality of life, growth, sleep, and communication abilities[9–11]. However, dental treatment can greatly enhance children's psychological and social well-being, reducing pain and improving eating and sleeping habits. One study highlighted that parents observed positive social changes in their children post-treatment, including increased smiling, improved academic performance, and greater engagement in social activities[10].

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The prevalence of dental caries varies by region, with traditionally lower rates observed in developing countries and higher rates in developed nations[2,6,12]. This geographical disparity has become increasingly complex due to rapid economic growth and changes in dietary habits. Although minor differences may exist based on gender or ethnicity, these are largely overshadowed by more significant factors such as sugar intake, lifestyle choices, and economic status[2].

In recent years, Syria has encountered significant challenges due to ongoing conflict, which has severely impacted its healthcare system, including dental care services. This situation has resulted in a rise in dental issues, including cavities, gingivitis, and tooth loss, making dental health a pressing public health concern for children in Syria[13].

In 2011, Dashash and Blinkhorn[14], reported a 61% prevalence of dental caries among five-year-old children. By 2016, the rate for children aged 8–12 was 79.1%[15], while in 2019, the prevalence among 12-year-old children escalated to 86%[16]. By 2023, the prevalence of dental caries in children aged 10–13 years reached 90.4%[17].

Understanding the prevalence and risk factors associated with dental caries is crucial. However, data regarding these factors in pediatric patients in Syria remains sparse. While a limited survey on the prevalence of oral diseases has been conducted, the specific risk factors contributing to dental caries in children are still unclear. Therefore, this study aims to estimate the prevalence of dental caries and identify the associated risk factors among children in Damascus, Syria. The findings from this survey will be valuable for dental professionals and policymakers in designing effective dental services for school-aged children.

Materials and methods

Study design and settings

This observational cross-sectional study aimed to assess the prevalence of dental caries in children aged 8–12 years from February 2023 to April 2024. Participants were recruited from randomly selected public and private primary and secondary schools in Damascus. All procedures adhered to relevant guidelines and received ethical approval from the Ethical Research Committee at Damascus University (No. 2601), with additional written consent from the Ministry of Education. Informed consent was obtained from the guardians of all participants before data collection. The STROBE guidelines were followed in reporting this cross-sectional study.

Population sampling

To minimize selection bias, a multi-stage cluster sampling technique was employed in this study. This method involves dividing the population into clusters and randomly selecting samples from those clusters. The population included school children, selected from primary schools with ages ranging from 6/7 to 11/12, and secondary schools with ages ranging from 12/13 to 14/15 in Damascus.

The first stage of the cluster sampling dividing Damascus into nine localities based on the health sectors map provided by the Ministry of Health. In the second stage, schools were randomly selected from these areas, resulting in a total of 13 schools. In the third stage, a systematic random sampling method was employed to select every third child from class attendance lists, every third child listed in the attendance records for each class was selected, based on the total number of students present in the school.

School directors in the selected districts were contacted, and those who agreed to participate were included in the study. Parents received an informational brochure detailing the study's purpose, and methods, and a consent form.

The sample size was determined using the formula $\left[\text{Eq. (1)} : z^2 p \frac{1-p}{d^2}\right]$, which is recommended for descriptive cross-sectional studies[18]. 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[15]. The desired margin of error (d) was established at 3%. This calculation indicated a need for 702 participants, but 1052 children were ultimately recruited for the study.

Inclusion and exclusion criteria

Participants were selected based on signed informed consent provided by their parents. Eligibility was limited to boys and girls aged 8 to 12 of Syrian descent. Children who were uncooperative, had medical issues or chronic diseases, had orthodontic appliances, were smokers, or were special needs children were excluded from the study.

Study protocol and data collection

Strict sterilization protocols were adhered to during dental examinations. Each child's clinical examination was conducted individually using sterile mouth mirrors, WHO probes with a ball-shaped end (0.5 mm), gauze, and dental gloves. The child was seated with their head tilted at a horizontal angle of 45 degrees. Examinations were carried out in a specially prepared room at the participants' schools, utilizing natural light supplemented by a flashlight.

A structured questionnaire was employed to collect socio-demographic information, including age, gender, parental education level, occupation, total income, number of family members, sugar intake, and oral care practices. This included details on the timing and frequency of brushing, the use of oral hygiene aids like dental floss and mouthwash, parental involvement in oral care, and the frequency of dental visits. Parents were asked to complete this form with the specified information.

Dental examinations for all selected children were conducted in accordance with World Health Organization guidelines for caries diagnosis. To minimize inter-examiner variability only one examiner performed the assessments. Calibration procedures were implemented before and during the study to ensure consistent

diagnostic standards. Additionally, re-examinations were performed on approximately one in ten randomly selected children to monitor inter-examiner reliability.

Outcomes assessment

Age was formed into three groups for statistical purposes, the first one included age [8–10[, the second one [10–12[, and the latest one was 12 and above.

In epidemiological studies, various indices have been developed to identify dental caries and their associated causes and risks. The primary aim of these indices is to standardize data collection for comparing the prevalence of dental caries across different populations[19].

The status of permanent and primary teeth was assessed using the DMFT (Decayed, Missing, and Filled Permanent Teeth) and dmft (decayed, missing, and filled primary teeth) indices. For over 70 years, these indices have served as the primary tool for evaluating oral and dental health globally, and provide a comprehensive quantification of dental caries and their outcomes, making it essential for monitoring community oral health interventions and formulating related policies[20,21].

According to the WHO guidelines, DMFT is the sum of the number of Decayed, Missing, and Filled Teeth in the permanent teeth, with the D component representing all teeth affected by caries, filled with recurrent caries, only the roots are left and temporary filling, the M component accounts for teeth lost due to untreated caries, and the F component includes teeth filled without caries. For primary teeth, dmft index was used and the calculation of the dmft index followed a similar approach[21].

Plaque index (PI) was measured according to Löe and Silness, recording the presence of plaque with severity classified as follows: 1 = mild, 2 = moderate, and 3 = severe[22].

Statistical analysis

The collected data were analyzed using IBM SPSS software version 23 (IBM Corp., Armonk, USA). Descriptive statistics were presented as means, standard deviations, medians, counts (n), and percentages (%). *Kolmogorov-Smirnov test* indicated that the data followed a normal distribution; therefore, the student's t-test was utilized to compare two groups, while ANOVA was applied for comparisons among more than two groups. Categorical data were analyzed using the Pearson chi-square test, and logistic regression analysis was performed for multivariate analysis. A p-value of ≤ 0.05 was considered statistically significant.

Results

This survey included 1,052 children aged 8 to 12, with a nearly balanced gender distribution. The distribution of the sample according to demographic variables is presented in Table 1. The study found an overall dental caries prevalence exceeding 90%, with mean DMFT and dmft scores of 2.07 ± 1.91 and 3.74 ± 2.25, respectively. The associations between sociodemographic factors and caries prevalence, as well as the DMFT and dmft scores, are shown in Table 1.

Children who attended public schools, belonged to large families, had fathers and mothers with only primary education or lower, as well as those from low socioeconomic status (SES) backgrounds, exhibited the highest prevalence of dental caries, with statistically significant associations ($P < .001$, $P = .047$, $P < .001$, $P = .010$, $P < .001$, respectively). However, no significant association was found between caries prevalence and gender ($P = .228$), age ($P = .684$), or mother's occupation ($P = .171$). The DMFT scores demonstrated significant associations with gender ($P < .001$), age ($P < .001$), school type ($P = .002$), and paternal and maternal education levels ($P = .003$ and $P = .017$, respectively). Similarly, the dmft scores were significantly associated with age ($P < .001$), family size ($P = .001$), and maternal education level ($P = .042$) (Table 1).

Most children only brush their teeth once daily, with low use of dental floss and mouthwash. Parent involvement in their children's oral hygiene was limited, and dental visits were infrequent. Plaque accumulation was prevalent (Table 2). Oral hygiene behaviors were evaluated for associations with caries prevalence and dmft/DMFT scores and presented in Table 2.

Children who did not brush their teeth, did not use dental floss or mouthwash, visited the dentist only when necessary, had severe plaque accumulation, and lacked parental supervision, exhibited a higher prevalence of caries. All these factors were significantly associated with caries prevalence and dmft/DMFT scores ($P < .001$). Moreover, excessive sugar consumption was significantly associated with both caries prevalence ($P = .040$) and DMFT values ($P = .011$), while no significant association was found between dmft values and sugar intake ($P = .256$).

Multiple logistic regression indicated that three key variables were identified as risk factors for dental caries, including dental floss usage, dental visits, and brushing habits (Table 3). Children who did not use dental floss were more than two and a half times more likely to develop caries compared to those who did use it ($P = .008$). Additionally, the risk of caries was more than three times higher in children who had never visited the dentist ($P = .001$) and approximately nine times higher for those who only visited the dentist when necessary ($P < .001$) compared to those who had attended regular check-ups. In contrast, children who brushed their teeth in the morning (OR: 0.264, $P = .011$) or twice daily (OR: 0.350, $P = .010$) were significantly less likely to experience dental caries compared to those who did not maintain a consistent brushing routine.

Discussion

This survey aimed to evaluate the prevalence and allied determinants of caries among children in Damascus, Syria. Utilizing a cross-sectional design, a sample of 1052 children was selected through a multi-stage cluster sampling technique from various regions within Damascus, representing a broad range of socio-economic, demographic, and cultural characteristics. As the capital and largest urban center in Syria, Damascus functions

Variables	Categories	*N* (%)	Caries prevalence (%)[a]	dmft[b]	DMFT[b]
				Mean ± SD	Mean ± SD
Total		1052 (100%)	955 (90.8%)	3.74 ± 2.25	2.07 ± 1.91
Gender	Male	495(47.1%)	455 (91.9%)	3.84 ± 2.20	2.32 ± 2.05
	Female	557 (52.9%)	500 (89.8%)	3.66 ± 2.28	1.84 ± 1.75
P-value			*P* = .228	*P* = .245	***P* = < 0.001***
Age	[8–10[	404 (38.4%)	364 (90.1%)	4.60 ± 2.24	1.03 ± 1.12
	[10–12[	423 (40.2%)	388 (91.7%)	3.18 ± 1.97	2.38 ± 1.60
	≥ 12	225 (21.4%)	203 (90.2%)	1.82 ± 1.21	3.33 ± 2.51
P-value			*P* = .684	***P* = < 0.001***	***P* = < 0.001***
School type	Public	939 (89.3%)	864 (92%)	3.74 ± 2.27	2.13 ± 1.94
	Private	113 (10.7%)	91 (80.5%)	3.77 ± 2.08	1.53 ± 1.50
P-value			***P*= < 0.001***	*P* = .902	***P* = .002***
Family size	Small	515 (49%)	458 (88.9%)	3.46 ± 2.30	2.05 ± 1.93
	Medium	433 (41.2%)	397 (91.7%)	3.93 ± 2.21	2.07 ± 1.92
	Large	104 (9.9%)	100 (96.2%)	4.33 ± 1.94	2.12 ± 1.80
P-value			***P* = .047***	***P* = .001***	*P* = .957
Father's education level	Primary and below	189 (18.7%)	182 (96.3%)	3.97 ± 2.27	1.95 ± 1.78
	Middle or Secondary school	442 (43.7%)	406 (91.9%)	3.74 ± 2.14	2.30 ± 2.11
	University and above	381 (37.6%)	329 (86.4%)	3.63 ± 2.37	1.86 ± 1.72
P-value			***P* = < 0.001***	*P* = .321	***P* = .003***
Mother's education level	Primary and below	166 (15.8%)	155 (93.4%)	3.84 ± 2.30	2.20 ± 2.09
	Middle or Secondary school	462 (43.9%)	429 (92.9%)	3.93 ± 2.15	2.21 ± 2.01
	University and above	424 (40.3%)	371 (87.5%)	3.52 ± 2.30	1.86 ± 1.70
P-value			***P* = .010***	***P* = .042***	***P* = .017***
Mother's occupation	Worker	441 (41.9%)	394 (89.3%)	3.61 ± 2.20	1.99 ± 1.74
	Not Worker	611 (58.1%)	561 (91.8%)	3.84 ± 2.28	2.12 ± 2.02
P-value			*P* = .171	*P* = .149	*P* = .257
SES	Low	381 (36.2%)	359 (94.2%)	3.81 ± 2.10	2.09 ± 1.98
	Moderate	411 (39.1%)	379 (92.2%)	3.81 ± 2.30	2.17 ± 1.80
	High	206 (24.7%)	217 (83.5%)	3.55 ± 2.36	1.87 ± 1.96
P-value			***P* = < 0.001***	*P* = .357	*P* = .149

Table 1. Characteristics of students' oral health indices Dmft, DMFT, and caries prevalence according to their demographic variables. [a]Dichotomous estimate (proportion of children with any decayed, missing, or filled tooth: dmft + DMFT > 0 in %). [b]dmft/DMFT is an index to show teeth decayed, missing, or filled tooth. *A significant coefficient. SD: Standard deviation.

as a socio-demographic hub that accommodates residents from across the country, including large numbers of internally displaced persons fleeing conflict in rural and peripheral areas. The ongoing Syrian crisis has forced millions of families to relocate to urban centers like Damascus, seeking relative safety and access to essential services[23]. Consequently, the city has become a microcosm of Syria's population, blending urban residents with displaced individuals from diverse geographic and cultural backgrounds.

Compared to international dental health standards[24], the findings revealed a notably high prevalence of caries (90.8%), signaling a significant public health concern. The research offers vital insights into how sociodemographic, behavioral, and environmental factors impact dental health in Syrian children, underscoring broader healthcare challenges exacerbated by prolonged conflict, which has critically undermined healthcare infrastructure, including dental care services.

Worldwide, dental caries remains a major chronic condition, affecting 60–90% of school-aged children and nearly all adults[3]. This study particularly draws attention to the fact that over 90% of Syrian children suffer from caries with mean dmft and DMFT scores of 3.74 ± 2.25 and 2.07 ± 1.91, respectively. This signifies a substantial increase from a 2016 study by Ballouk and Dashash[15], which reported a prevalence of 79.1% and dmft/DMFT values of 2.47 ± 2.94/2.03 ± 1.81 in schoolchildren aged 8–12 in Damascus. In a different setting, Alhaffar et al.[16], stated that 12-year-olds had an 86% caries prevalence by 2019. However, it aligns with the 2023 study by Mesrabi et al.[17], which found a caries prevalence of 90.4% among children aged 10–13 years in Damascus, as well as similar rates in Iran (89.9%)[25], and Saudi Arabia (91.3%)[26]. The prevalence in this study exceeds that reported in other Asian and African countries and other regions worldwide, including India (74.7%)[27], North India (36.5%)[28], Ethiopia (46.9%)[9], and Brazil (55.5%)[29].

The heightened prevalence in Syria is likely attributed to differences in sample size, demographic factors, and dietary habits, which may account for the variations in results compared to other studies. However, greater emphasis should be placed on the unique factors contributing to this prevalence in the context of the Syrian

Variables	Categories	*N* (%)	Caries prevalence (%)[a]	dmft[b]	DMFT[b]
				Mean ± SD	Mean ± SD
Total		1052 (100%)	955 (90.8%)	3.74 ± 2.25	2.07 ± 1.91
Teeth brush (*N* = 1052)	Yes	885 (84.1%)	791 (89.5%)	3.58 ± 2.20	1.90 ± 1.67
	No "never"	167 (15.9%)	163 (97.6%)	4.65 ± 2.29	2.92 ± 2.72
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
Frequency of teeth cleaning (*N* = 885)	Once daily	454 (51.3%)	432 (95.2%)	3.69 ± 1.95	1.79 ± 1.49
	Twice or more daily	200 (22.6%)	141 (70.5%)	1.99 ± 1.86	1.15 ± 1.26
	Not every day or seldom	231 (26.1%)	219 (94.8%)	4.68 ± 2.16	2.79 ± 1.91
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
Teeth cleaning period (*N* = 885)	In the morning	48 (5.4%)	39 (81.3%)	3.73 ± 1.64	0.77 ± 0.90
	Before bedtime	328 (37.1%)	312 (95.1%)	3.59 ± 2.00	1.77 ± 1.52
	In the morning + before bedtime	197 (22.3%)	141 (71.6%)	2.19 ± 2.01	1.25 ± 1.31
	No fixed time	312 (35.3%)	300 (96.2%)	4.40 ± 2.18	2.63 ± 1.80
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
Visit your dentist	Never visit a dentist	423 (40.2%)	387 (91.5%)	3.63 ± 2.35	2.33 ± 2.13
	When I feel pain only	484 (46%)	469 (96.9%)	4.06 ± 2.06	2.16 ± 1.76
	Regularly	145 (13.8%)	99 (68.3%)	2.91 ± 2.39	0.98 ± 1.91
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
The habit of teeth flossing	Yes	131 (12.5%)	84 (64.1%)	2.22 ± 2.35	0.98 ± 1.22
	No	921 (87.5%)	871 (94.6%)	3.94 ± 2.15	2.22 ± 1.94
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
Use of mouthwash	Yes	36 (3.4%)	20 (55.6%)	1.75 ± 2.06	0.72 ± 1.11
	No	1016 (96.6%)	935 (92%)	3.81 ± 2.22	2.11 ± 1.91
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
Parental supervision in teeth cleaning	Yes	467 (44.4%)	391 (83.7%)	3.14 ± 2.26	1.51 ± 1.57
	No	585 (55.6%)	564 (96.4%)	4.20 ± 2.12	2.51 ± 2.04
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
sugary snacking habits	Once or less	993 (94.4%)	897 (90.3%)	3.72 ± 2.226	2.02 ± 1.87
	More than once	59 (5.6%)	58 (98.3%)	4.11 ± 2.02	2.85 ± 2.39
P-value			***P* = .040***	*P* = .256	***P* = .011***
Plaque prevalence	PI = 0	103 (9.8%)	68 (66%)	1.77 ± 2.09	1.01 ± 1.46
	PI < 0	949 (90.2%)	887 (93.5%)	3.96 ± 2.16	2.18 ± 1.92
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***
Visible plaque index (VPI)	Low	419 (43.8%)	370 (88.9%)	3.43 ± 1.95	1.62 ± 1.49
	Mild	362 (38.1%)	349 (96.4%)	4.12 ± 2.22	2.46 ± 1.88
	Sever	171 (18%)	168 (98.2%)	4.89 ± 2.12	2.95 ± 2.46
P-value			***P* = < 0.001***	***P* = < 0.001***	***P* = < 0.001***

Table 2. Oral health-related behaviors of children based on caries prevalence and severity. [a]Dichotomous estimate (proportion of children with any decayed, missing, or filled tooth: dmft + DMFT > 0 in %). [b]dmft/DMFT is an index to show teeth decayed, missing, or filled tooth. *A significant coefficient. SD: Standard deviation.

conflict. While previous studies in Syria have documented high caries rates[15–17], the present findings highlight a notable increase compared to earlier research. This upward trend underscores the worsening impact of war-related disruptions on oral health. Furthermore, the conflict has severely impacted public health services, limiting access to dental care and exacerbating socioeconomic challenges. Restricted access to health and education services has been a significant consequence of the Syrian crisis[30]. Hundreds of dental clinics were closed, and many specialists emigrated during the conflict[31]. Alhaffar et al.[16], reported a marked neglect of oral health during this period, with increased rates of dental decay and tooth loss due to necrosis. Similarly, Saltaji highlighted the adverse effects of the war on refugees, including decreased oral hygiene and heightened prevalence of periodontal diseases such as chronic generalized gingivitis and periodontitis[31]. Economic hardship has further compounded these issues, forcing many Syrians to prioritize basic necessities like food over oral hygiene products such as toothbrushes and toothpaste[16,31]. Emphasizing these factors will highlight this study's novel contributions and strengthen its relevance for public health interventions in conflict-affected regions.

The study found a slightly higher prevalence of dental caries recorded in boys compared to girls, though the difference was not statistically significant. This finding is in concordance with other findings[28], suggesting that access to care and parental supervision may outweigh gender-specific behaviors in this context. Conversely,

Variables	Categories	*P*-value	OR	95% CI (lower–higher)	
Dental floss	No	**0.008***	2.583	1.275	5.234
	Yes	Reference			
Brush time	In the morning	**0.011***	0.264	0.095	0.733
	Before bedtime	0.515	1.336	0.559	3.194
	In the morning + before bedtime	**0.010***	0.350	0.157	0.780
	No fixed time	Reference			
Visit doctor	Never visit a dentist	**0.001***	3.304	1.591	6.864
	When I feel pain only	< **0.001***	9.102	3.910	21.191
	Regularly	Reference			

Table 3. Logistic regression model identifying risk factors for dental caries among schoolchildren ($N = 1052$). *A significant coefficient. OR: Odds Ratio. CI: Confidence Interval.

other researchers mentioned a higher level of caries in males[9,32,33], while others stated the same in females[25,34]. These discrepancies may arise from variations in regional and age group factors.

The current study revealed comparable caries rates across various age groups. Children ages 8 to 10 had the highest dmft score and the lowest DMFT score, indicating that early adolescence may be a critical period for the development of caries. This may be a result of dietary changes, poor oral hygiene habits, and a delay in preventive therapy. Younger children are particularly susceptible due to their transition from primary to permanent teeth and underdeveloped self-care habits, compounded by thinner enamel in primary teeth[28,34]. As age increases, dmft scores tend to decline while DMFT scores rise, likely due to a lack of awareness regarding the importance of maintaining primary teeth and the misconception that they are less valuable since they will be replaced by permanent teeth. The early loss of primary teeth may result in the premature eruption of permanent teeth, making them more vulnerable to caries, which aligns with previous studies conducted in Egypt, India, and Iran[25,32,35].

Children from families with lower SES exhibited a higher prevalence of dental caries. The study demonstrated that children in public schools had a significantly higher caries prevalence compared to those in private schools. This disparity emphasizes the impact of SES on oral health outcomes. Children in public schools, often from lower-income families, may encounter limited access to dental care, lower awareness of oral hygiene, and reduced parental involvement in their oral health. These findings are consistent with studies linking low SES to increased caries risk[16,25,32]. Conversely, other studies have reported higher caries prevalence in children from higher SES families, potentially due to increased sugar consumption and frequent snacking[36,37]. However, Ghandour found no statistically significant difference in caries prevalence among socioeconomic groups[38].

A strong correlation was identified between lower parental education levels and higher caries rates. This finding aligns with studies indicating that parental education significantly influences children's oral health behaviors, as higher educational attainment is often associated with improved health literacy and preventive care[39,40], although some studies found no significant relationship[41].

Larger families demonstrated a higher prevalence of dental caries, potentially indicating limited financial and educational resources, limited access to oral healthcare, as well as reduced parental attention per child to oral hygiene, as suggested by prior research[14,42,43]. Maternal occupation has a multifaceted impact on children's oral health and caries rates. This study did not find a significant correlation with caries prevalence, aligning with previous research findings[40,44]. Nonetheless, a substantial correlation was found in another study, suggesting that children of working mothers experienced higher rates of caries[45]. This may be attributed to less supervision and inconsistent family routines, which can adversely affect dietary habits and dental care practices.

This study provides compelling evidence connecting poor oral hygiene practices to the elevated prevalence of dental caries among children in Damascus. Children who failed to brush their teeth had a caries prevalence of 97.6%, accompanied by high dmft and DMFT scores. Infrequent brushing and lack of commitment to a brushing routine were also linked to higher caries rates, whereas children who brushed twice daily exhibited significantly fewer caries. These results underscore the crucial role of regular tooth brushing in caries prevention, in line with existing research[28,32,34].

Parental supervision emerged as another critical factor, with more than half of parents not monitoring their children's brushing habits, contributing to increased caries rates. This finding is supported by studies conducted in Ethiopia[9], Egypt[32], and Syria involving 5-year-old children[14], which suggests that a lack of parental involvement is associated with poor oral hygiene and excessive sugar consumption, both of which are linked to high caries rates.

The infrequent use of oral hygiene aids such as dental floss and mouthwash further heightens the risk of caries in this population. The low adoption of these practices may result from limited education or financial constraints that restrict access to these products. Children who utilized these aids had significantly lower dmft and DMFT scores, highlighting the importance of interdental cleaning in preventing plaque accumulation and decay. Previous research indicates that individuals who regularly brush their teeth and use dental floss tend to possess better oral health knowledge[46].

The study also identified a strong association between irregular dental visits and caries prevalence. Children who only visited the dentist when experiencing pain had the highest caries rates and dmft scores, compared to

those with regular check-ups. This emphasizes the importance of preventive dental care, where regular visits enable early intervention and limit the progression of caries. The significant association between regular dental check-ups and reduced caries prevalence observed in this study aligns with findings from previous research[47,48]. The high odds ratios (OR) for children who never visited a dentist (OR: 3.304) or only visited when necessary (OR: 9.102) underscore the necessity for public health strategies that promote regular dental visits, particularly in underserved communities.

Dietary factors also had a substantial impact, with increased sugar consumption correlating with higher caries indices, consistent with other studies[32,34]. However, McDonald's could not establish any correlation between sugar intake and caries prevalence, as noted in the study by Plaka et al.[28].

Plaque accumulation was notably prevalent, affecting 90% of the children. Those with severe plaque exhibited significantly higher caries rates and dmft/DMFT scores. This is in concordance with the American Academy of Pediatric Dentistry's guidelines (AAPD), which associate plaque buildup with an increased risk of caries in young children[49].

The findings of this study, which reveal a high prevalence of dental caries, carry significant implications for policymakers and dental health providers, highlighting the urgent need for targeted public health interventions, especially in conflict-affected areas such as Damascus. The collapse of healthcare infrastructure, economic instability, and conflict-induced displacement exacerbate oral health disparities, making it imperative to implement sustainable, low-cost, community-focused strategies.

Addressing the worsening oral health crisis requires a multifaceted approach that combines policy interventions that include integrating oral health into broader public health programs, supporting essential dental products, and expanding preventive dentistry programs, particularly in schools. Additionally, strengthening the healthcare system by rebuilding and equipping public dental clinics, encouraging the return of dental professionals, and training community health workers to provide basic oral health education and preventive care. The deployment of mobile dental units in underserved areas can improve access to essential dental services and preventive treatments for populations with limited access to fixed healthcare facilities. Finally, implementing targeted community-based programs such as oral health awareness campaigns targeting parents and school children to improve oral hygiene practices, fluoridation initiatives, and nutritional interventions to reduce sugar consumption, are crucial, particularly in displaced communities with low health literacy. By addressing these challenges through coordinated efforts, policymakers and healthcare providers can improve oral health outcomes and overall well-being in post-conflict communities.

While this study offers valuable insights, certain limitations should be acknowledged. The cross-sectional design restricts the ability to make causal inferences, and the reliance on self-reported data, which may introduce potential recall bias. Conducted solely in Damascus, because logistical and security issues made nationwide sampling impractical. Despite the large and diverse sample, replication in various locations is necessary to assess the broader applicability of the results. Additionally, the absence of radiographic imaging may have affected the diagnostic accuracy. Future research should employ longitudinal designs and radiographic assessments to more effectively evaluate caries risk factors and progression in children.

Conclusion

This study provides valuable insights into the prevalence of caries and the effects of sociodemographic factors and oral behaviors on dental caries in children. The prevalence of dental caries among schoolchildren in Damascus, Syria remains notably high, with an incidence rate of approximately 91%. This study identifies significant associations between dental caries prevalence and various sociodemographic and behavioral factors, including lower parental education levels, enrollment in public schools, larger family size, low socioeconomic status, infrequent dental visits, lack of dental floss and mouthwash use, high sugar consumption, inconsistent tooth brushing habits, and insufficient parental supervision.

Statistical analyses in this study identified irregular dental visits, lack of flossing, and unreliable brushing routines as the most common risk factors for developing dental caries among children aged 8–12 in Damascus. Conversely, no significant association was observed between caries prevalence and age, gender, or maternal occupation.

Data availability

The data provided for the results presented in this study is available through the corresponding author upon request.

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Author contributions

L.A.SH.: collected the data, did the clinical work, interpreted the data, wrote the manuscript, and participated in designing the study. M.D.: participated as the research supervisor and contributed in study design, data analysis, and writing of the manuscript. L.A.SH.: made the final proof. All authors have read and approved the manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

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