


## Pattern and Severity of Early Childhood Caries among Preschool Children in Northern Region, Saudi Arabia: A Cross-Sectional Study

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### Abstract

**Objective:** To investigate the pattern and severity of early childhood caries (ECC) by using the decayed and filled surface (dfs) index in preschool children in Al-Jouf, Saudi Arabia. **Material and Methods:** A convenience sample of 270 preschool children below 5 years of age (144 boys, 126 girls) attending outpatient pediatric dental clinics was selected for the study. World Health Organization criteria were used to diagnose caries through assessment of the dfs index. Information regarding oral hygiene practices, socio-economic status, and educational status of the mother was obtained through a structured questionnaire given to mothers. The data were statistically analyzed with the Chi-square test and Student's t-test. **Results:** 73% of children were not brushing regularly; 74.4% of them were using fluoridated toothpaste. In the maxillary teeth, boys had a higher mean dfs index (10.25), as well as a higher number of decayed surfaces (ds), than girls. In the mandibular teeth, boys and girls had similar mean dfs indices. Significant differences were observed between boys and girls regarding filled buccal surfaces ( $p=0.001$ ) and occlusal surfaces ( $p=0.001$ ) in maxillary teeth. The mandibular first molar was the most commonly affected tooth (93.3%); lower anterior teeth were the least affected teeth (2-4%) among the primary dentition. **Conclusion:** The ECC pattern in the northern region of Saudi Arabia follows the typical pattern of nursing caries.

**Keywords:** Child, Preschool; Dental Care for Children; Dental Caries; Tooth, Deciduous.

## Introduction

Caries is an infectious disease, the effects of which include pain, inadequate nutrition, speech problems, sleep disturbances, and orthodontic problems, in children; psychological effects are observed in both children and parents due to poor esthetics [1]. Early childhood caries (ECC) has been defined as the presence of any decayed, missing, or filled teeth in children under 6 years of age; severe early childhood caries (S-ECC) is indicated by the presence of any smooth surface caries in children under 3 years of age [2-5].

Several studies have revealed very high caries prevalence among preschool children in Saudi Arabia (KSA) [6,7]. Recent reports from developed countries indicate unequal distributions in caries prevalence among preschoolers, with higher caries prevalence and severity in certain ethnic and immigrant groups [8,9]. However, caries prevalence and severity are reportedly high in Middle Eastern countries (2012-2014). In 2015, it was reported that the mean decayed, missing, and filled teeth (dmft) and decayed, missing, and filled tooth surfaces (dmfs) indices of Emirati preschool children were 10.9 and 32.1, respectively [10]. Whereas in Saudi preschool children, it was found that mean dmft was 6.1 [11].

There is a lack of critical research and scarcity of information regarding the prevalence and severity of ECC in preschool children in KSA [12,13]. This is likely related to the difficulty inherent in gaining access to patients in the pre-school age group. However, the need for data regarding the oral health of pre-school children remains important with respect to caries prevalence, pattern, and severity; these data form the basis for determining the magnitude and quality of caries prevention programs and treatment needs in a population. Therefore, there is an ongoing need to assess caries patterns and severity. In KSA, dental caries is regarded as a major public health problem [14].

Therefore, the present study was performed to investigate the pattern and severity of ECC by using the decayed and filled surface (dfs) index in preschool children who visited a pediatric dental clinic in Al-Jouf province, KSA.

## Material and Methods

### Study Design and Sample

This cross-sectional study was conducted in the city of Sakaka, which is the capital of Al-Jouf province, located in the northern region of KSA; it had an estimated population of 517,500 in 2016.

A convenience sample of 270 preschool children below 5 years of age, who visited an outpatient pediatric dental clinic was selected for the study. The study was conducted during the period from March 2018 to September 2018. In the present study, children with ECC were included; children with special health care needs were excluded, as were those whose parents/caregivers refused to allow their child to participate.

### Data Collection

A type III clinical examination was performed by a single examiner using disposable mouth mirrors and artificial light on a dental chair. The community periodontal index (CPI) probe was used to confirm visual evidence of caries. During the examination, older children were seated on a dental chair (i.e., those who could sit in the dental chair did so; these were “older” children), whereas younger children were examined with their mothers’ assistance by means of the “knee-to-knee” position. Five to 10 preschool children were examined per week. A trained dental assistant assisted in recording codes at the chairside.

World Health Organization criteria [15] were used to diagnose caries by using the dfs index. Each individual surface of the tooth (i.e., buccal, lingual, mesial, distal, and occlusal) was examined and recorded. No radiographs were taken for this study. A dental health questionnaire was prepared, which included a series of questions regarding the child’s age, socio-economic status, mother’s education level, and oral hygiene practices, such as tooth brushing frequency; the parents were asked about the use of commercially available fluoridated toothpaste; they were also asked about the usage of non-fluoridated toothpaste, such as herbal Meswak® (Dabur Products, New Delhi, India).

We defined low economic status as monthly income between 2000-4000 Saudi Riyals; middle economic status was defined as monthly income between 5000-9000 Saudi Riyals; high economic status was defined as a monthly income of more than 10,000 Saudi Riyals [16]. With regard to the mother’s education level, we considered the mother to be uneducated if she had no formal education since birth. Completion of high school was considered a low educational level; completion of a bachelor’s degree or higher was considered a high educational level [16].

#### Examiner Calibration

A single experienced pediatric dentist participated in the study; intra-examiner reproducibility was assessed by the Kappa ( $\kappa$ ) statistic. To ensure reliability during the study, the examiner re-examined 10% of the children and reproducibility was assessed; the intra-examiner Kappa value was 0.82.

#### Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows Software, version 22 (IBM Corp., Armonk, NY, USA). The Chi-square test and Student’s t-test were applied; p-value was considered as statistically significant at  $<0.05$ .

#### Ethical Aspects

Consent was obtained from parents/caregivers before each child was enrolled. This study was performed in accordance with the ethical principles and approval of the Local Committee of Bioethics, Jouf University, KSA (Approval No. 14-16-8/39). All procedures were in accordance with the Declarations of Helsinki.

## Results

Of 270 participants, 53.3% were boys and 28.5% had high socio-economic status. Regarding mother's education level, 61.5% of the mothers had low education status (Table 1). The analysis of hygiene habits revealed that 73% of children were not brushing regularly and 74.4% of children were using fluoridated toothpaste.

**Table 1. Distribution of the sample according to demographic and oral hygiene characteristics.**

| Characteristics.              |             |      |         |
|-------------------------------|-------------|------|---------|
| Variables                     | Frequency   |      | p-value |
|                               | N           | %    |         |
| Mean Age (Years)              | 4.70 ± 0.81 |      |         |
| Gender                        |             |      |         |
| Male                          | 144         | 53.3 | 0.1307  |
| Female                        | 126         | 46.7 |         |
| Socioeconomic Status          |             |      |         |
| High                          | 77          | 28.5 | 0.0001* |
| Medium                        | 126         | 46.7 |         |
| Low                           | 67          | 24.8 |         |
| Maternal Education Level      |             |      |         |
| Low                           | 166         | 61.5 | 0.0001* |
| High                          | 99          | 36.7 |         |
| Uneducated                    | 5           | 1.8  |         |
| Tooth Brushing Frequency      |             |      |         |
| Not Regular                   | 197         | 73.0 | 0.0001* |
| Once                          | 64          | 23.7 |         |
| Twice                         | 9           | 3.3  |         |
| Use of Fluoridated Toothpaste |             |      |         |
| Yes                           | 201         | 74.4 | 0.0001* |
| No                            | 69          | 25.6 |         |

\*Statistically Significant.

The number of decayed surfaces was greater in male children, compared with females; this was statistically significant. Further, significant differences were observed between boys and girls regarding filled buccal surfaces ( $p=0.001$ ) and occlusal surfaces ( $p=0.001$ ) in maxillary teeth (Table 2).

**Table 2. Comparison of prevalence of decayed and filled teeth at various surfaces in maxillary and mandibular teeth between males and females.**

| Condition | Surfaces | Maxillary |             |            |         | Mandibular |             |            |         |
|-----------|----------|-----------|-------------|------------|---------|------------|-------------|------------|---------|
|           |          | Male<br>N | Female<br>N | Total<br>N | p-value | Male<br>N  | Female<br>N | Total<br>N | p-value |
| Decayed   | Distal   | 102       | 72          | 174        | 0.0190* | 90         | 90          | 180        | 0.0850  |
|           | Mesial   | 90        | 54          | 144        | 0.0010* | 66         | 59          | 125        | 0.7830  |
|           | Buccal   | 78        | 54          | 132        | 0.0640  | 84         | 71          | 155        | 0.8520  |
|           | Lingual  | 78        | 54          | 132        | 0.0640  | 66         | 77          | 143        | 0.0080* |
|           | Occlusal | 120       | 108         | 228        | 0.5910  | 139        | 119         | 258        | 0.7930  |
|           | Labial   | 60        | 18          | 78         | 0.0001* | 0          | 0           | 0          | 1.0000  |
|           | Incisal  | 12        | 0           | 12         | 0.0010* | 0          | 0           | 0          | 1.0000  |
|           | Palatal  | 36        | 12          | 48         | 0.0010* | 0          | 0           | 0          | 1.0000  |

|        |          |    |   |    |         |    |    |    |        |
|--------|----------|----|---|----|---------|----|----|----|--------|
| Filled | Distal   | 0  | 0 | 0  | 1.0000  | 12 | 18 | 30 | 0.1110 |
|        | Mesial   | 0  | 0 | 0  | 1.0000  | 18 | 12 | 30 | 0.4640 |
|        | Buccal   | 12 | 0 | 12 | 0.0010* | 18 | 18 | 36 | 0.6330 |
|        | Lingual  | 0  | 0 | 0  | 1.0000  | 12 | 6  | 18 | 0.2540 |
|        | Occlusal | 12 | 0 | 12 | 0.0010* | 18 | 17 | 35 | 0.7730 |
|        | Labial   | 0  | 0 | 0  | 1.0000  | 0  | 0  | 0  | 1.0000 |
|        | Incisal  | 0  | 0 | 0  | 1.0000  | 0  | 0  | 0  | 1.0000 |
|        | Palatal  | 0  | 0 | 0  | 1.0000  | 0  | 0  | 0  | 1.0000 |

\*Statistically Significant.

Overall mean dfs index in maxillary teeth was higher in males (10.25) than in females (7.05) and was significant ( $p=0.002$ ). Among the individual decayed surfaces, statistically significant differences were found in all tooth surfaces, except palatal surfaces of the molars (Table 3).

**Table 3. Comparison of mean maxillary decayed teeth between males and females.**

| Surface  | Condition | Male  |           | Female |           | t-value | p-value |
|----------|-----------|-------|-----------|--------|-----------|---------|---------|
|          |           | Mean  | Std. Dev. | Mean   | Std. Dev. |         |         |
| Distal   | Decayed   | 1.75  | 1.59      | 1.33   | 1.73      | 2.0569  | 0.0407* |
|          | Filled    | 0.00  | 0.00      | 0.00   | 0.00      | --      | --      |
| Mesial   | Decayed   | 1.96  | 1.77      | 1.14   | 1.59      | 3.9562  | 0.0001* |
|          | Filled    | 0.00  | 0.00      | 0.00   | 0.00      | --      | --      |
| Buccal   | Decayed   | 1.13  | 1.24      | 0.81   | 1.18      | 2.1297  | 0.0341* |
|          | Filled    | 0.17  | 0.55      | 0.00   | 0.00      | 3.3719  | 0.0009* |
| Lingual  | Decayed   | 1.21  | 1.39      | 1.00   | 1.39      | 1.2311  | 0.2194  |
|          | Filled    | 0.00  | 0.00      | 0.00   | 0.00      | --      | --      |
| Occlusal | Decayed   | 2.63  | 1.44      | 2.24   | 1.42      | 2.2168  | 0.0275* |
|          | Filled    | 0.17  | 0.55      | 0.00   | 0.00      | 3.3719  | 0.0009* |
| Labial   | Decayed   | 0.88  | 1.27      | 0.43   | 1.10      | 3.0629  | 0.0024* |
|          | Filled    | 0.00  | 0.00      | 0.00   | 0.00      | --      | --      |
| Incisal  | Decayed   | 0.13  | 0.44      | 0.00   | 0.00      | 3.1844  | 0.0016* |
|          | Filled    | 0.00  | 0.00      | 0.00   | 0.00      | --      | --      |
| Palatal  | Decayed   | 0.25  | 0.43      | 0.10   | 0.29      | 3.3755  | 0.0008* |
|          | Filled    | 0.00  | 0.00      | 0.00   | 0.00      | --      | --      |
| Total    | Decayed   | 9.92  | 7.29      | 7.05   | 6.62      | 3.3675  | 0.0009* |
|          | Filled    | 0.33  | 1.11      | 0.00   | 0.00      | 3.3719  | 0.0009* |
|          | dfs       | 10.25 | 7.42      | 7.05   | 6.62      | 3.7191  | 0.0002* |

\*Statistically Significant; t-test.

Among the mandibular teeth, mean dfs indices for male and female children were 8.41 and 8.59, respectively ( $p>0.05$ ) (Table 4).

**Table 4. Comparison of mean mandibular decayed teeth between males and females.**

| Surface | Condition | Male |           | Female |           | t-value | p-value |
|---------|-----------|------|-----------|--------|-----------|---------|---------|
|         |           | Mean | Std. Dev. | Mean   | Std. Dev. |         |         |
| Distal  | Decayed   | 1.16 | 1.25      | 1.49   | 1.51      | -1.9629 | 0.0507  |
|         | Filled    | 0.12 | 0.44      | 0.19   | 0.50      | -1.1834 | 0.2377  |
| Mesial  | Decayed   | 0.91 | 1.26      | 0.86   | 1.13      | 0.3704  | 0.7114  |
|         | Filled    | 0.21 | 0.58      | 0.10   | 0.30      | 1.9424  | 0.0531  |
| Buccal  | Decayed   | 1.37 | 1.58      | 1.34   | 1.60      | 0.1523  | 0.8790  |
|         | Filled    | 0.41 | 1.19      | 0.43   | 1.34      | -0.1183 | 0.9059  |
| Lingual | Decayed   | 1.12 | 1.48      | 1.23   | 1.28      | -0.6755 | 0.5000  |
|         | Filled    | 0.12 | 0.44      | 0.10   | 0.43      | 0.5305  | 0.5962  |

|          |         |      |      |      |      |         |        |
|----------|---------|------|------|------|------|---------|--------|
| Occlusal | Decayed | 2.82 | 1.22 | 2.62 | 1.22 | 1.3180  | 0.1886 |
|          | Filled  | 0.17 | 0.47 | 0.24 | 0.61 | -1.1252 | 0.2615 |
| Labial   | Decayed | 0.00 | 0.00 | 0.00 | 0.00 | --      | --     |
|          | Filled  | 0.00 | 0.00 | 0.00 | 0.00 | --      | --     |
| Incisal  | Decayed | 0.00 | 0.00 | 0.00 | 0.00 | --      | --     |
|          | Filled  | 0.00 | 0.00 | 0.00 | 0.00 | --      | --     |
| Palatal  | Decayed | 0.00 | 0.00 | 0.00 | 0.00 | --      | --     |
|          | Filled  | 0.00 | 0.00 | 0.00 | 0.00 | --      | --     |
| Total    | Decayed | 7.37 | 5.45 | 7.54 | 5.50 | -0.2449 | 0.8067 |
|          | Filled  | 1.03 | 2.73 | 1.06 | 2.68 | -0.0651 | 0.9482 |
|          | dfs     | 8.41 | 5.79 | 8.59 | 5.96 | -0.2584 | 0.7963 |

The dental caries pattern was compared among the various deciduous teeth. Among the posterior teeth, the mandibular first molar was the most commonly affected tooth, followed by the mandibular second molar, maxillary second molar, and maxillary first molar. Among the anterior teeth, the maxillary central incisor was the most commonly affected tooth, followed by maxillary canines and lateral incisors; least affected were the mandibular anterior teeth (2-4%) (Table 5).

**Table 5. Comparison of prevalence of dfs in maxillary and mandibular sides in different teeth between males and females.**

| Tooth           | Maxillary |      |        |      |       |      |         | Mandibular |      |        |      |       |      |         |
|-----------------|-----------|------|--------|------|-------|------|---------|------------|------|--------|------|-------|------|---------|
|                 | Male      |      | Female |      | Total |      | p-value | Male       |      | Female |      | Total |      | p-value |
|                 | N         | %    | N      | %    | N     | %    |         | N          | %    | N      | %    | N     | %    |         |
| 1st Molar       | 120       | 83.3 | 84     | 66.7 | 204   | 75.6 | 0.0010* | 139        | 95.9 | 113    | 90.4 | 252   | 93.3 | 0.0730  |
| 2nd Molar       | 120       | 83.3 | 102    | 81.0 | 222   | 82.2 | 0.6100  | 126        | 86.9 | 113    | 90.4 | 239   | 88.5 | 0.3680  |
| Canine          | 42        | 29.2 | 36     | 28.6 | 78    | 28.9 | 0.9100  | 30         | 20.7 | 24     | 19.2 | 54    | 20.0 | 0.7600  |
| Lateral Incisor | 36        | 25.0 | 24     | 19.0 | 60    | 22.2 | 0.2400  | 6          | 4.1  | 0      | 0.0  | 6     | 2.2  | 0.0210* |
| Central Incisor | 60        | 41.7 | 30     | 23.8 | 90    | 33.3 | 0.0020* | 6          | 4.1  | 6      | 4.8  | 12    | 4.4  | 0.7920  |

\*Statistically Significant.

## Discussion

This survey was conducted on preschool children within an outpatient dental clinic at the College of Dentistry, Jouf University, to assess the pattern and severity of ECC. Information regarding the caries pattern in preschool children assists in understanding the caries expression and appropriate prevention and treatment planning.

The caries burden is reportedly higher in Riyadh than in the Jeddah region [13]. This difference in caries prevalence may be attributed to a diverse array of caries risk factors; sociodemographic and social variables are considered high-risk factors predictive of ECC [17]. Caries prevalence has been related to a variety of socioeconomic factors, and a higher prevalence of caries has been observed among individuals with low socioeconomic status [18]. Earlier studies conducted in Saudi children found an association between low prevalence of caries and high socioeconomic status [19-21]. Moreover, ECC was more prevalent among Saudi preschool children whose mothers were less educated [22]. A similar result was observed in our study: 61.5% of mothers had a low education level. Notably, more than half of the parents/caregivers were using fluoridated toothpastes for their children in our study population. In a prior report, more than half of

Saudi mothers were unaware whether their toothpaste was fluoridated [20]. In our study, 73% of the children either never or rarely brushed their teeth. Parents' dental knowledge and attitudes toward their own dental health have been significantly associated with their children's oral health and oral hygiene practices [20]. Oral hygiene measures should be implemented upon eruption of the first primary tooth; twice-daily use of fluoridated toothpaste with a soft toothbrush of appropriate size is recommended [23].

In our study, in the maxillary arch, the most highly involved decayed tooth was the second primary molar (82.2%), followed by the first primary molar (75.6%), central incisor (33.3%), canine (28.9%), and lateral incisor (22.2%). In the mandibular arch, the most highly involved tooth was the first primary molar (93.3%) followed by the second primary molar (88.5%), canine (20%), central incisor (4.4%), and lateral incisor (2.2%). The caries pattern in the study population, particularly the high percentage of carious maxillary incisors and minimal involvement of mandibular incisors, are suggestive of the nursing caries pattern. These findings were similar to those of other published reports [6,24-27]. This may be because mandibular teeth are less subjected to dryness due to the protective mechanism of saliva [28].

In the present study, it was observed that, regarding decayed surfaces (ds), the occlusal surface was most highly involved in the maxillary arch, followed by distal, mesial, buccal, lingual, labial, palatal, and incisal surfaces. In the mandibular arch, the occlusal surface was the most highly involved surface, followed by distal, buccal, lingual, and mesial surfaces. It was also observed that mandibular lower labial surfaces, as well as incisal and lingual surfaces, were not involved in decay in our study sample; this is suggestive of a nursing caries pattern. In our study, posterior teeth were more affected by caries than anterior teeth. These findings were similar to those of other published reports [6,24-26,29]. This may be due to the complex morphological nature of posterior teeth. In our study, occlusal surfaces were most frequently affected by caries, followed by proximal surfaces and smooth surfaces. This is not in agreement with a study performed in Chandigarh, India [29], where proximal surfaces were more affected than occlusal surfaces, due to higher involvement of proximal surfaces of anterior teeth with nursing bottle caries. Such a high prevalence of caries is alarming and is indicative of a need for strong oral hygiene education among parents of preschool children, and, even more importantly, continuous follow-up reinforcement. The high prevalence of nursing caries and the dmft scores in the children could be attributed to lack of dietary and oral hygiene discipline, in addition to very late first dental visit for a routine checkup.

In our study, nearly similar higher mean values were found for decayed occlusal surfaces of the maxillary and mandibular arch, compared with other tooth surfaces, between boys and girls. Several studies reported that the maxillary arch was more affected than the mandibular arch [6,30]. However, the prevalence of ECC in one country typically cannot be compared with another; results from one ethnic group cannot be extrapolated beyond that group, even within the same country [31]. In the present study, it was observed that decayed component were the major components of the dfs index, suggesting a large unmet treatment need. This finding was similar to that of other



studies conducted on preschool children [32,33]. This may be due to a lack of oral awareness in the parents, or to oral hygiene practices, high cost of dental treatment, and/or limited accessibility and availability of dental services.

The results of this study cannot be generalized because the study sample was not representative of the entire population of Al-Jouf preschool children. The main limitation in this study is the limited number of study population; the study cannot be compared with other regional studies because the study population in this study consisted of children presenting for their screening visits in a pediatric dental clinics (i.e., a convenience sample). As such, this was the only center where a pediatric dentist was available in the entire Al-Jouf region. Many preschool children are referred from primary dental centers to Jouf University dental center every day. The results found in this study represent a baseline for further research and the resources required to serve Al-Jouf preschool children. As limitations, non-cavitated lesions could not be recorded in our study; therefore, underestimation of the severity of the ECC might be present in our study.

Prevention of ECC can be achieved by the education of prospective and new parents, as well as by the identification of “high risk” children [34]. Such preventive strategies should be focused on the individual mother and child by preventing the transfer of cariogenic bacteria from mother to infant, using preventive agents such as fluoride and teaching good oral hygiene practices [35]. The high level of dental decay in Al-Jouf preschool children in this study could be attributed to prolonged bottle-feeding, high sweets consumption, poor oral hygiene, and lack of regular dental visits. Therefore, prevention is recommended for the continuing problem of ECC. Although it is an infectious and transmissible disease, it is preventable with individual and community-based intervention. Therefore, studies investigating ECC must address particularly longitudinal studies, because different exposures can vary over time. Further studies with a greater number of samples and from different regions of KSA are strongly recommended.

## Conclusion

In the maxillary arch, the most highly involved decayed tooth (d) is the second primary molar, followed by the first primary molar, central incisor, canine, and lateral incisor. In the mandibular arch, the most highly involved tooth is the first primary molar, followed by the second primary molar, canine, central incisor, and lateral incisor. Regarding decayed surfaces (ds), the occlusal surface was most highly involved in the maxillary arch, followed by distal, mesial, buccal, lingual, labial, palatal, and incisal surfaces. In the mandibular arch, the occlusal surface was the most highly involved surface, followed by distal, buccal, lingual, and mesial surfaces. The children in this study demonstrated a nursing caries pattern.

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