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Developmental defect of enamel and caries experience on first permanent molar in primary school children in district of Sungai Buloh, Selangor, Malaysia

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ABSTRACT

Objective: To evaluate the prevalence and association of developmental defects of enamel (DDE) and caries experience on the first permanent molar (FPM) among children aged 7-10 years old in Selangor, Malaysia. **Methods**: A total of 212 students of Islamic Primary School, Sungai Buloh aged between 7 and 10 years old were randomly selected. A full intraoral examination was conducted and recorded using International Caries Detection and Assessment System (ICDAS) classification and modified DDE index primarily on the first permanent molar. Clinical photographs of FPM was taken using digital single-lens reflex (DSLR) to aid in the diagnosis of DDE. Statistical analysis was done using SPSS 24. **Results:** A total of 848 FPM were examined in this study; 252 FPM of children aged 7 years old, 232 FPM of children aged 8 years old, 180 FPM of children aged 9 years old, and 184 FPM of children aged 10 years old. Among them, 82.7% (n=701) were caries-free (ICDAS code 00); 11.4% (n=97) with caries severity ranging from early caries (ICDAS code 01) to severe caries (ICDAS 06); 0.9% (n=8) were filled (ICDAS code 30, 40, 60); 0.1% (n=1) with secondary caries and 4.8% (n=41) were unerupted (ICDAS code 99). The prevalence of DDE with demarcated opacity was 19.35% (n=164); diffuse opacity 2.4% (n=20); hypoplasia 0.5% (n=4), and other defects were 0.1% (n=1). The association between dental caries and DDE was statistically significant at $p < 0.001$ and the odd ratio (OR) was 3.48. **Conclusions:** The presence of DDE increased the risk of caries three times higher than without DDE. Understanding the contributing factors of the development and progression of dental caries may help clinicians to prioritise an appropriate preventive measure to those who are in need.

Keywords: Developmental defect of enamel (DDE); caries; first permanent molar; International caries detection and assessment system (ICDAS); modified developmental defects of enamel index

1 INTRODUCTION

The first permanent molar (FPM) plays a salient role in maintaining the function of mastication and established a balanced occlusion. Early loss of first permanent molar may lead to supra-eruption of opposite teeth, midline shift, premature contact of teeth, and it may also result in asymmetric growth of mandible[(1)]. Despite the important role in oral function, the first permanent molar has a higher prevalence of dental caries[(2)], even shortly after their eruption[(3,4)]. This is due to characteristics (pits and fissure) that are favourable for the bacterial plaque build-up[(5)], and it is the first permanent teeth erupted on average at 6-year old which has been exposed to oral environment longer than other teeth[(6)]. The progression of the decay on FPM is expeditious during the first two years after eruption[(7)]. Therefore, in the absence of preventive measures and early detection of caries risk, these teeth may experience all the consequences derived from the development of caries[(8)].

Dental caries is a non-communicable and preventable disease that results from an imbalance of the oral environment between multiple causative and protective factors. The presence of four causative factors, namely diet, host factor, time, and microorganism are crucial in the development and progression of dental caries. Hence, any defect or hypomineralization of tooth structure is one of

the predictors of developing dental caries[9]. Developmental Defects of Enamel (DDE) is an alteration in the quality and quantity of the enamel by disruption and/or damage to the enamel organ during amelogenesis process[10]. It plays a crucial clinical significance not only for its vulnerability towards dental caries but also for aesthetic appearance and dental sensitivity[11]. Teeth with enamel defects can allow additional plaque accumulation due to the presence of surface porosities, causing caries to progress faster[12]. High caries rates of first permanent molar associated with a developmental defect in enamel make the tooth uniquely susceptible to deep occlusal decay that may lead to advance caries development[7]. Therefore, this study aimed to evaluate the prevalence and association of developmental defects of enamel (DDE) and dental caries status among children aged 7-10 years old in the district of Sungai Buloh, Selangor, Malaysia.

2 MATERIALS & METHODS

A total of 212 children aged 7-10 years old from Islamic Primary School Sungai Buloh were evaluated in this study. This study was approved by the Ethics committee of the University of Technology MARA (Sungai Buloh, Malaysia). Written informed consent was granted by the parents or legal guardians of the participants before the clinical examinations. Clinical examinations were carried out at the schools using a portable dental chair. All examinations were conducted by three examiners who had been trained and calibrated to use ICDAS and DDE index, as recommended by the World Health Organization for the evaluation of enamel defects. Clinical examinations were done using a disposable mouth mirror, dental probe aided by a portable light to detect any discontinuity on the enamel surface of the first permanent molar (PFM). Before the dental examination, the surfaces of the teeth were wiped with gauze to remove any debris that was present. Full dental charting was recorded using the International Caries Detection and Assessment System (ICDAS) but only FPM was evaluated for any presence of DDE using a modified DDE index. A clinical photograph of all first permanent molar was taken using DSLR (Canon 550D) with aperture f/22, shutter 200 per second, and ISO 400-1000. The lens focal length was fixed between 90 mm and 160 mm to provide a good working distance from the patient of around 0.5 metres. Disposable mouth mirror was used to provide a reflected image when areas of difficult access are photographed.

A series of four clinical photographs; upper right, upper left, lower right, and lower left of first permanent molar were taken. All clinical photographs were collected and confirmed the DDE diagnosis by a principal investigator. Modified Developmental Defects of Enamel (DDE) Index was used to classify the types of enamel defects. Score 0 is normal appearance, score 1 is demarcated opacities; the white/cream and the yellow/ brown subtypes, score 2 is diffuse opacities; diffuse lines and patches, confluent patches, and confluent patches with staining and/or the loss of enamel and score 3 is hypoplasia; hypoplasia pits and hypoplasia missing enamel.

The prevalence and association of DDE and dental caries were presented and analysed with Microsoft SPSS Software 24.0 Version.

3 RESULTS

Out of 212 participants, more than half were female (55.7%, n=118) and 44.3% (n=94) were male. Table 1 shows the demographic profile of the study population. The age distribution of study population aged 7, 8, 9 and 10 were 63 (29.7%), 58 (27.4%), 45 (21.7%) and 46 (21.7%) respectively.

Table 1: Demographic Profile of Study Population

Variable		N (%)
Gender		
	Male	94 (44.3)
	Female	118 (55.7)
Age		
	7	63 (29.7)
	8	58 (27.4)
	9	45 (21.2)
	10	46 (21.7)
Total		212 (100)

A total of 848 first permanent molars were assessed in this study; 252 first permanent molar of children aged 7 years old, 232 first permanent molar of children aged 8 years old, 180 first permanent molar of children aged 9 years old and 184 first permanent molar of children aged 10 years old. Table 2 shows the dental status of the first permanent molar in all age groups. Among them, 82.7% (n=701) were ICDAS 00; 11.4% (n=97) were with carious lesion ICDAS code 01-06; 0.9% (n=8) were filled (ICDAS code 30, 40, 60); 0.1% with secondary caries and 4.8% (n=41) were unerupted that is ICDAS code 99.

Table 2: Caries status of first permanent molar in allage group

Age	Sound n(%)	Caries n(%)	Filled teeth n(%)	Secondary caries n(%)	Total n(%)
7	190 (88.8)	24 (11.2)	0 (0.0)	0 (0.0)	214 (100)
8	210 (91.3)	17 (7.4)	3 (1.3)	0 (0.0)	230 (100)
9	147 (81.7)	29 (16.1)	4 (2.2)	0 (0.0)	180 (100)
10	154 (84.2)	27 (14.8)	1 (0.5)	1 (0.5)	183 (100)
Total	701 (82.7)	97 (11.4)	8 (0.9)	1 (0.1)	807 (100)

Unerupted first permanent molar = 41 teeth

The permanent first molar tooth with DDE was observed more commonly in the 10-year-old age group (31.5%), followed by 7 years old (26.2%), 9 years old (22.2%), and 8 years old (10.8%). Table 3 summarises the prevalence of DDE with respect to the age group. Table 4 shows the prevalence of different types of DDE in the study population. 618 (72.9%) were having a normal appearance and 41 (4.8%) of FPM examined were unerupted. The most prevalent of DDE type was demarcated opacity (score 1) followed by diffuse opacity (score 2), hypoplasia (score 3), and other defects (score 4) with the prevalence of 164 (19.3%), 20(2.4%), 4 (0.5), and 1 (0.1) respectively.

Table 3: Prevalence of DDE of FPM in children aged 7-10years old in Islamic Primary School Sungai Buloh

		Age				
		7 n(%)	8 n(%)	9 n(%)	10 n(%)	Total n(%)
DDE	Yes	66 (30.8)	25 (10.9)	40 (22.2)	58 (31.7)	189 (23.4)
	No	148 (69.2)	205 (89.1)	140 (77.8)	125 (68.3)	618 (76.6)
Total n (%)		214 (100)	230 (100)	180 (100)	183 (100)	807 (100)

Table 4: Prevalence of DDE of FPM by type of defects in all age group

Modified DDE Index	Prevalence n(%)
Score 1 (Normal)	618 (72.9)
Score 2 (Demarcated Opacity)	164 (19.3)
Score 3 (Hypoplasia)	20 (2.4)
Score 4 (Other defect)	1 (0.1)
Unerupted	41 (4.8)
Total	848 (100)

The relationship between the caries experience and the developmental defect of enamel among all first permanent molar was also examined. Among 188 teeth diagnosed with DDE, 49 (26.1%) were having caries and 139 (73.9) were caries-free (Table 5). On the other hand, among 619 teeth have no DDE, 57 (9.2%) were with caries while 562 (90.8%) were caries-free. The association was statistically significant at $p < 0.001$ and the odd ratio is 3.48.

Table 5: The relationship of the caries experience and developmental defect of enamel in FPM

	Caries experience		Total	p-value
DDE		Yes n(%)	No n(%)	< 0.001*
	Yes	49 (26.1)	139 (73.9)	188 (100)
	No	57 (9.2)	562 (90.8)	619 (100)
		106	701	807

*significant p value at p =0.5
Odds Ratio (exposed/unexposed) = 3.48

4 DISCUSSION

The finding from this study shows that the caries-free status of the first permanent molar among the study population was between 81-91%. This suggested that the caries development and progression start as early as 7 years old where the tooth erupted after about a year. This finding was supported by Chen et al. (2012) which concluded that the progression of the decay on FPM is expeditious during the first two years after the eruption. Thus, preventive measures should be implemented as early as possible to reduce the prevalence of dental caries and should be placed as a priority among other interventions taken.

Another finding from this study shows that demarcated opacities (score 1) is the highest prevalence among the study participants. Previous literature also found that demarcated opacities were the most prevalent DDE types both in permanent teeth[13], where demarcated opacities were significantly associated with dental caries in permanent incisors and molars primarily[14,15]. Our study highlighted that there is a statistically significant association between DDE and caries experience. Hence, DDE can be considered as one of the contributing factors for the development and progression of dental caries. DDE can be shortly seen after their eruption period before dental caries develops[16]. Thus, it is vital to identify DDE as early as possible and to tailor preventive measures to those identified individuals, hence may reduce the risk of having dental caries in the future.

In addition, our research has shown some advantages of using ICDAS in epidemiological studies. Research has shown that DMFT was being used frequently in epidemiological studies as it is accepted worldwide, less time-consuming, and the possibility to compare previous and future data[17]. However, dmf/DMF scoring is based on cavitated tooth, while ICDAS scores all the caries stages as early as white spot lesion up to the most severely cavitated tooth. Our study has been supported by a previous study[18], which stated that ICDAS scoring can be used in epidemiological studies as a diagnostic tool. Besides, this study also reported no significant difference between dmf/DMF with ICDAS in diagnosing caries. Therefore, ICDAS can be used to maximize the data collection as it records the severity of caries.

As a limitation of this study, the participants involved are in a range of Islamic Primary School Sungai Buloh students. Lack of parental consent and the absence of participants during the day of examination were limitations encountered while conducting the study. The total number of participants per age group cannot be standardised as multiple factors were affecting the participation, such as parental consent and

the total number of students per level in this school.

5 CONCLUSION

Within the limitations of this study, it can be concluded that the prevalence of caries-free status among 7 to 10 years old is 88.8%, 91.3%, 81.7%, and 84.2% respectively. The prevalence of DDE with demarcated opacity was 19.35% (n=164); diffuse opacity 2.4% (n=20); hypoplasia 0.5% (n=4), and other defects were 0.1% (n=1). The association between dental caries and DDE was statistically significant, hence, DDE can be considered as an important predictor for dental caries development.

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