# ENAMEL DEFECTS AND CARIES IN PRETERM CHIDREN AGED 5-10 YEARS IN DUBAI, UNITED ARAB EMIRATES

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# ABSTRACT

## ENAMEL DEFECTS AND CARIES IN PRETERM CHIDREN AGED 5-10 YEARS IN DUBAI, UNITED ARAB EMIRATES

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**Background:** Enamel defects are among the most commonly reported dental findings in preterm/low birth weight children. They potentially lead to an increase in caries susceptibility.

**Aim:** To assess the prevalence of enamel defects and dental caries in a group of preterm children (aged 5-10 years) in Dubai, United Arab Emirates (UAE).

**Materials and Methods:** This is a retrospective cohort study of sixty-two preterm children (mean age=8.1±1.54) and sixty-two full-term children (mean age=8.1±1.73) of both genders born in Latifah Children's Hospital in Dubai (UAE). The medical records were retrospectively reviewed for all births between January 2007 and December 2012 to obtain demographics, birth condition, gestational week and birth weight. A dental examination to check for enamel defects and dental caries was performed by one calibrated examiner.

**Results:** The prevalence of enamel defects in the pre-term study group was significantly higher than the full-term control group (58.15% and 24.2% respectively; $P< 0.001$). Enamel defects were 4.34 times more prevalent among preterm children. Birth weight was a statistically significant factor contributing to enamel defects ($P<0.001$). Preterm children with low and very-

low birth weight had more enamel defects 34(94.4%) than full-term children with normal birth weight 13(86.7%). Intubation and type of delivery were significant contributing factors to enamel defects ($P<0.05$). Pre-term children had double the risk of white or creamy demarcated opacities and three times more risk of post eruptive breakdown compared to the full-term group ($P=0.017$). In the primary dentition the mean *dmft* was 4.61±4.30, while in the permanent dentition DMFT was 0.38±0.99. There was a statistically significant difference in permanent teeth caries experience amongst pre-term children compared to the full-term control as measured by DMFT ($P=0.008$), while there was no statistically significant difference in primary teeth caries experience as measured by *dmft* ($P=0.222$).

**Conclusion:** The findings of this study revealed that, in the UAE city of Dubai, there was a high prevalence of enamel defects in the pre-term group. Dental caries experience in the permanent dentition was significantly higher in the pre-term group compared to their full-term counterparts.

# DEDICATION

***I am dedicating this thesis to four beloved people who means the world to me. My mother, father, husband and my lovely son.***

# DECLARATION

I declare that all the content of this thesis is my own work. There is no conflict of interest with any other entity or organization

Name: Anood Alshehhi

Signature:

# ACKNOWLEDGMENTS

This study is wholeheartedly thanks to my beloved parents and husband who have been my source of inspiration and gave me the strength and the confidence that built me up, who continually provide their moral, spiritual and emotional support. Special thanks for my bundle of joy that enlighten my life during my Master journey, my son “Fares” who will blow his first birthday candle in the coming days. To my classmates who made this journey filled with laughter and achievement.

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My deep gratitude to my dear country that gave me the happy past, the great present and bright future and I promise to do my best in serving and giving back all the great things being always number one and achieving its mission.

At the end, I would like to thank every child who participated in this study, and I thank every mother who cared about her child wellbeing and made a positive contribution to the community.

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# List of ABBREVIATIONS

WHO = World Health Organization (WHO)

MIH = Molar-incisor hypomineralisation (MIH)

HSPM = Hypomineralized second primary molars (HSPM)

UAE = United Arab Emirates

D/d = Decayed

M/m = Missing

F/f = Filled

NICE = National Institute for Clinical Excellence (NICE) guidelines

PEB = Post-eruptive enamel breakdown (PEB)

GCP = Good Clinical Practice (GCP)

DHCC = Dubai Health Care City

US = United States

IFPB = Indian Foundation for Premature Babies

ECC = Early childhood caries ECC

VLBW= Very low birth weight (VLBW)

# 1. INTRODUCTION

A premature infant as defined by the World Health Organization (WHO) is any newborn with less than 37 weeks' gestation or fewer than 259 days after the last menstrual period.(1) The incidence of preterm births is estimated to be 5-10% in Europe, North America, and parts of South America. Meanwhile; higher incidence is reported in most African and Southeast Asian countries (10-30%).(2)

Preterm births prevalence is increasing and is estimated to be 15 million preterm births occurring each year worldwide with males being born earlier with higher mortality and morbidity rates than female preterm infants.(3)

When the infants are born between the 35th and 36th weeks of the pregnancy; they are considered as mildly premature while delivery occurring between the 31$^{st}$ and 34$^{th}$ weeks of the pregnancy puts the infant in the moderate category. Severe prematurity is considered when the delivery occurs at or before30 weeks of gestation.(4)

The pre-term and/or low birth weight deliveries affect many aspects of health, and increase the economic, social, family, and individual demands leading to an impact on the quality of life of these children.(5)

In the recent years, the improvement of perinatal care aided by significant medical advances resulted in the reduction of mortality and morbidity in pre-term children. However, some complications will inevitably be present especially with the lower gestational age such as; neonatal rickets, hypocalcemia, perinatal anoxia, anemia, infections, and metabolic, renal, respiratory, cardiovascular and hematological diseases. This necessitates using multiple drug therapies and often orotracheal or laryngoscopic intubation to overcome the respiratory difficulties. Moreover, these problems might result in poor feeding and lack of optimal nutrition,

including vitamin and mineral deficiencies for short or long time periods, all of which might have an impact on the oral structures of these babies.(6)

Higher prevalence of enamel defects in the low birth weight preterm infants had been reported in the literature when compared to normal birth weight controls. Hypoplasia and enamel opacities were among the most reported dental findings in these preterm infants.(7)

Primary teeth development starts early in pregnancy and the whole process of enamel formation and maturation is completed around 12 months postnatally.(8) During this process any disorder in amelogenesis will result in either a quantitative defect (enamel hypoplasia; reduced enamel thickness giving pits or groves to partial or complete absence of the enamel) or a qualitative defect (enamel hypo-mineralization; changing the tooth translucency and the opacities into white, yellow or brown color) depending on the time of the attack.(9) The attributed mechanism might be due to the early defects in the metabolism of calcium along with the fact that calcium and phosphorus accumulate mainly during the third trimester of pregnancy.(10) An example of the qualitative defects are the molar-incisor hypomineralisation (MIH) in the permanent dentition or hypomineralised second primary molars (HSPM) in the primary dentition.(11)

Enamel disturbances have many clinical implications including esthetic concerns and social embarrassment due to the dental appearance, associated symptoms and sensitivity, increased caries susceptibility, altered occlusal function and treatment challenges. Moreover, enamel defects in the primary dentition might be predictive of similar defects in the permanent one.(12) (13)

Hypoplastic enamel was associated with increased susceptibility to dental caries due to the reduction in mineralization, increased porosity, thinner enamel, increased tooth breakdown, and irregular surfaces allowing more bacterial aggregation. This is compounded by long term intake

of sucrose containing medications and associated inaccurate feeding practices.(14) (15) Therefore, more attention needs to be given to premature children including early diagnosis and preventive care.

The oral health status of Dubai premature children has not been studied. Thus, this study aimed to assess the prevalence of enamel defects and caries status in preterm born children in Dubai, UAE and compare them with their full-term healthy counterparts.

# 2. LITERATURE REVIEW

In this chapter the literature will be reviewed regarding children's premature birth and its complications including definition, prevalence, classification with associated general and dental complications.

## 2.1 Definition of a preterm or premature child

A preterm or premature child is defined as a "newborn of less than 37 weeks' gestation or born within fewer than 259 days after the last menstrual period with a birthweight less than 2,500 grams." World Health Organization (WHO).(16)

## 2.2 Prevalence of preterm birth

Preterm birth is prevalent worldwide with a global incidence of 15 million per year.(17) In the United States (US), nearly 1 in 10 babies is born preterm. The rate of preterm birth increased in the US in the late 20th century, from 9.5% in 1981 to a peak of 12.8% in 2006.(18) Male neonates were more likely to be born premature than female neonates. Male preterms were also reported to have more mortality and morbidity than female preterms.(3) (19)

In Europe, North America, and parts of South America, a percentage of 5-10% was reported. Whereas most African and Southeast Asian countries have increased prevalence's between10-30%. In Brazil, preterm babies represent nearly 10% of all births.(20) India, on the other hand, is the main contributor to the world's prematurity concern, with almost 3.6 million premature births each year compare to the 15 million global incidence yearly. The rate of premature births in India is rising and was reported to be around 21% of babies in 2015 according to the WHO report with collaboration with Indian Foundation for Premature Babies (IFPB).(21)

In Saudi Arabia, a total prevalence of 7.5% of preterm birth was reported.(22) While to our

knowledge no studies have assessed the prevalence of pre-term children in UAE are available, experts in the field indicated that it was consistent with various studies from different parts of the world that reported an incidence of 10%.(23)

**2.3 Etiology of preterm birth**

The accurate cause of preterm births is unknown, as it's usually multi-factorial and may be related to diseases in the fetus or mother.(24) Many factors may contribute such as the mother's age (both extremes- young or old), decreased maternal body mass index, short inter-pregnancy intervals, smoking mother, low socio-economic status and psychological stress.(21) Premature birth can be also classified as spontaneous premature birth or medically indicated (iatrogenic) premature birth. Two- thirds of all preterm births are considered to be spontaneous. Risk factors for spontaneous delivery include previous spontaneous preterm delivery, short cervix, short inter-pregnancy interval, multiple pregnancy, and uterine anomalies. The strongest risk factor was a previous spontaneous preterm birth, with recurrence rates reported to be around 15- 50% depending on the number and gestational age of previous preterm deliveries.(18) Medically indicated or iatrogenic preterm births include a wide-range of maternal and fetal abnormalities such as preeclampsia, poorly controlled diabetes, intrauterine growth restriction, and abnormal placentation. One-third of all preterm deliveries in the US were predicted to be medically indicated.(18) Maternal periodontal disease may be considered an independent risk factor of preterm births and low birth- weight as supported by McGaw.(25)

**2.4 Classification of birth prematurity**

A prematurity degree can be classified as mild, moderate and extreme. (different studies have different classifications).

A. Mild: when the child is born between the $35^{th}$ and $36^{th}$ weeks of gestation.

B. Moderate, if the child is born between the 31st and 34th weeks.

C. Extreme, if the gestational age is less than or equal to 30 weeks.(16)

Premature birth is the most frequent cause of low birth weight.(26) As a consequence children are classified according to their birth weight as:

A. Normal weight (above 2500 g)

B. Low weight (between 1500 and 2500 g)

C. Very low weight (less than 1500 g).(27)

**2.5 Preterm and low birth weight children's general health problems**

The birth of pre-term and/or low birth weight newborns causes multiple general health problems that impact the family and the individual economically and socially.(5) Controlling the risk factors which might cause a preterm delivery is important to improve the quality of life of premature infants. Prematurity presents an economic millstone on society along the emotional distress for the families. At least 26.2 billion US dollars each year were estimated to be used to cover the prematurity cost including medical costs, educational costs, and lost productivity in the US.(28) Hospital admissions for preterm babies were estimated to be 13 days compared to 1.5 days for full term babies. The first year of preterm life cost medically ten times greater than those for full term infants.(29)

In preterm delivery, children are born unprepared for extra-uterine life; as a result, they might need neonatal intensive care in order to prevent possible complications of specific organs, such as the brain, lungs and eyes.(24) Because of the respiratory problems resulting from the underdeveloped lung tissues, such children may also need artificial ventilation through an orotracheal or laryngoscopic intubation to overcome breathing problems.(6)§

The essential factors that predispose the neonate for complications are the gestational age and the

birth weight. Lower gestational ages increase the morbidity and mortality rates of preterm infants. Infants born before or at 25 weeks are at highest risks of serious persistent deterioration and have the lowest survival rates.(30) In addition to gestational age, morbidity and mortality also increase with decreasing birthweights.(31)

Generally speaking, all preterm infants are believed to have increased risk of short and long-term complications, such as cerebral palsy, impaired neurodevelopmental issues, and chronic medical demands in comparison with the full-term infants.(32) Recently, advancement in perinatal care result in decrease the mortality and morbidity rates in preterm infants, however, their life may not be without complications.(33) Among the most prevalent complications are neonatal rickets, hypocalcemia, perinatal anoxia, anemia, infant jaundice, underdeveloped immune system, infections, and metabolic, renal, respiratory, cardiovascular and hematological diseases.(6) Such complications might lead to feeding difficulties, undernourishment and dietary deficiencies in the short or long term.(34) Others might lead to physical or mental impairments.(35)

In the United Arab Emirates following a neonatal audit, improvements in neonatal care were instituted between 1992/1994 [period 1] and 1995/1998 [period 2]. From period 1 to 2 there was a 17% decline in the neonatal mortality and morbidity rates in infants with birth weight < 1000 g and >2500g decreased by 36% and 35% respectively from periods 1 to 2.(36)

**2.6 Preterm and low birth weight child's oral and dental health problems**

Dental tissues can be affected by preterm birth as well resembling other tissues and organs of the body. The effect varies individually depending on many factors, such as: gestational age, birthweight, postnatal medical conditions and interferences and growth and developmental factors. The manifestation of certain dental complications are higher among preterm infants compared with full-term infants.(37)

### 2.6.1 Enamel defects and Molar Incisor Hypomineralization (MIH)

2.6.1.1 Introduction

Dental enamel is the hardest and the most mineralized structure in the human body. Amelogenesis begins with the bell stage of tooth development. Ameloblasts are located in the inner enamel epithelium and undergo a series of maturation process, producing a protein-rich enamel matrix.(38) Dental enamel is from ectodermal origin that, once formed, loses its metabolic activity. In another word, any disruption during the formation stage will present as a permanent defect in the relevant tooth.(7)

A high percentage (96% )of enamel defects have been reported among preterm infants and/or very low and extremely low birthweight with the highest prevalence and severity reported among the sickest preterm infants and those with congenital complications or syndromes.(5)

The most reported affected teeth in the primary dentition are the incisors, followed by molars and then canines. Maxillary arch tend to be more generally affected than mandibular arch.(4) Enamel defects prevalence in the primary dentition range between 4 and 75% relying upon the society studied and the scoring system used.(39) Moreover, developmental enamel defects in the primary dentition may be anticipative of similar defects in the permanent dentition. (11)

In the permanent dentition, incisors and first molars enamel defects are also believed to be more prevalent in preterm infants, especially if medications, such as amoxicillin, were used often in early life.(40) Recently, these enamel defects became known as molar-incisor hypomineralization (MIH) in the permanent dentition or hypomineralized second primary molar (HSPM) in the primary dentition.(41)

MIH is defined as demarcated, qualitative developmental defects of systemic origin of the

enamel of one or more permanent first molar with or without the involvement of incisors.(42) The clinical manifestations of MIH differ both between and within patients. The affected enamel is porous and fragile, frequently causing rapid breakdown after eruption.(43) Recently a new definition was introduced to differentiate between molar incisor hypomineralization and molar hypomineralization in which the latter was defined as demarcated enamel opacities that appeared both discolored (white, cream, yellow, or brown) and sharply bordered against normal enamel in which 1 or more molars must be affected, excluding incisor-only cases arising from traumatic injury.(44)

MIH prevalence is approximately high and differ extremely between studies, a prevalence of 8.6% in Saudi Arabia had been reported. In Europe the reported prevalence range from 3 to 22%.(45) The combined global prevalence reported by a recent study to be 14.2% (46).

Multiple possible causative factors for MIH have been suggested. Prenatal susceptibility (like maternal smoking or illness during pregnancy), perinatal susceptibility (like premature or prolonged birth, low birth weight, cesarean delivery, and birth complications) and postnatal susceptibility (like early childhood illness or medication or breastfeeding).(47)

Histologically, MIH-affected teeth show a changed arrangement of enamel crystals and less clear prism sheaths. The hypomineralized enamel shows reduce mechanical properties, with less hardness and modulus of elasticity compared with normal enamel.(48) Increased proteins quantity is also reported in MIH-affected enamel.(49)

2.6.1.2 Definition of an enamel defect

An enamel defect is an abnormality in quality and quantity of the enamel, resulting from disruption in the amelogenesis process. Enamel hypoplasia is a quantitative defect induced by incomplete deposition of immature enamel by ameloblasts during the secretory stage.(50) It

manifests clinically as reduced enamel thickness giving pits, grooves or generalized lack of enamel.(11) Enamel hypomineralization is a qualitative defect caused by incomplete mineralization or maturation of the enamel, changing the enamel translucency and opacity. The defective enamel is of normal thickness, but with opacities which might be diffuse or demarcated with white, yellow or brown color. (51)

Diffuse opacities generally affecting multiple teeth undergoing enamel maturation at the same time are believed to be of systemic insult. As opposed to demarcated opacities and hypoplasia which are usually present in teeth which had been exposed to a localized and transient injury. The clinical manifestation and severity of the defects is usually related to the stage of development during which the injury occurs, the extent and duration of the insult.(12)

2.6.1.3 Etiology

Enamel defects are linked to multiple genetic, acquired, systemic and local etiological factors. Since enamel does not remodel or repair, the deformity presents a record of the injuries affected the enamel during its development. To date, the etiology of enamel defects is still not totally clear and the causes are questionable.(52)

Primary teeth development starts during week 12 of pregnancy (in third month), progresses all through pregnancy and the enamel formation completes around 12 months postnatally after normal gestational age (37– 40 weeks). In prenatal infants the mineralization stage is thereby decreased by 10 weeks or more. Therefore, children born before week 29 will lose an essential developmental stage for teeth during the last trimester.(8)

On the other hand, enamel development of first permanent teeth starts at week 28, while mineralization commences at the time of birth and is completed during the first 3 years of life. Enamel defects can result from multiple factors that alter the ameloblasts, disturb matrix

formation or maturation during this tooth development time.(8)

Development of enamel defects have been linked to multiple aspects, including pre, peri and postnatal complications and local, systemic or hereditary conditions. They include maternal causes, such as age at the birth of the child, social factors, illness or infections during pregnancy (pre-eclampsia, diabetes, rubella), undernourishment, use of anti-allergic or anti-asthmatic medicines, alcohol drinking or smoking during the pregnancy, dioxins or Bisphenol A exposure. Perinatal exposure to bisphenol A, which is an Endocrine-disrupting chemical has been linked to enamel defects because it disrupts protein removal during amelogenesis.(4)

Multiple child aspects have been linked to enamel defects too, such as low birth weight, fever, infectious and other illness, inadequacy or prolonged breastfeeding (breast milk contains too little calcium (Ca) and phosphorus (P) to allow maximum intra-uterine mineral retention in preterm infants), dietary complications, use of the antibiotic amoxicillin, hyperbilirubinemia, and breathing problems.(52)(53)

In the past, enamel defects in preterm infants were particularly linked to localized trauma caused by laryngoscopes, endotracheal intubation, and oral or nasogastric tube feeds. Oral intubation, however, is now largely replaced by nasal intubation, resulting in a decreased development of enamel defects of this reason.(35)

The disrupted calcium (Ca) metabolism early in life may be an essential element behind enamel abnormality in primary teeth, besides the fact that the main accumulation of Ca and P happens during the last trimester of pregnancy.(54) The earlier a child is born, the less Ca and P that are acquired. The consequence of disrupted Ca metabolism at the time of teeth mineralization also depend on other postnatal problems.(55)

Chemical investigations of primary teeth of preterm infants revealed that the calcium: carbon ratio of the enamel surfaces were extremely less (and therefore more porous) in preterm infants compared with full-term infants.(56) Light and scanning electron microscope search also showed a high frequency of thinner hypomineralized enamel, widened neonatal lines, and the constant presence of marked incremental lines in the postnatal enamel in pre-term infants.(57) Even after a period of catch-up, postnatally formed enamel could not sufficiently compensate prenatal enamel.(58) Some studies agreed that enamel hypoplasia is significantly greater among very-low-birthweight infants with lower serum phosphorous levels.(59)

2.6.1.4 Clinical complications of developmental enamel defects

The existence of enamel defects increases the possibility of dentine exposure and hypersensitivity, dental caries, tooth wear, and, if anteriorly located, aesthetic issues due to staining and structural abnormality. Children with enamel defects may experience anxiety and social distress due to their dental appearance.(60) In the primary dentition existence of enamel defects increases the possibility of early childhood caries (ECC). The relation between enamel defect and ECC may be underestimated because the presence of caries hides the underlying undiagnosed enamel defects. (60)

A. Dental caries

Definition of Dental Caries According to WHO is " localized post eruptive pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity".(61)

Ultrastructural analysis showed hypoplastic teeth as being significantly prone to dental caries because of reduce mineralization, increase porosity, irregular rough tooth surfaces, with

increase structural breakdown due to poor enamel quantity and quality permitting bacterial aggregation which is favorable to the growth of *Streptococcus mutans*, causing carious lesions.(62)

Preterm infants are more probable to need medications for a prolonged extent of time and these medications may be acidic and/or rich in sucrose, facilitating the growth of a more acidogenic and cariogenic oral bacteria.(63)

Increased maternal contact during feeding, may also play role in early migration of cariogenic bacteria in predentate preterm infants.(64) Furthermore, weight gain is generally an issue for preterm infants resulting in higher tendency of on-demand, frequent and night feeding. Hospitalization of preterm infants early in their life usually lead to cessation of breastfeeding and depending on high-caloric infant formulae that's rich in sugar content.(65)

Preterm infants especially those with breathing difficulties usually are mouth breather, which predispose them to increase caries risk as a result of mouth drying, salivary dehydration, increased adherent dental plaque, and decreased oral cleansing.(66)

While the risks of dental caries, especially early childhood caries (ECC), are likely to be increased in preterm infants, some studies for example, Nelson et al. (2010) revealed similar incidence of dental caries in the primary and permanent dentitions of preterm and full term infants.(67) On the other hand, other research showed that primary teeth caries was lower among preterm infants compared with full-term infants and proposed that this may be a result of early and increase access to dental examinations.(68)

B. Tooth wear

Preterm infants are at risk of gastroesophageal reflux or regurgitation and this increases their risk to tooth wear.(69) They are also at higher risks of erosion due to exposure to extrinsic acids as a

result of medications, frequent consumption of fresh and dried fruits and juices particularly in the existence of developmental enamel defects.(70)

Enamel weakened by erosion process may be at increased risk of attrition and abrasion along with dental caries.(71) Further, neurosensory disorders present in preterm infants which predispose them to parafunctional habits such as bruxism, increase their risk to attrition and abrasion.(70)

### 2.6.2 Other dental anomalies in pre-term infants

Preterm infants reported to have nearly 10% reduction in the primary tooth crown dimensions. The lower the weight at birth, the smaller the tooth crown dimensions.(72) This is most likely associated with reduction in enamel in the existence of developmental enamel defects or mineral loss. In the permanent dentition, the same changes in tooth crown dimensions are not reported, which may be because preterm infants catch up in growth after birth as the physiologic derangement reduce.(60)

Tooth morphology anomalies, such as dilaceration of crowns and roots of primary teeth and arrested tooth development, are linked to localized trauma to the underlying tooth germ/s caused by heavy pressure on the alveolar ridge at the time of intubation and/or from laryngoscope.(60)

Tooth number developmental anomalies, like hypodontia and hyperdontia, have also been reported as a common finding in preterm infants. The risks of tooth number abnormality increase significantly in pre-term infants with a syndrome or cleft lip and/or cleft palate.(73)

Frequent or prolonged use of medications (e.g. ciprofloxacin) as well as localized trauma may increase the risk of tooth crown discolorations among preterm infants.(74) Specific medications or supplements such as liquid iron supplements can also predispose the preterm infants to extrinsic staining.(75)

### 2.6.3 Palatal deformities in pre-term infants

Many factors affect palatal formation deformity. The narrow elongated premature baby head may cause a narrow high vaulted palate aiding in palate collapse.(76) Intubation process in preterm infants may exert pressure on the midline palate and alveolar ridge affecting its growth. Additional pressure to the endo-tracheal tube to maintain it in proper location may also alter the developing palate. Infants sucking on their endo-tracheal tubes may also cause some shaping of the tissues. The modified palatal morphology can contribute to malocclusions such as cross bite increasing the demand for future orthodontic treatment. In addition, alterations in the eruption path of the teeth, can affect the occlusion and tooth spacing, increasing the need for orthodontic treatment as well.(76)

### 2.6.4 Previous studies of enamel defect in preterm infants

Exploring the literature from all over the world showed a significant association between enamel defects in primary dentition and prematurity and/or low birth weight. A study by Nelson et al. in USA reported that the incidence of hypoplasia and enamel defects were significantly higher in very low birth weight (VLBW) compared with normal birth weight infants to extent that VLBW had approximately 5 and 2.3 times greater risk for enamel hypoplasia and any other defects respectively. (7) Wagner et al. from Germany reported that preterm birth and low birth weight children had a 4.9 times higher possibility of having enamel defects in their primary teeth than children with full-term birth and normal birth weight.(77)

In Brazil in 2011, a study by Takaoka et al. reported prevalence of enamel defects in preterm infants to be 87% compare to 44% in full term children and found that tracheal intubation in preterm infants was strongly associated with enamel defects.(78) Another study, in Brazil by Cruvinel et al. showed a significant prevalence of enamel hypoplasia in pre-term infants in the

primary dentition ($p<0.001$), while the other risk factors such as family income, educational level, trauma, and diseases failed to show any significant correlation with either enamel defects or caries.(79)

Thirteen studies included in a systematic review carried out in Denmark in 2014 reported an association between preterm birth and enamel hypoplasia in primary dentition. Increased risk of enamel opacities in primary dentition in very-low birth-weight children was also reported. Four out of seven studies in this systematic review that dealt with enamel defects in the permanent dentition concluded increased risk of enamel opacities.(80)

In the permanent dentition, Nelson et al. 2010 conclude that in very- low birth-weight adolescents there was a 75% increase of demarcated opacities in permanent incisors and first permanent molars compared to the full-term group ($p < 0.05$) and these demarcated opacities were a significant predictor of DMFT in incisors and molars.(67) Arrow et al. reported double the risk of enamel defects in the permanent first molars and he found that neonatal health factors were important for the occurrence of enamel defects.(81)

Aine et al. studied the prevalence of enamel defects in primary and permanent dentition for children born prematurely and full-term children in Finland. Enamel defects in preterm children was way higher compared with controls in both the primary (78% vs 20%, $P<0.001$) and permanent (83% vs 36%, $P<0.001$) dentitions.(10)

Rythen et al. from Sweden also compared the primary and the permanent dentition. He concluded that children born extremely preterm had more frequent mineralization defects in the primary dentition and more severe mineralization defects in the permanent dentition. While, the frequency of caries did not differ between the groups.(82)

### 2.6.5 Caries in preterm infants

There is no agreement in the literature regarding the caries experience in pre-term children. While many studies supported no difference in DMFT/dmft score between pre-term and full-term children, others indicated higher caries experience in pre-term infants due to underlining enamel defects.

Nirunsittirat et al. from Thailand demonstrated an inverse relationship between preterm and childhood caries. Low birth weight and small gestational age were not associated with dental caries in the studied population.(83) Similar result reported by Tanaka et al. (2014) who failed to detect any significant associations between low birth weight, preterm birth or small gestational age and the prevalence of dental caries in Japan.(84)

On the other hand, Junior et al. from Brazil found a higher prevalence of ECC among children with low birth weight (80.4%) than those born with a normal weight (9.9%) and those born preterm (82.8%) compared with those born at term (13.7%).(85) Similarly, in Brazil enamel defects were strongly associated with early childhood caries as per Oliveira et al. study (2006) who reported a total of 16.9% teeth with enamel defects had become decayed ($p = 0.0001$), while only 0.9% of the teeth without enamel defects developed caries.(86)

Finally, a systematic review and meta-analysis also in Brazil in 2017 by costa et al. demonstrated a clear association between developmental defects of enamel and dental caries in the primary dentition, leading to suggestion of preventive approach of dental caries and specific attention to children with developmental enamel defects.(87)

### 2.6.6 Causes of enamel defects in general

Wuollet et al. form Finland support the hypothesis of illnesses and/or antibiotics as causative factors of MIH, in which children with MIH had history for infectious diseases and received

penicillin or macrolides more often than the children without MIH during the first 3 years of life.(88) Allazzam et al. from Saudi Arabia agree with these finding. He reported that the prevalence of MIH is significantly associated with childhood illnesses during the first four years of life including asthma, adenoid infections, tonsillitis, fever, and antibiotics intake.(89)

In contrast, a recent study published in 2018 in Sweden did not find serious health problems in early childhood to increase the risk of developmental enamel defects. In the same study dental injuries to the primary anterior teeth increased the risk of enamel defects in the permanent dentition.(90)

# 3. AIMS AND OBJECTIVES

To our knowledge, the prevalence of enamel defects and dental caries experience in pre-term born children has not been investigated in the UAE. Hence, the aim of this study was to assess the prevalence of enamel defects and dental caries in the preterm children compared to their full-term counterparts. In order to reach the above-mentioned aims, the following specific objectives were formulated:

- To determine the prevalence of enamel defects in primary and permanent teeth of preterm children and compare it to healthy full-term controls.
- To identify possible risk factors associated with the enamel defects.
- To measure and compare the dmft/DMFT indices of both groups.

**Research question**

- How, if at all, does prevalence of enamel defect and dental caries differ between preterm and full-term children?

**Null hypothesis**

- There is no difference in the prevalence of enamel defects and dental caries in the preterm children compare to full term children.

# 4. MATERIALS AND METHODS

## 4.1 Study design, location and population

This is a retrospective cohort study of children who were born prematurely in Latifa hospital, a governmental hospital in Dubai, UAE. Latifa hospital is the referral center for most complicated pregnancies and premature births in Dubai and the Northern Emirates of the UAE. The medical records in Latifah hospital were reviewed for all births between January 2007 and December 2012. The control group comprised of age and gender matched full-term healthy children located in the same geographic region of Dubai and the Northern Emirates. Study methodology is summarized in figure 1.

### 4.1.1 Sample size

A sample size power calculation based on the results of Gravina et al. study (91) was performed as a guide using the following equation:

$$n = \{(p_1(1-p_1) + (p_2(1-p_2)\}(\frac{Z_{\frac{\alpha}{2}}}{E})^2. (92) (93)$$

Where P1 is prevalence of enamel defect in preterm and p2 is a prevalence of enamel in full terms and E is the width of 95% confidence interval for bilateral test, given by

$$E = \sqrt{\frac{Z_{\alpha/2}\, p(1-p)}{n}}$$

The above equation revealed that the required sample size is 60 per each group.

4.1.2 Sampling technique

**1-Pre-term group**

Records of all the preterm children registered in the medical records department of Latifa Hospital born during the period between January 1st 2007 and December 31st 2012 were obtained after securing Ethical approval from the MBRU-Institutional Review Board (Appendix1) and the Ethics and Research Committee at the Dubai Health Authority (DHA) reference number DSREC-10/2017_09 (Appendix 2). Total number of preterm children included in the records were 2640. For every birth year, one hundred children were randomly selected by a computer randomization software (Stata software). A total of six hundred families were contacted. Out of the families who expressed their interest to participate, only 62 preterm children came to the clinic for their examination appointment.

**2-Control group**

The control group consisted of full-term healthy children born in Latifah hospital. Control group children were matched in age and gender to the study group.

**4.2 Inclusion and exclusion criteria**

4.21 Inclusion criteria

1-Study Group

- Preterm children (current age = 5-10 years) born before the 37th gestational week in Latifah hospital in the period of January 1st 2007 to December 31st 2012.
- Both UAE and non-UAE nationals were eligible to participate.

2-Control Group

- Healthy children aged 5-10 years born after full-term pregnancy.

- Children born in Latifah hospital.
- Control group must match the study group in age and gender.

4.22 Exclusion criteria

- Children with special healthcare needs.
- Children of mothers who refuse to sign the consent form and participate in the study.

**4.3 Data collection**

Data were collected using clinical data recording sheet (Appendix 3) through dental examination. The list of the participants from Latifa hospital for both study and control groups were coded anonymously and all references to the identity of the child were eliminated by the main co-author and then the participants list which consisted of participant's serial number, name and phone number was provided to the main investigator to invite them to participate in the study through phone call and being blinded of their status of birth.

Participants who attended the clinic and signed the consent form were first examined intra-orally for enamel defects and dmft/DMFT. Once the examination was done, mothers were then asked to fill the questionnaire and details of their child's birth.

4.3.1 Examiners calibration

The principle examiner was trained and calibrated to use the recently proposed standardized scoring method by the European Academy of Paediatric Dentistry for enamel defects by Ghanim et al. (2015).(94) The calibration was done by Dr.Eman Alnuaimi, specialist in pediatric dentistry in Hamdan Bin Mohamed College of Dental Medicine. Intra- and inter-examiner reliability was calculated using Kappa statistics prior to starting the data collection. The results were as follow:

**- Intra Kappa**: The result was 100% concordance.

-**Inter Kappa** (McNemar's test): There was matching between the examiners (kappa=0.92-0.94).

4.3.2 Questionnaire interview

A structured questionnaire, which was previously tested in study by Cruvinel et al.(79) was used to obtain the demographic details (serial number, date of birth, gender, mother education and occupation) (Appendix 4).

An informed consent form was prepared to explain the study to the mothers and obtain their consent to participate a long with their children and assure them of total confidentiality of the information provided. The questionnaire and the consent form were translated to Arabic and back translated to English to ensure accuracy. Arabic or English questionnaires and consent forms were given to the mothers as appropriate (Appendix 5).

A pilot study was conducted with 10 of the mothers of the children attending our clinics regularly to ensure accuracy and clarity of the questionnaire. Similarly, A pilot study conducted for the clinical examination including 10 patients to evaluate the reliability of the study.

The medical history was obtained from Latifah hospital medical records to determine the possible association with the dental defects. The following information was obtained from the medical histories:

- Preterm birth
- Weight at birth
- Type of delivery (Caesarean, vaginal)
- Any aided respiratory device used for the infant

Through the questionnaire the following related information were obtained:

- Diseases during pregnancy

- Hospitalization in the first years of life
- Systemic infectious diseases occurred in the first 3 years of life such as: (pneumonia, tonsillitis, ear infections, chickenpox, rubella, measles, systemic antibiotic medication)
- History of trauma.

4.3.3 Dental examination:

Once the contact information from Latifah hospital medical records were identified, the potential participants were contacted by phone call to explain the study and to arrange for a visit to complete the questionnaire and perform the clinical examination for children of mothers who were willing to sign the informed consent. Consent to participate was obtained and signed by the mothers and the questionnaire was completed as explained above. The clinical examination was performed at the dental clinics of Dubai Dental Hospital/Hamdan Bin Mohammed College of Dental Medicine.

The examination was completed using sterile gloves, dental light, dental mirror and if needed a sterilized gauze used for cleaning. For enamel defects assessment teeth were examined wet (i.e. not air-dried before scoring). A ball-ended explorer was used when needed to remove debris, record dmft/DMFT and to check for surface irregularity and cavitation, being careful not to damage the tooth surface. The examiner followed a consistent, systematic approach in examination. Starting the examination from the maxillary right quadrant, then maxillary left quadrant, continuing to the mandible left quadrant and ending on mandible right quadrant. The indices recorded during the examination are described below.

4.3.4 Cross infection control

The examiner and assistant adhered to standard infection control protocol as per the National Institute for Clinical Excellence (NICE) guidelines. (95)

- For patients with latex allergy natural rubber latex gloves were available
- After the examination gloves were discarded immediately into waste disposable bags
- All operative staff worn eye protection, protective clothing and face masks which is changed between patients
- Patient was provided with Eye Protection
- All instruments were sterilized
- Disposable sharp instruments were placed in the sharp container
- Hands hygiene were implemented immediately before and after examining each patient using alcohol hand rubs or hand washing
- Disposable gloves worn by all clinical staff immediately before patient contact and removed after completing the examination

4.3.5 Indices

The following indices were recorded:

1. **Enamel defects index** (MIH/HSPM) by Ghanim *et al.* (2015).(94)

These were used to record enamel defects in both primary and permanent dentitions for each individual. The number of teeth with the type of defects were recorded together with the total number of erupted teeth (primary and permeant teeth) in the data recording sheet.

The following key features, as agreed by the European Academy of Paediatric Dentistry were used to identify teeth affected by enamel defects, MIH and HSPM: (Demarcated opacities, Post-eruptive enamel breakdown (PEB), Atypical restoration, Atypical carious lesions, Extraction of molar due to MIH/HSPM). These key features a long with further breakdown of each feature are explained in table 1.

Along with the clinical status criteria, the type and color of the defects were also recorded according to the EAPD criteria.(94) Color ranges were recorded as white–cream–orange-yellow–brown. In order for a surface to be included in the examination, at least 1/3 of the surface or the crown length of the incisor must be visible. When two MIH/HSPM lesions exist per surface (example, creamy and brown opacities) the more severe score is assigned. The tooth was considered normal if there was any doubt about the presence of the defect.

| Clinical status criteria | |
|---|---|
| 0 | **No visible enamel defect** |
| 1 | **Enamel defect, Not MIH/HSPM** |
| **11** | Diffuse opacities |
| **12** | Hypoplasia |
| **13** | Amelogensis imperfecta |
| **14** | Hypomineralization defects (not MIH/HSPM) |
| 2 | **Demarcated opacities** |
| **21** | White or creamy demarcated opacities |
| **22** | Yellow or brown demarcated opacities |
| 3 | **PEB** |
| 4 | **Atypical restoration** |
| 5 | **Atypical caries** |
| 6 | **Missing due to MIH/HSPM** |
| **7** | **Cannot be scored** |

Table 1: European Academy of Paediatric Dentistry enamel defects index (Ghanim et al., 2015)

2. **Caries Index: DMFT\dmft index** was recorded after dental examination of the children in both groups. Both primary and permanent teeth were examined and given a specific code as in D (decayed), M (missing) and F (filled) (Appendix 6).

The WHO criteria were followed in order to correctly record the following: (96)

- No tooth should be recorded more than once, either decayed, missing or filled teeth
- A tooth is considered to be present in the mouth when any part of it is visible
- Tooth is considered sound if it shows no evidence of treated or untreated clinical caries
- Decay is considered whenever there is a caries lesion present
- Filled teeth with secondary caries should be counted as decayed
- Teeth missing only due to caries should be counted as missing
- Unerupted teeth, teeth missing due to trauma or congenitally missing are not counted as missing
- A tooth which is decayed as well as filled is considered as decayed
- Temporary restorations are considered as decayed.

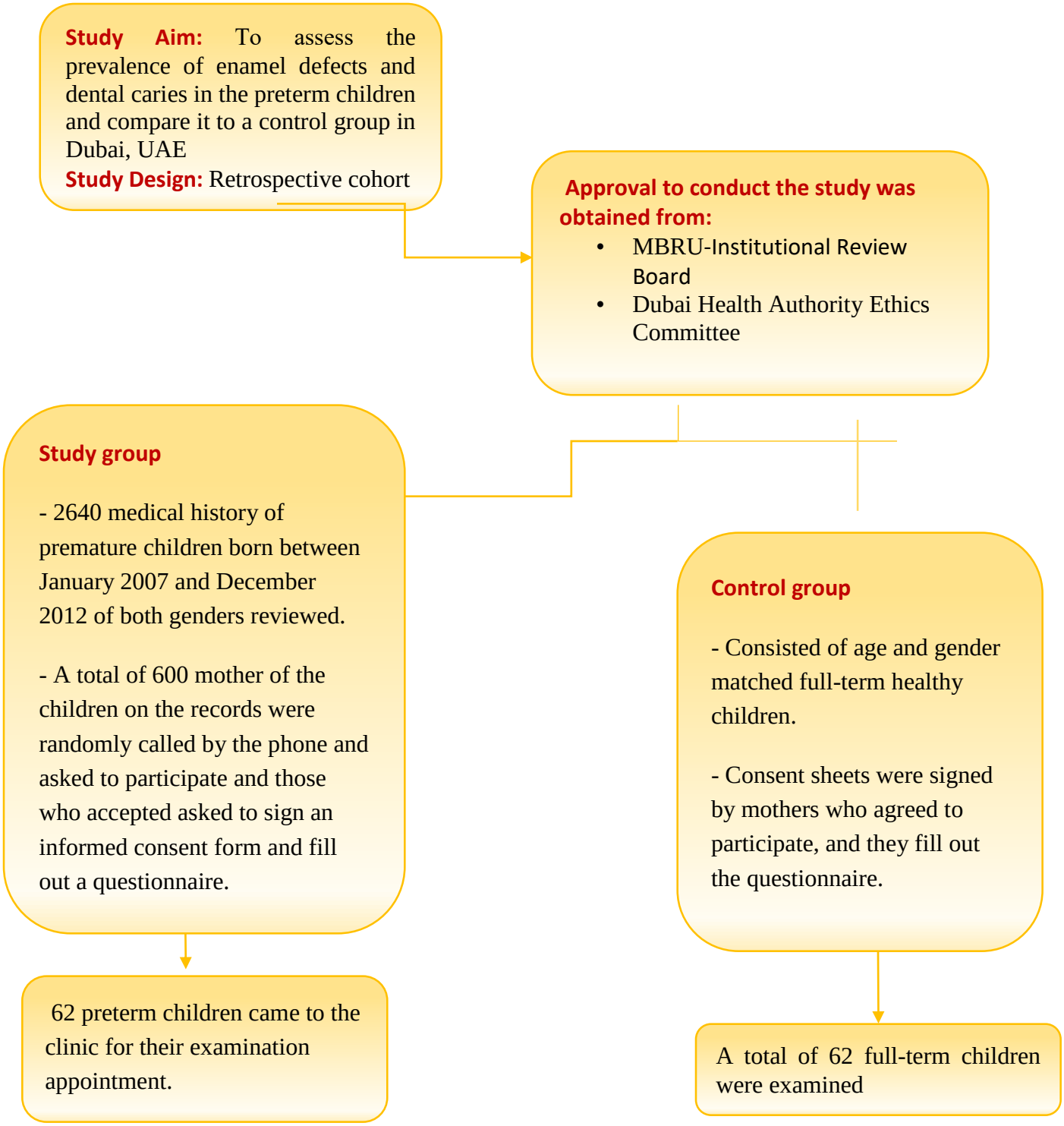



Figure1: Flow chart the study design

### 4.4 Statistical analysis

Data was entered into computer using SPSS for windows version 20.0 (SPSS Inc., Chicago, IL 2009). Results were cross-tabulated to examine the independency between variables. Statistical analysis was performed using $\chi$2-square for test of association and Fisher's exact test as appropriate. Where two or more continuous independent variables examined, t-test and analysis of variance were used.

Frequency tables' bar and lines graphs were utilized as descriptive statistics. A P-value of less than 0.05 was considered significant in all statistical analysis.

### 4.5 Ethical considerations

This study conducted in full conformance with principles of the “Declaration of Helsinki”, Good Clinical Practice (GCP), and within the laws and regulations of the UAE/DHCC. The ethical approval obtained from the Research Ethics Review Committee in Hamdan Bin Mohammed College of Dental Medicine (Appendix 1)

# 5. RESULTS

## 5.1 Study sample characteristics

The demographic characteristics of the 62 pre-term children and 62 full-term controls are shown in Table 2 which showed no significant differences between the full and preterm groups. Data regarding their gender, age, mothers' education and occupation are described. Pre-term children had an average age of 8.1(±1.54), while the full-term group had an average age of 8.1(±1.73), P<0.913. For gender distribution, 32(51.6%) of pre-term children were males compared to 30(48.4%) females, and in the full-term group 34(54.8%) were males compared to 28(45.2%) females with no statistically significant difference between the two group (P=0.429). No statistically significant difference existed between mothers' education and occupation in the pre-term and full-term group with P=0.152 and 0.075 respectively.

**Table 2: The demographic characteristics of study participants**

| Variables | Full-term | Pre-term | P-value |
|---|---|---|---|
| **Gender** | | | |
| Male | 34(54.8%) | 32(51.6%) | 0.429 |
| Female | 28(45.2%) | 30(48.4%) | |
| **Age** | 8.1(1.73) | 8.1 (1.54) | 0.913 |
| Mean (SD) | | | |
| **Mothers' education** | | | |
| At least secondary | 19(30.6%) | 13(20.9%) | 0.152 |
| At least diploma | 43(69.4%) | 49(79.1%) | |
| **Mother's occupation** | | | |
| Unemployed | 33(53.2%) | 24(38.7%) | 0.075 |
| Employed | 29(46.8%) | 38(61.3%) | |

### 5.2 Medical history of study participants

The medical history of pre-term and full-term groups is described in Table 3. There was a statistically significant difference between the two groups in relation to their weight at birth, need for intubation, diseases during pregnancy, systemic diseases and admissions early in life (P<0.05). Weight at birth was significantly different between the two groups (P< 0.001). The majority of the pre-term group presented with low birth weight [37 (59.7%)] while in the full-term group, the majority had normal birth weight [(58 (93.5%)].

For pre-term group most of the deliveries were by caesarean section [(44 (73.3%)], while in the full-term group vaginal delivery was the main type of delivery (46 (71.9%)) creating a significant difference between the two (P <0.001). The majority of the preterm infants were intubated with breathing devices [(48 (96.0%)], while in the full-term group only two (4.0%) were intubated. In the full-term group 53 (60.2%) did not report any complications during the pregnancy, while in the preterm group 27(77.1%) had one or more pregnancy complication(s). In the above medical histories, a P-value <0.001 resulted in statistically significant difference between the two groups.

The systemic infections and antibiotic exposure were reported to be higher among the pre-term group [33 (53.2%)] compared to 12 (19.4%) in full-term group (P <0.001). More hospital admissions during the first three years of life were reported in the pre-term group 20 (74.1%) compared to 7 (25.9%) in full-term group and this was statistically significant (P <0.01).

History of traumatic dental injuries was the only variable with no statistically significant difference between the pre-term and full-term group (P= 0.301).

| Variables | Full-term | Pre-term | P-value |
|---|---|---|---|
| **Weight at birth** | | | |
| Normal weight (≥ 2.5 Kg) | 58 (93.5%) | 3 (4.8%) | |
| Low weight (1.5-2.5 KG) | 4 (6.5 %) | 37 (59.7%) | < 0.001 |
| Very low weight (<1.5 kg) | 0 (0.0%) | 22 (35.5%) | |
| **Type of delivery:** | | | |
| Vaginal | 46 (71.9%) | 18 (28.1%) | < 0.001 |
| Caesarean | 16 (26.7%) | 44 (73.3%) | |
| **Intubation** | | | |
| No | 60 (81.1%) | 14 (18.9%) | < 0.001 |
| Yes | 2 (4.0%) | 48 (96.0%) | |
| **Diseases during pregnancy** | | | |
| No | 53 (60.2%) | 35 (39.8%) | < 0.001 |
| Yes | 8 (22.9%) | 27 (77.1%) | |
| **Systemic diseases and antibiotic exposure** | | | |
| No | 50 (80.6%) | 29 (46.8%) | < 0.001 |
| Yes | 12 (19.4%) | 33 (53.2%) | |
| **Hospital admission early in life** | 55 (56.7%) | 42 (43.3%) | |
| No | 7 (25.9%) | 20 (74.1%) | 0.004 |
| Yes | | | |
| **Dental trauma** | 55 (88.7%) | 52 (83.9%) | |
| No | 7 (11.3%) | 10 (16.1%) | 0.301 |
| Yes | | | |

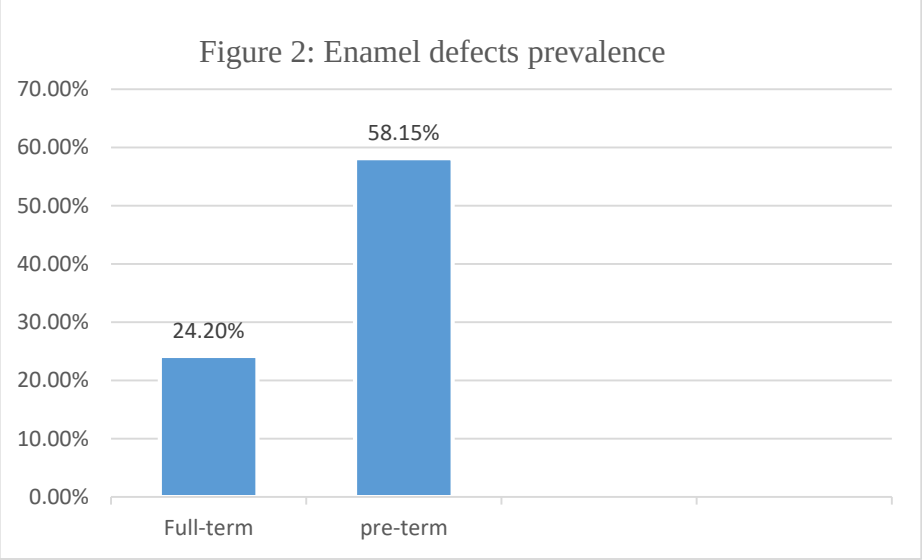
**Table 3: Medical history for the study participants.**

### 5.3 Enamel defects

5.3.1 Enamel defects prevalence

The collected data revealed that the overall prevalence of the enamel defects in both groups was 51(41%). The preterm group prevalence was 36 (58.15%) and was significantly higher (P < 0.001) compared with full-term group 15 (24.2%) as shown in Figure 2.

There was an association between being preterm and enamel defects in such a way that the enamel defects were 4.34 times more prevalent among preterm children compared with full-term children [odd ratio (OR)4.338, CI 95% [2.010-9.366].




5.3.2 Enamel defects and birthweight

Figure 3 shows the distribution of birthweight among the full-term and pre-term groups. More than half of the pre-term group [37 (59.7%)] had low birth weights, followed by very low birth weights [22 (35.5%)] while only 3 (4.8%) presented with normal birth weights. On the other hand, full term group were mostly of normal birth weight [58 (93.5%)], 4(6.5%) presented with low birth weights and none of them had a very low birth weight (P <0.001).

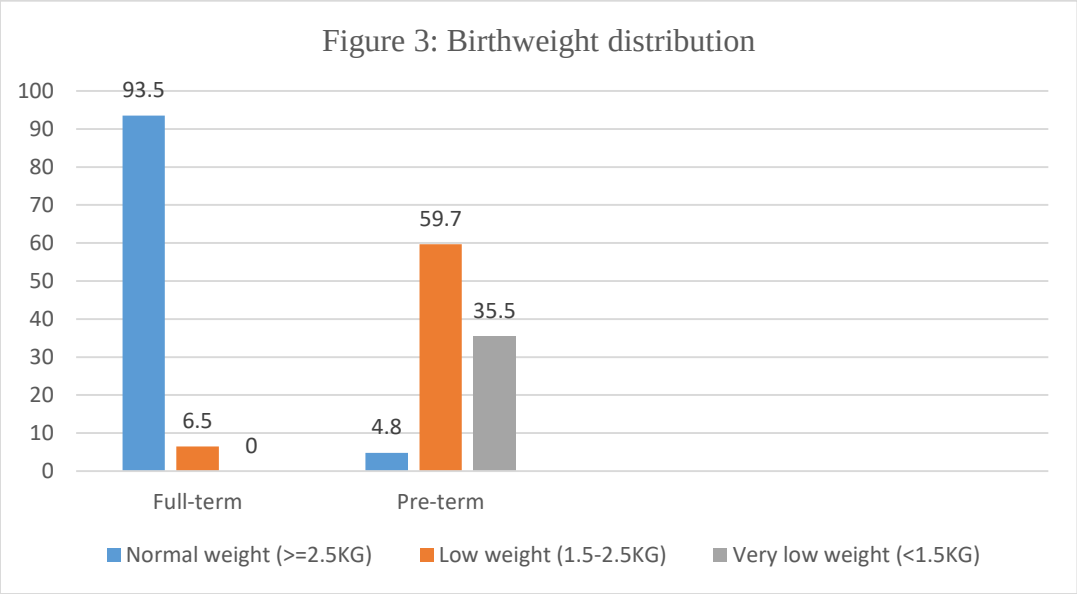



Table 4 presents the relationship between the birthweight and the enamel defects. The highest proportion of enamel defects was found in the pre-term infants with abnormal birth weights (low and very low birth weights) 34(94.4%). No enamel defects presented in the majority of the full-term infants who had a normal birth weight 45(95.7%). Birth weight was found to be a statistically significant factor contributing to enamel defects (P <0.001).

**Table 4: Enamel defects and birth weight**

| Enamel defects | Full-term | | Pre-term | | P-value |
|---|---|---|---|---|---|
| | Normal birth weight | Abnormal birth weight | Normal birth weight | Abnormal birth weight | |
| No | 45 (95.7%) | 2 (4.3%) | 1 (3.8%) | 25 (96.2%) | < 0.001 |
| Yes | 13 (86.7%) | 2 (13.3%) | 2 (5.6%) | 34 (94.4%) | < 0.001 |

5.3.3 Other possible causes of enamel defects

This study also investigated the other possible causes of enamel defects as presented in Table 5 such as type of delivery, intubation, diseases during pregnancy, hospitalization and systemic disease early in life as recalled by the mothers.

Regarding the type of the delivery, in the pre-term group 25(69.4%) who had a caesarean delivery had enamel defects, while 19 (73.1%) did not develop any defect. The majority of the full-term group were through vaginal delivery and 36(76.6%) did not develop any enamel defects, while 10(66.7%) had the defect (P=0.02) indicating that the type of delivery was a statistically significant factor contributing to enamel defects.

Intubation was among the most significant factors contributing to enamel defects (P-value <0.001). In the full-term group we had only two (13.3%) children who were intubated and both of them developed enamel defects. While in the pre-term group we had 29 (80.6%) of children who were intubated and had an enamel defects as a result.

For diseases during pregnancy, three (21.4%) of the full-term group developed an enamel defect compared to 16(44.4%) in the preterm group. In the pre-term group, 13(36.1%) had a history of admission early in the life had enamel defects, on the other hand six (40%) of the full-term group who had admission developed an enamel defect. Both factors were statistically not significant, P-Values (0.19 and 1.00) respectively.

Enamel defects were found in eight (53.3%) of full-term group who had antibiotic exposure early in life compared to 22 (61.1%) in the preterm group. In the full-term group four (8.5%) took antibiotics early in life compared to 11 (42.3%) in the pre-term group and none of them developed an enamel defect(P=0.75) indicating that antibiotic exposure and systemic infections were not statistically significant factors.

Finally, history of previous dental trauma as well was not a statistically significant factor to enamel defects (P=<0.09).

**Table 5: Other possible causes of enamel defects.**

| Enamel defects | No | | Yes | |
|---|---|---|---|---|
| | Full-Term | Pre-term | Full-term | Pre-term |
| Type of Delivery | | | | |
| **Vaginal** | 36 (76.6%) | 7 (26.9%) | 10 (66.7%) | 11 (30.6%) |
| **Caesarean** | 11(23.4%) | 19 (73.1%) | 5 (33.3%) | 25 (69.4%) |
| P-Value | < 0.001 | | 0.028 | |
| Intubation | | | | |
| **No** | 47 (100%) | 7 (26.9%) | 13 (86.7%) | 7 (19.4%) |
| **Yes** | 0 (0.0%) | 19 (73.1%) | 2 (13.3%) | 29 (80.6%) |
| P-Value | < 0.001 | | < 0.001 | |
| Diseases during pregnancy | | | | |
| **No** | 42(89.4%) | 15(57.7%) | 11 (78.6%) | 20 (55.6%) |
| **Yes** | 5 (10.6%) | 11 (42.3%) | 3 (21.4%) | 16 (44.4%) |
| P-Value | 0.003 | | 0.197 | |
| Hospitalization early in life | | | | |
| **No** | 46 (97.9%) | 19 (73.1%) | 9 (60.0%) | 23 (63.9%) |
| **Yes** | 1 (2.1%) | 7 (26.9%) | 6 (40.0%) | 13 (36.1%) |
| P-Value | 0.002 | | 1.000 | |
| Systemic diseases and antibiotic exposure | | | | |
| **No** | 43 (91.5%) | 15 (57.7%) | 7 (46.7%) | 14 (38.9%) |
| **Yes** | 4 (8.5%) | 11 (42.3%) | 8 (53.3%) | 22 (61.1%) |
| P-Value | 0.002 | | 0.757 | |
| Dental Trauma | | | | |
| **No** | 40 (85.1%) | 23 (88.5%) | 15 (100%) | 29 (80.6%) |
| **Yes** | 7 (14.9%) | 3 (11.5%) | 0 (0.00%) | 7 (19.4%) |
| P-Value | 1.000 | | 0.090 | |

5.3.4 Types of enamel defects

Table 6 demonstrates the different types of enamel defects. The most common type of enamel defects reported in both full and pre-term groups was white or creamy demarcated opacities, accounting for 14 (22.6%) of the defects in the full-term and 26 (41.9%) in the pre-term group with statistically significant difference between the two group (P=0.017). Pre-term children had double the risk of white or creamy demarcated opacities compared to full terms.

The second most common type of defect in the preterm group was post eruptive breakdown accounting for 13 (21%) of the defects in the pre-term group compared to four (6.5%) in the full-term group with statistically significant difference between the two groups (P=0.017). Pre-term children had three times increased risk of post-eruptive breakdown compared to their full-term counterpart.

Atypical caries presented a statistically significant difference between the full-term and pre-term group with P=0.007, affecting seven (11.3%) of pre-term group and none in the full-term group. The presence of all of the yellow or brown demarcated opacities, atypical restorations, diffuse opacities, hypoplasia and hypomineralization defects (not MIH/HSPM) was not statistically significantly different between the pre-term and full-term group (P-value 0.5, 0.372, 0.5, 0.248, 0.122 respectively).

The least common type of defect among the pre-term group was diffuse opacities as only [one (1.6%)], followed by hypoplasia [two (3.2%)], but were not reported in the full-term group.

**Table 6: Types of enamel defects in study participants**

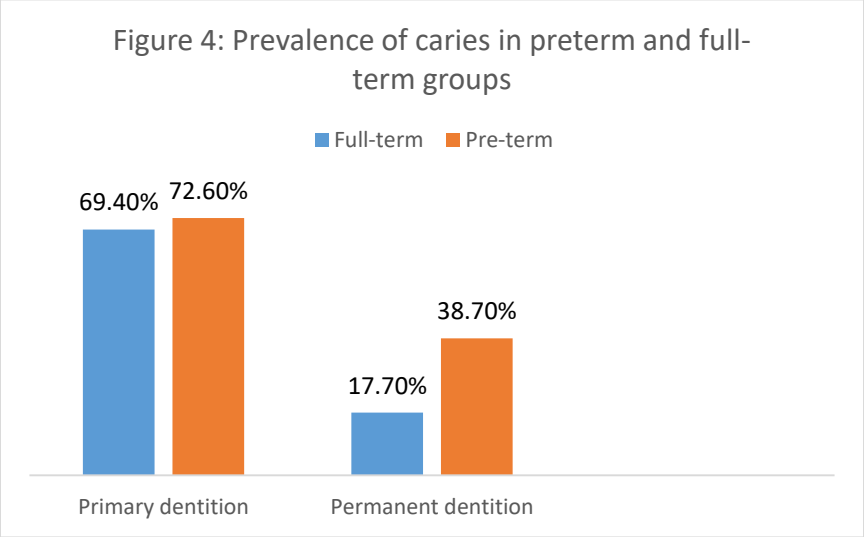
| Type of enamel defects | Full Term | | Pre term | | Odd ratio [95%CI] | P-value |
|---|---|---|---|---|---|---|
| | No | Yes | No | Yes | | |
| **White or creamy demarcated opacities** | 48(77.4%) | 14 (22.6%) | 36(58.1%) | 26 (41.9%) | 2.476 [1.135,5.403] | 0.017* |
| **Yellow or brown demarcated opacities** | 59(95.2%) | 3 (4.8%) | 58(93.5%) | 4 (6.5%) | 1.356 [0.291,6.328] | 0.500 |
| **PEB**** | 58(93.5%) | 4 (6.5%) | 49(79.0%) | 13 (21.0%) | 3.847 [1.178,12.562] | 0.017* |
| **Atypical restorations** | 58(93.5%) | 4 (6.5%) | 56(90.3%) | 6 (9.7%) | 1.554 [0.416,5.8000] | 0.372 |
| **Atypical caries** | 62(100%) | 0 (0.0%) | 55(88.7%) | 7 (11.3%) | 0.470 [0.388,0.570] | 0.007* |
| **Diffuse opacities** | 62(100%) | 0 (0.0%) | 61(98.4%) | 1 (1.6%) | 0.496 [0.415,0.593] | 0.500 |
| **Hypoplasia** | 62(100%) | 0 (0.0%) | 60(96.8%) | 2 (3.2%) | 0.492 [0.411,0.589] | 0.248 |
| **Hypo mineralization defect (not MIH/HSPM)** | 62(100 %) | 0 (0.0%) | 59(95.2%) | 3 (4.8%) | 0.488 [0.406,0.585] | 0.122 |

*Statistically significant **Post Eruptive Breakdown

## 5.4 Dental caries

### 5.4.1 Prevalence

The prevalence of caries in the primary dentition among preterm children was 72.6% while for the full-term control it was 69.4%. In the same context, the prevalence of caries in the permanent teeth among pre-term children was 38.7% while for the full-term controls it was 17.7% as shown in Figure 4.




### 5.4.2 DMFT/*dmft* caries indices

Permanent and primary dentitions' caries status in terms of DMFT and *dmft* is summarized in Table 7. The decayed component of DMFT in pre-term group had a mean of (1.00 ± 0.83) whereas in the full-term group it was (0.90 ± 0.70), p-value = 0.793 showing no statistically significant difference in the permanent teeth decay between preterm and full-term group.

In the full-term children, the studied group showed no missing permanent teeth due to caries, while in the preterm group missing permanent teeth had a mean of (0.04 ± 0.20);

however, this was not shown to be at a statistically significant (p-value= 0.847). Filled teeth as well did not present a significant difference between the two group (p-value= 0.370).

In general, there was a statistically significant difference in permanent teeth caries experience amongst pre-term children compared to the full-term control as measured by DMFT (P-value = 0.008).

There was no statistically significant difference in primary teeth caries experience amongst pre-term children compared to the full-term control as measured by *dmft*. The *dmft* scores were comparable in pre-term children as compared to their controls (3.45 ± 3.32 vs 4.61 ± 4.30, P- value =0.222).

With regards to the decayed primary teeth, children in the control group had a mean of 1.02 (± 0.85) comparable with the per-term group (1.35 ± 0.74) which was not statistically significant (p- value= 0.066). Missing primary teeth had mean of 0.53 (± 0.79) in full-term group, compared to 0.22 (± 0.42) in pre-term group (p-value= 0.08: not statistically significant).

**Table 7: Permanent dentition (DMFT) and primary caries status (dmft)**

| Variables | Full-term | Pre-term | P-Value |
|---|---|---|---|
| Permanent dentition caries status (DMFT) | | | |
| **DMFT index** | 0.38 ± 0.99 | 1.00 ± 1.55 | 0.008* |
| **Decayed** | 0.90 ± 0.70 | 1.00 ± 0.83 | 0.793 |
| **Missing** | 0.0006 | 0.04 ± 0.20 | 0.847 |
| **Filled** | 0.90 ± 0.83 | 0.62 ± 0.71 | 0.370 |
| **Primary dentition caries status (*dmft*)** | | | |
| ***dmft* index** | 4.61 ± 4.30 | 3.45 ± 3.32 | 0.222 |
| **decay** | 1.02 ± 0.85 | 1.35 ± 0.74 | 0.066 |
| **missing** | 0.53 ± 0.79 | 0.22 ± 0.42 | 0.086 |
| **filled** | 1.04 ± 0.89 | 0.68 ± 0.76 | 0.058 |

*Statistically significant

# 6. DISCUSSION

The prevalence of enamel defects and caries status in preterm born children in Dubai has not been investigated yet. Therefore, this study provided an opportunity to assess these oral health problems among those who were born prematurely in Latifa hospital in Dubai and compare them to a matched full-term control.

The samples used in this study were matched in age and gender. The preterm group included 32(51.6%) males and 30(48.4%) females, compared to 34(54.8%) males and 28(45.2%) females included in the full-term group. No significant differences existed in age and gender. With regards to geographical distribution, the study sample was chosen from Latifa hospital in Dubai which is considered the referral center for most complicated pregnancies and premature births in Dubai and the Northern Emirates of the UAE, and the control group participants were matched accordingly. A sample size calculation was conducted prior to data collection.

### 6.1 Enamel defects' measurement

The recent proposed standardized scoring method by the European Academy of Paediatric Dentistry (EAPD) for enamel defects by Ghanim *et al.* (2015) was used to identify and record enamel defects.(94) This method was introduced to enable the researcher to use a standardized tool and criteria which would lead to consistent results and allow proper comparison between different studies.

### 6.2 Enamel defects' prevalence

In the present study, enamel defects' prevalence in the preterm group was significantly higher, (58.15%) compared with the full-term group (24.2%). This was similar to findings in other studies such as Takaoka *et al*. from Brazil who reported an 87% prevalence of

enamel defects in the preterm group compared to 44% in the full- term group ($p < 0.001$).(78) Similarly, Aine *et al.* from Finland reported a 78% prevalence of enamel defects in the primary dentition of preterm children compared to 20% in the full term group and 83% prevalence in the permanent dentitions of preterm children compared to 36% in the full term group.(10) Also, Cruvinel *et al.* from Brazil reported a high prevalence of enamel defects as well; out of a total 80 children examined, around 72.5% had enamel defects in at least one tooth.(79) Pimlott *et al.* in the USA reported a prevalence of 37% of children having at least one enamel defect out of total 106 premature children examined. Another study from Brazil also had similar findings, 110 teeth out of 1388 examined presented with enamel defects in the pre-term group compared to 64 teeth out of 1710 teeth in the full-term group.(91)

In our study, we found that being preterm increases the risk of developing enamel defects by 4.34 times. In comparison, Arrow *et al.* in Australia found that prematurity increases the risk of enamel defects 2.75 times.(81) Although our study did not look at dental micro histopathology, a possible explanation of high prevalence of enamel defects among the pre-term infants group generally, can be explained by the different chemical and the microscopic properties of the dental hard tissues of the pre-term infants. Rythén *et al*. in 2008 found that exfoliated primary teeth of preterm individuals to have 5% higher degree of porosity than primary teeth of full term children.(57) In addition to that, Rythen *et al.* in 2012 found that the enamel of pre-term children had more carbon (C) percentage, less calcium percentage (Ca) and lower Ca/C ratio in the outer enamel which make the pre-term enamel more porous than the full-term children.(56) These differences in the chemical properties are due to the fact that the pre-term children have shorter period of tooth

mineralization and are missing an important cycle of tooth development by10 weeks or more during the last trimester of pregnancy.(56)

**6.3 Enamel defects and birthweight**

In the present study, we found that birth weight was a statistically significant factor contributing to enamel defect in primary and permanent dentition combined. Pre-term infants with low birth weight had the highest incidence of enamel defects (94.4%). While enamel defects were present in only 4.3% of the full-term infants who had a normal birth weight. In comparison, Wagner *et al*. (2017) found that being pre-term with low birth weight makes the child 4.9 times more at risk of developing enamel defects compared to full-term children with normal birth weight.(77) While Lunardelli *et al.* reported slightly more than double the risk of enamel defects in primary dentition of low birth-weight children (OR = 2.6) compared to full term born children.(98) Arrow *et al.* reported the odd ratio of enamel defects in low-birth weight children in the permanent dentition to be (OR = 2.11; 95% CI = 1.03–4.31).(81) This was lower than what was reported in our study as highlighted above. Cruvinel reported that enamel defects were more prevalent in very low birth weight (VLBW) compared to low birth Wight (LBW) and normal birth weight (NBW) in Brazil. Birth weight was significantly associated with hypoplasia (p-value <0.001).(79) In a cohort study by Nelson *et al.* in 2013 VLBW children had a mean of ($1.37 \pm 2.63$) for any type of enamel defects compared to ($0.53 \pm 1.18$) in NBW ($p < 0.001$).(7) The higher prevalence of enamel defects in VLBW children can be explained by the increased morbidity of these children with more complications and interventions needed in the short and long term which might leave an impact on the dental tissues.(100)

## 6.4 Other possible causes of enamel defects

### 6.4.1 Mode of delivery

In our study, there was a statistically significant difference between the two groups in relation to the mode of delivery. Most of the pre-term delivery mode was by a caesarean section (73.3%), while in the full-term group vaginal deliveries were the most common (71.9%). Similar significant differences were reported by Takaoka *et al.* in Brazil.(78) In the present study, mode of delivery was a significant factor contributing to increased risk of enamel defects. This was in agreement with a Brazilian study where type of birth was significantly associated with the occurrence of hypoplasia.(79) These findings could be because caesarean sections are usually prone to more complications which reflected as enamel defects in the developing dentition. In contracts, a study by Allazzam *et al*. (2014) in Saudi Arabia did not find any association between mode of delivery and the presence of enamel defects.(89)

### 6.4.2 Intubation and enamel defects

In the present study, infants' intubation was significantly related to enamel defects. In the pre-term group 80.6% of the children where intubated and all of them developed enamel defects, while in the full-term group only two children were intubated because of hypoxia and respiratory complications and both of them developed enamel defect.

Takaoka *et al.* from Brazil also reported similar finding in such a way that all the 87% pre-term children who were intubated developed enamel defects.(78) Another Brazilian study by Gravina *et al*. found all the children who were intubated and received ventilatory support developed hypoplasia.(91) Mechanical trauma from intubation in pre-term infants was reported to have an effect on the oral structures.(99) Endotracheal and oral-gastric intubation can create excessive force on the developing crowns of the teeth in the palate disturbing the amelogenesis process

resulting in enamel defects.(35).

6.4.3 Diseases during pregnancy, hospitalization, systemic infectious diseases and antibiotic exposure early in life

In the present study we did not find any association between enamel defects and the following factors: complications and diseases during pregnancy, hospitalization early in life and systemic infectious diseases and antibiotic exposure during the first three years of life. Allazzam *et al.* from Saudi Arabia had similar findings in their study.(89)

Wuollet *et al.* 2016 from Finland studied the association between childhood illness and antibiotic exposure as possible risk factors of MIH. They found that most types of childhood illness were not associated with MIH, except for acute otitis media, however this association was not statistically significant. Regarding antibiotic usage, they found that children who had at least one course of amoxicillin or penicillin had a higher risk for MIH, however other antibiotic did not increase the risk.(100)

Wagner *et al*. in his study in 2017 found that children with systemic general diseases had double the risk of developing enamel defects (OR 2.45), similarly does the antibiotic exposure (OR 2.21), while hospitalization early in life increase the risk of enamel defects to 4 fold (OR 4.44).(77)

Similarly, Arrow *et al.* 2009 in Australia concluded that infection during the early years of life is a significant risk factor for the development of enamel defects (OR 6.88).(81)

6.44 Enamel defects and traumatic dental injuries

Traumatic dental injuries to the primary dentition can result in number of complications in their permanent successors such as white or yellow-brown crown discoloration, hypoplasia of the permanent incisors and tooth malformation.(102) In the present study trauma was ruled out of

being a source of the underlying enamel defect by investigating trauma history. We did not find any association between history of traumatic dental injuries and enamel defects. However, a recent study in Sweden in 2018 found that traumatic dental injuries to the primary dentition, occurring before the age of four, increased the risk of developmental enamel defects in their permanent successors in comparison to children older than four years.(90)

**6.5 Types of enamel defects**

In our study, there was a statistically significant difference in the most common type of enamel defect between the study group and the control group. Demarcated opacities accounted for 22.6% of the defects in the full-term groups compared to 41.9% of the defects in the pre-term group. The least common type of defect observed was diffuse opacities affecting only one pre-term child and none of the full-term children. Similar findings were reported in a cohort study in 2017 by Wagner *et al.* from Germany who found that the demarcated opacity was the most common type of defect affecting 75.0% of the studied population and the diffuse opacity was the least occurring type of defect (5.0%).(77) Cruvinel *et al*. reported significant difference between pre-term and full-term groups regarding the prevalence of demarcated opacities and hypoplasia.(79) Allazzam *et al*. also reported that demarcated opacity was the most occurring type of defect (56.5%) while post eruptive breakdown was the second most frequently found type of defect (26.1%) in the preterm group, which was similar to our findings.(89) Takaoka *et al.* in Brazil reported that demarcated opacities were more common in the pre-term group compared to the full term group, however the difference was not statistically significant. They also found that hypoplasia in the form of pits was more frequent in the pre-term group.(78) In contrast, Gravina *et al*. (2013) found that the most common type of defect in the pre-term group was hypoplasia, while in the full-term group it was demarcated opacities.(91)

### 6.6 Dental caries and enamel defects

For dental caries detection, *dmft*/DMFT index was used according to WHO criteria (1997).(96)

In the literature, there are conflicting data regarding the prevalence of caries in pre-term children compared to full-term born children, while some reported increased risk, others found the opposite. In the present study, there was a statistically significant difference in DMFT index (P-Value = 0.008) between pre-term and full-term group.

Nelson *et al*. studied dental caries in very low birth weight adolescents and reported a similar finding.(67) Kumar *et al*. (2017) in India studied the presence of dental caries in pre-term children aged 2-8 years with enamel defects. They reported increased risk of dental caries in pre-term group compared to full-term.(103) Rythen *et al.* reported no statistically significant difference in the caries prevalence between the group who were born pre-maturely compared to full-term control.(82) A systematic review in 2017 reported that children with enamel defects had three times increased risk of developing dental caries (OR 3.33; 95%CI 1.75,5.51).(87). A possible explanation of the above results may be due to a higher prevalence of plaque, *Streptococcus mutans* and lower saliva secretion in pre-term adolescents.(82)

In the primary dentition, our study demonstrated a higher prevalence of caries among preterm children of 72.6% compared to the full-term control (69.4%). This difference was not statistically significant. A close prevalence of 82.8% of caries in the primary dentition was reported in the pre-

term group in a cross-sectional study in Brazil, however a lower prevalence of 13.7% was reported in the full-term group.(85) A study in Japan in 2014 reported a lower prevalence of dental caries in the pre-term group (12.9%) compared to (21.1%) in full-term children.(84)

On the other hand, other studies reported a higher prevalence of caries in primary dentition in the presence of enamel defects, such as a study by Oliveira *et al.* who stated that enamel defects strongly increase the risk of dental caries.(86) Similarly, a higher prevalence of caries among the pre-term children (33%) compared to 17% in full-term children was reported in a Brazilian study although the difference was not statistically significant.(78)

Suggested possible factors besides enamel defects that can contribute to a higher risk of caries among the pre-term children could be, increased consumption of sugary medications, xerostomia as a result of some medications, high caloric diet to gain more weight and higher reflexes among the pre-term children.(104) Moreover, the rough surfaces of the enamel defects can be easily occupied by dental biofilm and *Streptococcus mutans* species, this early colonization of the cariogenic bacteria increases the risk of developing dental caries.(58)

In the present study a lower mean *dmft* (3.45 ± 3.32) was found in the pre-term group compared to full-term group (4.61 ± 4.30), however, the difference was not statistically significant. Another study carried out in Thailand in 2016 reported that the preterm children had lower *dmfs* compared to full-term children (12.9 ±15.1 versus 14.4 ±12.3) respectively.(83)

A possible explanation of the above findings could be due to enhanced care from the parents of their pre-maturely born child. Nirunsittirat *et al*. in Thailand found that pre-term children had benefited more from the dental services compared to the full-term children.(83) Nelson *et al.* in their study found that supervised brushing from parents or caregiver was significantly greater in the pre-term group compared to full-term group.(67) Another possible reason reported by Ramos *et al*. that pre-term children with very low birth

weight had a significant delay in the eruption of the deciduous dentition when compared to full term infants considering their chronological age.(105)

### 6.7 Limitations of the study

As with every study, perfection is desired, however, there are obstacles and challenges at the time of conducting a study. Pointing out study limitations is good practice, and helps in understanding the overall outcome, as well as allowing for one to realize improved methods which may help overcome these challenges in future research. The limitations in this current study are as follows:

- Accuracy of information given by mothers who some of them might not be recall pre-, peri- and post-natal information.
- Having prospective cohort longitudinal data collection and following the study sample over time allows a more accurate assessment of possible influencing early life factors and their relationship with enamel defects.
- Having a bigger sample size will make the result more representative for the studied group.

# 7. CONCLUSIONS and RECOMMENDATIONS

This current study concludes the following:

- Enamel defects were significantly higher in the pre-term group compared to the full-term group. Enamel defects were four times more common in the pre-term group compared to the control.
- Birth weight was significantly related to the occurrence of enamel defects. Pre-term children with low and very-low birth weight presented with more enamel defects than full-term children with normal birth weight.
- The majority of the pre-term group had a caesarian delivery, while in the full-term group the majority were delivered through vaginal delivery. Type of delivery was statistically related to the occurrence of enamel defects.
- Intubation was significantly related to enamel defects.
- There was a significant difference between the pre-term and the full-term group regarding diseases during pregnancy, systemic disease early in life with antibiotic exposure and hospital admissions. However, these factors were not significantly related to the occurrence of enamel defects in preterm children.
- The most common type of enamel defects reported in both full and pre-term groups were white or creamy demarcated opacities, with the pre-term group having double the risk.
- Pre-term children had three times increased risk of post eruptive breakdown compared to their full-term counterparts.
- The presence of atypical caries was significantly higher in the pre-term group.
- There was a statistically significant difference in permanent teeth caries experience amongst pre-term group compared to the full-term control as measured by DMFT,

however, it was not significantly different in primary teeth caries experience as measured by *dmft*.

Looking at the outcomes of this study, the following recommendations suggested for future research are:

- To present the findings of this study to the provider of health care of pre-term children in Latifah Hospital; then to all health care provider across the UAE.
- To increase parental/caregiver education and awareness programs, which stress the importance of oral health in pre-term children.
- To establish early consultation with a specialist pediatric dentist or general dentist for preterm infants, in particular those with low birthweights as they are at higher risks of dental conditions.
- Co-operation between pediatric dentists, pediatricians and neonatologists in order to establish improved prevention and community oral healthcare programs which target pre-term children.
- To conduct a similar study to include all pre-term children in the UAE and include all other oral health aspects, in order to achieve a better understanding of their treatment needs.

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# 9.0 APPENDICES

**APPENDIX 1:** Ethical approval from the Research Ethics Review Committee in Dubai Healthcare City, MBRU-Institutional Review Board, Dubai, UAE

**APPENDIX 2:** Dubai Health care Authority ethical approval

**APPENDIX 3:** Clinical data recording sheet

**APPENDIX 4:** Demographic details questionnaire

**APPENDIX 5:** Study Consent sheets to be signed by parents/legal guardians

**APPENDIX 6:** Caries index

# APPENDIX 1

Date: 1/06/2017

Dear Dr Anood

Re: Your research protocol

Titled: Prevalence of enamel defects and caries ……

Thank you for submitting your research protocol to the Research and Ethics committee of the Hamdan Bin Mohammed College of Dental Medicine, MBRU.

It was originally considered at the meeting held on: 21/05/2017

The points raised in my letter of 22/05/2017 have been addressed although in actual fact this study is a retrospective cohort study as you are determining disease (caries and enamel defects) in 2 groups with a known preceding event/exposure (preterm v full term babies).

Although you mention training and calibration there is no detail regarding how and when this was done.

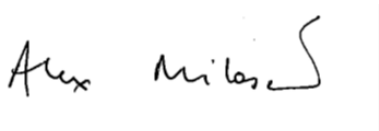
This study is now approved.

The committee would like to remind you that it is a requirement of the programme that you complete a research dissertation, which comprises 15% of credits within the 3-year MSc programme.

Good luck with your study

With best wishes

Yours sincerely,



Prof A Milosevic

Chair, Research and Ethics Committee, HBMCDM

## APPENDIX 2

GOVERNMENT OF DUBAI

**DUBAI SCIENTIFIC RESEARCH ETHICS COMMITTEE APPROVAL LETTER**

DUBAI HEALTH AUTHORITY

| | | | |
|---|---|---|---|
| **From :** | Dubai Scientific Research Ethics Committee (DSREC), Dubai Health Authority | **Date :** | 21 Nov 2017 |
| **To :** | Dr. Mahmoud Saleh ElHalik, Consultant Neonatologist, NICU/Pediatrics Department, NICU, Latifa Hospital, DHA | **Ref :** | DSREC-10/2017_09 |
| **Study Site:** | Latifa Hospital, DHA | | |

Subject: Approval for the research proposal: ***"A case-control study of enamel defects and caries in 5-9 years old preterm born children in Dubai, UAE"***

Dear Dr. Mahmoud Saleh ElHalik,

Thank you for submitting the above mentioned research proposal to Dubai Scientific Research Ethics Committee, DHA. The Dubai Scientific Research Ethics Committee has been organized and operates in accordance with the ICH/GCP guidelines and the committee is registered with the Office for Human Research Protection (OHRP).

Your request was discussed during the committee meeting held on 20 NOV 2017. We are pleased to advice you that the committee has granted an ethical approval for below mentioned study documents.

| No | Study Documents |
|---|---|
| 1 | Application form for the Ethical Approval of a Research Project |
| 2 | Study Proposal |
| 3 | Data Collection Tool |
| 4 | Confidentiality Agreement: Patient Information |
| 5 | Request For review of medical records |
| 6 | Resume of Principal Investigator and Co-investigators |

Please note that it is DSREC's policy that the principal investigator should report to the committee of the following:

1. Anything which might warrant review of ethical approval of the project in the specified format, including:
   - any serious or unexpected adverse events and
   - unforeseen events that might affect continued ethical acceptability of the project
2. Any proposed changes to the research protocol or to the conduct of research
3. Any new information that may affect adversely the safety of the subjects
4. If the project is discontinued before the expected date of completion (reason to be specified)
5. Annual report to the DSREC about the progress of the study
6. A final report of the finding on completion of the study

**APPENDIX 3**

# Clinical examination

- Present of enamel defect: (0) No (1) Yes

**Clinical status criteria (Long form)**

0 = No visible enamel defect.
1 = Enamel defect, not MIH/HSPM
- 11 = diffuse opacities
- 12 = hypoplasia
- 13 = amelogenesis imperfecta
- 14= hypomineralisation defect (not MIH/HSPM)

2 = demarcated opacities
- 21 = White or creamy demarcated opacities
- 22 = Yellow or brown demarcated opacities

3 = PEB
4 = Atypical restoration
5 = Atypical caries
6 = Missing due to MIH/HSPM
7 = Cannot be scored*

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E | D | C | B | A | A | B | C | D | E | | | | |
| | | | | | | | | | | | | | | | | |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| | | | | | | | | | | | | | | | | |
| | | | E | D | C | B | A | A | B | C | D | E | | | | |
| | | | | | | | | | | | | | | | | |

- Total number of erupted teeth ……
- Number of teeth with defects …….

**APPENDIX 4**

# General information

1) Child identification Nr ……..

2) Date of examination …….

3) Gender: ( ) male ( ) Female

4) Date of birth……

5) Educational level of mother: ( )None ( )Primary education

( )Secondary ( )Diploma/ Bachelor ( )Higher education

6) Occupation of mother: ( ) Employed ( )Unemployed

## Medical history

- Preterm birth (<37 weeks of pregnancy) ( )Yes ( )No

if yes during which week:

- Between 35th and 36th weeks ( )
- Between 31st and 34th weeks ( )
- Less than or equal to 30 weeks ( )

-Weight at birth:

- Normal weight (above 2500 g) ( )
- Low weight (between 1500 and 2500 g) ( )
- Very low weight (less than 1500 g) ( )

- Type of delivery: ( ) Caesarean ( ) Vaginal

-Any aided respiratory device used for the infant ( )Yes ( )No
if yes specify ……

- Diseases during pregnancy ( )Yes ( )No
if yes specify ……

- Hospitalization in the first years of life ( )Yes ( )No
if yes specify ……

-Systemic infectious diseases occurred in the first 3 years of life such as:(pneumonia, tonsillitis, ear infections, chickenpox, rubella, measles, systemic antibiotic medication): ( )Yes ( )No if yes specify ……

- History of trauma ( )Yes ( )No if yes specify …….

# المعلومات العامة

١-الرقم التعريفي للطفل .....

٢-تاريخ الفحص .....

٣- الجنس: ( ) ذكر ( ) أنثى

٤-تاريخ الميلاد .....

٥-المستوى التعليمي للأم: ( ) غير متعلم ( )ابتدائي ( ) ثانوية عامة
( ) جامعي ( )دراسات عليا

٦- وظيفة الأم: ( ) ربة منزل ( ) عاملة

## التاريخ الطبي

- هل ولد الطفل ولادة مبكرة (قبل الأسبوع ٣٧) ( )نعم ( )لا

اذا كان الجواب نعم خلال أي أسبوع:

1. بين الأسبوع ٣٥ و ٣٦
2. بين الأسبوع ٣١ و ٣٤
3. اقل عن او خلال الأسبوع ال ٣٠

- وزن الطفل أثناء الولادة :

في المعدل الطبيعي (اكثر من ٢٥٠٠ جرام)

نقص في الوزن (بين ١٥٠٠ و ٢٥٠٠ جرام)

نقص حاد في الوزن (أقل من ١٥٠٠ جرام)

- نوع الولادة: ( ) ولادة طبيعية ( )ولادة قيصريه

-هل تم استخدام أي أجهزة تساعد الطفل على التنفس : ( ) نعم ( ) لا

اذا كان الجواب نعم اذكر بالتفصيل.....

- هل تعرضت الام لأي مرض خلال فترة الحمل ( ) نعم ( )لا

اذا كان الجواب نعم اذكر بالتفصيل.....

-هل تم ادخال الطفل للإقامة ف المستشفى خلال السنوات الأولى في حياته ( ) نعم ( ) لا

اذا كان الجواب نعم اذكر بالتفصيل.....

-هل تعرض الطفل لأي مرض معدي خلال السنوات الثلاث الأولى في حياته مثل :( التهاب الصدر- التهاب اللوزتين- التهاب الاذن –مرض الجدري –الحصبة الألمانية – الحصبة – تم اخذ مضادات حيوية)

( ) نعم ( ) لا

اذا كان الجواب نعم اذكر بالتفصيل.....

-هل تعرض الطفل لاي إصابة في الاسنان ( ) نعم ( ) لا

اذا كان الجواب نعم اذكر بالتفصيل.....

**APPENDIX 5**

# Informed Consent Form

**Title of Study: A study of enamel defects and caries in 5-10 years old preterm born children in Dubai, UAE**

**Principal Investigator: Dr. Anood Mohammed,** Department of Paediatric Dentistry, Hamdan Bin Mohammed College of Dental Medicine, Building 34, Dubai Healthcare City, Dubai, UAE. Telephone: (050) 265 7777.

Please take your time to review this information form, and feel free to consult with or discuss this study with your dentist, colleagues, family, friends, and/or physician before deciding whether or not to participate. If you have any questions regarding the study or any related issues we encourage you to ask the principal investigator, as listed above. This consent form may contain words that you do not understand. Please ask the research staff to explain any words or information you do not clearly understand.

**Purpose of the study**

- This study will be conducted by the Department of Paediatric Dentistry in Hamdan Bin Mohammed College of Dental Medicine; to assess the prevalence of enamel defects and caries in preterm infants comparing them to full term born infant and to identify any possible risk factors associated with the enamel defects.

**Study procedures**

If you choose to take part in this study, the following procedures will happen: your child will be examined clinically using a mouth mirror and probe and the presence or absence of enamel defect and caries will be recorded.

No treatment will be provided to, or denied from, your child as a result of your participation in this study. You may stop participating in this study at any time. However, if you decide to stop participating, we encourage you to talk to the research staff first.

**Risks and discomforts**

There are no recognized risks or discomforts that may be caused to your child by participation in the study.

**Benefits**

There may or may not be a direct benefit to your child from participating in this study. We hope the information we collect will help dentists/parents to better understand how the birth condition might affect the enamel states and the carious susceptibility of the children. Eventually it will help to determine if specific prevention regimen is recommended for this risk group.

**Cost / Payment**

There is no cost to you for participating in the study and you will receive no payment or reimbursement for any expenses related to taking part in this study.

Alternatives: You should feel no obligation to participate in the study.

**Confidentiality**

All information obtained from this study is confidential and will remain so. Information gathered in this study may be published or presented in public forums; however, your name and other identifying information will not be used or revealed. In any published data, your identity (and your child's) will be protected and treated as confidential according to the Personal Health Information Act of UAE. To protect your identity, every participant will be given a Study Number instead of their name in all documents related to the study. All information obtained from this study will be used strictly for research purposes only. If the study information is to used in any subsequent investigation, your consent will be taken.

Hamdan Bin Mohammed College of Dental Medicine Research Ethics Board may review study records for purposes of quality assurance only. Despite efforts to keep your personal information confidential, absolute confidentiality cannot be guaranteed. Your personal information may be disclosed if required by law.

All records relating to this study will be kept in a secure, locked area and only those persons identified will have access to these records. If any of your child's medical/research records need to be copied to any of the above, his/her name and all identifying information will be removed. No information revealing any personal information such as your/your child name, address or telephone number will leave the HBMCDM.

**Voluntary participation / Withdrawal from the study**

Your decision to allow your child to participate in the study is voluntary. You may refuse to give consent for child to participate in the study or withdraw from it at any point in time. If the research staff feels that it is in your child best interest to withdraw her/him from the study, they will remove you without your consent.

We will tell you about any new information that may affect your child health, welfare, or willingness to stay in this study.

**Questions**

Please feel free to ask questions regarding the study or anything related to it that requires further clarification. To contact the research staff regarding a question, please call:

Dr. Anood Mohammed at (050) 265-7777 or Dr. M. Kowash at (050) 593-9004.

Do not sign this consent form unless you have had a chance to ask questions and have received satisfactory answers to all of your questions.

# STATEMENT OF CONSENT

I have read this consent form. I have had the opportunity to discuss this study with Dr. Anood Mohammed and/or her research staff. I have had my questions answered in a language I understand. All risks, benefits, costs, and alternatives regarding this study have been thoroughly explained to me. I believe that I have not been unduly influenced by any research team member to participate in the study by any statements or implied statements. Any relationship I or my child may have with the research team has not affected my decision to participate. I understand I will be given a copy of this consent form after signing it. I understand my and my child's participation in the study is voluntary and I may choose to withdraw my child from it at any point in time. I freely agree to participate in this research study and I give consent for my child to participate in the research study as well.

I understand that any information regarding my child's identity will be kept confidential, but that confidentiality cannot be guaranteed. I authorize the inspection of any of my records related to this study by the Hamdan Bin Mohammed College of Dental Medicine Research Ethics Board for quality assurance purposes.

By signing this consent form I have not waived any of the legal rights that I or my child have as a participant in a research study.

Parent/legal guardian's signature: _____

Date: _____ (day/month/year)

Parent/legal guardian's printed name: _____

I, the undersigned, attest that the information in the participant Information and Consent Form was accurately explained to, and apparently understood by, the participant or the participant's legally acceptable representative and that the

consent to participate in this study was freely given by the participant or the participant's legally acceptable representative.

Witness signature: _____

Date: _____ (day/month/year)

Witness printed name: _____

موافقة على المشاركة في بحث علمي

**عنوان البحث :عيوب مينا الاسنان والتسوس لدي الأطفال الخدج في مدينة دبي**

نحن مجموعة أخصائيين )طب أسنان الأطفال من كليه دبي لطب الأسنان)، نجري دراسة حول إذا ما كانت هناك عيوب في طبقة مينا الأسنان وزيادة في نسبة التسوس لدي الأطفال الخدج المولودين في إمارة دبي مقارنة بالأطفال المولودين بعد تمام فترة الحمل.

الهدف الأساسي من هذه الدراسة: التعرف على مشاكل صحة الفم والأسنان على وجه التحديد فيما يتعلق بطبقة مينا الأسنان ونسبة التسوس، وكيفية وضع الحلول المناسبة لها عن طريق هيكلة برامج طبية متكاملة لصحة الفم والأسنان يلبي جميع الاحتياجات العلاجية والوقائية.

كما هو معلوم فان أي دراسة بحث تستلزم وجود أشخاص ينضمون ويشتركون في الدراسة، لذا في حال موافقتكم سنقوم بإجراء فحص أسنان مجاني لطفلكم باستخدام أدوات الفحص الأساسية وسيتم إعلامكم بنتيجة الفحص، البيانات التي سيتم رصدها ستستخدم لهذا البحث فقط، مع الاحتفاظ بسريه تامه للمعلومات الشخصية لطفلك.علما بان لجنة البحوث الطبية وافقت على هذه الدراسة مسبقا.

إذا مشاركة طفلك في هذه الدراسة هو عمل تطوعي ويعتبر خطوة فعالة نحو مجتمع واعي وصحي. كنت ترغب في المشاركة الرجاء التوقيع أدناه. قد نحتاج لمراجعه الملف الطبي لطفلك للحصول على المعلومات اللازمة، حيث سيتم ذلك بخصوصيه تامه. ولي الأمر له الحق بإخراج طفله من الدراسة في اي وقت من غير اية تبعات أو خسائر. في حالة انسحاب الطفل من الدراسة سوف يتم التخلص من المعلومات بشكل نهائي.

اذا كانت لديك أسئلة ما عن هذا البحث، أو ما يتعلق بحقوقك في المشاركة فمن الممكن التصال في اي وقت من الأوقات بـ د.عنود الشحي على الرقم ٠٥٠٢٦٥٧٧٧٧ أو بـ دكتور مولود كواش على الرقم ٠٥٠٥٩٣٩٠٠٤

يمكن ان تتخدم البيات للمشاريع البحثية في المتقبل شريطة ان هوية طفلك لن يتم التعرف عليها.

البيانات التي سيتم رصدها ستستخدم للبحوث المستقبلية مع الاحتفاظ بسرية تامة للمعلومات الشخصية لطفلك، مع العلم بانه ستؤخذ موافقة أخرى من قبل لجنة مراجعة أخلاقيات البحوث العلمية

في مدينة دبي الطبية للدراسة المستقبلية.

عزيزي ولي الأمر:

بمجرد إمضائك على هذا المستند تقر بأنك توافق اختياريا على المشاركة في ها البحث وأن المعلومات المدونة أعلاه قد شرحت لك شفهياً.

إمضاء المشارك _____ التاريخ _____

إمضاء الشاهد _____ التاريخ _____

شاكرين لكم تعاونك معنا

## APPENDIX 6

## DMFT/dmft :

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E | D | C | B | A | A | B | C | D | E | | | | |
| | | | | | | | | | | | | | | | | |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| | | | | | | | | | | | | | | | | |
| | | | E | D | C | B | A | A | B | C | D | E | | | | |
| | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prim. Teeth | o | | d | | m | | f | | dmf | | | |
| Perm. Teeth | O | | D | | M | | F | | DMF | | | |

Codes for individual tooth status: small letters for primary teeth, capital letter for permanent teeth.

O = Sound tooth. , d / D = Decayed tooth. , m / M = Missed. , f / F = Filled

| d= | D= |
|---|---|
| m= | M= |
| f= | F= |

| Permanent | | Primary |
|---|---|---|
| 0 | sound | A |
| 1 | decayed | B |
| 2 | filled & decayed | C |
| 3 | filled, no decay | D |
| 4 | missing due caries | E |
| 5 | missing, other reason | - |
| 6 | sealant | - |
| 7 | bridge abutment, crown | G |
| 8 | unerupted | - |
| 9 | excluded | - |