Original Research

Caries diagnosis in mixed dentition among 6 to 12 years old children of Kedah using ICDAS-II method

Sivadas Ganapathy[1], Vaishnavi Vedam[1], Chow Chee Shoon[2], Diana Brennai Anak Awan[2], Doong Su Ann[2], Edric Tan Wei Khing[2]

[1]Senior Lecturer, Faculty of Dentistry, Asian Institute of Medicine, Science and Technology (AIMST) University, Malaysia;
[2]Undergraduate students, Faculty of Dentistry, Asian Institute of Medicine, Science and Technology (AIMST) University, Malaysia

ABSTRACT:
Introduction: School children have been the focus of preventive programmes aimed at preventing carious lesion development and retarding its progression in the earlier stages. The purpose of the research was to assess the caries status of mixed dentition in children aged between 6-12 years in Kedah using the ICDAS-II method. Also, this study focused to determine the gender & race distribution of paediatric patients. **Materials and Methods:** A cross sectional study was conducted on 110 patients involving child patients among 6 to 12 years old who visited AIMST university pediatric dental clinic, Kedah. Caries status and its correlation with gender and race distribution of mixed dentition in children were assessed using the ICDAS-II method. **Results:** Pie Chart analysis depicted the age, gender and racial distribution for children visiting the AIMST dental clinic, Kedah. Caries coding using ICDAS II coding for deciduous and permanent teeth of children between 6-12 years children were analyzed using suitable statistical analysis. Based on the ICDAS II scoring criteria and results obtained in Kedah, Malaysia, school dental service served as a main thrust in gaining the oral health awareness among the primary school students by practicing tooth brushing drills and regular dental check-up in schools. Emphasis on the fluoride tooth paste and oral hygiene was re-emphasized. **Conclusion:** In this study, ICDAS-II identified high prevalence of dental caries in the age group of 6 to 12 years old in Kedah that indicated the necessity of implementation of more oral health awareness campaigns and caries prevention programmes.
Key words: Caries diagnosis, ICDAS II, Public health

INTRODUCTION
Oral health is important to general health condition of an individual. [1] Dental caries has a substantial impact on quality of life by causing pain, discomfort, chewing difficulties, general health disorders and psychological problems. [2] School children have long been the focus of preventive programmes aimed at preventing carious lesion development and retarding its progression in the earlier stages. Management of caries through anticipatory and positive activities, at the childhood would be advantageous because these lesions would not demand multifaceted treatments and more people would be accomplished in keeping their teeth into parenthood. [3] National Oral Health Survey of School Children 2007 (NOHSS 2007) revealed a caries prevalence of 74.5% and 41.5% among 6-year-

99

olds and 12-year-olds respectively. [4] In 1997, the caries prevalence was 80.9% and 60.9% among 6-year-olds and 12-year-olds respectively. [5] This indicates that caries prevalence has declined but persistently high caries prevalence especially among the 6-year-olds demand more concerted efforts from dental professionals. [6]

Effective detection and calculation of dental caries lesions as an outcome of dental caries disease has been a challenge for a long time. [7, 8] The lesions can be detected on all surfaces of the primary, permanent, and mixed dentitions. Surface lesions can then be evaluated based on the type of the teeth (incisors, canines, premolars, and molars) or surfaces (occlusal, proximal, and free smooth surfaces). Mixed dentition stage normally includes the age groups from 6 to 12 years, when the permanent teeth are erupting and the primary teeth exfoliating. The mixed dentition is the first stage to study an association of the number of caries lesions between the primary and permanent teeth. [9] Caries diagnosis is a multistep process - detection of the lesion, followed by an assessment of the severity of the lesion, which again is followed by an assessment of the activity of the lesion. [10] A diagnostic method for dental caries should allow the detection of the disease in its earliest stages and for all pathologic changes attributable to the disease to be determined from early demineralization to cavitation. Unfortunately, none of the currently accepted clinical caries diagnostic methodologies have the ability to account for the dynamics of dental caries, including the possibility of reversal. [11]

The visual-tactile method, a combination of light, mirror, and the probe for detailed examination of every tooth surface, is by far the most commonly applied caries detection method in general practice worldwide. [11] Carious lesions can also be detected radiographically when there has been enough demineralization to allow it to be differentiated from normal. They are valued in noticing proximal caries which may go unnoticed during clinical examination. [12] Caries detector dyes are non-specific protein dyes that stain collagen in the organic matrix of less mineralized dentin, whether it is infected or not. Thus, it can be used to detect carious lesions. [13] Electrical conductance measurement (ECM) is also one of the caries detection method dated back to 1878. The basis of the use of ECM is observations which show that sound surfaces possess limited or no conductivity, whereas carious or demineralized enamel should have a measurable conductivity that will increase with the increase of demineralization. [14] Some of the recent advances in caries detection are fibre optic transillumination (FOTI), quantitative light-induced fluorescence (QIF) and DIAGNOdent. [12]

In 2002, a group of researchers proposed a new detection system: the International Caries Detection and Assessment System (ICDAS), which gathers the best aspects from other systems. It was developed to produce an internationally accepted system, allowing the dentists to assess the tooth decay activity and compare data from distinct sites and in different periods. [15] ICDAS I criteria were developed in Ann Arbor, Michigan in August 2002. [16] In 2005, aiming to publish progress in the ICDAS classification, more professionals gathered and produced the current version of this index, calling it ICDAS II. [15]

The International Caries Detection and Assessment System (ICDAS) is a clinical scoring system for use in dental education, clinical practice, research, and epidemiology. This scoring system provides a outline to upkeep and enable personalized treatment of the dental decay for greater long term wellbeing results. [17] The ICDAS caries system provides a vital step forward in giving a coherent framework of comparison against which the potential benefits and performance of existing and new aids to caries diagnosis can be evaluated against the enhanced clinical visual method. Epidemiological surveys are vital for the growth and application of effective oral health care packages. [18] The aim of this study is to diagnose and determine the caries prevalence in mixed dentition among 6 to 12 years old children of Kedah state using ICDAS-II method.

The purpose of the research was to assess the caries status of mixed dentition in children aged between 6-12 years in Kedah using the ICDAS-II method. The codes contained in ICDAS-II enabled us to assess the disease severity of a particular carious lesion. It functions as a tool to monitor carious lesion progression along time and hence helped in selecting the treatment. Also, this study focused to determine the gender & race distribution of paediatric patients who visited AIMST Dental Clinic.

MATERIALS AND METHODS
A cross sectional study was conducted involving child patients among 6 to 12 years old who visited AIMST university pediatric dental clinic. A total of 110 children were selected by convenient sampling. Clinical examination was carried out after brushing or scaling. Dental surfaces were examined, and were given two-digit code whereby the first one refers to the presence of restoration/sealant and the second, the severity of carious lesions. Only children whose parents/ guardians/legally acceptable representative signed an informed consent term were included in the sample. The exclusion criteria were: non-signature of an informed consent term, non-cooperative children and children with special needs. The examination protocol was conducted first with wet teeth and then, relative isolation was made with cotton rolls. Then, the surfaces were dried with air spray for 5 seconds, as established in the ICDAS Manual. [10] The clinical dental mirror and periodontal probe with 0.5 mm ball end from the WHO were used.

100

Code	Criteria
0	Sound tooth surface
1	First visual change in the enamel
2	Distinct visual change in the enamel. When wet, there is a white spot lesion and or brown carious discoloration
3	Initial localized enamel breakdown without visual signs of dentinal involvement
4	Underlying dark shadow from the dentin with or without enamel breakdown
5	Distinct cavity with visible dentin cavitation in opaque or discolored enamel with exposed dentin in the examiner's evaluation
6	Extensive distinct cavity with a clearly visible dentin. Cavity is both deep and wide. An extensive cavity involves at least half of a tooth surface, possibly reaching the pulp

Reference: International Caries Detection and Assessment System II (2007)

RESULTS

Pie chart 1 above is a simple representation of the gender distribution of the research participants. Red colour represents female while blue colour represents male. 58.2% of the pie chart is coloured red, indicating that 58.2% of the participants are female, while the rest are males (41.8%). In other words, out of the total number of participants (n=110), 64 are females while 46 are males.

Pie chart 2 above is a representation of the age distribution of the research participants. The participants are divided into 7 groups according to their age, with each group represented by one colour as shown above. Based on the pie chart, it can be clearly seen that most of the participants are 8 years old (yellow), which accounts for 26.4% of the research participants. This is followed by participants who are 12 years old (18.2%; purple), 11 years old (15.5%; light blue), 7 years old (12.7%; orange), 10 years old (10.9%; dark blue) and 9 years old (9.1%; green). There is least number of participants who are 6 years old (red), which only accounts for 7.3% of the research participants. In other words, out of the total number of participants (n=110), 8 are 6 years old, 14 are 7 years old, 29 are 8 years old, 10 are 9 years old, 12 are 10 years old, 17 are 11 and 20 are 12 years old. Regarding the age of the participants, the mean value is 9.23 (± 1.94) years.

Pie chart 3 above is a representation of the race distribution of the research participants. The participants are divided into 3 groups according to their race, with each group represented by one colour as shown above. Based on the pie chart, it can be clearly seen that most of the participants are Malay (green), which accounts for 84.5% of the participants. Chinese comes next (blue), which accounts for 9.1% of the participants. There is least number of participants who are Indian (red), which only accounts for 6.4% of the participants. In other words, out of the total number of participants (n=110), 93 are Malay, 10 are Chinese and 7 are Indian.

Bar chart 1, pie chart 4 and 5 above are representations of the distribution of teeth of research participants with different ICDAS caries code according to types of dentition. Each ICDAS caries code is represented by a specific colour. Code 1, 2, 3, 4, 5 and 6 are represented by dark blue, red, green, purple, light blue and orange colour respectively.

Out of all the carious teeth (n=256) found in deciduous dentition of the participants, most of them were diagnosed with ICDAS caries code 6 (n=77; 30.1%). This is followed by those diagnosed with ICDAS caries code 5 (n=63; 24.6%), ICDAS caries code 3 (n=44; 17.2%),

101

ICDAS caries code 4 (n=31; 12.1%) and ICDAS caries code 2 (n=23; 9.0%). There is least number of teeth diagnosed with ICDAS caries code 1 (n=18; 7.0%).

Out of all the carious teeth (n=75) found in permanent dentition of the participants, most of them were diagnosed with ICDAS caries code 2 (n=33; 44.0%). This is follo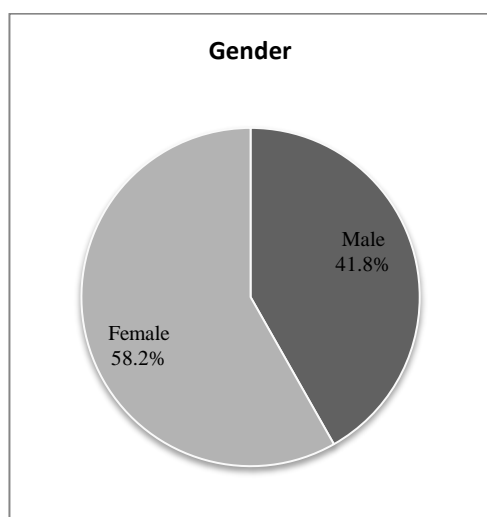wed by those diagnosed with ICDAS caries code 1 (n=16; 21.3%), ICDAS caries code 3 (n=13; 17.3%), ICDAS caries code 4 (n=6; 8.0%) and ICDAS caries code 5 (n=4; 5.3%). There is least number of teeth diagnosed with ICDAS caries code 6 (n=3; 4.0%). Mean number of teeth with impact from every ICDAS caries code is shown on the tables below

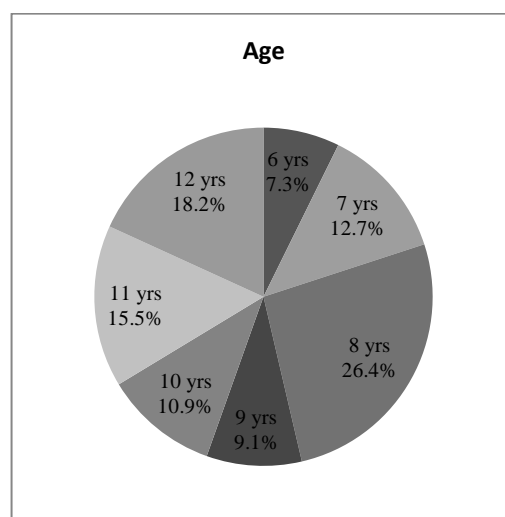TABLE 1: Mean number of deciduous teeth with impact from every ICDAS caries code

Caries Code	1	2	3	4	5	6
Mean	0.16	0.21	0.40	0.28	0.57	0.70
Standard deviation	0.516	0.592	0.890	0.780	1.288	1.524

TABLE 2: Mean number of permanent teeth with impact from every ICDAS caries code
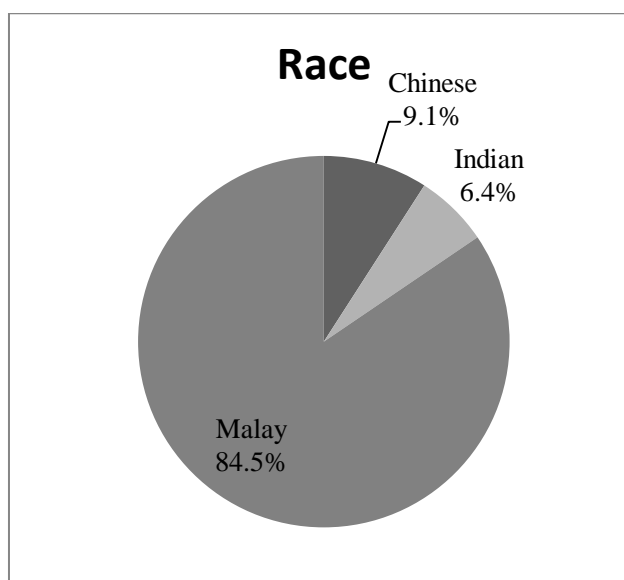
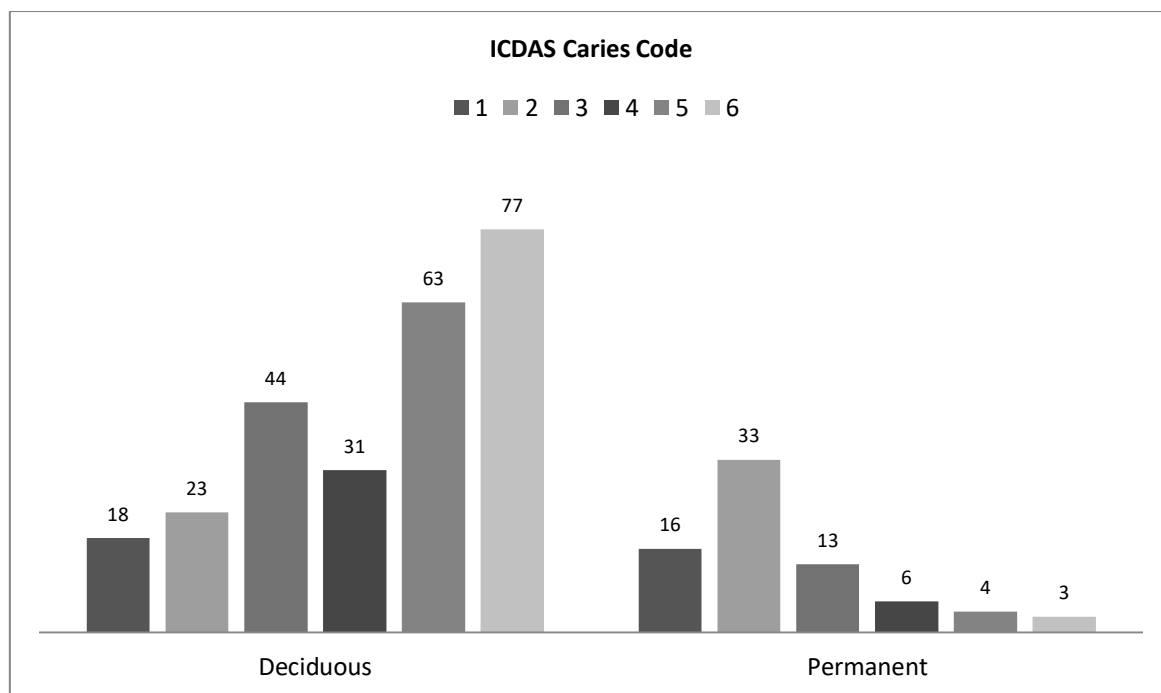| Caries Code	1	2	3	4	5	6
Mean	0.15	0.30	0.12	0.05	0.04	0.03
Standard deviation	0.504	0.863	0.423	0.265	0.188	0.164

PIE CHART 1: Gender distribution of participants
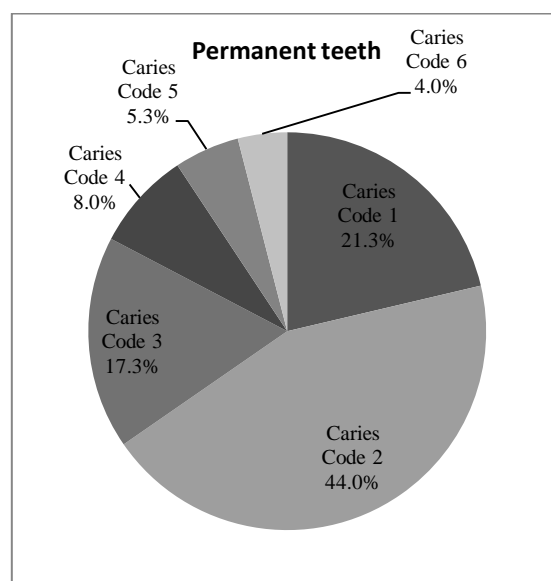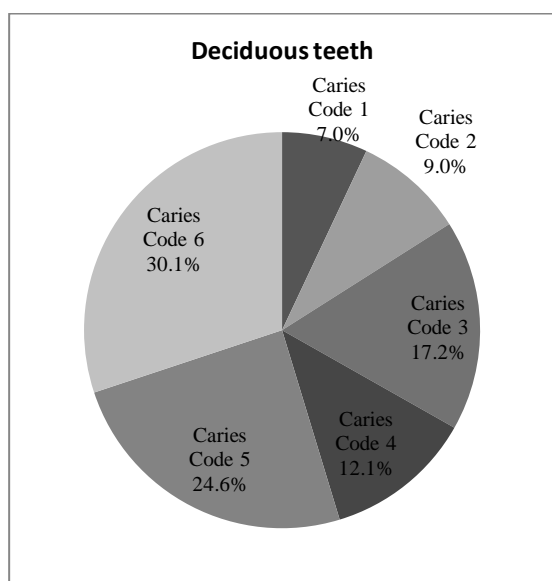

PIE CHART 2: Age distribution of participants

PIE CHART 3: Race distribution of participants

102

BAR CHART 1: Distribution of teeth with different ICDAS caries code according to types of dentition

PIE CHART 4 & 5: Distribution of teeth with different ICDAS caries code according to types of dentition

DISCUSSION

Children with mixed dentition (age between 6 to 12 years old) in Kedah State had shown to be a group of population who required great concern regarding their oral health. To detect the caries of the teeth surfaces, we applied visual tactile method with probe, mirror and light after drying the teeth surfaces. According to the study conducted, we were able to obtain results of following aspects' distribution of participants:

gender, age, race, caries prevalence in mixed dentition with the application of International Caries Detection and Assessment System (ICDAS) II. Implementation of ICDAS II had shown excellent reproducibility, reliability and precise caries detection. Apart from that, a detailed treatment plan could be customized for each participant with the usage of ICDAS II.

According to Pie Chart 1 (Gender distribution of participants), amount of female participants

103

(58.2%) predominated over male participants (41.8%) by 16.4%. Female participants had shown greater awareness regarding oral health comparing to male participants. As the study conducted was for patients below 12 years old, most of their parents were concerned about the participants' aesthetic appearance, especially young girls. The result proved that their parents noticed the participants grow increasingly conversant with the great physiological impact regarding aesthetic appearance as patients hit puberty stage. One of the solid evidence could be by stating the necessity of orthodontic treatment as their chief complaint.

Meanwhile in Pie Chart 2 (Age distribution of participants), the age distribution of participants could be arranged in ascending order: 6 years old (7.3%), 9 years old (9.1%), 10 years old (10.9%), 7 years old (12.7%), 11 years old (15.5%), 12 years old (18.2%) and 8 years old (26.4%). 8 years old group accounted for the greatest amount of participants because most of the permanent first molars had erupted by the age of 8 in which treatments like fissure sealants and Class I restorations were required. 12 years old group was the second largest age group because they were more understanding, cooperative and less anxious comparing with other age groups.

Apart from that, in Pie Chart 3, Malay participants (84.5%) were the main group of races among Chinese (9.1%) and Indian (6.4%). Malay participants outweighed Chinese participants by 75.4% and 78.1% in Indian participants. The reason for this distribution was most of Malay participants were from an Islamic religious school nearby in which transportation was provided. Chinese participants outweighed Indian participants by 2.7% because of greater Chinese population than Indian in Kedah.

On the other hand, Bar Chart 1 and Pie Chart 4 indicated that the deciduous teeth having ICDAS caries code 6 (30.1%), followed by ICDAS caries code 5 (24.6%), ICDAS caries code 3 (17.2%), ICDAS caries code 4 (12.1%), ICDAS caries code 2 (9.0%) and ICDAS caries code 1 (7.0%). By having ICDAS score 6 being the greatest amount, it showed that most of the carious deciduous teeth were deep caries with extensive distinct cavity (pulpal involvement) despite of having shallower pits and fissures in permanent teeth. The participants tend to have regular intakes of sugary food and even in between meals. "Nursing bottle caries" were seen in some of the participants, indicating the lack of oral hygiene awareness in their parents. Most of the participants' parents were not showing great concern regarding participants' oral hygiene by assuming that deciduous teeth serve no important role in future. The participants were not taught well to brush teeth properly and not brought to dentists regularly. Another misconception was that majority of the people believed that saving deciduous teeth was pointless as it might still exfoliate. Attitudes and behaviours shown by the participants during dental treatment were not all positive according to Frankel's behaviour rating scale. This further increased the difficulty to complete any treatments. Caries in deciduous teeth mostly involved pulp due to greater pulp chambers and thinner dentinal walls comparing with permanent teeth. By having ICDAS caries score 1 being the least amount, it showed that there was insufficient oral health care concern given to the teeth with first visual change in enamel.

Besides that, Bar Chart 2 and Pie Chart 5 showed that most of the permanent teeth having ICDAS caries code 2 (44.0%), followed by ICDAS caries code 1 (21.3%), ICDAS caries code 3 (17.3%), ICDAS caries code 4 (8.0%), ICDAS caries code 5 (5.3%) and ICDAS caries code 6 (4.0%). By having ICDAS score 2 being the greatest amount, it showed that most of the permanent teeth were diagnosed with distinct visual change in enamel. Upon eruption of permanent teeth especially molars, it indicated that participants reached the age of 7 and above which meant they were attending primary schools. In Malaysia, school dental service served as a main thrust in gaining the oral health awareness among the primary school students by practising tooth brushing drills and regular dental check-up in schools. They were more understanding and cooperative to learn about the importance of oral hygiene. ICDAS caries score 6 was being the lowest prevalence because of pre-existing undifferentiated odontoblasts in permanent teeth were able to form tertiary dentine upon reacting towards caries. Permanent teeth exposed to sufficient topical fluoride such as usage of fluoridated toothpaste were able to produce shallower pits and fissures and fluorapatite (more acid resistant), therefore enhancing remineralization property. Fluoride inhibits plaque bacteria by blocking enzyme enolase during glycolysis.

104

CONCLUSION

In this study, ICDAS-II identified high prevalence of dental caries in the age group of 6 to 12 years old in Kedah. This indicates the necessity of implementation of more oral health awareness campaigns and caries prevention programmes. Instead of using Black's classification, the application of ICDAS-II allows the dental officers to plan the treatments easily for each participant, by deciding the types of restorations or treatments given to certain severity of dental caries. However, the usage of ICDAS II requires short training period and it takes longer time to diagnose under dried tooth condition.

REFERENCES

1. Kwan SYL, Petersen PE, Pine CM, Borutta A. Health-promoting schools: an opportunity for oral health promotion. Bulletin WHO 2005; 83:677–68.
2. Clementino MA, Gomes MC, Pinto-Sarmento TCA, Martins CC, Granville-Garcia AF, Paiva SM. Perceived impact of dental pain on the quality of life of preschool children and their families. Plos One. 2015; 10:e0130602.
3. de Amorim RG, Figueiredo MJ, Leal SC, Mulder J, Frencken JE. Caries experience in a child population in a deprived area of Brazil, using ICDAS II. Clin Oral Investig. 2012;16(2):513-20.
4. Oral Health Division, Ministry of Health Malaysia. National Oral Health Survey of Schoolchildren 2007 (NOHSS 2007).
5. Oral Health Division, Ministry of Health Malaysia. National Oral Health Survey of Schoolchildren 1997 (NOHSS 97), 1998.
6. Oral Health Division, Ministry of Health Malaysia. (2011). National Oral Health Plan for Malaysia 2011-2020.
7. Ismail AI. Visual and visuo-tactile detection of dental caries. J Dent Res. 2004; 83:56-66.
8. Pitts N. "ICDAS"--an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. Community Dent Health. 2004; 21(3):193-8.
9. Honkala E, Runnel R, Honkala S, Olak J, Vahlberg T, Saag M, Mäkinen KK. Measuring Dental Caries in the Mixed Dentition by ICDAS. Int J Dent. 2011; 2011:150424.
10. Ekstrand KR, Ricketts DN, Kidd EA. Occlusal caries: pathology, diagnosis and logical management. Dent Update. 2001; 28:380-7.
11. Zangooei Booshehry M, Fasihinia H, Khalesi M, Gholami L. Dental caries diagnostic methods. DJH 2010; 2(1):1-12.
12. K. S. Kumar. (2011). Caries diagnosis. Retrieved 17 March 2016 from http://www.slideshare.net/drkskumar/caries-diagnosis-10066187
13. Young DA. New caries detection technologies and modern caries management: Merging the strategies. Gen Dent 2002; 50(4):320-31.
14. Stookey GK, Jackson RD, Zandona AG, Analoui M. Dental caries diagnosis. Dent Clin North Am. 1999; 43(4):665-77.
15. dos Santos Souza ES, Bezerra ACB, de Amorim RG, Azevedo TDPL. Caries Diagnosis in the Mixed Dentition Using ICDAS II. Braz Res Paediatr Dent Int Clin 2015, 15(1):13-21.
16. International Caries Detection and Assessment System Coordinating Committee. Rationale and Evidence for the International Caries Detection and Assessment System (ICDAS II). Reviewed September 2011 (unchanged from 2005).
17. Maxim DC, Luchian I, Cernei R, Mihalas E, Toma V. Value of ICDAS index in a preschool community from Iaşi. Rev Med Chir Soc Med Nat Iasi. 2013; 117(2):509-14.
18. Holst D. Causes and prevention of dental caries: a perspective on cases and incidence. Oral Health Prev Dent. 2005; 3(1):9-14.

105