Prevalence of Early Childhood Caries in a selected district in Sri Lanka

[1]F.N.Shahim,[2]S.Abayaratna,[3]S.Sivayogn, [4]J.Perera

Abstract

Introduction
Early childhood caries is a widely recognised health problem in many countries, even though it is a very much neglected problem in Sri Lanka .

Objective: The objective of this study was to determine the prevalence and severity of early childhood caries among children below five years in the Kalutara district in Sri Lanka.

Methodology: This study was carried out using the latest diagnostic criteria developed by the National Institute of Dental Cranio - Facial Research, USA. A cross sectional descriptive design was adapted to determine the prevalence of early childhood caries.

A total of 830 children below five years participated in the study. A total of 20 clusters was selected by multistage stratified random sampling techniques. A cluster was a Public Health Midwife area, and a minimum of 40 children from each selected PHM area participated in the study.

All data collection was carried out by the Principal Investigator, assisted by a recorder. Clinical examination of the teeth of the children was carried out by the Principal Investigator.

Results: The prevalence of early childhood caries among children below five years was 63%. The prevalence rose sharply after one year from 23.3% to 76.1% during the fifth year. The severity of the disease was found to be high, with the severe component of early childhood caries being high up to three years.

The mean dmft for children below five years was 4.65. A large proportion of the decay was untreated. A large proportion of caries was non-cavitated, thereby the need for caries arresting care is high.

Conclusions: Early Childhood Caries should be recognised as a priority health problem in Sri Lanka.

Key words: early childhood caries, prevalence, Sri Lanka.

Introduction

Dental caries is the most common disease of childhood. Dental decay in infants and toddlers is now collectively known as Early Childhood Caries (ECC) (1). This is a virulent form of tooth decay that affects the primary dentition of infants and pre- school children (2). It is a serious socio-behavioural and dental problem that afflicts infants and toddlers in many countries (3). ECC has now been found to be an infectious disease. It is possible for mothers or other caregivers to pass caries causing bacteria to an infant.

ECC is characterized by distinctive patterns of smooth surface carious lesions affecting primary maxillary incisors of infants and young children (4). Characteristic lesions develop rapidly in many teeth on surfaces normally considered to be at low risk to decay (2).

At the workshop conducted by National Institute of Dental & Craniofacial Research Bethesda, USA, ECC has been defined as ***the presence of one or more decayed (noncavitated or cavitated lesions), missing or filled tooth surfaces in any primary tooth(5).***

This study too has been conducted using this definition and diagnostic criteria.

Although the aetiology of ECC is similar to that of other types of coronal, smooth surface caries the biology may differ in some respects. The bacterial flora and host defence systems in the young infant are in the process of being established. In addition tooth surfaces are newly erupted and immature, and may show hypoplastic defects. Thus in ECC there may be unique risk factors in infants and young children (1).

[1]Lecturer, Dental Therapists Training School, Maharagama.
[2]Course Director, Community Medicine and Community Dentistry, PGIM, Colombo.
[3]Senior Lecturer, Dept. of Community Medicine and Family Medicine, University of Sri Jayawardenapura, Nugegoda.
[4]Head, Dept. of Microbiology, Faculty of Medicine, Colombo.

It is now well understood that ECC is a multifactorial disease and has numerous biological (6), psychosocial (1) and behavioural (1) risk factors. These risk factors vary from population to population (7).

While the cause of dental caries in young children is multifactorial the disease has an involvement with *Streptococcus* infection. *Streptococcus mutans* has now been thought to have a distinct association with ECC. *Streptococcus mutans* organisms have been found to be present in these carious lesions. The major reservoir from which an infant acquires *Streptococcus mutans* is thought to be from the mother (8).

In most cases, the distribution of ECC lesions is characteristic with the maxillary primary incisors being the most severely affected. The primary mandibular incisors are generally unaffected. Since primary maxillary incisor teeth are among the first teeth to erupt they are also the first teeth to be affected (initially developing broad areas of enamel demineralization or white spot lesions at the gingival margin) (2).

Though no reports are available on prevalence of ECC in Sri Lanka, a study done to determine the oral health status of pre-school children (3years-5years) 1995, in the Matale district revealed a caries prevalence of 60% (9). The dmft of 6 year old children has been found to be 4.1 and the prevalence of caries 76.42% (National · Oral Health Survey 1993/94) (10) . This prevalence has been reported for six year old children. The diagnostic criteria were the WHO caries diagnostic criteria. These diagnostic criteria included only cavitated lesions.

Though in Sri Lanka prevalence studies have not been reported, a substantial body of literature from numerous countries exists at present which documents the prevalence of ECC. In developed countries the prevalence is reported to vary between 1%-12%. However in developing countries and within disadvantaged populations in developed countries the prevalence has been reported to be as high as 70% in the pre-school population (11) .
Studies in the Asian region are lacking. A study conducted in Indonesia in 1979, among children less than 5 years reported a prevalence of 48% (2). A recent study conducted to describe the dental caries status of pre-school children in Hong - Kong, in 1999, by Bedi and Holt revealed a prevalence of 39% (12).

The importance of the primary dentition cannot be underestimated. Even though a permanent dentition would replace the primary dentition it is vital that the primary dentition remains healthy and is retained till such time due to the following reasons:

(1) Maintenance of the arch length - the space occupied by the deciduous tooth provides the correct pathway and position for the permanent tooth to erupt. Premature loss of deciduous teeth leads to development of malocclusion.

(2) For proper nutrition, growth and development of the child a healthy dentition is necessary. When teeth are diseased with caries it may cause discomfort and pain to the child and he may refuse to eat, thus hindering general well-being of the child. Lack of sleep and / or balanced diet has been found to lead to a significant decrease in a child's age-adjusted weight (13). Decay in deciduous teeth has been associated with general health problems, failure to thrive and nutritional problems.

(3) Caries in the primary dentition can damage the erupting permanent tooth (Turner's Tooth), The developing permanent tooth if damaged appears discoloured and is of different morphology.

(4) It increases the risk of caries in the permanent tooth. Children with ECC have a much greater probability of subsequent dental caries both in the deciduous and the permanent dentitions (14, 15, 16, 17, 18).

(5) The pain caused by caries or dental abscesses is of much distress to the child, parents and the dental surgeon. In severe cases it can lead to ear infections, septicaemia, meningitis and such life threatening situations.

(6) Appearance of the child is of much concern to the child itself and even more, to the parents. A beautiful smile helps to boost a child's self esteem. Healthy smiles play an important role in the development of a positive sense of self esteem. The

cosmetic value of teeth has become more appreciated. The unsightly appearance of carious teeth may be psychologically traumatic to both the child and the parents.

(7) The primary dentition is of vital importance for the development of speech (19). Early loss of teeth may slow the development of proper speech (20).

(8) Literature has also shown that the cost for treating ECC is also very high (11,21,23). The US-PHS has estimated a cost between US$ 700 - US$ 1200 to treat one child with ECC. If hospitalization is necessary an additional US$ 1000 could be added to the total bill. In another cost-estimate done in the USA it gives a figure of US$ 3000, as treatment is complicated and often several teeth have to be extracted under sedation or under GA in the operating theatre (23).

Objective

To determine the prevalence and severity of Early Childhood Caries (ECC) among children aged five years or less in a selected district in Sri Lanka.

Methodology

A cross-sectional study design was adopted. The study was conducted among children below five years in the Kalutara district, in the Western Province. All children resident in the study area and 5 years or less than 5 years on the day of interview and in whom at least one deciduous tooth had erupted were eligible to be included in the study. The upper limit of age was selected to be 5 years. Since the study was carried out during home visits the upper age limit has to be kept at 5 years, since the school entrance age for Sri Lanka is 5 years, therefore the likelihood of finding children above 5 years would be less. The National Institute of Dental and Craniofacial Research in a recently concluded workshop have recommended that all future studies on "early childhood caries" should include all preschool children between birth and 71 months of age (5). The age group that has been selected for this study is comparable with other studies, as these age groups have been included in similar studies done in other countries. Children from the estate area and who were not permanent residents of the study area were not eligible to participate in the study.

The sample size was calculated for a prevalence of 50% as there were no figures available for Sri Lanka. A minimum number of 800 subjects had to be examined. Clusters were allocated on probability proportional to size (PPS) of the population, and this was used to identify the study population. A multi-stage stratified sampling technique was used to identify the study population. Allocation of clusters was done on probability proportional to the size (PPS) of the population used to identify the study population . Considering the sample size of 800 and the number of children included in a cluster (40), 20 clusters (800/40) were required for the study. Since this study was a community based study all children were selected randomly by visiting homes in selected clusters. The PHM was a key figure, who assisted in selection of the study subjects. Since the PHM knew the geography of her area as well as the children under her care, her assistance was sought in selecting the study subjects. In each area selected, a minimum of 40 children were seen. A minimum of 8 children in each age group less than 12 months,12 -24 months, between 25-36 months, between 37 -48 months and between 49 -60 months were examined. Therefore at least 160 children in each age category were seen. By this the prevalence for each age category could be calculated.

Clinical Oral Examination

Personnel involved

(a) **Examiner** -The Principal Investigator was the only examiner carrying out clinical examinations. Further being the sole examiner eliminates inter-examiner variability. The examiner underwent a one week training programme, at Dental Therapists Training School, Maharagama in clinical examination of ECC in children, (using diagnostic criteria recommended by NIDCR, USA) by a Consultant Community Dental Surgeon. It was found that Kappa value was 0.83 for clinical examination of ECC, indicating good percentage agreement.

b) **Recorder**- one retired School Dental Therapist was recruited as recorder. The study

was explained to her and a one week training and calibration programme was conducted.

Clinical Examination for caries

All examinations were carried out by the PI. Sterile mouth mirrors were used to examine the mouths of children. All clinical examinations were conducted under natural light. A well illuminated area, generally the garden, was selected for this purpose. The tooth surfaces were cleaned and dried using a sterile cotton swab, and examined. All data were recorded in the caries assessment form .All subjects and their mothers/caregivers who required treatment were given referral letters to the nearest School Dental Clinic or Hospital Dental Clinic. Where necessary health education on the importance of tooth brushing and dietary. counseling was carried out.

Results

A total of 830 subjects participated in the study.
Table 1 represents the distribution of the study sample. All five age groups of children were represented in almost equal proportions (approx.20%).

Males in the study sample were 53.7% and females 46.3%.

The Sinhalese ethnic category comprised the largest proportion of the study sample (89.6%); and 9.6% were represented by the Muslim ethnic group. Tamils were represented by less than 1%.
The rural sector formed 80% of the study sample and the urban sector 20%.

Table 1. Distribution of study sample by age, ethnicity, location type and sex

Characteristics	Total (n=830)	
	No.	%
Age in months		
< 12	150	18.1
13 – 24	183	22.0
25 – 36	174	21.0
37 – 48	164	19.8
49 – 60	159	19.2
Ethnicity		
Sinhalese	744	89.6
Tamil	6	0.7
Muslim	80	9.6
Residence type		
Urban	168	20.2
Rural	662	79.8
Sex		
Male	446	53.7
Female	384	46.3
Total	830	100.0

Prevalence of Early Childhood Caries(ECC)

ECC was diagnosed according to the diagnostic criteria recommended by NIDCR, USA

Table 2. Prevalence of ECC among study sample.

ECC status	Number	%
With ECC	523	63.0
Without ECC	307	37.0
Total	830	100.0

Table 2 indicates that the overall prevalence of ECC in children below 5years was 63% (95% CI = 59.72 – 66.28).

Table 3. Distribution of study sample by age and ECC status

Age in months	With ECC (n=523)		Without ECC(n=307)		Total (n=830)		Significance
	No.	%	No.	%	No.	%	
00 – 12	35	23.3	115	76.7	150	100.0	$\chi^2_{\text{Linear Trend}}$ =77.89
13 – 24	122	66.7	61	33.3	183	100.0	P<0.001(S)
25 – 36	126	72.4	48	27.6	174	100.0	
37 – 48	119	72.6	45	27.4	164	100.0	
49 – 60	121	76.1	38	23.9	159	100.0	
Total	523	63.0	307	37.0	830	100.0	

Table 3 indicates that age specific prevalence of ECC increased with age. Chi square for linear trend was statistically significant. ($\chi^2_{\text{Linear Trend}}$ =77.89 p<0.001)

Severity of Early Childhood Caries (ECC)

Table 4. Prevalence of ECC among study population classified according to severity

ECC status		Number	%	95%CI
With ECC	Severe ECC	467	56.3	51.5 – 60.5
	Non severe ECC	56	06.7	2.5 – 11.5
Without ECC		307	36.99	
Total		830	100.00	

Table 4 indicates that the severe component of ECC was much higher (56.3%) than the non-severe component of ECC (6.7%). 89.2% of those with ECC had severe type.

Table 5. Age specific prevalence of ECC with severity among study population

Age in months	With ECC (n=523)				Without ECC(n=307)		Total (n=830)	
	With severe ECC (n=465)		With non severe ECC (n=58)					
	No.	%	No.	%	No.	%	No.	%
00 – 12	35	23.3	0	0.0	115	76.7	150	100.0
13 – 24	120	65.6	2	1.1	61	33.3	183	100.0
25 – 36	124	71.3	2	1.1	48	27.6	174	100.0
37 – 48	97	59.1	22	13.4	45	27.4	164	100.0
49 – 60	91	57.2	30	18.9	38	23.9	150	100.0
Total	467	56.3	56	6.7	307	37.0	830	100.0

Table 5 indicates that the proportion of severe ECC is very high among children below 3 years. After 3 years there is an increase in the non severe ECC and a decrease in the severe type of ECC.

Figure 6. Distribution of severe ECC among children with ECC by age

Table 6. Mean dmft by Age

Age in months	Mean d_1	Mean d_2	Mean m	Mean f	Mean dmft
<12	0.72	0.00	0.00	0.00	0.72
13-24	2.35	0.81	0.00	0.00	3.17
25-36	3.36	1.93	0.00	0.04	5.33
37-48	2.68	3.60	0.00	0.42	6.30
49-60	2.17	4.08	0.08	0.06	6.40

Overall	Dmft	4.65
d_1	Non-cavitated decay	2.29
d_2	Cavitated decay	2.32
M	Missing	0.008
F	Filled	0.028

From Table 6 it can be deduced that the mean dmft increased with age. The dmft in children less than 1 year was 0.72, contributed solely by the d_1 (non-cavitated) component. Thereafter a steady increase of the mean dmft can be seen up to 3 years. Both d_1 and d_2 (cavitated) components increased up to 3 years. Up to 3 years the non-cavitated component is more than the cavitated component. After the 3rd year a change in the pattern of dmft components can be observed. The d_2 (cavitated) component is higher than the d_1 (non-cavitated) component from 3-5 years. A very high proportion of the cavitated component was observed in the 3-5 year category. A very minor "missing" and "filled" component has been observed in the older age groups (above 3 years).There was no missing component in the first 2 years. The overall mean dmft was calculated and was found to be 4.65 for children below 5 years. In all age groups, the ages the decayed component has contributed to he major part of the dmft.

Discussion

Early Childhood Caries has now been recognized as a problem with many implications which include somatic growth retardation, general ill health, poverty and other oral problems. Unfortunately little attention has been given to the problem of ECC in Sri Lanka.

Of the 830 children studied, 384 (46.3%) were females and 446 (53.7%) males.One hundred and sixty eight (20%) children resided in urban areas and 662 (80%) in rural areas. Seven hundred and fourty four (89.6%) Sinhala, 80 (9.6%) Muslim and 6 (0.8%) Tamil children were included in the study. The proportionate distribution of the sample is representative of the Kalutara district. In the ethnic distribution the Tamils were represented in a lower proportion. This may be because the estate population was not included in the study. The Sinhala and Muslim groups have been slightly over represented. Ethnic distribution in the Kalutara district was 87.9% and 8.8% for Sinhalese and Muslims respectively (Department of Census, 2001).

Age stratification of the sample was in equal proportions. According to the sample size required (800), 160 subjects in each group had to be seen. Children below 12 months with teeth were difficult to find, thus only 150 subjects were included in the study. (Table 1)

As indicated in Table 2, the overall prevalence of ECC in children below 5 years was found to be 63% (figure 3). The prevalence of dental caries among 6 year old children in Sri Lanka and the Kalutara district was 76.4% and 78.5% respectively as reported by the National Oral Health Survey 1994 (27).

The overall prevalence includes age groups of all children below 5 years, Since the prevalence in the lower age groups is low there is a dilution effect in the overall prevalence. This is the reason for the overall prevalence to be less than the caries prevalence of 6 year old children in the National Oral Health Survey (1994/95). The age specific overall prevalence of ECC was observed to increase with age (Table 3). A prevalence of 76.6% was seen in the 49-60 month age group and a prevalence of 23.2% was observed among children below one year.

It can also be deduced, that a sharp rise in the age specific overall prevalence of ECC occurred after 1 year, and thereafter increased progressively.
This is a very important inference as it focuses on the fact that ECC begins at a very young age and therefore stresses the need for early attention.

This also emphasizes the fact that awareness, attention and care has not been focused on the deciduous dentition. Many studies have shown that the prevalence of ECC in many developing countries and immigrant populations in developed countries is high. These results are in agreement with those studies (2, 5, 24,25).

Further, it is distressing to note that among children below one year of age, a prevalence of 23.2% of ECC exists. The fact that ECC has commenced almost immediately after eruption of the deciduous dentition has to be considered seriously when planning for the prevention of ECC.

This study employed the latest diagnostic criteria recommended for ECC . An important feature of the diagnostic criteria of ECC in this study was the inclusion of *non-cavitated carious lesions* (white spots). In a meta-analysis carried out by Ismail and Sohn *cavitation* had been the common criterion used to define dental caries (26). It was also found that there was a wide variation in the case definitions and diagnostic criteria used to diagnose ECC.

The age specific prevalence should be considered seriously in planning oral health services. Severity of ECC would be discussed subsequently.

The severity of ECC has been determined by the diagnostic criteria of ECC used in this study . It was found that overall the severe component was high. The non-severe component formed a minor component (Table 4 and Figure 5). On observing age specific prevalence of ECC, proportions of severe ECC was higher in all age groups up to 3 years. Thereafter the proportion of severe ECC declined up to 5 years (Table 5 and Figure 6). This indicates that the burden of disease in Sri Lanka is high.

On observing mean dmft levels (Table 6), the mean dmft of children below 5 years was 4.65, out of which the d_1 component (non-cavitated lesions) was 2.29 and the d_2 component (cavitated lesions) was 2.32. Also the m component (missing) and the f component (filled) values were very low, 0.008 and 0.02 respectively. Since almost 50% of the d component is non-cavitated, a large fraction is preventable. Also a large proportion of caries have not been treated. This highlights that dental services to children needs to be planned to cater to those needs, and maximum use of dental personnel and resources should be utilised to fill the deficiencies.
When viewing the dmft by age, a high decayed component was exposed. This was seen to increase with age, with quite a high dmft value of 6.4.The National Oral Health Survey 1994, reports a dmft of 4.1 for Sri Lanka and 3.9 for the Kalutara district, among 6 year old children (10).

Further, on analysing the details, a very high untreated component of decay was found. The d_2 component (cavitated lesions) was 4.08 among 49-60 month old children. The filled and the missing components were very low, 0.06 and 0.08 respectively (Table 6) This reveals that there are lapses in dental services for children below 5 years. There is currently no obligatory dental screening done in Sri Lanka, until the child enters school, after 5 years of age. This age is a little too late for proper care of deciduous teeth.
The mean dmft of children below one year was 0.72, the mean d_1 (non-cavitated lesions)was 0.68 and d_2 (cavitated lesions) was 0.3.This trend was observed up to 3 years after which the d_2 component was more than the d_1 component. On studying the ECC trend with age, it suggests that the first three years need very vigilant screening and awareness, as non-cavitated lesions can re-mineralise.

This further confirms the fact that prevention of ECC and reversibility of the lesion is possible if attended to at this stage. Preventive care should begin early and it must be done so, with the objective of decreasing the prevalence of ECC.

This further emphases the need for a total reorganisation of dental services to meet the needs of the problem of a large burden of disease which should be carried out with short term and long term planning.

Recommendations

i. ECC has to be recognised as a priority health problem among the health personnel and the community with the main objective of reducing the prevalence of ECC.

ii. Education programs on ECC and training programs to detect early signs of ECC, risk behaviour and referral to the appropriate place for attention, should be conducted among the health staff and the community. The health staff includes –

- all dental personnel, all dental surgeons and school dental therapists.
- all primary health care personnel.
- medical officers and paediatricians.

The community includes –

- all pregnant mothers, parents of children below 5 years and all caregivers.

This may require KAP studies to evaluate the level of awareness.

iii. Enhancing preventive dental services – more community dental clinics and preventive clinics should be provided by the health authorities with facilities to provide fluoride preventive care (fluoride varnish application, fissure sealents use, fluoride gel application)

iv. The first three years of childhood have proved to be more at risk to ECC. Therefore a system where children are screened early should be developed. Therefore, the integration of ECC preventive services to MCH services is recommended. The very satisfactory utilisation of MCH services by mothers provides an excellent opportunity to reach mothers and children for prevention of ECC.

v. ECC preventive services should include –

- Screening of all pregnant mothers, all necessary dental treatment should be carried out (scaling, restoration of carious teeth) so as to achieve low bacterial counts. This would help to reduce the transmission of bacteria to child.
- Early obligatory screening of children.
- Brushing instructions counseling of risk behaviour groups.

References

1. Seow WK. Biological mechanisms of early childhood caries. Community Dentistry and Oral Epidemiology 1998; **26:** Supplement **1:** 8-27.

2. Milnes AR. Description and epidemiology of nursing caries. Journal of Public Health Dentistry 1996; 56: 38-50.

3. Ismail AI. Prevention of early childhood caries. Community Dentistry and Oral Epidemiology 1998; **26:** Supplement 1: 49-61.

4. Tinanoff N. Introduction to early childhood caries conference initial description and current understanding. Community Dentistry and Oral Epidemiology 1998; **26:** Supplement **1:** 5-7.

5. A report of a workshop sponsored by the National Institute of Dental and Craniofacial Research, the Health Resources and Administration , and the Health care Financing Administration - Diagnosing and reporting early childhood caries for research purposes. Journal of Public Health Dentistry 1999, **59:**3 192-2000.

6. Reisine S, Douglas GM. Psychosocial and behavioural issues in ECC. Community Dentistry and Oral Epidemiology 1998; **26:** Supplement **1:** 32-44.

7. Wyne AH. ECC: Nomenclature and case definition. Community Dentistry and Oral Epidemiology 1999; **27**:313-5.

8. Chin James, Control of Communicable Diseases Manual : 17th Edition, 2000 – an official reporting of the American Public Health Association.

9. Denuwara HK. Oral health status among 3-5 year old children attending pre-school children in Matale DDHS area. MSc.(Community Dentistry) dissertation, University of Colombo(1995).

10. Ministry of Health, Colombo, Sri Lanka. National Oral Health Survey 1994/95. 1997.

11. Weinstein P. Public health issues in early childhood caries. Community Dentistry and Oral Epidemiology 1998; **26:** Supplement 1: 84-90.

12. Bedi R, Holt RD. A survey of dental caries in Hong-Kong pre-school children. British Dental Journal 1999; **187**(11): 616-620.

13. Shulman R, Chussid S. The effect of dental rehabilitation on the body weight of children with early childhood caries. Paediatric Dentistry 1999; **21(2):** 109-13.

14. Johnsen DC, Gerstenmaier JH, DiSantis TA, Berkowitz RJ. Susceptibility of nursing caries children to future approximal molar decay. Paediatric Dentistry 1986; **8**:168-70.

15. Johnsen DC, Schechner TG, Gerstenmaier JH. Proportional changes in caries patterns from early to late primary dentition. Journal of Public Health Dentistry 1987; **47**:5-9.

16. Kaste LM, Marianos D, Chang R, Phipps KR. The assessment of nursing caries and its relationship to high caries in the permanent dentition. Journal of Public Health Dentistry 1999; **54**:64-8.

17. O'Sullivan DM, Tinanoff N. Maxillary anterior caries associated with increased caries risk in other primary teeth. Journal of Dental Research 1993; **72**:1577-80.

18. O'Sullivan DM, Tinanoff N. The association of early dental caries patterns in pre-school children with caries incidence. Journal Public of Health Dentistry 1996; **56:** 81-3.

19. Kennedy DB. Paediatric operative dentistry - Dental Practitioners Handbook, Second Edition 1979,Published Bristol: John Wright and Sons Limited.

20. Press Release: ECC reaches epidemic reaches proportions. 9.9.01 <http://www.msn.com//AAPD.htm 11.09.01.

21. Milnes AR, Rubin CW. A retrospective analysis of the costs associated with the treatment of nursing caries in a remote Canadian aboriginal population. Community Dentistry and Oral Epidemiology 1993; **21:** 253-60.

22. Kelly M, Bruerd B. The prevalence of BBTD among two native American populations. Journal of Public Health Dentistry 1987; **47**:2,94-97.

23. Billing RJ. Symposium: Needed a research agenda for ursing caries. Journal of Public Health Dentistry 1996; **56:** 1:1 37.

24. Ismail AI. A systemic review of clinical diagnostic criteria of early childhood caries. Journal of Public Health Dentistry 1999; **59**:3, 171-191.

25. Kaste LM, Selwitz RH, Oldakowski RJ, Brunelle JA, Winn DM, Brown LJ. Coronal caries in the primary and permanent dentition of children and adolescents 1 -17 years of age: United States, 1988-1991. Journal of Dental Research 1996; **75**(Special Issue): 631-41.

26. James PMC, Parfitt GJ, Falkner F. A study of the aetiology of labial caries of the deciduous incisor teeth in small children. British Dental Journal 1957; **103:** 37-40.