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Dental caries experience in preschool children of Thiruvananthapuram, Kerala: Is it related to the sociodemographic factors?

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Abstract: *Background*: *Early childhood caries (ECC) is a multi-factorial childhood disease with biological, socio-cultural-economic and behavioural determinants. In children, past caries experience (caries prevalence) is the strongest correlated variable with caries increment and the most powerful predictor of caries. Objectives: The aim of this cross-sectional study was to determine the prevalence of ECC among preschool children residing in rural and urban areas of Trivandrum district, Kerala, South India and also to study the association between socio demographic factors and caries risk, based on children's past caries experience,. Methods: A random sample of 531 children, aged between 2-6 years, was selected from Anganwadi Centres (AWCs) and Govt. & private Pre-primary schools (PPSs) in the urban and rural areas of the district using a multistage stratified random sampling method. Caries was recorded at the level of cavitation according to the WHO criteria (1997) and child's caries experience was determined using the measure: the dmft index. Information regarding socio demographic factors were collected through a structured proforma. The data was subjected to statistical analysis. Results: The prevalence of ECC in the study sample was found to be 59.6% and the mean dmft index was 2.98 ± 3.583. The only socio demographic factor found to have a strong association with caries risk was strata to which the child belonged [χ^2= 7.528, p = 0.006]. Conclusion: More than half of the preschoolers had dental caries. There is an urgent need to implement preventive and curative oral health programs for preschool children in rural and urban areas.*

Keywords: *Early childhood caries, Prevalence, Preschool children, Past caries experience*

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I. Introduction

Dental caries is the most common chronic disease in young children and may develop as soon as teeth erupt. It is recommended that the term "early childhood caries" **(ECC)** be used when describing any form of caries in infants and preschool children.[5] ECC is a multi-factorial disease seen in infants and toddlers, affecting their general health and growth pattern.[1] ECC has become a public health problem because of its relatively high and apparently growing prevalence and its rapid progression, leading to the destruction of the deciduous dentition[6]. Intervention early in the disease process, is desirable because timely and effective management can arrest the caries process and obviate, minimize or delay the need for restorative care.

A comprehensive review of the epidemiology of ECC showed that its prevalence varies from population to population,[6] ranging from 6-90%, with most developed countries in the lower end and most developing countries in the middle to higher end of this range.[9] In India, the prevalence of caries among preschool children is in the range of 40-70%[10] with 54 % in 2-5 year old children in Trivandrum district, Kerala. [11.] [Refer Tables 1 & 2].

Table 1: Reported prevalence of ECC in various countries

Year	Place	Age	Prevalence
1985	Nigeria	3-6 years	40%[23]
1989	England	5-6 years	7%[23]
1991	Sweden	5-6 year	7.7%[23]
1994	Kuwait	5-6 years	67%[23]
2000	Brazil	3-6 years	46%[33]
2003	Korea	3-6 years	56.5%[23]

2004	Thailand	3 years	67.5%[8]
2007	USA	2-5 years	6.3%[34]
2008	South Africa	36-71 months	32%[35]
2009	Boston	1-3 years	3%[36]
2009	Tehran	12-15 months	26%[37]
2009	Saudi Arabia	5 years	83% [25]
2010	Germany	3-4 years	7.3- 20.3%.[6]
2011	USA	2-5 years	27.9%[5]
2011	Mexican-American	2-11 years	55.4%[5]
2011	Japan	18 months	2.8%[5]
2011	Japan	3 years	25.9%[5]
2012	Venezuela	4 years	64.4%[10]
2012	Venezuela	5 years	72.8[10]
2012	Venezuela	6 years	72.8%[10]
2012	Saudi Arabia	3-6 year	62.7%[10]
2012	China	2 -6 years	53% [10]
2012	Karachi, Pakistan	3-6 years	51%[38]

Table 1: Reported prevalence of ECC in the various cities/states in India

Year	Place	Age	Prevalence
1992	Aurangabad	3-6 years	47.8%[23]
1999	Udupi	5-6 years	57.3%[23]
1999	Hubli, Dharwad City	3-6 years	54.1%[23]
2001	Rural areas of Sikkim	5-6 years	22%[23]
2001	Urban areas of Sikkim	5-6 years	61.8%[23]
2001	Orissa	5-6 years	56.01% [23]
2001	West Bengal	5-6 years	52.4%[23]
2003	Kerala	3-6 years	51.46%[23]
2004	National Oral Health Survey, India	5 years	50.0%[28]
2005	Urban Pondicherry	5-6 years	44.4%[23]
2006	Ahmedabad	3-6 years	60.77%[29]
2012	Urban Bangalore and Urban Davangere	3-6 years	56.6%.[30]
2012	Mysore city	3-6 years	56.6%.[23]
2012	Mysore city	5-6 years	57.59%.[23]
2012	Mangalore (AWW)	3-5 years	81.4% [10]
2012	Chandigarh	3-6 years	48.3%[10]
2012	Belgaum	3-5 years	63.17%[31]
2012	Bangalore	8-48 months	27.5%[32]
2012	Haryana	3-7 years	33.8% [28]
2012	Kerala	< 4 years	44%[10]
2012	Thiruvananthapuram city	1-3 years	50.6%[22]
2015	Thiruvananthapuram district	2-5 years	54%[11]

Caries risk assessment (CRA) is one of the cornerstones in patient-centered caries management. CRA is the determination of the likelihood of the incidence of caries (ie, the number of new cavitated or incipient lesions) during a certain time period or the likelihood that there will be a change in the size or activity of lesions already present.[12,13] Past caries experience or preexisting dental caries (caries prevalence) as well as new carious lesions appearing during a given period (caries incidence) are considered as predictors of future caries development.[14, 15] Several studies, using a set of predictor variables, have shown caries experience in children to be the strongest correlated variable with caries increment and the most powerful predictor of caries. More recent studies have shown that bacteriological or behavioral variables did not add to the predictive power of caries experience. With no changes in oral health habits, the past caries activity can provide useful information about future caries activity in children where the caries experience reflects recent caries activity.[16, 17]A child developing a high dmft count before the age of five has a higher risk of becoming an adolescent with a high DMFT count and later becoming an adult with the same problem[14] and they can be often designated as 'high risk children.'

Thus past caries experience is an excellent practical and effective predictor for use in community health, and children can be classified, as having high or low caries risk according to their dmft [HR, when dmft>0 and LR, when dmft=0].[19] No specific studies regarding caries risk in preschool children and how it is influenced by the various sociodemographic factors have been reported in Thiruvananthapuram district. Hence this study was undertaken to determine the caries prevalence in preschool children, which represents their past caries experience, reflecting the recent caries activity in them, and hence helps in predicting the future caries risk in young children and also to find out the association between the various socidemographic factors and caries risk in these children.

II. Materials and Methods

This cross sectional study was carried out over a period of six months among the preschool children of Thiruvananthapuram district. Ethical clearance was obtained from the Institutional Ethics Committee for Human Research. Permission was obtained from the Director, Social Welfare Department, Child Development Project Officer (CDPO), ICDS, in charge of the concerned AWCs, and Headmaster/Headmistress/Principal of the concerned Govt. and private PPS. Informed verbal and written consent were obtained from the mothers for participating in the study and for conducting oral examination of their children.

A pilot study was conducted among 50 children, 30 children from a Govt. PPS and 20 from an AWC. Sample size was calculated by using the formula, $z\alpha^2 \times p \times q / d^2$. A sample size of 354 was needed based on the estimated prevalence of ECC which was 64% with 95% confidence and an absolute precision of 5%. A stratified multistage cluster sampling method was used so that children from urban and rural areas were equally represented in the final sample. After adjustment for the cluster design, the final sample size was fixed as 531

(as per Epi info 6.0, software by WHO). All children whose mothers were present on the day of visit and who gave consent were included in the study. Exclusion criteria comprised of those children with developmental enamel defects and systemic diseases. 298 mother-child pairs from the urban area and 261 mother-child pairs from the rural area participated in the study. Thus a total of 559 preschool children were included in the study.

Quantitative assessment of caries was done by oral examination of each child using autoclaved mouth mirror and explorer in the presence of good natural day light, as per WHO recommendations. Caries was diagnosed using visual and tactile methods and caries was recorded at the level of cavitation according to the WHO criteria (1997).[20]

Child's caries experience was determined using the measure: the deciduous decayed, missing and filled teeth (dmft) score - dmft index. The dmft was calculated for each child by adding all teeth with one or more carious lesions (either currently carious or filled, implying previous caries) and any missing teeth (those extracted due to caries).[21] As all of the dental examinations were carried out by a single Pediatric dental surgeon (the investigator), the technique of recording caries index was not calibrated. Information was also collected at the time of oral examination on socio-demographic details which were entered in a structured proforma, to evaluate a possible association between caries risk and the socio-demographic variables in the sample population.

All mothers who participated in the study were given oral health education by the investigator during the interactive sessions conducted which lasted for 30-45 minutes. Children who needed further evaluation of caries risk and management of existing caries were referred to the tertiary health centre (Dept. of Pedodontics and Preventive Dentistry, Govt. Dental College, Thiruvananthapuram).

The proforma of 28 children were incomplete and hence excluded from further analyses. The data of 531 children were analyzed using SPSS version 16 (IBM SPSS Inc.). The estimated prevalence of dental caries in the sample was expressed as percentage, dmft was expressed as mean and standard deviation, and the associations between caries risk and the sociodemographic variables were analyzed by Chi square test.

III. Results

Demographic data of the 531 children are provided in Table 3.The mean age of the children studied was 50.86 months ± 12.545 months, in the age range of 24-72 months (2-6 years). 37.3% children were under 4 years of age and 62.7% above 4 years. There was an almost equal representation of male and female children. The stratified random sampling method has resulted in an almost equal representation of both the strata in the final sample.

Table 3: Baseline demographic characteristics and caries experience of the study sample

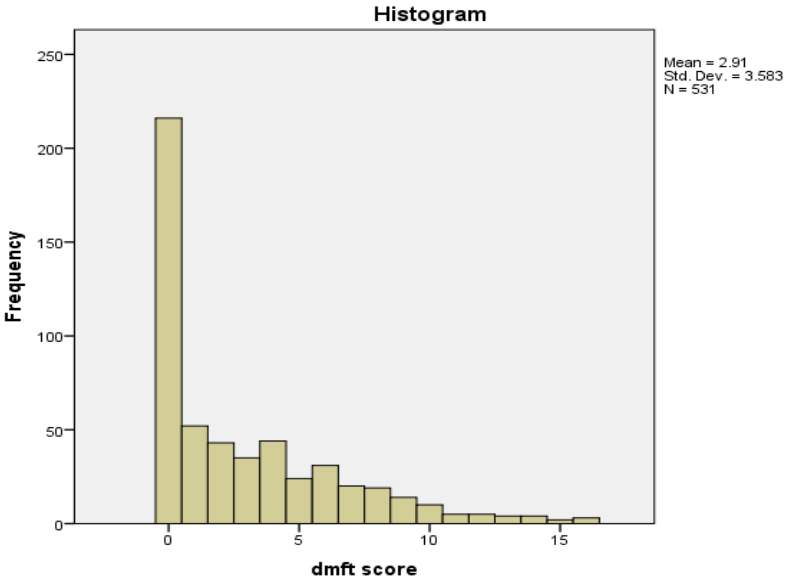
Variables		n	%
Age	<48 months	198	37.3
	≥ 48 months	333	62.7
Gender	Male	264	49.7
	Female	267	50.3
Strata	Urban	252	47.5
	Rural	279	52.5
School	Pvt. PP	253	47.6
	Govt.(PP & Angwdy)	278	52.4
Employment status	Unemployed	350	65.9
	Employed	181	34.1
Educational level	Upto 7 std	39	7.3
	8-12 std	256	48.2
	Graduate and above	236	44.4
Family income	Low	150	28.2
	Moderate	186	35.0

	High	195	36.7
Past caries -experience	Caries- free (dmft=0) Caries in at least 1 tooth (dmft ≥1)	216 315	40.7 59.3

N = 531

The results of the oral examination data revealed that of the 531 children examined, 315 children presented with caries, having a dmft index of 1 or more.

Figure 1: Distribution of dmft scores



Mean dmft= 2.91, SD= 3.583, Range16 (0-16), Median dmft= 1 (IQR= 0-5).
22% children were having very high dmft

Association between socio-demographic variables and caries risk based on past caries experience
Table 4 shows the relationship between socio-demographic variables and risk of developing caries:

Table 4: Association between socio-demographic variables and caries risk

Socio Demographic Variables		Risk groups				Total	Chi - square value	p -value
		Low		High				
		n	%	n	%	N		
Age	<48 months	55	27.8	143	72.2	198	3.650	0.056
	≥ 48 months	103	30.9	230	69.1	333		
Gender	Male	75	28.4	189	71.6	264	0.359	0.549
	Female	83	31.1	184	68.9	267		
Strata	Urban	65	25.8	187	74.2	252	7.528	0.006*
	Rural	93	33.3	186	66.7	279		
Type of School	Pvt. Pre Primary	90	35.6	163	64.4	253	0.298	0.585
	Govt. (Pre Primary & Anganwady)	68	24.5	210	75.5	278		
Employment Status	Unemployed	100	28.6	250	71.4	350	0.196	0.658
	Employed	58	32	123	68	181		
Education Level	Low	6	15.4	33	84.6	39	0.311	0.856
	Average	76	29.7	180	70.3	256		
	High	76	32.2	160	67.8	236		
Income Category	Low	31	20.7	119	79.3	150	3.178	0.204
	Medium	65	34.9	121	65.1	186		
	High	62	31.8	133	68.2	195		

N= 531

* **Strata is the only variable having significant association with caries risk.**

IV. Discussion

The present study was carried out to estimate the prevalence of ECC in 2 to 6 year old preschool children of Thiruvananthapuram district and to determine the association between caries risk and sociodemograghic factors. Children below 2 years of age were not included in the study as it was difficult to get these children as a cluster of the sample at a common place.

In the sample studied, prevalence of ECC among 2 to 6 year old preschool children was 59.3 % and hence it can be assumed that atleast 59.3% of children were having risk of developing future caries. This prevalence is high as compared to earlier studies done in Trivandrum.[11,22]

The high prevalence of caries in our study and other developing countries may be due to absence of community fluoride implementation and preventive programmes in these places and also due to more consumption of refined food in an urbanized society.[10] Other reasons for the higher prevalence of dental caries among preschool children in India may be:

(1) Lack of awareness about importance of primary teeth and oral health.[10]

(2) Parents are not properly motivated to seek periodic preventive dental checkups and prompt restorative care for their children.

(3) Limited accessibility and non-affordability of preventive and therapeutic dental services.[10]

(4) Poor knowledge, attitudes and practice towards factors associated with ECC.[39]

(5) Lack of an organized preventive oral health care system.[1]

Distribution of dmft score

In our study the distribution of the dmft score in the sample showed a positively skewed distribution indicating that a small proportion of the preschool children bear the maximum caries severity. The mean dmft score was 2.91 ± 3.58, ranging from 0 to 16, with a 95% CI (0 - 7.017). The median was 1, reflecting the fact that approximately 50% of the preschool children in Thiruvananthapuram district had none or one tooth affected by caries, and the inter-quartile range equaled 0-5 (Q3-Q1), expressing that the middle 50% of the 2-6 year olds had a dmft between 0 and 5. It also showed that 22% of the children were having very high dmft, ranging from 6-16 [Fig 1]. In a study done in 3-6 year old preschool children in Mysore City, Karnataka[23] it was 2.02 ± 2.29. Closer dmft values were observed in earlier studies conducted in eastern states of India and Pondicherry.[23]

Relationship between socio-demographic variables and caries risk as assessed by past caries experience

In a systematic review on the risk factors for dental caries in young children, the following socio-demographic factors were found to have significant relationship with caries: Gender of child (male), public rather than private, family income, father unemployed, low parental education, low maternal education, single mother, occupation of head of household, high number children per family, 3+ adults in household, rural or urban domicile, mother with full-time jobs, birth order, immigrant background, mother's age, 2+ children living in household, cohabitation of parents, ethnicity, parental occupation.[40]

In our study, it was observed that younger (below 4 years) and older (above 4 years) preschool children were having similar caries risk [χ^2=3.650, p= 0.056]. In a study by Mandal et al in the Eastern states of India reported that dental caries was higher in children aged 5-6 years. The study by Tewari et al in primary school children of Haryana found that mean prevalence of caries was highest in 6 years old children.[10]

In the present study, there was no statistically significant difference in caries risk among boys (71.6%) and girls (68.9%) [χ^2=0.359, p= 0.549]. No statistically significant difference in prevalence of dental caries among male (56%) and female children (57.1%) were reported by Agarwal et al, and the result is also in agreement with the earlier studies in Recife, Brazil in 2002 (females 30%, males 26%) and Jordan (females 4.1% and males 6.2%). No difference in caries experience between male and female children may be due to the fact that dietary and oral hygiene practices related to dental caries are mostly controlled by parents / caretakers at this early age. As a result it may be too early to develop any gender difference. The results of our study are not in agreement with the earlier studies in Pondicherry (females 41%, males 48%) in 2005 and Aurangabad (females 45%, males 58%) in 1992 where more number of males was affected than females. They attributed this difference to diet, geographical location and cultural differences seen in some societies where males are given more priority.[23] Another study has reported that caries experience is significantly associated with gender, with girls being less likely to experience oral disease by the age of 5 years than boys do. However, when girls do experience caries they will present more severe disease levels. Earlier emergence of primary teeth in girls than in boys (yet to be confirmed), would result in longer exposure times of teeth to the oral environment and this could explain more advanced disease levels when caries is present.[42]

In the present study, 2 to 6 year old boys and girls were having almost equal dmft scores, with the mean dmft score being 2.87 ± 3.545 in boys and 2.94 ± 3.625 in girls. This is in agreement with a study done among preschool children in anganwadis in Chandigarh which reported no statistically significant difference in caries experience expressed as dmft scores between girls and boys, though the mean dmft score was slightly higher in boys. [10]

In the present study, the socio-demographic variable found to have statistically significant association with caries risk in preschool children was strata, the child's setting. It was found that children from the urban areas were having significantly higher caries risk than children from rural areas [χ^2= 7.528, p = 0.006] [Fig 2].

The mean dmft score was also found to be significantly higher in urban children (3.38 ± 3.775), while in rural children it was 2.48 ± 3.348 [t = 2.938, p = 0.003] [Fig 3].

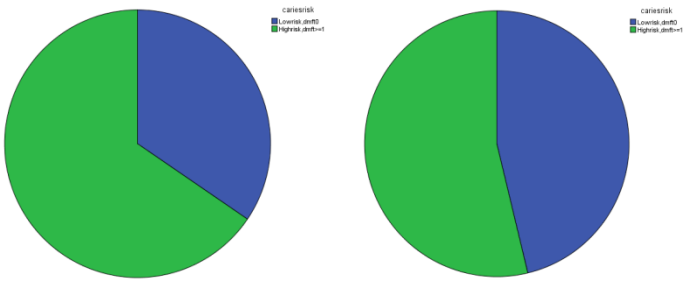


Fig 2: Caries risk in urban and rural preschool children showing higher caries risk (74.2%) in urban children where as only 66.7% rural children are at high risk of developing caries.

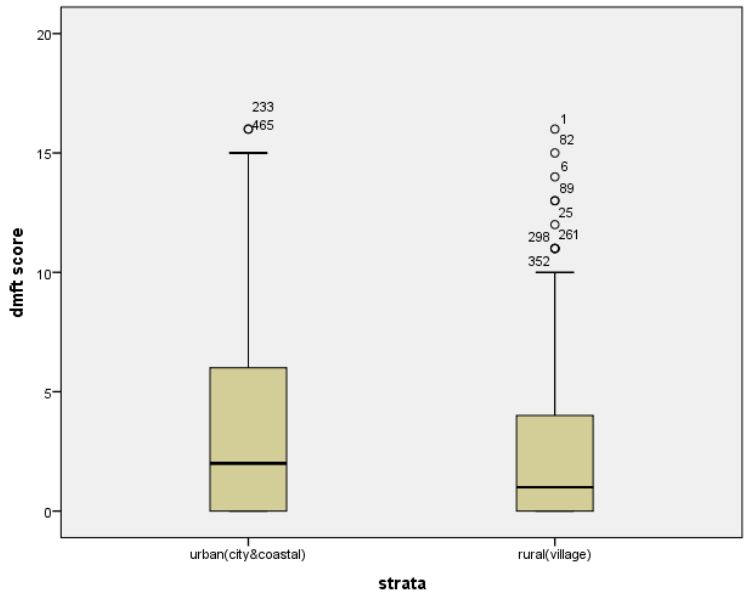


Figure 4: Box plot showing the median dmft in urban and rural children
Median dmft in urban children =2 [IQR=0-6] while the median dmft in rural children =1 [IQR=0-4]

This is in agreement with the study reporting higher dmft score (2.25) in urban settings. The reason of high caries prevalence in children of urban areas could be due to consumption of more of fast food, candies and refined diet. A study by Mandal et al on prevalence and severity of dental caries in children in the Eastern states of India also showed that the dental caries was higher in urban settings.[10] In Thailand, national oral health data collected showed that prevalence and severity of caries in 3 year old children was more in rural areas (70.3% and 3.9 dmft).[8]

Though 75.5% children in the Govt. PPSs and AWCs were having high caries risk, as compared to 64.4% children in the private PPSs, in this study, the type of school was not having any significant association with caries risk [χ^2= 0.298, p = 0.585]. The mean dmft score was 3.05 ± 3.694 in the Govt. PPSs and AWCs group and 2.75 ± 3.456 in the private PPS group. The results of present study are in agreement with a study conducted in Saudi Arabia in 2000 where caries prevalence was more among children from government schools (76%) than private preschools (69%). The reason they stated was that children from higher socioeconomic strata go to private preschools and their parents are better educated and in better position to be more conscious of or concerned about the diet and oral hygiene of their children. But in a study on ECC prevalence, severity and pattern in 3-6 year old preschool children in Davengere, there was no difference in caries prevalence between children of government and private preschools.[23]

With regard to employment status of the mothers, the results of our study showed no significant difference in caries risk in preschool children of employed or unemployed mothers [χ^2=0.196, p= 0.658] . Furthermore, educational level of the mothers was also evaluated as risk factor for ECC and there was no significant difference in caries risk in children of mothers with low education level as compared to average or

high education and hence maternal education is not a good predictor of caries in early childhood [χ^2=0.311, p= 0.856]. But it was found that, the caries risk was much higher (84.6%) in children whose mothers were either illiterate or having studied only up to primary level or up to 7th standard where as the risk was only 70.3% in children of mothers who had studied up to either 10th or 12th, and 67.8% in children whose mothers were either graduates or professionals.

In this study, though caries risk was found to be similar across children from families with various income levels [χ^2= 3.178, p = 0.204], children from low income families were at higher risk of developing caries (79.3%), while it was only 65.1% and 68.2% in the middle and higher income groups. The mean dmft scores were 3.51 ± 3.968, 2.37 ± 2.971 and 2.96 ± 3.741 in the low, middle and high income groups respectively. These findings are in agreement with many other studies which have reported that socially deprived children are at more risk of developing caries and prevalence of ECC is also more in such children.

SES status may increase ECC risk in several ways. Chen considers low SES individuals have more fatalistic health beliefs, lower perceived need for and utilization of dental health care services.[43] Among the preschool children in anganwadis of a North Indian city when various socioeconomic groups were compared, maximum dmft score was seen in lower strata at 3.50, which is in agreement with our study. The reason for this could be due to lack of awareness about oral health importance and also due to non affordability of toothpaste and tooth brushes. A study by Jose and King in pre-school children in Kerala showed that the children with high risk of dental caries belonged to lower socioeconomic class.[10]

In this study, except for strata, all other socio-demographic factors like age of the child, gender, type of school, mother's employment status and education level and family income were found to have no significant association with caries risk.

The actual prevalence of caries and hence the caries risk may be even higher as caries was recorded only at the level of cavitation in this study and hence children with incipient non cavitated lesions might have been considered as caries free and thus at low risk of developing future caries.

V. Conclusion

The evidence from this study can be used to take informed decisions on caries preventive programmes and caries risk minimizing activities in preschool children. Caries risk assessment can be integrated into the current heath care initiatives of ICDS program and also introduced at the level of preprimary schools as a population-based screening measure which will be valuable in identifying and targeting children with high caries risk. Individual preventive measures may then be given particularly to such children.

References:

[1]. Abu Hamila. Early Childhood Caries and Certain Risk Factors in a Sample of Children 1-3.5 Years in Tanta. Dentistry. 2013;4:1 http://www.omicsonline.org/

[2]. Douglass JM, Douglass AB, Silk HJ. A practical guide to infant oral health. Am Fam Physician 2004;70:2113-20.

[3]. Marcia M, Ditmyer, Connie Mobley, Quinn Draper, Christina Demopoulos, Steven Smith. Development of a theoretical screening tool to assess caries risk in Nevada Youth. Journal of Public Health Dentistry. 2007; 68(4):201-8

[4]. Wendy E. Mouradian, Elizabeth Wehr, James J. Crall. Disparities in Children's Oral Health and Access to Dental Care. *JAMA.* 2000;284(20):2625-31.

[5]. Yumiko Kawashitha, Masayasu Kitamura, Toshiyuki Saito." Early Childhood Caries". International Journal of Dentistry. 2011;vol. (7pages)1-7 http://www.hindawi.com/

[6]. Annerosa Borutta, Maik Wagner, Susanne Kneist. Early Childhood Caries: A Multi-Factorial Disease. OHDMBSC.2010; IX(1):32-38

[7]. American Academy of Pediatric Dentistry Reference Manual. Oral Health Policies. Pediatric Dent. 2003;22:22

[8]. Vachirarojpisan T, Shinada K, Kawaguchi Y, Laungwechakan P, Somkote T, Detsomboonrat P. Early childhood caries in children aged 6-19 months. Community Dent Oral Epidemiol. 2004; 32: 133-42

[9]. Rahul Naidu, June Nunn, Maarit Forde. Oral healthcare of preschool children in Trinidad: a qualitative study of parents and caregivers. BMC Oral Health. 2012; 12:27

[10]. Raj Sonika, Sonu Goel, Sharma Vijaylakshmi, Naveen Kishan Goel. Prevalence of dental caries and its association with Snyder test among preschool children in anganwadis of a North Indian city. International Journal of Public Health Dentistry 2012:3(1):1-10. http://journalgateway.com/

[11]. Kuriakose S, Prasannan M, Remya KC, Kurian J, Sreejith KR. Prevalence of early childhood caries among preschool children in Trivandrum and its association with various risk factors. *Contemporary Clinical Dentistry*. 2015;6(1):69-73. doi:10.4103/0976-237X.149295.

[12]. Tsang P et al. Medical approach to dental caries: Fight the disease, not the lesion. Pediatric Dent. 2006 :28 (2): 188-98

[13]. Crall JJ. Development and integration of oral health services for preschool-age children. Pediatr Dent 2005 : 27 (4): 323-30

[14]. Chedid NR., Buorgeois D., Kaloustian H., Baba NZ., Pilipili C. Caries prevalence and caries risk in a sample of Lebanese preschool children. O.S.T. T.D.J. 2011; 34(2) :31-45

[15]. Gunnel Hansel Petersson, Per-Erik Isberg Svante Twetman. Caries risk assessment in school children using a reduced Cariogram model without saliva tests. BMC Oral Health. 2010; 10:5. http://www.biomedcentral.com/content/pdf/1472-6831-10-5.pdf

[16]. Van Palenstein, Helderman WH, Mulder J, van't Hof MA, Truin GJ. Validation of a Swiss method of caries prediction in Dutch children. Community Dent Oral Epidemiol. 2001; 29: 341–5.

[17]. Margherita Fontana. Assessing patients' caries risk. JADA. 2006; 137(9):1231-9.

[18]. Bratthall D, Hansel Petersson G. Cariogram – a multifactorial risk assessment model for a multifactorial disease. Community Dent Oral Epidemiol. 2005; 33: 256–64

[19]. Vânia Baldini, Elaine Pereira da Silva Tagliaferro, Gláucia Maria Bovi Ambrosano, Marcelo de Castro Meneghim, Antonio Carlos Pereira. Use of occlusal sealant in a community program and caries incidence in high- and low-risk children. J Appl Oral Sci. 2009:396-402
[20]. World Health Organization. Oral Health Surveys: Basic methods Geneva, Switzerland; WHO, 1997 World Health Organization. Oral Health Surveys. Basic Methods.4thedn.Geneva,Switzerland:WHO1997.http://www2.paho.org/hq/ dmdocuments/ 2009/OH_st_Esurv.pdf.
[21]. Zander A, Sivaneswaran S, Skinner J, Byun R, Jalaludin B. Risk factors for dental caries in small rural and regional Australian communities. Rural and Remote Health 13: 2492. (Online) 2013 Available: http://www.rrh.org.au
[22]. N. Retnakumari, Jibi Cyriac. Childhood caries as influenced by maternal and child characteristics in preschool children of Kerala- An epidemiological study. Contemperory Clinical Dentistry.2012;3(1):2-8
[23]. Deepti Agarwal, Sunitha S, C.V.K. Reddy, Priyanka Machale. Early Childhood Caries Prevalence, Severity and Pattern in 3-6 Year Old Preschool Children of Mysore City, Karnataka. Pesq Bras Odontoped Clin Integr. 2012; 12(4):561-65
[24]. MG Gussy, EB Waters, EM Riggs, SK Lo, NM Kilpatrick. Parental knowledge, beliefs and behaviours for oral health of toddlers residing in rural Victoria. Australian Dental Journal. 2008;53; 52-60
[25]. N. A. Al Ghanim , J. O. Adenubi , A. A. Wyne & N. B. Khan. Caries prediction model in pre-school children in Riyadh, Saudi Arabia. International Journal of Paediatric Dentistry 1998;8: 115-122
[26]. A. Brown. Caries prevalence and treatment needs of healthy and medically compromised children at a tertiary care institution in Saudi Arabia. Eastern Mediterranean Health Journal,.2009; 15(2):378-86
[27]. Cynthia M Pine1 et al. Developing explanatory models of health inequalities in childhood dental caries. Community Dental Health. 2004; 21: 86–95
[28]. Filstrup SL, Briske D, da Fonesca M, Lawrence L, Wandera A, Inglehart MR. Early childhood caries and quality of life: child and parent perspectives. Pediatric Dent. 2003; 25:431–40.
[29]. WHO. Management of dental caries in selected rural areas of Gujarat through Atraumatic restorative technique (ART). WHO Collaborative Program (2006-2007).
[30]. Telakar-Pahel B, Rozier RG, Slade GD: Parental perceptions of children's oral health: The Early Childhood Oral Health Impact Scale. Health Qual Life Outcomes 2007;5:6. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1802739/pdf/1477-7525-5-6.pdf
[31]. Roopali Manohar Sankheshwari,Anil V. Ankola, Pradeep S. Tangade, Mamata I. Hebbai. Feeding habits and oral hygiene practices as determinants of early childhood caries in 3- to 5-year-old children. Oral Health Prev Dent. 2012;10: 283-90
[32]. Priya Subramaniam, P.Prashanth. Prevalence of early childhood caries in 8-48 month old preschool children in Bangalore city, South India. Contemperory Clinical Dentistry. 2012; 3(1): 15-21
[33]. Dini EL, Holt RD, Bedi R. Caries and its association with infant feeding and oral health - related behavior in 3-4 year old Brazilian children. Community Dent Oral Epidemiol. 2000; 28(4):241-8.
[34]. Iida ' Auinger P, Billings RJ, Weitzman M. Association between infant breast feeding and early childhood caries in the United States. Pediatrics 2007;120:944-52
[35]. Postma TC, Ayo-Yusuf OA, VanWyk P J. Sociodemograohic correlates of early childhood caries prevalence and severity in a developing country – South Africa. Int Dent J. 2008;58:91-97
[36]. Nunn ME, Dietrich T, Singh HK, Henshaw MM, Kressin NR. Prevalence of early Childhood Caries among very young urban Boston Children compared with US children. J Public Health Dent. 2009;69:156-62
[37]. Mohebbi SZ, Virtanen JI, Vahid-Golpayegani M, Vehkalahahti MM. A cluster randomized trial of effectiveness of educational intervention in in primary health care on early childhood caries. Careis Res 2009;43: 110-18
[38]. Narendar Dawani, Nighat Nisar, Nazeer Khan, Shahbano Syed , Navara Tanweer. Prevalence and factors related to dental caries among pre-school children of Saddar town, Karachi, Pakistan: a cross-sectional study. BMC Oral Health. 2012, 12:59 http://www.biomedcentral.com/content/pdf/1472-6831-12-59.pdf
[39]. Amila Zukanović. Caries risk assessment models in caries prediction. Acta Medica Academica. 2013;42(2):198-208
[40]. Rebecca Harris, Alison D Nicoll, Pauline M Adair and Cynthia M Pine. Risk factors for dental caries in young children: a systematic review of the literature. Community Dental Health. 2004; 21 (Supplement): 71–85
[41]. Harsh Priya, Shashdhar Acharya, Manojkumar, Meghashyam Bhat, Bharathi Purohit. Oral health status and treatment need among preschool children attending anganwadi centres- A comparative study. Oral Health Prev Dent. 2012; 10: 355-363.
[42]. Declerck D, Leroy R, Martens L, Lesaffre E, Garcia-Zattera M-J, Vanden Broucke S, Debyser M, Hoppenbrouwers K. Factors associated with prevalence and severity of caries experience in preschool children. Community Dent Oral Epidemiol. 2008; 36: 168–178.
[43]. KB Hallett, PK O'Rourke. Social and behavioural determinants of early childhood caries. Australian Dental Journal 2003;48:(1):27-33

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