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Association of Dental Caries With BMI, Nutritional Status and Mother's Knowledge About Oral Hygiene Status Among 6 To 14 Years Old School Going Children inNamakkal District.

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Abstract:*Dental Caries remains a major threat because food habits, lifestyle and mother's knowledge play a vital role in caries occurrence. This study is conducted to correlate the association of dental caries with BMI, nutritional status and mother's knowledge about oral hygiene status of children. Study was conducted among 519 children of 6 to 14 years in Namakkal district. Dental caries in both primary and permanent dentition, BMI, sociodemographic factors, were calibrated and mother's knowledge regarding the oral hygiene of children was assessed by 20 questionnaire & data statistically evaluated. Results have shown that there was a positive correlation between DMFT with age (p=0.0000) and no association of dental caries with BMI [dmft vs BMI (p=0.527), DMFT vs BMI (P=0.956)] and nutritional status [dmft vs nutritional status (p=0.189), DMFT vs nutritional status (p=0.977)]. Results of this study do not support an association of dental caries with BMI and nutritional status.*

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I. Introduction

Diabetes Globally, non-communicable diseases are increasingly recognized as a major cause of morbidity and mortality. Among them, overweight and obesity are imperative. The problem of overweight and obesity is not confined to adults but also to children and adolescents. The present changing dietary pattern among children is contributing childhood overweight and also stands as a risk factor in the development of dental caries. Both dental caries and malnutrition are serious public health problems with diet as a common risk factor. The nutritional disorder can interfere with tooth development and can have impact on the formation of tooth structure, altering the properties of the enamel and increasing susceptibility to caries. Children and adolescents comprise a group of individuals varying in size, maturity, personality and emotion experience, oral health, family background even based on sociodemographic factors. The Body Mass Index (BMI) reveals the health status of the children in relation to their age groups. The mother's knowledge on the status of oral hygiene of their children is mandatory to be cautious enough in understanding the prevalence of dental caries. The aim was to correlate the prevalence of dental caries with BMI, nutritional status among 6 to 14 years old school going children in Namakkal district and also to compare mother's knowledge regarding the oral hygiene status of the children.

II. Material and Methods

The present study was conducted among 519 children of age 6 to 14 years age group (both male and females), randomly selected from different primary schools in Namakkal district.

Study Design: Cross- sectional observational study.

Study Location: Different primary schools in Namakkal district, Tamilnadu, India.

Sample Size:519 patients.

Sample Size Calculation: The sample size was estimated on the basis of a single proportion design. The target population from which we randomly selected from different primary schools in Namakkal district. We assumed that the confidence interval of 10% and confidence level of 95%.

Subjects &Selection Method:

Inclusion criteria:

1.Students between 6-14 year of age.
2.Students of bothsexes are included.
3.Students who are willing to participate.
4.Students with informed consent form.

Exclusion criteria:

1. Children with congenitally missing teeth.
2.Children with systemic disorders like respiratory disorders, neuromuscular and cardiac disorders and who are diagnosed with any syndromes are excluded.
3.Children under orthodontic intervention.
4.Children not willing to participate in the examination.
5.Students with physical and mental impairment were excluded.

Procedure methodology

This is a Cross-Sectional observational study. Oral examination was done by two trained and calibrated examiners. Examination time for each student will range from 3-4 minutes. Written consent from the concerned school authority was obtained. Verbal consent from the students who are willing to participate were obtained

Instruments used:

- Weighing scale.
- Height chart.
- IDA specifiedPlane Mouth Mirror and Explorer.
- Light source.
- Sufficient instruments where been used in the examination site and proper autoclaving was carried out at the site.

All data were analyzed by two examiner who were calibrated for intra- examiner variability to observe the various study parameters. Examination was carried out under natural light and with the aid of clean mouth mirror and fine pointed straight explorer with aseptic precautions.

Dental caries presence was assessed using the DMFT index for permanent dentition and dmft index for deciduous teeth.

BMI was calculated using the formulae BMI = weight (kg) / height (m2).

The study sample were divided into four groups according to the BMI for age percentile and height of the same age and sex category – underweight, healthy weight, overweight, obese.

The prestructured questionnaire have been given to the children prior and filled by the parents for the nutritional status and for the parent's knowledge regarding oral hygiene care for their children. After written informed consent was obtained, a well-designed questionnaire was used to collect the data of the recruited patients retrospectively. The questionnaire included socio-demographic characteristics such as age, gender, nationality, height, weight. Ethical clearance for the study was obtained by local ethical committee (IEC/VDCW).

Statistical analysis

Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL). Student's *t*-test was used to ascertain the significance of differences between mean values of two continuous variables and confirmed by nonparametric Mann-Whitney test. In addition, paired *t*-test was used to determine the difference between baseline and 2 years after regarding biochemistry parameters, and this was confirmed by the Wilcoxon test which wasa nonparametric test that compares two paired groups. Chi-square and Fisher exact tests were performed to test for differences in proportions of categorical variables between two or more groups. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

Table1: Association between BMI and dmft score

BMI Inference	dmft score									Total	χ2	p value
	0	1	2	3	4	5	6	7	8			
Underweight	346	57	28	7	7	1	5	1	3	455	16.656	0.863#
Normal	52	8	1	0	0	0	0	0	0	61		
Overweight	0	1	1	0	0	0	0	0	0	2		
Obese	1	0	0	0	0	0	0	0	0	1		
Total	399	66	30	7	7	1	5	1	3	519		

#Non-significant (p>0.05)

Table 1 Shows the association between BMI and dmft score. the majority of subjects were underweight and had 0 dmft score while only one subject was obese and had 0 dmft score. Overall high dmft score was observed in underweight subjects followed by normal and overweight and least in obese. The association between BMI and dmft score was found statistically non-significant (p>0.05).

Table2: Correlation between BMI and dmft score

		Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Interval by Interval	Pearson's R	-.071	.024	-1.620	.106#

#Non-significant (p>0.05)

Table 2 Represents the correlation between BMI and dmft score by application of Pearson's R test. A negative correlation (-.071) was found with statistically non-significant difference (p>0.05).

Table3: Association between BMI and DMFT score

BMI Inference	DMFT Score					Total	χ2	p value
	0	1	2	3	4			
Underweight	401	37	11	3	3	455	1.653	1.000#
Normal	53	5	2	1	0	61		
Overweight	2	0	0	0	0	2		
Obese	1	0	0	0	0	1		
Total	457	42	13	4	3	519		

#Non-significant (p>0.05)

Table 3 Reflects the association between BMI and DMFT score. The majority of subjects were underweight and had 0 DMFT score while only one subject was obese and had 0 DMFT score. Overall high DMFT score was observed in underweight subjects followed by normal and overweight and least in obese. The association between BMI and DMFT score was found statistically non-significant (p>0.05).

Table4 : Correlation between BMI and DMFT score

		Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Interval by Interval	Pearson's R	-.001	.040	-.012	.991#

#Non-significant (p>0.05)

Table 4 illustrate the correlation between BMI and DMFT score by application of Pearson's R test. A negative correlation (-.001) was found with statistically non-significant difference (p>0.05).

Table 5: Comparison of BMI with dmft and DMFT score

Dental Caries Score	BMI Inference	N	Mean	Std. Deviation	F	p value
dmft	Underweight	455	.501	1.220	2.12	0.097#
	Normal	61	.164	.416		
	Overweight	2	1.500	.707		
	Obese	1	.000			
	Total	519	.464	1.158		
DMFT	Underweight	455	.176	.559		
	Normal	61	.197	.572		
	Overweight	2	.000	.000		
	Obese	1	.000			
	Total	519	.177	.559		

#Non-significant (p>0.05)

Table 5 Shows comparison among dmft, DMFT score and BMI. The maximum subjects were underweight with respect to dmft and DMFT score and had mean±SD score 0.501 and 0.464 respectively. Similarly subjects who were obese had minimum dmft and DMFT score. However overweight subjects had highest mean dmft value (1.5±.71). On application of one-way ANOVA test, the comparison was found statistically non-significant (p>0.05) with 2.12 F value.

Table 6: The association between different oral hygiene questions and dmft score.

Questions 1 to 7	dmft score									Total	p value
	0	1	2	3	4	5	6	7	8		
Brushing twice daily	231	31	16	3	2	0	3	1	0	287	0.188#
Use of fluoridated tooth paste	211	28	17	3	4	0	3	0	1	267	0.674#
Mouth rinsing after every meal	300	44	21	7	3	0	2	1	1	379	0.036*
Dental visit every 6 months	171	25	11	1	1	0	1	0	0	210	0.179#
Dental decay noted in kid	282	43	21	5	6	1	3	0	3	364	0.653#
Bottle feeding at night and kid sleeping with milk bottle	14	0	3	1	1	0	1	0	0	20	0.091#
Aware that improper oral hygiene practice and bacterial accumulation causes dental decay	222	33	19	7	3	0	2	1	2	289	0.832#

#Non-significant (p>0.05), *Significant (p≤0.05)

Table 6 Reflects the association between different oral hygiene questions and dmft score.

The majority of subjects who brush twice daily had 0 dmft score while the number decrease with increase in dmft score. None of the subject had dmft score 5 while one subject had dmft score 8. The overall association between brushing twice daily habit and dmft score was found statistically non-significant (p>0.05).

Most of subjects who use fluoridated tooth paste, rinse their mouth after every meal and visit to dentist after every 6 months had 0 dmft score while the number decrease with increase in dmft score. None of the subject had dmft score 5 in subjects use fluoridated tooth paste and rinse their mouth after every meal while subjects visit to dentist after every 6 months had 5, 7 and 8 dmft score. The overall association between brushing twice daily habit, use fluoridated tooth paste & visit to dentist after every 6 months with dmft score was found statistically non-significant (p>0.05). However, a statistically significant association was observed between habit of mouth rinsing after every meal and dmft score (p<0.05).

Most number of subjects who noted dental decay in kid had 0 dmft score while the number decrease with increase in dmft score. None of the subject had dmft score 7. The overall association between who noted dental decay in kid with dmft score was found statistically non-significant (p>0.05). Interestingly subjects who noted decay in kid had highest number of dmft score (8) in three subjects.

Subjects who replied yes for bottle feeding at night and kid sleeping with milk bottle had the highest dmft score (2) in 15% of the subjects. However overall association with dmft score was found statistically non-significant (p>0.05).

The majority of subjects who answered yes regarding awareness about improper oral hygiene practice and bacterial accumulation causes dental decay had dmft score 0 followed by dmft score 1 to 8. The association with dmft score was found statistically non-significant (p>0.05).

Table 7: The association between different oral hygiene questions and DMFT score.

Q 1 to 7	DMFT Score					Total	p value
	0	1	2	3	4		
Brushing twice daily	252	24	6	3	2	287	0.863#
Use of fluoridated tooth paste	224	28	11	3	1	267	0.017*
Mouth rinsing after every meal	325	36	11	4	3	379	0.101#
Dental visit every 6 months	172	24	8	4	2	210	0.004*
Dental decay noted in kid	323	28	9	3	1	364	0.682#
Bottle feeding at night and kid sleeping with milk bottle	18	1	1	0	0	20	0.902#
Aware that improper oral hygiene practice and bacterial accumulation causes dental decay	254	25	7	3	0	289	0.780#

#Non-significant (p>0.05), *Significant (p≤0.05)

Table 7 Reflects the association between different oral hygiene questions and DMFT score.

The majority of subjects who brush twice daily had 0 DMFT score while the number decrease with increase in DMFT score. None of the subject had DMFT score 5 while one. The overall association between brushing twice daily habit and DMFT score was found statistically non-significant (p>0.05).

Most of subjects who use fluoridated tooth paste, rinse their mouth after every meal and visit to dentist after every 6 months had 0 DMFT score while the number decrease with increase in DMFT score. None of the subject had DMFT score 5 in subjects use fluoridated tooth paste and rinse their mouth after every meal while subjects visit to dentist after every 6 months had more of 0 DMFT score. The overall association between brushing twice daily habit was found statistically non- significant (p>0.05), butuse of fluoridated tooth paste & visit to dentist after every 6 months with DMFT score was found statistically significant (p<0.05). However, a statistically non-significant association was observed between habit of mouth rinsing after every meal and DMFT score (p>0.05).

Most number of subjects who noted dental decay in kid had 0 DMFT score while the number decrease with increase in DMFT score. None of the subject had DMFT score more than 5. The overall association between who noted dental decay in kid with DMFT score was found statistically non-significant (p>0.05).

Subjects who replied yes for bottle feeding at night and kid sleeping with milk bottle had the highest DMFT score (2) in 15% of the subjects. However overall association with DMFT score was found statistically non-significant (p>0.05).

The majority of subjects who answered yes regarding awareness about improper oral hygiene practice and bacterial accumulation causes dental decay had DMFT score 0 followed by DMFT score 1 to 4. The association with DMFT score was found statistically non-significant (p>0.05).

Table8: The association between different oral hygiene question (Breast Feeding) and dmft score.

Question 8		dmft score									Total	P value
		0	1	2	3	4	5	6	7	8		
Breast Feeding	**No Response**	18	71	1	0	0	0	0	0	0	90	0.911#
	Less	190	23	42	2	2	1	2	1	2	265	
	Normal	162	31	14	11	3	0	2	0	1	224	
	Longer	29	7	3	1	9	0	1	0	0	50	
Total		399	66	30	7	7	1	5	1	3	519	

#Non-significant (p>0.05)

Table9: The association between different oral hygiene question (Breast Feeding) and DMFT score.

Question 8		DMFT Score					Total	p value
		0	1	2	3	4		
Breast Feeding	No Response	23	43	0	0	0	66	0.356#
	Less	197	26	19	3	3	248	
	Normal	196	13	7	5	0	221	
	Longer	41	2	0	0	3	46	
Total		457	42	13	4	3	519	

#Non-significant (p>0.05)

Table 10: The association between different oral hygiene question and dmft score.

Q 9 to 15	dmft score									Total	p value
	0	1	2	3	4	5	6	7	8		
Aware that cold drinks affect teeth?	318	53	23	7	7	1	4	1	3	417	0.756#
Sweet consumption	231	39	18	5	4	0	4	0	3	304	0.593#
Nut consumption	212	41	20	1	4	0	2	1	3	284	0.106#
Fruit consumption	300	55	25	7	6	1	3	0	3	400	0.807#
Often consumes cool drinks	174	23	13	2	3	1	1	1	2	220	0.972#
Vegetable consumption in between meals	359	59	27	6	6	1	4	1	3	466	0.995#
Skipping meals	155	29	12	4	3	1	2	1	1	208	0.801#

#Non-significant (p>0.05)

Table 11: The association between different oral hygiene question and DMFT score.

Q 9 to 15	DMFT Score					Total	p value
	0	1	2	3	4		
Aware that cool drinks affect teeth?	374	30	8	3	2	417	0.192#
Sweet consumption	265	27	9	3	0	304	0.205#
Nut consumption	248	21	10	2	3	284	0.238#
Fruit consumption	350	34	11	3	2	400	0.905#
Often consumes cold drinks	187	24	6	3	0	220	0.085#
Vegetable consumption in between meals	407	39	13	4	3	466	0.563#
Skipping meals	193	8	6	0	1	208	0.021*

#Non-significant (p>0.05), *Significant (p≤0.05)

Table 12: The association between different oral hygiene question and dmft score.

Q 16 to 20	dmft score									Total	p value
	0	1	2	3	4	5	6	7	8		
Aware that milk consumption is good?	366	63	29	6	7	1	5	1	3	481	0.872#
Aware that lot of consumption of sweet is bad for oral cavity?	317	55	26	7	6	1	4	1	3	420	0.995#
Snacking in between meal?	198	44	18	5	3	1	1	1	1	272	0.114#
Aware that skipping meals is bad for health?	342	54	28	7	6	1	4	1	2	445	0.782#
Aware that improper oral hygiene leads to improper health?	314	52	25	7	6	1	4	1	3	413	0.882#

#Non-significant (p>0.05)

Table 13: The association between different oral hygiene question and DMFT score.

Q 16 to 20	DMFT Score					Total	p value
	0	1	2	3	4		
Aware that milk consumption is good?	422	40	12	4	3	481	0.904#
Aware that lot of consumption of sweet is bad for oral cavity?	376	27	12	2	3	420	0.015*
Snacking in between meal?	251	12	7	0	2	272	0.004*
Aware that skipping meals is bad for health?	390	37	11	4	3	445	0.839#
Aware that improper oral hygiene leads to improper health?	372	26	10	2	3	413	0.017*

#Non-significant (p>0.05), *Significant (p≤0.05)

IV. Discussion

The association between DMFT and obesity among school aged children remains unclear, as these two parameters in all pre-adolescents may indicate that obesity and DMFT share similar underlying factors, regardless of age, nationality, socioeconomic differences, and differing oral healthcare habits.

In addition to evaluating the association between BMIand dental caries, this studyalso assessed the mother's knowledge on oral hygiene status of children. Subjects were categorized as underweight, normal, overweight and obese usingthe 2015 growth reference charts proposed by theIAP for Indian children. Although WHO growthreference charts for 5- to 19-year-old subjects arecommonly used by researchers, they might not be suitablefor use in the Indian population as growth patternsin children differ between regions based on thetime of puberty and on nutritional, environmental andgenetic factors [10].

There was no association between BMI and dentalcaries: dental caries prevalence and experience did notdiffer significantly between the categories of BMI.Also, BAZ scores did not differ significantly betweenthe caries-severity categories. In this study, BMI wasalso used as a continuous variable because categorization might lead to loss of data, despite being a usefulmethod of presentation. The literature on the associationof dental caries with BMI is conflicting; threesystematic reviews [11,12] found no strong evidence ofan association, while one reported a small association(i.e. caries in permanent dentition is more prevalent inobese children). Furthermore, caries assessment methodsand BMI classification criteria differed across thestudies included in these reviews.Similarly, to the above, there have been conflictingfindings from studies in adolescent and child populationsin India. Half of these studies observed no association, while the other half found a direct association, with more caries being reported in children who were obese or overweight. An important reason for the discrepancies, that also influences any comparison between the studies is non-uniformBMI cut-off values.

The relationship between dental caries and BMI has been studied by numerous authors, with often controversial and limited results (Xavier et al.,2013). Empirical findings suggest the existence of such a relationship, but very few studies to date have confirmed and characterized this relationship (Batista et al.,2007).

Shakya et al (2003) found a negative correlation between BMI and the number of dental carries in both types of dentition (primary and permanent).

Panwar NK et.al (2014) Study on relationship between the nutritional status and dental caries in 8-12-year-old children of Udaipur City, India thus, the study showed that the children with normal BMI for age had more caries in their primary teeth, as well as in their permanent teeth, than the overweight children.

Kumar S et.al. (2017) conducted a study to assess the Relationship between body mass index and dental caries in children, and the influence of socio-economic status (SES). BMI was not associated with dental caries prevalence and experience in this population. The association of BMI with dental caries varied across SES categories. In the high-SES category, overweight children experienced fewer caries than did normal-weight children.

In 2007 Willerhausen et al [9] conducted a Cross-sectional study in Germany among 6-11-year-old children and revealed a positive statistical association was observed between BMI and caries in both deciduous and permanent dentition. Pinto et al 2007 Prospective cohort study in Pediatric dental clinic of Pennsylvania School of Dental Medicine among No correlation was found between dental decay in obese and nonobese children ($p = 0.99$).

Although not statistically significant, caries prevalence and experience were lower in overweight children than in children from other BMI categories.

The prevalence of overweight in the present study (17.25%) is supported by a finding and more than another finding conducted in India. It is worth mentioning that the calculated global prevalence of overweight (including obesity) in children aged 5-17 years is estimated by the WHO, International Obesity Task Force (IOTF) to be approximately 10%, but this is "unequally distributed.

Many studies had reported that overweight children had lower dental caries when compared to normal weight children. In 2006, Macek and Mitola found that the normal weight children have more dental caries experience in both primary and permanent dentition. Similarly, Narksawat et al found that overweight children were less likely to have dental caries in primary (OR = 0.6) and permanent dentition (OR = 0.5) than normal weight children. It was also found that underweight and normal weight schoolchildren were more likely to have dental caries at least 1.94 times and 2.22 times, respectively compared to overweight and obese children who are 12 – 14 years old.

Prospective longitudinal studies are needed to investigate causal relationship between dental caries and obesity, and also to study the long-term association with more accurate indicators such as dietary patterns and health behaviors.

The main findings of the study, namely lower caries prevalence and experience in overweight children and the influence of SES on this relationship, are in contrast to the literature on the intake of free sugar, dental caries,

and nutritional status. This warrants longitudinal and life-course studies on larger representative populations from diverse cultural backgrounds to understand the interplay between social disparities, BMI and the severity of dental caries. In order to facilitate international comparisons, it would be beneficial if future studies were to use uniform and appropriate methods for assessing caries, SES, and BMI. Dentists from the study region, in their position as health-care providers, can educate and motivate parents, particularly those children who are overweight, on healthy eating practices. Furthermore, health-education programmes for preventing dental caries and obesity, with multisectoral co-ordination between health and education departments of the state, should be contemplated. Data obtained from this study can act as baseline information and can be helpful in evaluating the effectiveness of the implemented programs.

V. Conclusion

Results of this study do not support an association of dental caries with BMI and nutritional status and Mother's knowledge was good regarding oral hygiene practices for their children.

Study adds evidence to the existing literature that dental caries was not strongly associated with BMI and nutritional status[8] (KumarS. et.al, int dent J.2017).

Caries experienceare multifactorial, and their relationship to be weakened the study area, our subjects were representative of rural/semi-urban school-going children of the Namakkal district in Tamilnadu with usage of fluoride.

References

[1]. Md Zabirunnisa Begum, Myla Nagamalleshwari, Pachava Srinivas, Jayaprakash S. Gadagi, Praveen Gadde, KoneruJyothirmai . Is body mass index truly related to dental caries? Survey on predisposing factors for overweight among Indian school children. Dental Hypotheses Oct-Dec 2014 / Vol 5 | Issue 4.

[2]. Bud Anamaria Manuela Chibelean, Mariana Pacurar, Daniela Eşian, Muica Monica-Cristina, Eugen Bud . Correlation between bmi, dental caries and salivary buffer capacity in a sample of children from Mures County, Romania. European Scientific Journal July 2015 edition vol.11, No.21.

[3]. Alvarez JO. Nutrition, tooth development and dental caries. American Journal of Clinical Nutrition.1995;61:410S-416S.

[4]. Maddelon de Jong Lenters, Paula van Dommelen, Annemarie A. Schuller and Erik H.W. Verrips. Body mass index and dental caries in children aged 5 to 8 years attending a dental paediatric referral practice in the Netherlands. BMC Research Notes 2015 8:738.

[5]. Gyanendra Mishra, Seema Thakur, Parul Singhal, Shiv Nath Ghosh, Deepak Chauhan, CheranjeeviJayam Assessment of child behavior in dental operatory in relation to sociodemographic factors, general anxiety, body mass index and role of multimedia distraction. Journal of Indian Society of Pedodontics and Preventive Dentistry 2016; 34:159-64.

[6]. Jing-jing Liang, Zhe-qing Zhang, Ya-jun Chen, Jin-cheng Mai, Jun Ma, Wen-han Yang and Jin Jing Dental caries is negatively correlated with body mass index among 7-9 years old children in Guangzhou, China. BMC Public Health (2016) 16:638

[7]. ServetKesim, BetülCicek, CuneytAsm Aral, Ahmet Ozturk, Mumtaz Mustafa Mazıcıoglu,SelimKurtoglu. Oral Health, Obesity Status and Nutritional Habits in Turkish Children and Adolescents: An Epidemiological Study. Balkan Medical Journal, Vol. 33, No. 2, 2016.

[8]. Kumar S, Kroon J, Lalloo R, Kulkarni S, Johnson NW. Relationship between body mass index and dental caries in children, and the influence of socio-economic status. Int Dent J.2017 Apr;67(2):91-97. doi: 10.1111/idj.12259. Epub 2016 Oct 17.

[9]. Willerhausen B, Blettner M, Kasaj A, Hohenfellner K. Association between body mass index and dental health in 1290 elementary schools in a German city. Clin Oral Investig. 2007 Sep;11(3):195–200.

[10]. Khadilkar V, Yadav S, Agrawal KK et al. Revised IAP growth charts for height, weight and body mass index for 5- to 18-year-old Indian children. Indian Pediatr 2015 52: 47–55.

[11]. Silva AE, Menezes AM, Demarco FF et al. Obesity and dental caries: systematic review. Rev Saude Publica 2013 47: 799–812.

[12]. Hooley M, Skouteris H, Boganin C et al. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. Syst Rev 2012 1: 57.

[13]. Honne T, Pentapati K, Kumar N et al. Relationship between obesity/overweight status, sugar consumption and dental caries among a+dolescents in South India. Int J Dent Hyg 2012 10:240–244.

Dr. Arumugasamy Niranjana. "Association of Dental Caries With BMI, Nutritional Status and Mother's Knowledge About Oral Hygiene Status Among 6 To 14 Years Old School Going Children in Namakkal District." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), Vol. 18, no. 02, 2019, pp. 25-32.