ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 7(C), pp. 27919-27924, July, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

ASSOCIATION OF NUTRITIONAL STATUS, DIET AND DENTAL CARIES AMONG 12-15 YEAR OLD SCHOOL CHILDREN – A CROSS-SECTIONAL STUDY

Aparna KS*., Puranik Manjunath P and Shanbhag Namita

Department of Public Health Dentistry, Government Dental College and Research Institute, Bangalore, Karnataka 560002

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0907.2358

ARTICLE INFO

Article History:
Received 15th April, 2018
Received in revised form 7th May, 2018
Accepted 13th June, 2018
Published online 28th July, 2018

Key Words:

Body mass index, dental caries, food frequency questionnaire, nutritional status, school children.

ABSTRACT

Nutritional status has a profound effect on general and oral health. A sugar-rich diet is associated with obesity and dental caries. Obesity and dental caries are both common childhood diseases that can have an impact on the overall development of children.The relationship between nutritional status, diet and dental caries is complex. The study aimed to assess the association of nutritional status, diet and dental caries among 12-15 year old schoolchildren. A cross-sectional study was conducted among 240 school children aged 12-15 years in Bangalore city. Dietary habits were recorded using food frequency questionnaire. Nutritional status and caries were assessed using Body Mass Index (BMI) and WHO caries criteria respectively. Chi Square test, unpaired t-test, Kruskal-Wallis test, Spearman's correlation and linear regression were applied. Majority of the study participants belonged to underweight category, Mean BMI, FFQ and DMFT were found to be 15.61±3.53, 2.68±3.18 and 2.62±3.4 respectively. Sugar consumption was more in the obese and overweight category. Highly significant positive correlation was found between diet and dental caries ($\rho = 0.689$, $p<0.001$). In a linear regression, diet showed a highly significant association with dental caries ($\beta = 0.71$, $p<0.001$). There was no association between nutritional status and dental caries. There is an association between diet and dental caries. However, nutritional status was not associated with either diet or dental caries.

INTRODUCTION

Nutritional status has a profound effect on general and oral health.[1] Optimal nutrition is vital for growth and enhancing host resistance.[2] Globally, nutritional deficiency and dietary excess are two key problems associated with nutrition.[3] Under-nutrition exacerbates the cariogenicity of dietary sugars.[4] Obesity and overweight can negatively affect the physiological and psychological well-being of the affected individual. Both can increase the risk of cardiovascular diseases, dental caries and decreased masticatory performance.[5,6]

Dental caries and obesity are common childhood diseases that can negatively affect the development of children and pose a burden to a country's health expenditure. Ironically, both are multifactorial and have common risk factors which include diet and lifestyle.[5] The other risk factors of dental caries include plaque buildup, poor oral hygiene and consumption of fermentable carbohydrates.[7] Children with caries can experience pain and ultimately tooth loss. This can cause a reduction in food intake, which may lead to stunted growth. In contrast, increased consumption of fermentable carbohydrates can result in increased body weight and incidence of dental caries.[8] The relationship between nutritional status, diet and dental caries is complex. Children's dietary habits are significant contributors to childhood obesity and dietary imbalance causes dental caries. Obese and overweight children prefer sweet foods more frequently compared to children with normal weight.[5]

There are contradictory results regarding the relationship between the nutritional status and the occurrence of dental caries in children. Reports have linked caries with overweight[3,9,10] and underweight children[3,8,11-13] while some studies[5,6,14-21] have failed to find association between nutritional status and dental caries. Studies showing the effect of both diet and nutritional status on dental caries in Indian schoolchildren are scarce. Hence, this study was conducted with the following research question and hypothesis:

Research question: Is there an association between nutritional status, diet and dental caries among school children?

Corresponding author:* **Aparna KS
Department of Public Health Dentistry, Government Dental College and Research Institute, Bangalore, Karnataka 560002

Research hypothesis: There is an association between nutritional status, diet and dental caries among school children. The objectives of the studies were to assess the association of nutritional status, diet and dental caries among 12-15 year old school children.

MATERIALS AND METHODS

A cross-sectional study was conducted among 12-15 year old school children from September-October 2017 in Bangalore city. Ethical clearance was obtained from *Institutional Ethical Committee.* Necessary permission was obtained from school authorities. Informed consent was obtained from the parents of the study participants after explaining the purpose and procedure clearly. Informed assent was obtained from the study participants. Principal investigator was trained and calibrated prior to start of the study to ensure reliability (k=0.80).

Food Frequency Questionnaire (FFQ) was developed, based on previous literature.[22,23] It consisted of a finite list of sugary food and beverages with response categories to indicate usual frequency of consumption over the time period. Content validity was assessed by the subject experts. Internal consistency (α) was found to be good (0.82).Readability and comprehension was assessed during pilot study. Necessary corrections and modifications were made.

A pilot study was conducted among 30 study participants to calculate the sample size and to check the feasibility of the study. Based on the prevalence of dental caries as measured by WHO 2013 caries criteria[24], the sample size was calculated using the formula:

$$N = \frac{Z_{\alpha/2}^2 \times P(1-P) \times D}{E^2}$$

Where P= Prevalence of dental caries i.e.73.3%, statistical power =80%, Z_α =1.96 at 95% confidence interval, E= margin of error-10%, Design effect, D=1.5

$$N = \frac{(1.96)^2 \times 0.73\,(1-0.73) \times 1.5}{(0.073)^2} = 213$$

The sample size of 213 was rounded off to 240. School children from government, aided and private schools were included. Children with conditions that make assessment of oral health status difficult such as restricted mouth opening, systemic conditions which are known to influence oral health were excluded from the study.

List of government, aided and private schools were obtained from various websites.[25,26] From this list, two schools each from government, aided and private schools were selected based on simple random sampling method from the same geographical location. Equal number of study participants was recruited from government, aided and private schools and in the age groups ranging from 12 to 15 years [60 each].

Data was collected using a structured questionnaire followed by clinical examination by a single calibrated examiner and recorded by a trained assistant. Besides demographic profile, oral hygiene practices and dental visits were recorded. Socioeconomic status was assessed using modified Kuppuswamy classification (income updated based on Consumer Price Index for September 2017).[27]

Dietary habits were assessed using self-administered food frequency questionnaire. Nutritional status was assessed by measuring height and weight and Body Mass Index was calculated. Height was recorded with the help of a measuring tape (precision- Class II precision with a potential error of ±2.3mm over a 10m length.[28] Weight was measured using a digital weighing machine (Geonaute Scale 100; precision-Graduation: 100g ; Max weight: 150kg). Clinical assessment of dental caries was done using WHO 2013 caries criteria. Infection control procedures were observed throughout the study.

The data collected were entered into MS excel spread sheet. Data was analyzed using the Statistical Package for Social Sciences (IBM SPSS Statistics V22.0). Descriptive and inferential statistical analyses were done. Chi Square test, unpaired t-test, Kruskal-Wallis test, Spearman's correlation and linear regression were applied. Linear regression analysis was performed using two models with dental caries as dependent variable. Model 1 included four independent variables-Age, gender, socioeconomic status and nutritional status (BMI). Model 2 also included four independent variables-Age, gender, socioeconomic status and diet (Food Frequency Questionnaire). Kuppuswamy's income categories were updated using online calculator[27] with Consumer Price Index for Industrial Workers (CPI-IW) being 285 for September 2017. For FFQ, weights were developed with daily consumption as 1 and other scores relative to it. Based on BMI classification for children given by Indian academy of Pediatrics (IAP) [28], the study participants were grouped as: Underweight (<16.2 kg/m^2), Normal weight (16.3-23.1 kg/m^2), Overweight-(23.2-26.5 kg/m^2) and Obese (≥26.6 kg/m^2). Level of significance was considered at 5% ($p < 0.05$).

RESULTS

In this study, equal proportions of 12-15 year school children were present. The mean age in the current study was 13.5±1.12 years. Males were higher in proportion than females. (Table 1)

Table 1 Demographic characteristics of the study participants

Age (Years)	Total N=240 (%)
12	60(25.0)
13	60(25.0)
14	60(25.0)
15	60(25.0)
Gender	
Male	122(50.8)
Female	118(49.1)

Majority of parents of the study subjects' had completed high school education (67.9%), were semiskilled workers (66.6%) and belonged to lower middle class (85.8%). More than three-fourth of the study participants (77.9%) had never visited a dentist. Among those who visited dentist 37.73% reported to have visited dentist within past 1 year. Pain was the main reason for dental visit (71.16%) and restoration (60.37%) was the most common dental treatment utilized.

Most of the study participants reported sugar exposure 2-3 times/day. Regarding nutritional status study participants were predominantly underweight (74.1%), whereas others were either normal (22.0%), overweight (2.9%) or 02 (0.8%) obese. Dental caries experience was found to be 76.25%.

Among study participants, Mean BMI, FFQ score and DMFT were found to be 15.61±3.53, 2.68±3.18 and 2.62±3.4 respectively. There were no significant difference in Mean BMI and FFQ score according to age and gender. There was no significant difference in dental caries experience according to age. Females had significantly higher caries experience than males. (p=0.015) (Table 2)

Table 2 Mean Body Mass Index (BMI), Food Frequency Questionnaire score, Caries experience among study participants according to age and gender

Age (years)	Mean BMI(kg/m^2)	Mean FFQ score	Mean Caries experience
12	14.80±2.70	2.44±3.18	2.48±3.42
13	15.34±3.16	2.51±2.96	2.64±2.45
14	15.97±3.98	2.35±2.54	2.53±2.7
15	16.33±3.99	3.26±3.47	3.03±3.65
p	0.08	0.532	0.541
Gender			
Male	15.97±3.71	2.45±2.97	2.15±2.93
Female	15.25±3.31	2.90±3.30	3.10±3.76
p	0.11	0.224	0.015*
Total	**15.61±3.53**	**2.68±3.18**	**2.62±3.4**

*Statistically significant, p<0.05. BMI=Body Mass Index, FFQ=Food Frequency Questionnaire

Mean DMFT was lower in normal category (1.54±2.04) when compared to other categories (underweight-2.87±3.60, overweight-2.85±2.81 and obese-2.5±2.82). Mean FFQ score was lower in normal category (1.46±1.75) when compared to other categories (underweight-2.96±3.34, overweight-3.85±4.77 and obese-5.0±7.07). There was no significant difference in dental caries experience according to BMI and FFQ score. (Table 3)

Table 3 Mean caries experience (DMFT) and Food Frequency Questionnaire score (FFQ score) among study participants according to Body Mass Index (BMI)

Caries experience	Underweight	Normal weight	Overweight	Obese	p value
DT	2.42±3.04	1.33±1.85	2.71±2.81	2.0±2.82	0.18
MT	0.12±0.45	0	0	0	-
FT	0.32±0.82	0.20±0.56	0.14±0.37	0.5±0.70	0.615
DMFT	2.87±3.60	1.54±2.04	2.85±2.81	2.5±2.82	0.414
FFQ Score	2.96±3.34	1.46±1.75	3.85±4.77	5.0±7.07	0.3

DMFT=Decayed, Missed, Filled Teeth

Highly significant moderate positive correlation was found between diet and dental caries. (ρ = 0.689, p<0.001) A weak negative correlation was found between nutritional status and dental caries (ρ = -0.009, p=0.88) and between nutritional status and diet (ρ = -0.05, p=0.37) although relation was not statistically significant. (Table 4)

Table 4 Correlation between BMI, Diet and Dental Caries

Correlations	ρ value	p value
Diet versus DMFT	0.689	<0.001**
BMI versus DMFT	-0.009	0.88
Diet versus BMI	-0.05	0.372

****Statistically highly significant, ρ=Rho**

Model 1 showed no association between age and dental caries (β = 0.096, p=0.14). Gender was found to have a significant association with dental caries (β = 0.131, p=0.04). There was no association between socioeconomic status and dental caries (β = -0.070, p=0.28). No association was found between nutritional status (BMI) and dental caries (β = -0.011, p=0.86).

In Model 2, there was no association between age and dental caries (β = 0.108, p=0.07) and gender and dental caries (β = 0.095, p=0.11). No association was found between socioeconomic status and dental caries (β = -0.045, p=0.45). Diet (FFQ score) had a highly significant association with dental caries (β = 0.375, p<0.001). (Table 5)

Table 5 5 a: Linear regression analysis with Dental Caries as dependent variable

Table 5 Model 1

Model 1 Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	R^2	p value
	B	SE	β			
Constant	-.624	3.445	-	-.181	-	.856
Age	.292	.198	0.096	1.474	0.007	0.14
Gender	.893	.439	0.131	2.032	0.020	0.04*
Socioeconomic status(SES)	-.150	.139	-0.070	-1.077	0.021	0.28
Nutritional status(BMI)	-.012	.071	-0.011	-.165	0.017	0.86

***Statistically significant**

Table 5 a Model 2

Model 2 Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	R^2	p value
	B	SE	β			
Constant	-4.096	3.163	-	-1.295	-	.197
Age	.327	.182	.108	1.803	0.007	.073
Gender	.646	.405	.095	1.594	0.020	.112
Socioeconomic status(SES)	-.098	.129	-.045	-.757	0.021	.450
Diet(FFQ)	1.780	.284	.375	6.265	0.158	<0.001**

****Statistically highly significant**

DISCUSSION

Oral health, diet, and nutritional status are closely linked.[2] Dental diseases have an impact on diet and nutrition, facial appearance and speech.[4] Dental caries is a diet-related disease. It ultimately results in tooth loss and reduces the ability to eat and cause pain and anxiety. [29]

Nutrition plays an important role in the initial growth and development of oral tissues and their continuous integrity through the lifespan. Under-nutrition is associated with enamel hypoplasia and salivary gland atrophy which increases the risk of dental caries, and the effect of this is profound during the pre-eruptive stages of tooth development.[2]

Obesity has an impact on both general health and oral health. It often coexists in developing countries with under nutrition.[5] The prevalence of underweight children in India is among the highest in the world whereas there are a small, but increasing percentage of overweight children who are more prone for non-communicable diseases such as diabetes and cardio-vascular heart disease later in life.[20]

Increased sugar consumption has resulted in dental problems and malnutrition. [7] Snacks, often high in refined carbohydrate, and in particular all types of sticky and sweet foods are associated with increased caries risk.[7,30]

Referencing has been done by studies conducted in India[1,3,5,8,9,14,15,20,31] Thailand[7,12,13,16] , Saudi Arabia[6,11,32]

France[17] Hong Kong[10] England[18] Spain[19] and Portugal[21]. Seven studies assessed all the three variables considered in the present study (nutritional status, diet and dental caries) while fifteen studies assessed only two variables (nutritional status and dental caries).

In this study, age group was 12-15 years the mean age being 13.5±1.12 years which is comparable with previous studies.[1,3,6-21,31,33]

Gender-wise, proportion of males was slightly higher than females in this study, although difference between the groups was not statistically significant. Similar observations were made in many studies (proportion of males ranged from 50.6%-53%)[7,5,8,9,14,18,20].

Socio-economic factors, together with poorer parental levels of education and income increase likelihood of malnutrition and dental caries.[7] In this study most of the parents of the study participants had high school education, were semiskilled workers and belonged to lower middle class (85.8%) which is similar to three studies[18-20] whereas two studies had higher proportion (47.3%) in upper middle class[1,10] than the present study.

Utilization of dental services was low in this study similar to one study[20] whereas a study reported high utilization[7]. Most of the visits were symptom driven. This might be attributed to the insufficient knowledge among the study participants about the importance of a preventive dental visit.[20]

Practicing meticulous oral hygiene throughout life is essential to prevent dental diseases such as dental caries and periodontal diseases.[34] A higher proportion of study participants were using toothbrush and tooth paste for cleaning the teeth which is in accordance with the literature reviewed.[7,10,13,21]

BMI is a fairly reliable indicator of body fat measures in most people.[35] In the present study, three-fourth of the study participants (74.1%) belonged to underweight category. This finding is in line with four Indian studies (73.3%-87.1%).[8,9,15,20] High percentage of underweight children can be attributed to poor dietary habits and low living standards. On the contrary majority were in normal weight category in other studies (60% -76.90%).[1,3,5,6,10,12,13,16-21] Mean BMI of the study participants was 15.61±3.53 which is in line with one study(16.08±1.99 kg/m^2)[20] There was no significant difference in Mean BMI according to age (p=0.08) and gender (p=0.11). This finding was in accordance with studies reported in the literature.[3,5,7,12,14,16,18,19]

The Food Frequency Questionnaire (FFQ) is the most common dietary assessment tool used in large epidemiologic studies of diet and health.[36] This study developed specially structured questionnaire based on the foods commonly consumed in this region.

Most of the study participants reported sugar exposure 2-3 times/day whereas in a previous study majority reported sugar exposure 1-2 times/day.[9] There was no significant difference in Mean FFQ according to age and gender. Mean FFQ score was highest in the obese group, followed by overweight, underweight and normal category but there was no significant difference.

Dental caries is a chronic multifactorial disease whose risk factors include sugars, oral bacteria, saliva, tooth enamel and host susceptibility.[9] Oral health is often neglected in adolescent population which can be attributed to poor nutritional habits and poor self- care dental habits.[30] Untreated dental caries is suggestive of lack of oral health care or negligence towards oral health. In this study caries experience was 76.25% among the study participants. This finding is in line with three studies (78.6%-82.9%).[5,7,16] The studies have reported higher (90.1%)[21] and lower (24.8%-66%) caries experience[1,3,6,10,17,18] than this study. The mean DMFT in the literature reviewed range from 0.53-4.04. In this study mean DMFT was 2.62±3.4 which is in line with other studies (2.20-2.23).[7,12] The studies have reported higher (3.44-4.04)[8,18,32] and lower means (0.53-1.93) [13,15,17,32] than this study.

There was no significant difference in dental caries experience according to age which was similar to the studies reviewed.[5,7,16,18-21] In this study, females had higher dental caries experience which is in line with most of the studies[6,8-10,17,20]. The earlier eruption rate of teeth in females when compared to males can be a significant factor resulting in the higher caries experience in females.[37]

The mean DMFT in underweight category was 2.87±3.60 which is in line with one study (2.19)[13]. The studies have reported higher (3.03)[31] and lower means (0.53-1.66)[13,15,17,32] than this study. The mean DMFT in normal weight category was 1.54±2.04. The mean DMFT in overweight category was 2.85±2.81 which is in line with one study (2.56).[9] The mean DMFT in obese category was 2.5±2.82.

Dental caries experience did not differ significantly according to BMI which was similar to many studies.[5,6,14-21] On the contrary, some studies found dental caries more in underweight[7,8,11,12,31] overweight[6,32] both underweight and overweight[33] normal[13,32] and underweight category[13,32].

Highly significant moderate positive correlation was found between FFQ and DMFT suggesting a relationship between frequency of sugar consumption and caries experience. These findings were in accordance with some studies[5,7,9,12,17] whereas other studies could not find any relation[16,32].

A weak negative correlation was found between BMI and DMFT and between BMI and FFQ although the relation is not significant. This may indicate inter relationships between nutritional status and frequency of sugar consumption and caries experience which requires further studies for elucidation. These findings were in line with some studies[15,19,20] whereas other studies reported positive correlation with[9] or without significance[6]; significant negative correlation[8] while two studies reported no association[5,16].

Linear regression analysis was done with dental caries as outcome variable using two models. There was no association between age, socioeconomic status and dental caries in both the models. Gender was found to have a significant association with dental caries in Model 1 but not in Model 2.

There was no association between nutritional status (BMI) and dental caries in Model 1 which was similar to one study.[5] Some studies have found association between dental caries and overweight.[3,31,32] Some studies have reported no association

between dental caries and BMI[1,17,18,21] whereas dental caries was associated with underweight[7,8,11,13,31] overweight[3,9,10] normal[13,32] and underweight category[13,32] in other studies.

Diet (FFQ score) had a highly significant association with dental caries in Model 2 whereas one study found no association between diet and dental caries[32]. Some authors have reported significant association between diet and dental caries.[5,7,9,17]

The present study found highly significant association between diet and dental caries whereas nutritional status was not associated with either diet or dental caries.

The present study has certain limitations. Cross sectional study design does not allow assessment of causality between study variables. Bias inherent in questionnaire studies such as response bias, social desirability bias might be found in this study. Longitudinal studies with quantifiable Food Frequency Questionnaire, anthropometric measurements including Body Mass Index (BMI) and waist-to-hip (WHR) ratio are recommended for better understanding of association between nutritional status, diet and dental caries.

There is a need to create awareness about oral health among parents, children, and teachers by conducting school oral health programmes. Information regarding oral health should be included on a wider basis in the school curriculum in an attempt to prevent and control dental diseases.

CONCLUSION

There is an association between diet and dental caries. However, nutritional status was not associated with either diet or dental caries.

References

1. 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;67(2):91-7.
2. Harris NO, Garcia-Godoy F. Primary Preventive Dentistry. 6th ed. Upper Saddle River, NJ: Pearson Education; 2004.
3. Reddy KV, Thakur AS, Moon N *et al*. Association between overweight and dental caries among 8-13 year old school children in central India. *J Indian Assoc Public Health Dent*. 2018;16:22-5.
4. Murray JJ, Nunn JH, Steele JG. The Prevention Of Oral Disease. 4th ed. New York: Oxford University Press; 2003.
5. Elangovan A, Mungara J, Joseph E. Exploring the relation between body mass index, diet, and dental caries among 6-12-year-old children. *J Indian Soc Pedod Prev Dent*. 2012; 30:293-300.
6. Farsi DJ, Elkhodary HM. The prevalence of overweight/obesity in high school adolescents in Jeddah and the association of obesity association with dental caries. *Ann Saudi Med*. 2017;37(2):114-21.
7. Lueangpiansamut J, Chatrchaiwiwatana S, Muktabhant B, Inthalohit W. Relationship between dental caries status, nutritional status, snack foods, and sugar-sweetened beverages consumption among primary schoolchildren grade 4-6 in Nongbua Khamsaen school, Na Klang district, Nongbua Lampoo province, Thailand. *J Med Assoc Thai*. 2012;95(8):1090-7.
8. Shailee F, Sogi GM, Sharma KR. Association between dental caries and body mass index among 12 and 15 years school children in Shimla, Himachal Pradesh. *J Adv Oral Res*. 2013;4(1):7-14.
9. Thippeswamy HM, Kumar N, Acharya S, Pentapati KC. Relationship between body mass index and dental caries among adolescent children in South India. West Indian *Med J.* 2011;60(5):581-6.
10. Li LW, Wong HM, McGrath CP. Longitudinal association between obesity and dental caries in adolescents. *J Pediatr*. 2017;189:149-54.
11. Quadri MFA, Hakami BM, Hezam AAA *et al*. Relation between dental caries and body mass index-for-age among schoolchildren of Jazan city, Kingdom of Saudi Arabia. *J Contemp Dent Pract*. 2017;18(4):277-82.
12. Bica I, Cunha M, Reis M *et al*. Food consumption, body mass index and risk for oral health in adolescents. *Aten Primaria.* 2014;46:154-9.
13. Narksawat K, Tonmukayakul U, Boonthum A. Association between nutritional status and dental caries in permanent dentition among primary schoolchildren aged 12-14 years, Thailand. SE *Asian J Trop Med Public Health.* 2009;40(2):338-44.
14. Kottayi S, Bhat SS, Hegde KS *et al*. A cross-sectional study on the prevalence of dental caries among 12- to 15-year-old overweight schoolchildren*. J Contemp Dent Pract*. 2016;17(9):750-4.
15. Parkar SM, Chokshi M. Exploring the association between dental caries and body mass index in public school children of Ahmedabad city, Gujarat. *SRM J Res Dent Sci.* 2013;4:101-5.
16. Mitrakul K, Asvanund Y, Arunakul M, Srisuchat N, Chotthanakarn N. Assessing associations between caries prevalence and body mass index among children aged 6-12 years. SE Asian Trop Med Public Health. 2016;47(1):152-9.
17. Tramini P, Molinari N, Tentscher M, Demattei C, Schulte AG. Association between caries experience and body mass index in 12-year-old French children. *Caries Res.* 2009;43(6):468-73.
18. Hall-Scullin EP, Whitehead H, Rushton H, Milsom K, Tickle M. A longitudinal study of the relationship between dental caries and obesity in late childhood and adolescence*. J Public Health Dent*. 2017;96(1):17-24.
19. Almerich-Torres T, Bellot-Arcís C, Almerich-Silla JM. Relationship between caries, body mass index and social class in Spanish children. *Gac Sanit*. 2017;31(6):499-504.
20. Narang R, Saha S, Jagannath GV *et al*. Nutritional status and caries experience among 12 to 15 years old school going children of Lucknow. *J Int Dent Med*. 2012;5(1):30-5.
21. Frias-Bulhosa J, Barbosa P, Gomes E, Vieira MR, Manso MC. Association between body mass index and caries among 13-year-old population in Castelo de Paiva, Portugal. *Rev Port Estomatol Med Dent Cir Maxilofac.* 2015;56(1):3-8.
22. Design, use and interpretation of food frequency questionnaires. Available at:

https://www.birmingham.ac.uk (Accessed on: 01/09/2017)
23. NHANES food frequency questionnaires. Available at: https://www.cdc.gov (Accessed on: 01/09/2017)
24. World Health Organization. Oral Health Surveys- Basic methods. 5th ed. Geneva: WHO 2013.
25. List of schools in Bangalore. Available at: www.schoolsbangalore.blogspot.com (Accessed on: 01/09/2017)
26. List of schools names & addresses in Bangalore, India. Available at: www.indiacom.com/yellow-pages/ schools/bangalore (Accessed on: 01/09/2017)
27. Sharma R. Online interactive calculator for real-time update of Kuppuswamy's socioeconomic status scale. Available at: www.scaleupdate.weebly.com (Accessed on 26/10/2017)
28. Revised IAP growth charts 2015. Available at: https://iapindia.org. (Accessed on: 01/09/2017)
29. Nikiforuk G. Understanding dental caries. Vol.1: Etiology and mechanisms: basic and clinical aspects.1st ed. Basel: Karger; 1985.
30. Moreno LA, Rodriguez G, Fleta J *et al*. Trends of dietary habits in adolescents. *Crit Rev Food Sci Nutr*. 2010;50(2):106-12.
31. Prashanth ST, Venkatesh B, Vivek DK, Amitha HA. Comparison of association of dental caries in relation with body mass index (BMI) in government and private school children. *J Dent Sci Res*. 2011;2(2):1-5.
32. Bhayat A, Ahmad MS, Fadel HT. Association between body mass index, diet and dental caries in Grade 6 boys in Medina, Saudi Arabia. *East Mediterr Health J*. 2016;22(9):687-93.
33. Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. *Syst Rev*. 2012;1(1):57-83.
34. Limeback H. Comprehensive Preventive Dentistry. 1st ed. Iowa: John Wiley & Sons; 2012.
35. Onis MD, Bloessner M. WHO global database on child growth and malnutrition. Geneva: WHO; 1997.
36. Millen AE, Tooze JA, Subar AF *et al*. Differences between food groups of low and non-low-energy reporters on a food frequency questionnaire. *J Am Diet Assoc*. 2009; 109(7):1194-203.
37. Sloman E. Sex and age factors in the incidence of dental caries. *J Am Dent Assoc*. 1941;28(3):441-4.

How to cite this article:

Aparna KS *et al* .2018 , Association of Nutritional Status, Diet And Dental Caries Among 12-15 Year old School Children – A Cross-Sectional Study. *Int J Recent Sci Res.* 9(7), pp. 27919-27924. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0907.2358

****