Dental Research Journal

Original Article

Height and dental caries among 13-year-old adolescents in India: A sociobehavioral life course approach

Shilpi Singh[1], N. Vijayakumar[2]

[1]Department of Public Health Dentistry, Institute of Dental Studies and Technologies, Modinagar, Uttar Pradesh, [2]Department of Public Health Dentistry, Dr. Syamala Reddy Dental College and Hospital, Bengaluru, Karnataka, India

ABSTRACT

Background: The aim of the study was to assess the relationship between height and dental caries among 13-year-old adolescents in schools of Bangalore, India.

Materials and Methods: A cross-sectional study was undertaken on 1900 schoolchildren aged 13 years from both government and private schools of Bangalore using stratified random sampling. Demographic data; family-related factors; and general and oral health-related factors such as frequency of sugar consumption, dietary habits, oral hygiene practices, and dental attendance were interviewed using both open-ended and close-ended questions. Anthropometric measurements for height and weight were performed. Clinical examination was done and caries was recorded using the decayed, missing, and filled teeth (DMFT) index (WHO criteria, 1997). Data were analyzed using SPSS version 21.0, and descriptive statistics including percentages, mean, and frequencies were performed. Student's *t*-test and ANOVA were applied to find the significant differences between mean DMFT among groups. Categorical data were analyzed by Chi-square test for differences between groups. Pearson correlation coefficient was used to find the correlation among dental caries and height and body mass index (BMI). *P* value was set at a statistical significance level of 0.05.

Results: The prevalence of dental caries among the study population was 36.3% which was higher among girls as compared to boys. Dental caries was found to be significantly associated with socioeconomic status, family structure, birth order, use of oral hygiene aids, mouthrinsing, last dental visit, weight, and BMI. Height and BMI showed a strong negative correlation with dental caries.

Conclusion: The present study showed a significant negative correlation between height and dental caries. However, since both caries and height are a dynamic phenomenon, hence a longitudinal study exploring the possible relationship should be considered.

Key Words: Dental caries, height, schoolchildren, weight

Received: December 2018
Accepted: August 2019

Address for correspondence:
Dr. Shilpi Singh,
Department of Public Health Dentistry, Institute of Dental Studies and Technologies, Modinagar, Uttar Pradesh, India.
E-mail: shilpisingh076@gmail.com

INTRODUCTION

An individual's biological resources are influenced by their genetic endowment, their prenatal and postnatal development, and their social and physical environment in early life. Adversity in childhood becomes "embodied" at an early age and its full impact manifests later in life. Factors affecting the health status may accumulate gradually during lifetime, although there may be developmental periods when these factors have a greater impact on health than factors operating at other times.[1]

Access this article online

Website: www.drj.ir
www.drjjournal.net
www.ncbi.nlm.nih.gov/pmc/journals/1480

How to cite this article: Singh S, Vijayakumar N. Height and dental caries among 13-year-old adolescents in India: A sociobehavioral life course approach. Dent Res J 2020;17:373-9.

Over the last few years, there has been an increasing interest in conceptualizing disease etiology within a life course framework. A life course is the study of long-term effects on chronic disease and risk of physical and social exposures during gestation, childhood, adolescence, young adulthood, and later adult life. It includes the study of the biological, behavioral, and psychosocial pathways that operate across an individual's life course, as well as across generations, to influence the development of chronic diseases.[2] This dynamic framework brings together the effects of intrinsic factors (individual resources) with extrinsic factors (environmental factors).

Height is an important surrogate marker of early development and of social and physical environment exposures in early life. Height is affected by socioeconomic changes from birth to early adulthood. Babies from high socioeconomic families were found to be taller than those from lower socioeconomic families. Socioeconomic circumstances influence fetal development and growth during childhood suggesting an important role for diet in early life on adult health.[1] Thus, taller adult stature is an indicator of better development and health associated with beneficial exposures in early life. Disturbed patterns of physical growth parameters, namely weight, height, and head circumference, may therefore be considered as an indicator of underlying nutritional and psychological disorders. Height for age, as a measure of stunting growth, is an indicator of past or chronic malnutrition and is also influenced by genetic factors.[3] Height is a potential indicator of individual biological resources gained in childhood as it has been used to explain variations on coronary heart disease and mortality.[1]

Race is a very important factor when it comes to height since it influences the genetic build of a community. The Aryan race is different from the Afro-Americans. Likewise, the white native Americans are different from the Afro Americans. Each race has a set of particular genes which affect the height. Some races grow to be over 7 feet tall (e.g., African Watusis), whereas others are <5 feet tall (e.g., African Pygmies).[1] India has a mixed racial pattern comprising Indo-Aryans, Nordics, Dravidians, Mongoloids, and a predominance of Caucasoid races.

Poor growth and socioeconomic circumstances in early childhood may affect health-related behaviors and oral health in later life. Dental caries shares similar risk factors with other chronic diseases (Sheiham and Watt, 2000) and a similar approach can be hypothesized to oral diseases as used for other chronic diseases.[4,5] Dental caries is an etiologically complex disease process. It is likely that numerous microbial, genetic, immunological, behavioral, and environmental contributors are at play in determining the occurrence and severity of clinical disease; however, it can be prevented.[4,6] Dental caries also appears to be affected by nutritional deficiency; children with lower growth parameters had a higher caries experience in deciduous teeth.[3,7] Studies in populations with high levels of nutritional deficiency have found that children with low height for their age had a significantly greater caries experience in their primary dentition.[8,9]

Bangalore being a metropolitan city has children from different socioeconomic and cultural backgrounds. Because research on other aspects of health suggests that height is related to health, more dental research is needed on the subject, using adolescent's height as a surrogate measure for early influences on development and early childhood circumstances.[10,11] Hence, the aim of the study was to assess the relationship between height and dental caries among 13-year-old adolescents in schools of Bangalore, India.

MATERIALS AND METHODS

The present cross-sectional study was conducted among 13-year-old schoolchildren attending government and private schools of Bangalore, India. Prior to the start of the study, an official permission was obtained from the Director, Deputy Director of Public Instructions (DDPI) Office, Bangalore, forwarded through the Head of the Institution. Ethical clearance was obtained from the institutional review board. Prior written permissions were also obtained from the heads of the respective schools. A pilot study was carried out on 100 students aged 13 years randomly selected from two government and private schools in Bangalore to check the feasibility of the study, dental examination, interview procedures, and relevance of the pro forma. The results of the pilot study showed a caries prevalence of 45%. Hence, based on the results of a pilot study, modifications were done in the questionnaire, and the sample size for the main study was calculated using 80% power of the study at 95% confidence interval, thus obtaining a total sample size of 1900.

A stratified random sampling technique was employed to obtain the required sample size. The first stage

included selection of schools. A complete list of schools along with the number of 13-year-old children enrolled was obtained from the Office of the DDPI, Bangalore. In Bangalore, schools are divided as North and South Zones. The Bangalore South is further divided into five blocks (Anekal, South 1, South 2, South 3, South 4) comprising 919 government and private high schools. An equal number of government and private schools were included from each of the five blocks. Two government and two private schools were selected from each block using stratified random sampling by lottery method making a total of 20 schools. The second stage involved selection of study participants. The study participants were taken in equal proportion using simple random sampling from both government and private schools for equal representation in the study sample. Of 1900 children, 950 children were obtained from government schools and 950 children from private schools of Bangalore. Due consideration was given to maintain the equal number of boys and girls among the study participants. Since the total study population of 1900 was obtained from 20 schools in Bangalore South, hence 95 schoolchildren were taken from each school.

The inclusion criteria included children with permanent dentition who were willing to participate and had completed the chronological age of 13 years and should not have completed 14 years of age. The study participants' age was verified from the school register. Children who were medically compromised, handicapped, limb deformities/disability and those with congenital defects or acute infections of the oral cavity which interfered with the oral examination were excluded from the study. A detailed weekly and monthly schedule was prepared well in advance by informing and obtaining consent from authorities of respective schools. Even though a detailed schedule plan was prepared well in advance, few adjustments and changes had to be made while working it out practically. Prior written voluntary consent to examine study participants was obtained from the heads of respective schools who, in turn, had informed the parents of children and had obtained consent from them. Before conducting the survey, the training and calibration of the examiner was done. Training for the use of structured pro forma, intraoral examination for dental caries, and anthropometric measurements was done on 10 children aged 13 years. Subsequently, a total of 20 participants were examined on two occasions over 2 successive days. Intra-examiner reliability was assessed using kappa statistic, which was in the range of 0.90 for dental caries, showing a high degree of conformity in the observations.

A structured questionnaire was used to collect information regarding sociodemographic factors such as name, age, gender, address, and family income. Family-related factors such as father's and mother's occupation, birth order, and family structure were also assessed. General and oral health-related factors such as frequency of sugar consumption, dietary habits, oral hygiene practices, and dental attendance were also interviewed. Both open-ended and close-ended questions were used to derive the required information from the students.

Socioeconomic status was recorded according to the revised Kuppuswamy's scale. A structured questionnaire was filled before the clinical examination by interviewing the study participants by the investigator herself. The information gathered was rechecked from school records to eliminate any error on children's part. A maximum of 40 study participants were examined per day. Children were made to sit on the chair, and the oral examination of study participants was conducted in respective schools using a plane mouth mirror, explorer, and CPI probe under natural light (Type 3). Caries status was recorded as per the decayed, missing, and filled teeth (DMFT) index (WHO criteria 1997). Height was measured by the examiner herself with the child standing erect against a wall-mounted measuring tape in centimeters. Weight was also assessed by the examiner herself using a weighing balance in kilograms. Body mass index (BMI) was calculated using the formula BMI = Weight in kg/(height in meters).[2]

BMI classification given by the WHO/IASO/IOTF, 2000, was used to identify obese individuals.

Height and weight were then divided into three categories separately for boys and girls based on the normal reference values for 13-year-old children by the Indian Council of Medical Research guidelines, 2009.

Data analysis was carried out using the Statistical Package for Social Sciences version 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Descriptive statistics that included mean, standard deviation, and percentages were calculated for each of the categories. *t*-test was used to find the differences between means of different quantitative groups. Categorical data

were analyzed by Chi-square test for differences between groups, and ANOVA statistical tests were applied. Following descriptive statistics (frequency and distribution and cross-tabulation), correlation was found between dental caries and height and weight and BMI using Pearson's correlation coefficient. Generalized linear regression analysis was carried out to build models showing factors significantly associated with the DMFT. Significance for all statistical tests was predetermined at a probability value of 0.05 or less.

RESULTS

A total of 1900 schoolchildren participated in the study, wherein 268 (14.1%) study participants belonged to lower socioeconomic status, 1300 (68.4%) to middle socioeconomic status, and 332 (17.5%) to upper socioeconomic status. A total of 1410 (74.2%) study participants belonged to nuclear family type, followed by 478 (25.2%) belonging to joint family. The first birth order comprised 856 (45.1%) study participants, 920 (48.4%) of the study participants were second child, and only 124 (6.5%) of the study participants belonged to the third order or more [Table 1].

Association between several sociodemographic and personal characteristics showed that gender, socioeconomic status, family structure, birth order, use of oral hygiene aids, pattern of sugar consumption, and last dental visit were significantly associated with dental caries among the schoolchildren [Table 2].

Table 1: Descriptive statistics of the study population

Variables	*n* (%)
Socioeconomic status	
Lower	268 (14.1)
Middle	1300 (68.4)
Upper	332 (17.5)
Family structure	
Joint	478 (25.2)
Nuclear	1410 (74.2)
Others	12 (0.6)
Birth order	
First	856 (45.1)
Second	920 (48.4)
Third or more	124 (6.5)
Sugar consumption	
Not at all	150 (7.9)
Once	826 (43.5)
Twice	510 (26.8)
More than twice	414 (21.8)
Mode of cleaning teeth	
Toothbrush and toothpaste	1886 (99.3)
Toothbrush and toothpowder	14 (0.7)

Distribution of the study population according to height showed that among boys, 38 (2.0%) were <134.4 cm in height and majority of them, i.e., 568 (29.9%), were in the range of 134.5–151.0 cm, whereas 344 (18.1%) of the study participants were >151.0 cm in height. Among girls, only 46 (2.4%) were <135.5 cm in height, whereas a great majority (592, 31.2%) were in the range of 135.5–150 cm and only 312 (16.4%) were more than 150 cm in height. Majority of the boys, i.e., 516 (27.2%), were within the reference range for 13 years olds of 26.6–38.6 kg, whereas 3664 (19.2%) were more than 38.6 kg. Only 70 (3.7%) boys among the study population were <26.6 kg of weight. Among girls also, majority of them, i.e., 456 (24%) were within the range of 27.8–39.4 kg, whereas 404 (21.3%) of them were more than 39.4 kg in weight. Only a small percentage (90, 4.6%) of the study population was <27.8 kg of weight [Table 3].

The study participants had an overall caries prevalence of 36.3%, with a mean DMFT score of 0.85 ± 1.36. The prevalence of dental caries was 32.8% among boys and 39.9% among girls, which showed a statistically significant difference ($P < 0.001$). Among boys, 36.8% of those who were <134.4 cm in height had dental caries, with a mean DMFT of 0.37 ± 0.49; 36.9% of those between 134.4 and 151 cm had a mean DMFT score of 0.37 ± 0.48; and 25.6% of those more than 151 cm in height had dental caries, with a mean DMFT of 0.26 ± 0.44. Among girls, 34.8% of those <135.4 cm suffered from dental caries, with a mean DMFT of 0.35 ± 0.48; 38.2% of those between 135.4 and 150 cm had a mean DMFT of 0.38 ± 0.48; and 43.6% of those more than 150 cm in height had dental caries, with a mean DMFT of 0.44 ± 0.50 ($P = 0.023$) [Table 4].

A negative correlation was found between height and dental caries ($r^2 = -0.040$), which was statistically significant ($P < 0.023$) [Table 5]. Furthermore, there was a strong negative correlation between weight and dental caries ($r^2 = -0.067$) and BMI and dental caries ($r^2 = -0.072$), which was statistically significant ($P < 0.003$ and $P < 0.002$, respectively).

DISCUSSION

Dental caries is a multifactorial disease, and the stock of biological resources that one acquires in childhood

Table 2: Association of various sociodemographic and personal characteristics with dental caries

Parameter	Caries (%)	Caries free (%)	*P*
Gender			
Boys	32.8	67.2	0.001*
Girls	39.9	60.1	
School type			
Government	36.6	63.4	0.639
Private	34.9	65.1	
Socioeconomic status			
Lower	38.8	61.2	0.004*
Middle	34	66	
Upper	43.4	56.6	
Family structure			
Joint	41.0	59	0.004*
Nuclear	34.6	65.4	
Birth order			
First	24.8	75.2	0.001*
Second	46.5	53.5	
Third or more	40.3	59.7	
Diet pattern			
Vegetarian	39.4	60.6	0.168
Mixed	35.9	64.1	
Oral hygiene aids			
None	69.2	58.5	0.001*
Used	29.7	70.3	
Mode of cleaning teeth			
Toothbrush and toothpaste	36.5	63.5	0.118
Toothbrush and toothpowder	14.3	85.7	
Last dental visit			
Never visited	36.9	63.1	0.046*
1-3 months before	44.4	55.6	
4-6 months before	30.6	69.4	
>6 months back	33.1	66.9	
Pattern of dental attendance			
Never visited	36.6	63.4	0.096
Checkup mainly	34.3	65.7	
When in trouble/pain	36.1	63.9	
Sugar consumption			
Not at all	36.9	63.1	0.002*
Once	44.4	55.6	
Twice	30.6	69.4	
More than twice	33.1	66.9	

*P significant at $P<0.05$

may affect dental caries experience in adolescence. Dental caries also appears to be affected by nutritional deficiency; children with lower growth parameters were found to have higher caries experience. Factors that result in reduced birth weight, such as poor maternal nutrition and smoking during pregnancy, may therefore influence individual health resources as they are reflected in height and caries experience. Height is an important surrogate marker of early development and of social and physical environment exposures in early life and is related to health and longevity.[1,2] Studies in populations with high levels of nutritional deficiency have found that children with low height for their age had a significantly greater caries experience in their primary dentition.[9] There are very few contemporary studies linking height and caries in the permanent dentition. Height at 13 years of age was used as a marker of general health resources to test whether early childhood experiences affected adolescents' oral health as measured by dental caries status.[1] To eliminate confounding factors such as age and gender, an equal number of males and females aged 13 years were included in the study. Furthermore, an equal number of study participants were taken both from government and private schools to eliminate bias due to socioeconomic status.

As per the Indian Council of Medical Research guidelines for reference height at different age groups of the Indian population, height at 13 years of age was divided into three categories, which was different for males and females.

A negative correlation was found between height and dental caries ($r^2 = -0.040$), which was statistically significant ($P < 0.023$). However, two earlier attempts to investigate the relation between anthropometric measurements and dental caries in the permanent dentition in North American adolescents did not find a marked relationship. Cunningham in 1934 reported that among female adolescents aged 15–19 years, taller females had a higher caries experience (Cunningham, 1934).[10] On the other hand, case histories of 54 adolescents showed that shorter individuals had less caries (Hurme, 1935). More recently, shorter Saudi Arabian schoolboys aged 6–13 years had less caries in their permanent teeth after adjusting for age and social class (Abolfotouh *et al*., 2000).[11] Conversely, among Brazilian adolescents aged 13, taller individuals had a lower caries severity in the permanent dentition after adjusting for other demographic and social variables (Nicolau *et al*., 2005). No relationship was found between height and caries in a group of Scottish children aged 3–11 years with severe caries experience (Freire MC, 2008).[2] The possible reason could be that since both height and dental caries are a continuous dynamic process, hence a variety of factors over a period of time from birth to adulthood influence height and caries. First, untreated caries and associated infection can cause pain and discomfort and reduce intake of foods because eating is painful.[7,12] Second, severe caries can affect children's

Table 3: Distribution of the study population according to height and weight

Height (cm)	Study population, *n* (%)	Weight (kg)	Study population, *n* (%)
Boys			
<134.4	38 (2.0)	<26.6	70 (3.7)
134.4-151.0	568 (29.9)	26.6-38.6	516 (27.2)
>151.0	344 (18.1)	>38.6	364 (19.2)
Girls			
<135.4	46 (2.4)	<27.8	90 (4.6)
135.4-150.0	592 (31.2)	27.8-39.4	456 (24.0)
>150.0	312 (16.4)	>39.4	404 (21.3)

Table 4: Caries prevalence of study population according to height

Height (cm)	Affected (%)	Caries free (%)	Total (%)	Mean DMFT	*P*
Boys					
<134.4	14 (36.8)	24 (63.2)	38 (100)	0.37±0.49	0.023*
134.4-151.0	210 (36.9)	358 (63.1)	568 (100)	0.37±0.48	
>151.0	88 (25.6)	256 (74.4)	344 (100)	0.26±0.44	
Girls					
<135.4	16 (34.8)	30 (65.2)	46 (100)	0.35±0.48	
135.4-150.0	226 (38.2)	366 (61.8)	592 (100)	0.38±0.48	
>150.0	136 (43.6)	176 (56.4)	312 (100)	0.44±0.50	

DMFT: Decayed, missing, and filled teeth. **P* significant at *P*<0.05

Table 5: Correlation between caries prevalence and height and weight and body mass index

Variables	Correlation coefficient	*P*
Height	−0.040	0.023*
Weight	−0.067	0.003*
BMI	−0.072	0.002*

*Denotes statistically significant at *P*<0.05. BMI: Body mass index

quality of life and thereby growth. Impacts include pain, irritability, and disturbed sleeping habits.[13,14] Family circumstances, nutritional status, parents' level of education, and in addition, socioeconomic changes from birth to early adulthood affect height.[15,16] Hence, a longitudinal study would better provide an insight into this relationship.

Body height and weight are commonly used indicators of health capital. Body height was used as a potential indicator of the long-term, cumulative effects of inadequacies of health; weight was an indicator of malnutrition, revealing short- or long-term accumulation of weight.[17-19] Furthermore, India being a developing country with the majority of population, still struggling for basic needs, malnutrition, and underweight is a common finding as in the present study.

Furthermore, there was a strong negative correlation between weight and dental caries ($r^2 = -0.067$) and BMI and dental caries ($r^2 = -0.072$). This correlation was statistically significant. This significant correlation between caries and weight ($P < 0.003$) and BMI ($P < 0.002$) can be attributed to the socioeconomic status of our study population since majority of the population belonged to lower and middle social class. Hence, socioeconomic circumstances such as inadequate healthy food coupled with poor oral hygiene care due to economic constraints and lack of oral health awareness could be the contributory factors for increased caries prevalence in children who were underweight.[16,20-22]

The present study revealed that height was significantly correlated with dental caries experience among 13-year-old schoolchildren. However, statistical significance could not be reached for a number of oral health parameters studied. Structured questionnaires might have had limitations, whereby students may tend to report socially desirable answers such as frequent toothbrushing. However, objective measures, such as clinical examination, were used to overcome this limitation. It should be also noted that the present study was cross-sectional. Consequently, the results from this sample of the study population may not be interpreted for any causal association, and further, longitudinal studies may be undertaken.

CONCLUSION

The prevalence of dental caries was 36.3% among the study population which was significantly higher

among girls as compared to boys. The mean DMFT of the study population was 0.85 ± 1.36, and most of the teeth were in decayed category (mean DT = 0.84 ± 1.34). A significant negative correlation was found between caries prevalence and height.

Notwithstanding the fact that the results of this study support the relationship between dental caries and height, future longitudinal research should integrate validated dietary assessments, socioeconomic status, oral hygiene compliance, and other factors that may act as confounders or effect modifiers.

Financial support and sponsorship
Nil.

Conflicts of interest
The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

REFERENCES

1. Nicolau B, Marcenes W, Allison P, Sheiham A. The life course approach: Explaining the association between height and dental caries in Brazilian adolescents. Community Dent Oral Epidemiol 2005;33:93-8.
2. Freire MC, Sheiham A, Netuveli G. Relationship between height and dental caries. Caries Res 2008;42:134-40.
3. Nicolau B, Marcenes W, Bartley M, Sheiham A. A life course approach to assessing causes of dental caries experience: The relationship between biological, behavioural, socio-economic and psychological conditions and caries in adolescents. Caries Res 2003;37:319-26.
4. Nilchian F, Rodd HD, Robinson PG. The success of fissure sealants placed by dentists and dental care professionals. Community Dent Health 2011;28:99-103.
5. Nicolau B, Marcenes W, Sheiham A. The relationship between traumatic dental injuries and adolescents' development along the life course. Community Dent Oral Epidemiol 2003;31:306-13.
6. Peres MA, Barros AJ, Peres KG, Araújo CL, Menezes AM. Life course dental caries determinants and predictors in children aged 12 years: A population-based birth cohort. Community Dent Oral Epidemiol 2009;37:123-33.
7. Cinar AB, Murtomaa H, Tseveenjav B. The life-course approach in assessment of dental health: A Cross sectional study among Finnish and Turkish pre-adolescents. Eur J Dent 2008;2:153-60.
8. Hurme VO. Relation of dental caries to health history, physical measurements, and heredity. J Dent Res 1935;15:395-7.
9. Song YM, Smith GD, Sung J. Adult height and cause-specific mortality: A large prospective study of South Korean men. Am J Epidemiol 2003;158:479-85.
10. Floyd B. Associations between height, body mass, and frequency of decayed, extracted, and filled deciduous teeth among two cohorts of Taiwanese first graders. Am J Phys Anthropol 2009;140:113-9.
11. Salonen MK, Kajantie E, Osmond C, Forsén T, Ylihärsilä H, Paile-Hyvärinen M, *et al.* Role of socioeconomic indicators on development of obesity from a life course perspective. J Environ Public Health 2009;2009:625168.
12. Mattila ML, Rautava P, Sillanpää M, Paunio P. Caries in five-year-old children and associations with family-related factors. J Dent Res 2000;79:875-81.
13. Alvarez JO, Caceda J, Woolley TW, Carley KW, Baiocchi N, Caravedo L, *et al.* A longitudinal study of dental caries in the primary teeth of children who suffered from infant malnutrition. J Dent Res 1993;72:1573-6.
14. Johansson I, Lenander-Lumikari M, Saellström AK. Saliva composition in Indian children with chronic protein-energy malnutrition. J Dent Res 1994;73:11-9.
15. Mansbridge JN. The prevalence of dental caries in relation to maturity. Arch Dis Child 1958;33:455-64.
16. Esa R, Razak IA. Dental fluorosis and caries status among/2-13 year-old schoolchildren in Klang District, Malaysia. Ann Dent Univ Malaya 2001;8:20-4.
17. Moses J, Rangeeth BN, Gurunathan D. Prevalence of dental caries, socio-economic status and treatment needs among 5 to 15 year old school going children of Chidambaram. J Clin Diagn Res 2011;5:146-51.
18. Adekoya-Sofowora CA, Nasir WO, Oginni AO, Taiwo M. Dental caries in 12-year-old suburban Nigerian school children. Afr Health Sci 2006;6:145-50.
19. Varenne B, Petersen PE, Ouattara S. Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. Int Dent J 2006;56:61-70.
20. Ship II. Dental caries incidence in north and South Dakota Indian school children during 30 years. J Dent Res 1966;45:359-63.
21. Motamedi MR, Behzadi A, Khodadad N, Zadeh AK, Nilchian F. Oral health and quality of life in children: A cross-sectional study. Dent Hypotheses 2014;5:53-8.
22. Nilchian F, Asgary I, Mastan F. The effect of dental fluorosis on the quality of life of female high school and precollege students of high fluoride-concentrated area. J Int Soc Prev Community Dent 2018;8:314-9.