CO-RELATION BETWEEN BODY MASS INDEX AND DENTAL CARIES AMONG 12 & 15 YEARS OF SCHOOL GOING CHILDREN OF LUCKNOW

Dissertation

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In the specialty of

Public Health Dentistry

By

Dr. Amrita Rastogi

Under the Guidance of

Dr. ANURADHA. P

Professor and Head

DEPARTMENT OF PUBLIC HEALTH DENTISTRY

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES,LUCKNOW

(Faculty of Babu Banarasi Das University)

Batch: 2014-15

Dedicated to

My Loving Parents

and

Respected Teachers

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "***Co-Relation Between Body Mass Index And Dental Caries Among 12 & 15 Years Of School Going Children Of Lucknow***" is a bonafide and genuine review work carried out by me under the guidance of Dr. Anuradha P., Professor and Head of Department of Public Health Dentistry, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Date: 20/12/16

Place: Lucknow.

Amrita Rastogi.

Dr Amrita Rastogi

CERTIFICATE BY GUIDE

This is to certify that the Dissertation entitled ***"Co-Relation Between Body Mass Index And Dental Caries Among 12 & 15 Years Of School Going Children Of Lucknow"*** is a bonafide work done by ***"Dr.Amrita Rastogi"*** under my direct supervision and guidance towards the partial fulfillment of the requirement for the Degree Of Master Of Dental Surgery in the subject of Public Health Dentistry.

Date: 20/12/16

Dr. ANURADHA P.
Professor and Head of the Department
Department of Public Health Dentistry,
Babu Banarasi Das college Of Dental Sciences,
Lucknow.

CERTIFICATE BY CO-GUIDE

This is to certify that the Dissertation entitled ***"Co-Relation Between Body Mass Index And Dental Caries Among 12 & 15 Years Of School Going Children Of Lucknow"*** is a bonafide work done by ***"Dr.Amrita Rastogi"*** myt supervision and guidance towards the partial fulfillment of the requirement for the Degree Of Master Of Dental Surgery in the subject of Public Health Dentistry.

Dr. Sahana S.
Reader Department of Public Health Dentistry
Babu Banarasi Das college Of Dental Sciences,
Lucknow

ENDORSEMENT BY THE HOD/HEAD OF THE INSTITUTION

This is to certify that the Dissertation entitled ***"Co-Relation Between Body Mass Index And Dental Caries Among 12 & 15 Years Of School Going Children Of Lucknow"*** is a bonafide work done by ***"Dr.Amrita Rastogi"*** under the direct supervision and guidance of **Dr. Anuradha P.** Professor and Head of Department of Public Health Dentistry, Babu Banarasi Das college Of Dental Sciences, Lucknow, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

DR. Anuradha P.
Professor and Head
(Department of public health Dentistry)

Dr. Vivek Govila
Principal

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

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Date: 20/12/16.

Place: Lucknow.

Amrita Rastogi

Dr. Amrita Rastogi

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ACKNOWLEDGMENT

On the occasion of the successful completion of this assigned work, I offer my salutation to the almighty God, without his blessing this work wouldn't have been accomplished.

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-Dr. Amrita Rastogi

LIST OF ABBREVIATIONS

S.no.	Abbreviations	Full Forms
1.	BMI	Body Mass Index
2.	DMFT/dmft	Decayed, Missing, Filled Teeth
3.	WHO	World Health Organization
4.	n	Number of subjects
5.	SD	Standard Deviations
6.	ρ	Spearman coefficient (rho)
7.	DMFS/dmfs	Decayed, Missing, Filled Surface
8.	deft/defs	Decayed, extracted, filled teeth/surface
9.	NIH	National Institute of Health
10.	pH	Power of Hydrogen
11.	DF	Degree of Freedom
12.	±	Plus-Minus
13.	≥	Greater than or equal to
14.	%	Percentage
15.	x^2	Chi- Square
16.	NS	Not Significant

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ABSTRACT

ABSTRACT

Introduction: Diet plays an important role in the increased prevalence of obesity due to the higher consumption of foods rich in fat and carbohydrates. besides being directly associated with obesity, eating habits, especially regarding the intake of sucrose, have a well-established casual relationship with tooth decay, along with socio-demographic aspects, such as low socioeconomic status. So the aim of the study was to find correlation between BMI and Dental caries among 12 and 15 years school going children of Lucknow City. **Materials and Method**:A descriptive cross sectional study was conducted on 1022 subjects, including 265 males (50.8%) and 250 females (49.2%) of private school. And there were 250 males (50.0%) and 250(50.0%) females of Government school. A predesigned proforma was used to assesses the variables of the study. Dietary habit and Oral Hygiene Practices was also recorded. assessed Dental Caries was assesses using DMFT index (WHO criteria 1997) and BMI was assessed using the classification by Centre for Disease Control and Prevention (2006).**Result:** Overall correlation of the study subjects(n=1022) ,between BMI and DMFT scores with the Spearman's rho correlation Coefficient (ρ) of -.016 and p value= .600 showed a negative correlation between both the variables i.e., BMI and DMFT also showed no significant association during correlation respectively. **Conclusion** :The correlation between the BMI and Dental Caries among school going children 12 and 15 years of Lucknow city was inversely correlated with no statistical significance

INTRODUCTION

INTRODUCTION

Overweight and obesity, defined as excess body fat compared to lean body mass, are a growing public-health problem in the world.[1] Decreasing physical activity, increasing sedentary lifestyles and dietary changes are factors strongly associated with the development of overweight and obesity.[2]

Diet plays an important role in the increased prevalence of obesity due to the higher consumption of foods rich in fat and carbohydrates.[3] besides being directly associated with obesity, eating habits, especially regarding the intake of sucrose, have a well-established casual relationship with tooth decay, along with socio-demographic aspects, such as low socioeconomic status.[4]

Because caries is associated with poor dietary habits and inappropriate diets promote obesity, a biologically plausible association between obesity and dental caries has been inferred in the literature.

However, the pressure of a common factor such as a high-sugar diet, caused by the ingestion of food such as soft drinks, cake, and ice cream, seems to increase the probability of both diseases and seems to be the most acceptable theory to explain the relationship between obesity and dental caries.[5]

Obesity and dental caries are both multifactorial diseases that impact children's health and psychological development[6]

Today the world faces two kinds of malnutrition, one associated with hunger or nutritional deficiency and the other dietary excess. Urbanization and economic

development has resulted in rapid changes in diet and lifestyles. The world bank estimates that India is ranked 2nd in the world of the number of children suffering from malnutrition, after Bangladesh (in 1988), where 47% of the children exhibit a degree of malnutrition[7]. The prevalence of underweight children in India is among the highest in the world, and is nearly double that of Sub-Saharan Africa with dire consequences for mobility, mortality, productivity and economic growth. Simultaneously, there are a small, but increasing percentage of over weight children who are at a greater risk for non-communicable diseases such as diabetes and cardio-vascular heart diseases later in life[8].

According to the available literature, nutritional deficiencies may impair not only the tooth structure but also the development of salivary gland. During the formation of teeth the physical and chemical properties of enamel could be altered in the direction of increased dental caries susceptibility. There may be a greater prevalence of dental caries because the excessive consumption of sugary foods[9].

Under nutrition in early childhood affects skeletal growth and results in decreased height. Similarly, poor nutrition in early childhood affects tooth eruption and results in delayed emergence of the teeth. Delayed tooth eruption leads to exposure of the teeth in the oral environment for a lesser period of time. This may lead to the delay in caries acquisition. There appears to be a strong physiological association between skeletal growth and delayed tooth.[10,11]

There are controversial results documented regarding the relationship between the body mass index and the occurrence of dental caries in children. It has been claimed by some reports that being overweight is linked to caries, whereas, other reports state that caries is

more common in underweight children. Some studies claims that there is no significant relationship between dental caries and nutritional status in a group of obese children,[12,13] while other studies shows that children's dietary habits are a significant contributor to obesity and dental caries.[14,15]

Number of Indian studies on dental caries had been carried out mostly in adult and elderly population and in relation to socio-demography, hygiene and diet while in children related to prevalence and treatment of caries.[16] However, studies showing the effect of nutrition of dental caries in Indian school children are very scanty. Hence, an attempt had been made in the present study to assess the Co-Relation Between Dental Caries And Body Mass Index Among 12 & 15 Years Old School Going Children In Lucknow City.

AIM AND OBJECTIVES

AIM

- To assess the relationship between Body Mass Index and dental caries in 12 & 15 year old school going children of Lucknow city.

OBJECTIVES

- To assess the dental caries experience of 12 & 15 year old school going children.
- To assess body mass index of 12 & 15 year old school going children.
- To compare the relationship between BMI and Dental Caries among public and private school children of 12 years old in Lucknow City.

REVIEW OF LITERATURE

1. **Chen W, Chen P, Chen SC, Shih WT, Hu HC(1998)[16]**

   In this study, the cross-sectional data from a Three year old Children's Health Survey were evaluated. The body weight, height, body mass index (BMI), and decayed and filled teeth (dft) score were analyzed in 5,133 children. The prevalence of dental caries was not different significantly among different BMI groups. There were no significant differences in the dft score of carious children among different BMI groups. Little or no relationship was found between BMI and dft score. We conclude that there is no relationship between carious deciduous teeth and weight status in three-year-old children.

2. **P Mojon, E Budtz-Jørgensen, C H Rapin (1999[53]**

   The objective of the study was to evaluate the relationship between oral health status and nutritional deficiency. 324 institutionalized frail older adults (mean age 85) were included in study. Structured oral examination including an evaluation of mucosa, periodontal state,caries prevalence and denture quality. The nutritional status was assessed using serum albumin concentration and the body mass index. Physical dependence was assessed using the Barthel index. About two-thirds of the subjects were functionally dependent and half had either a body mass index <21 kg/m2 or serum albumin <33 g/l. Among the edentulous, wearing dentures with defective bases or not wearing dentures at all were the factors most associated with malnutrition. In dentate subjects, corresponding identifiers were the number of occluding pairs of teeth (five or fewer, either natural or prosthetic), the number of retained roots (four or more), and the presence of mobile teeth.

According to these criteria, 11% of the subjects had a compromised oral functional status. This was more frequently found in dependent subjects (37%) than semi-dependent subjects (18%; odds ratio, 2.6; 95% confidence interval, 1.4-4.8). Those with compromised oral functional status had a significantly lower body mass index and serum albumin concentration. Specific detrimental oral conditions are associated with nutritional deficiency in very old people.

3. **B. Willershausen , C. Haas, F. Krummenauer , K. Hohenfellner 2004**[21]

The aim of the study was to examine a possible correlation between presence of caries lesions and the nutritional habits taking into account the Body Mass Index in elementary school children. In this interdisciplinary study, 842 elementary school children (414 girls and 428 boys, age: 6-11 years; elementary grades 1-4) we examined. The dental examination included the determination of caries frequency (DF-T-/ df-t-values) and the medical evaluation assessed the pupils general health (i.e. the height and body weight; body mass index). This study showed an association between an increase of dental caries and high weight in elementary school children, the importance of nutrition with respect to high weight should be considered in future preventive programs, in addition to oral hygiene measures.

4. **Mark D. Macek, David J. Mitola (2006)**[22]

The purpose of the study was to examine the relationship between age-specific body mass index (BMI-for-age) and dental caries among US children. Body measures data and oral health data came from the 1999-2002 National Health and Nutrition Examination Survey. Outcome measures for primary and permanent

dentitions were: (1) dental caries prevalence; and (2) severity (geometric mean dft and DMFT). Covariates included: (1) age; (2) gender; (3) race/ethnicity; and (4) poverty status. Analysis was limited to children 2 to 17 years old. It was found that approximately 36% of overweight children 2 to 6 years old and 39% of overweight children 6 to 17 years old had dental caries. Geometric mean dental caries scores for overweight children were dft=3.3 and DMFT=2.5 for primary and permanent dentitions, respectively. Controlling for covariates, there was no significant association between BMI-for-age and dental caries prevalence in either dentition. In addition, among children with a positive history of dental caries, BMI-for-age was significantly associated with dental caries severity in the permanent dentition – overweight children had a lower geometric mean DMFT than did normal weight children.

5. **Sadeghi M, Alizadeh F; (2007)[42]**

The aim of the study was to determine the association between age-specific body mass index (BMI-for-age) and dental caries in children. In this cross-sectional study a total of 1003 children were screened. The findings showed that 16% of the children had a normal weight, 16.9% were at risk of overweight, and 67.1% were overweight. In the normal weight, at risk of overweight, and overweight groups, the mean ± SE for DFT were 0.34 ± 0.08, 1.23 ± 0.13 and 0.73 ± 0.05, respectively; and 2.01 ± 0.19, 2.76 ± 0.18 and 2.59 ± 0.13 respectively, for dft. Multiple linear regression showed that there was no statistically significant association between BMI-for-age and DFT (R = 0.06) and dft (R = 0.07) indices. 27.7%, 14% and 37.2% of children with normal weight, at risk of overweight and

with overweight were caries free, respectively. There was statistically significant association between BMI-for-age and being caries free (p = 0.0001). the study concluded that, there was no association between BMI-for-age and DFT/dft indices. In addition, a high prevalence of at risk of overweight and overweight was seen among 6-11-year-old children in Isafahan, Iran.

6. **Forestier IB, Lopes K, Souames M, Levy SA, Frelut ML, Lefevre MLB. (2006)[5]**

A study was conducted on 82 adolescents of age group 12 to 18 years to assess the caries experience in severely obese and non obese adolescent population in France(2006).The DMFT indices of a group of obese(n=41) and a group of non obese adolescents(n=41) were compared. The results showed that there was a significant association between BMI and DMFT indices(P=0.01) in the severely obese group. The results showed that the obese adolescents were more likely to have caries than the non obese ones. The study concluded that given the tremendous increase in the prevalence of obesity in children, dentists should promote a healthy diet not only to prevent dental decay but also to reduce the risk for obesity.

7. **Pinto A, Kim S, Wadenya R, Rosenberg H(2007)[17]**

The aim of the study was to evaluate the association between weight and dental caries in a random prospective cohort of children at their initial visit at an urban dental school. One hundred and thirty-five children were recruited in a four-month period. The DS/ds index was used to assess caries, and BMI percentile was calculated based on age and gender-adjusted published scales. Correlation

analyses, linear, and multivariate regression including age, gender, and BMI were calculated with a significance threshold of $p>0.05$. No correlation between dental decay in obese and non-obese children was detected ($p=0.99$).

8. **Levine RS , Nugent ZJ, Rudolf MC, Sahota P(2007)[25]**

The aim of the study was to investigate the relationship between the original dietary pattern, current dietary pattern, tooth brushing habit and oral health. Of the original children, 500 were traced to 32 secondary schools over a wide geographic area. Three-day, self-reported dietary data was obtained, together with information on tooth brushing habits. A dental examination was carried out using BASCD survey methodology. The children in this study had a lower DMFT (0.82) than found in the most recent survey for the area (1.39). No significant relationship was found between sugar-sweetened foods or drinks at age 7-11 and caries in the first permanent molar teeth at age 11-15 years, however a significant relationship was found between current sugar-sweetened drinks consumption and caries. Significantly less caries was associated with the reported moderate consumption of dairy products by the children when aged 11-15 years. A significant inverse relationship was found between claimed tooth brushing frequency and caries. Of those children aged 11-15 years claiming to brush at least once a day, 69% were caries-free with a mean DMFT of 0.69. Of the children who claimed to brush only occasionally or never, 52% were caries-free and they had a mean DMFT of 1.05. The conclusion of this study was, the reported consumption of sugar-sweetened drinks and the lack of regular tooth brushing were found to be the factors most strongly linked to caries.

9. Naraksawat K, Tonmukayakul U, Boonthum A.(2007)[4]

A cross sectional study was conducted on 862 school children of age 12 to 14 years in Thailand(2007) to assess association between nutrition and dental caries in permanent dentition and to identify oral hygiene indicators. The results show a negative relationship between nutritional status and the DMFT index, which increased when the nutritional status decreased(Spearman's rho correlation = -0.140,p<0.001).Normal weight and thin school children had a higher risk for dental caries than overweight and obese children. Normal weight and thin school children were more likely to have a DMFT of at least 1 by 1.94 times and 2.22 times respectively ,compared to overweight and obese children. Their study emphasized that school health promotional activities should emphasize eating habit improvement in order to reduce the incidence of caries.

10. L.B Oliveria, A. Sheiham, B. Marcelo(2008)[52]

The main objective of the study was to assess whether dental caries status was related to nutritional status in preschool urban Brazilian children aged 12–59 months. Dental and anthropometric examinations were conducted on 1,018 12–59-month-old children during the National Day of Children Vaccination. Dental caries prevalence and severity were measured using the decayed, missing or filled surfaces (dmfs) index. The World Health Organization (WHO) Child Growth Standards Reference was used to evaluate nutritional status. Results on nutritional status were presented as Z-scores.n The data collected included socio-economic conditions. Multilevel linear regression was applied to investigate the effect of nutritional, socio-economic, and demographic factors on the status of childrenÕs

dental caries. Caries was present in 23.4% of children. The final hierarchical logistic model showed a significant association between nutritional status and caries experience. Children with low Z-scores in some indexes had an increased risk of having caries. In addition, children whose mothers had ≤ 8 yr of education and were from lower-income families had an increased risk of high levels of dental caries. There was an association between nutritional and socio-economic factors, and dental caries. In conclusion, underweight children and those with adverse socio-economic conditions were more likely to have caries experience.

11. Alm A, Isakason H, Fahraeus C, Koch G, Anderrson GB, Nillson M, etal.(2009)[2]

A study was done to investigate the relationship between body weight status and dental caries on 3,6,15 and 20 year old children in Sweden(2009).The results showed that adolescents(15 years) and young adults(20 years) who were obese or overweight had statistically significant higher incidence of caries than normal weight children. At 6 years of age, the odds(OR) of having caries in obese children is 2.5 times higher than the odds of having caries in normal weight children (p=0.04).At 3 years of age ,no association was found between overweight or obesity and dental caries. The study concluded that overweight and obese adolescents and young adults had more caries than normal weight individuals.

12. Tramini P, Molinari N, Tentscher M, Demattei C, Schulte AG(2009)[41]

The aims of the study were to assess the distribution of body mass index (BMI) and D(3+4)MFT index in a sample of 12-year-old French children, and to compare several regression models in order to analyze the association between

those who consumed sweets more than once a day were more likely to have caries experience. The study concluded that there was a significant association between overweight/obesity and caries experience among school children of the Udupi district. Obesity and dental caries have common risk determinants and require a comprehensive multidisciplinary approach by dental healthcare professionals.

14. Modéer T, Blomberg CC, Wondimu B, Julihn A, Marcus C(2010)[45]

In this cross-sectional study , the hypothesis tested was; whether childhood obesity is associated with reduced flow rate of stimulated whole saliva and dental caries. The obese subjects exhibited higher number of decayed surfaces (DS), 0.7 vs. 0.1 (P = 0.008) and lower flow rate of stimulated whole saliva 1.2 vs. 2.0 ml/min (P < 0.001). Of obese patients, 17 subjects had VPI% >25 and 21 had BOP% >25, both compared to only 5 subjects of the normal weight with P values of 0.005 and <0.001, respectively. In a multivariate logistic regression model BMI was significantly associated with the flow rate of stimulated whole saliva less than the median value 1.5 ml/min (P < 0.001; odds ratio (OR) 1.36) as well as with DS (DS >0) (P = 0.002; OR 1.31) and the associations were not found to be confounded by any of the studied variables. The results indicate that childhood obesity is associated with reduced flow rate of stimulated whole saliva and dental caries and further strengthens obesity's negative effect on children's oral health.

15. Vázquez-Nava F et al (2010).[20]

The aim of this study was to determine the association between obesity and caries. A slightly higher percentage of dental caries was found in boys (19.6 %) than in girls (16.4 %). From the total sample, the mean BMI was 17.10 +/- 3.83.

17. Campos JA, Melanda EA, Antunes Jda S, Foschini AL (2011)[50]

This cross-sectional study was conducted for a spatially analysis of the distribution of dental caries and the nutritional status (NS) of 5-year-old preschool children of public schools in the city of Araraquara, São Paulo, Brazil. The sample was selected in a stratified probabilistic manner. A dental examination was conducted to investigate the dmft index. The anthropometric indicators of the weight/height (W/H), height/age (H/A), weight/age (W/A) and body mass index (BMI) were calculated to estimate the NS. A descriptive statistical analysis was conducted and a thematic map was created. At the end of the study 491 children had full address codification. A GPS device was used to ascertain the geographic reference points. A pluri-directional semi-variogram was elaborated. The results revealed that both variables presented a pure nugget effect showing the absence of a spatial correlation, in other words the dmft and nutritional status are not regionalized variables, and their values do not reveal direct spatial dependence. Dental caries and nutritional status are health conditions that do not reveal spatial dependence.

18. Nadia Al-Rawi, Anhar A1-Saadi(2011)[8]

In this study, the diabetic group included 27 children aged 10-13 years old of both gender. The control group included 30 non- diabetic children matching with study group. Diagnosis and recording of caries experience were through the application of decayed, missing and filled surfaces (dmfs, DMFS) indices. Salivary samples were collected and chemically analyzed for the detection of insulin hormone. Body Mass Index (BMI) specific for age and gender was used for assessment of

different between BMI groups (P=.41). OW and OB children had less primary tooth caries than UH children. (P=.04) The presence of new carious lesions at recall exams in primary teeth (P=.35) and permanent teeth (P=.96) was not significantly different between BMI groups. This study concluded that, a smaller proportion of obese and overweight children initially presented with primary tooth caries than underweight/healthy weight children.

22. **Norberg C, Hallström Stalin U, Matsson L, Thorngren-Jerneck K, Klingberg G(2012)**[23]

The aim of the survey was to study the association between dental caries and body mass index (BMI) in Swedish preschool children (born in 1999). A population-based and cross-sectional study design was used comprising all 920 5-year-old children in a defined area in and around the city of Lund. Anthropometric measures for the calculation of BMI were retrieved for each child. The occurrence of caries and fillings in the primary dentition, defined as deft (decayed, extracted, or filled primary teeth) and dt (decayed primary teeth), was collected from the children's dental records. The result of the study was The mean BMI was 16.1 (no differences between boys and girls). About 19.2% were overweight, of which 5.1% were obese. Overweight or obese children did not have higher deft or dt than others. However, children with low BMI (below -1 SD of national mean values for Swedish 5-year-olds) had statistically significantly higher deft and dt than children with normal BMI. This study concluded that, children with low BMI may be at risk of caries development. Low BMI may be associated with eating habits endangering dental health.

was found between obesity and the oral health status of the child population evaluated.

27. Ali Bagherian, Mostafa Sadeghi[10]

The aim of this study was to determine the association of dental caries and BMI-for-age in preschool children and whether BMI-for-age is similar or different between Severe Early Childhood Caries (S-ECC) and caries free children. In this study Four hundred preschool children aged 30-70 months were entered into this study. The parameters examined in this study were weight, height, BMI-for-age and number of decayed, extracted and filled surfaces of deciduous teeth (defs). Based on dental caries, the subjects were also divided into S-ECC and caries free groups. Then data was analyzed by t test, one way ANOVA, multiple regression and logistic regression tests. The result was the mean and SD of defs index was 8.37 ± 11.2. In the underweight, normal weight, at risk of overweight and overweight groups, these values were 4.89 ± 10.8, 8.84 ± 11.8, 8.68 ± 10.6, and 10.39 ± 10.2, respectively. Multiple regression analysis revealed a statistically significant direct association between BMI for age and defs index (P = 0.001) after adjusting for gender and age. The findings of the study was an association between higher defs scores and severe early childhood caries with overweightness.

28. Vineet Golchha, Pooja Sharma(2013)[15]

In this study, data collected was the part of Oral Health Survey and free dental checkup camp was organized in various schools of Noida. A total of 250, 9-11 years of school children constituted of the study group. By applying Pearson

this concluded with inference that increases in age and underweight children were more likely to have caries experience.

35. Shahraki T, Shahraki M, Omrani Mehr S(2013)[33]

The aim of this study was to investigate the association between dental caries and body mass index in 6-11 year-old children in Zahedan. In this cross-sectional study 1213 children (670 girls, 543 boys) were included. Body mass index (BMI) and clinical examination for determination of DFT (decay filling teeth) index (based on WHO criteria) were taken. Among children, 20.8% had low weight, 66.3% normal weight, 7.8% were overweight and 5.1% obese. In the low weight, normal weight, overweight, and obese groups, the mean ± SD values for DFT were: 0.63 ± 1.1, 0.88 ± 1.36, 1.16 ± 1.33, and 0.87 ± 1.31, respectively. There was a significant association between BMI and DFT (P = 0.005). The overweight group had higher DFT compared to the low and normal weight groups. 13.5% of low weight, 12.2% of normal weight, 14.7% of overweight and 22.6% of obese children had DFT = 0. There was no statistical association between BMI and being caries free (P = 0.4). This study concluded that, The mean DFT in the overweight group was higher than low and normal weight groups. There was a statistically significant association between BMI and DFT.

36. Sood S, Ahuja V, Chowdhry S(2014)[43]

The purpose of the study was to evaluate the association between anthropometric measurements and oral health status in the primary dentition of school-going children. In this study, 280 elementary school children (116 girls and 164 boys, age: 3-6 years) were examined. Among the study group, 58.3% of children were

vs 1.93 ± 1.79; p=0.039). The correlations between dmft/DMFT indexes and body composition parameters were analyzed and a significant correlation between dmft/DMFT indexes and FM% was observed (p=0.031 for dmft, p=0.022 for DMFT). This study shows a direct association between dental caries and obesity evident from a correlation between prevalence of dental caries and FM%. The analysis of food intake, dmft/DMFT, FM%, measured by DXA, demonstrates that specific dietary habits (intake of sugar-sweetened drinks, frequency of sugar intake limited to main meals, frequency of food intake between meals) may be considered risk factors that are common to both dental caries and childhood obesity.

38. Freitas AR et al (2014)[32]

The aim of this study was to evaluate the association between dental caries activity, quality of life and obesity in Brazilian adolescents. This study was conducted at public schools in Brazil, on a sample of 202 adolescents, 12 years of age. The sample was divided into two groups: O (overweight/obese; n = 101) and N (normal weight; n = 101). The Child-Oral Impacts on Daily Performance (Child-OIDP) index was applied. The DMFT scores were 1.67 and 2.12 and the SiC scores were 3.85 and 4.26 for groups O and N, respectively. BMI-for-age was significantly related to DCA (OR = 0.579; P < 0.000) and to SiC (OR = 0.649; P = 0.024). Positive associations between the impacts on eating, cleaning mouth and smiling were found (P < 0.05). DMFT values showed significant correlation with the emotional status performance in group O and the DCA was positively correlated with performance at school in group O (P < 0.05). In this study,

investigate whether these associations were modified by social class. Data were from the European Youth Heart Study (EYHS) merged with data on caries experience from the Danish National Board of Health, (SCOR register). At baseline, 26.2% of the children/adolescents were caries free and 39% at follow-up. A larger percentage of normal weight children/adolescents were caries free, compared with the overweight/obese group of children/adolescents. The linear regression analysis showed that childhood caries was generally not associated with either BMI or subsequent changes in BMI. No association was found for those with lower SES. An inverse association between caries and subsequent changes in BMI was found, but only among children with well-educated mothers

41. **Chłapowska J, Rataj-Kulmacz A , Krzyżaniak A , Borysewicz-Lewicka M(2014)** [51]

The aim of the study was to assess the prevalence of dental caries in 7 and 12-year-old children, depending on the nutritional status. The study included 225 children of both sex, age 7 (132) and 12 years (93) attending to randomly selected schools in Poznań. Caries frequency in children of normal weight in the population of 7-year-olds was 82.2% and 53.2% of children aged 12 years. In the group of 7-year-old pupils with overweight and underweight was respectively, 95.0% and 90.9%, 84.2% and 50.0% in the older group. A statistically significant difference between the attendance of dental caries in a group of 12-year-old children with overweight and normal weight and its deficiency was show. In population of 12-year olds caries DMF was - 1.62, and for children with overweight and underweight, respectively, 2.68 and 1.25. Approximately 66.7%

the least number was obesity. These differences were statistically significant. Children with obesity were 1.908 times (OR =1.908; CI95%=1.750, 2.079) more likely have caries than children with underweight or health weight. Overweight children were 1.547 times (OR = 1.547; CI95% = 1.479, 1.618) more likely to have caries than children with underweight or health weight. After adjusted the gender and age, a statistically significant association was also observed between body mass index categories and caries. This study stated that, obesity may have a significant effect on caries prevalence of primary school children in Wannan area, China.

45. Qadri G, Alkilzy M, Feng YS, Splieth C. (2015)[34]

The aim of the study was to determine the relationship between iso-body mass index (iso-BMI) and both dental caries status and caries increment among German school children. Six hundred and ninety-four students (age range 9-12 years, mean 10.34 ± 0.56, 48% females) were recruited from the fifth grade of 18 primary schools. The result of the study stated that, Iso-BMI was significantly associated with dental caries prevalence and severity in the permanent dentition (P = 0.039). Low-normal weight children had a lower mean DMFT (0.56) than did overweight/obese children (0.70). In addition, a border-line significant association was found between overweight/obese children and caries increment (P = 0.055). Conclusion of the study was, iso-BMI was associated with dental caries prevalence and severity, the association between caries increment and iso-BMI did not reach a statistical significance. Overweight/obese children however

acquired more additional carious lesions during the follow-up period than children with low-normal weight.

46. Yang F et al(2015)[44]

The study aims to investigate the caries status and its association with body weight in 8-year-old children in Qingdao, China. A cross-sectional investigation on 744 children aged 8 years during the Oral Health Survey in 2012. The prevalence of dental caries among the 744 children aged 8 years participating in this survey was 86.3%. The caries status represented by dmft (deciduous dentition) and (dmft + DMFT) (mixed dentition) values was 4.31 and 4.85, respectively, and the restoration rate was extremely low, which was no more than 3.0%. Significant difference was found in dmft/(dmft + DMFT) values between different BMI groups, and underweight individuals were found to have the highest dmft/(dmft + DMFT) value. An inverse relationship between body BMI and dmft/(dmft + DMFT) index was identified based on Pearson's correlation.

47. Pramod Kumar Yadav,Sabyasachi Saha, G.V. Jagannath, and Sanjay Singh(2015)[46]

The aim of the study was to assess the Prevalence of Developmental Defects of Enamel and its Association with, Dental-Caries and Nutritional Status in Pre-School Children of Lucknow, India. The prevalence of DED of any type was 39.9% with that of demarcated opacities being the highest, followed by Hypoplasia. The most frequently affected teeth were maxillary anterior teeth, while the least affected teeth were mandibular incisors. The mean dmft was 3.5. A positive association between DED and caries was observed. Association between

Dental Caries & BMI was non-significant whereas Pearson correlation showed a negative correlation between the two. In this study, the prevalence of enamel defects and caries was high, as the enamel defects were strongly associated with caries.

48. Chopra A, Rao NC, Gupta N, Vashisth S, Lakhanpal M(2015)[47]

This study was done to find out the correlation between body mass index (BMI), diet, and dental caries among 12-15-year-old school going children in Panchkula District. The mean Decayed Missing Filled Teeth (DMFT) score was found to be 1.72 with decayed, missing, and filled teeth to be 1.22, 0.04, and 0.44, respectively. When the sample was assessed based on type of diet, it was found that vegetarians had higher mean DMFT (1.72) as compared to children having mixed diet. Overweight children had highest DMFT (3.21) which was followed by underweight (2.31) and obese children (2.23). Binomial regression revealed that females were 1.293 times at risk of developing caries as compared to males. Fair and poor Simplified-Oral Hygiene Index (OHI-S) showed 3.920 and 4.297 times risk of developing caries as compared to good oral hygiene, respectively. Upper high socioeconomic status (SES) is at most risk of developing caries. Underweight, overweight, and obese are at 2.7, 2.5, and 3 times risk of developing caries as compared to children with normal BMI, respectively. This study concluded that, dental caries and deviations from normal weight are two conditions which share several broadly predisposing factors such as diet, SES, lifestyle and other environmental factors.

85.5% reported brushing their teeth at least once daily. Of the participants, 55.3% were either overweight or obese, and 42.2% demonstrated a high prevalence of dental caries with no significant difference in BMI when compared to the low dental caries group. In this study, a high prevalence of overweight/obesity and dental caries was observed among the participants. After controlling for potential confounders like smoking and brushing habits, significant positive correlation between BMI and DMFT was observed.

51. Davidson K, Schroth RJ, Levi JA, Yaffe AB, Mittermuller BA, Sellers EA(2016)[29]

The purpose was to determine whether there is an association between Body Mass Index (BMI) and S-ECC. Children with S-ECC were recruited on the day of their slated dental surgery under general anesthesia. Two hundred thirty-five children were included (141 with S-ECC and 94 caries-free). Significantly more children with S-ECC were classified as overweight or obese when compared to caries-free children (p□=□0.038) and had significantly higher mean BMI z-scores than caries-free children (0.78□±□1.26 vs. 0.22□±□1.36, p□=□0.002). Those with S-ECC also had significantly higher BMI percentiles (69.0 %□±□29.2 vs. 56.8 %□±□31.7, p□=□0.003). In this study, children with S-ECC had significantly higher BMI z-scores than caries-free peers.

52. Kumar S, Kroon J, Lalloo R , Kulkarni S, Johnson NW(2016)[27]

The aim of the study was, to determine the association of body mass index (BMI) with dental caries in Indian schoolchildren, and to analyze the influence of socio-economic status (SES). The study population consisted of 11- to 14-year-old

children from Medak District in Telangana State, India. A total of 1,092 subjects returned questionnaires and were clinically examined (giving a response rate of 85%). There were no significant differences in caries prevalence and experience across the categories of BMI. However, caries prevalence and experience in overweight children were 24.8% and 0.69 ± 1.51, respectively, while the corresponding values in normal-weight children were 35% and 0.85 ± 1.50, respectively. Among children of high-SES families, overweight children had approximately 71% fewer caries than did those who were normal weight [incidence rate ratio (IRR) = 0.29; 95% CI: 0.11-0.78)]. This study concluded that, 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.

53. Kottayi S, Bhat SS, Hegde KS, Peedikayil FC, Chandru TP, Anil S(2016)[28]

The objective of this study was to assess the association between overweight and dental caries among 12- to 15-year-old schoolchildren in Mangaluru district, Karnataka, India. Data were obtained from 2000 school-going children aged 12 to 15 years. The result of the study was, the mean BMI recorded was 26.87 ± 2.26 for the overweight children and 20.82 ± 1.48 for the normal-weight children. Even though the DMFT (3.90 ± 2.95) in the overweight children was slightly higher than the control group (3.36 ± 2.73), it was not statistically significant. The study concluded that, there is no significant association between overweight and dental caries among the schoolchildren of Mangaluru district in Karnataka.

54. Aluckal E, Anzil K, Baby M, George EK, Lakshmanan S, Chikkanna S(2016)[26]

The aim of the study was to assess the BMI status and to correlate between dental caries and BMI among the Anganwadi children of Belgaum city, Karnataka, India. Four hundred and thirty three children from 20 Anganwadi's belonging to the age group of 2 to 6 years of both sexes were measured for BMI and dental caries status. A significant association was found between children with normal BMI and those who were underweight, overweight, and under the risk for overweight. Children with overweight/obese or underweight/malnourished children had higher decayed and filled surfaces compared to children with normal weight. This study concluded, with the finding that nutritional status has a profound effect on dental caries. Underweight/malnutrition and overweight/ obesity have significant adverse implications for health. Childhood obesity and childhood dental caries are coincidental in many populations.

MATERIALS AND METHODS

A descriptive cross sectional study was conducted to determine the relationship between Body mass index and dental caries among 12 and 15 years school going children of Lucknow.

Study Area:-

Lucknow, the capital of Uttar Pradesh is situated 123 meters above sea levels. It covers area of 2528 sq. km with a population of 4,588,455 (2011 census).

For the study purpose, list of schools located within the Lucknow municipality was obtained from District school Officers (DSO), Chowk, Lucknow. The various categories of school were government, aided and unaided private schools, thereby giving a chance to incorporated students from different background.

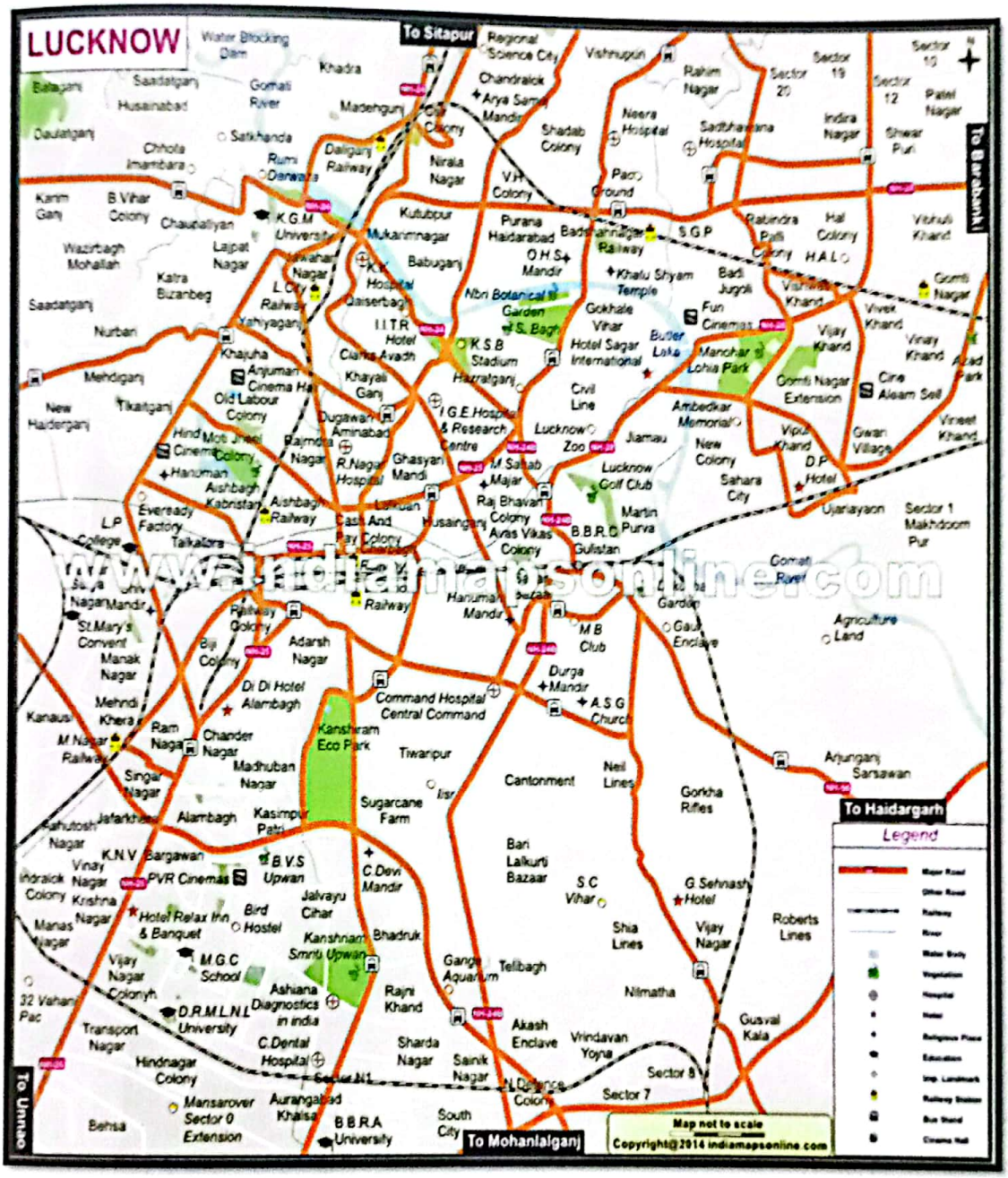
Study Population:-

The city of Lucknow was divided into four zones. From each zones, 5 schools were selected, i.e. a total of 20 schools. The schools were selected by simple random sampling method following the lottery method of selection. The ratio was maintained while selecting the samples from different areas. In every school, the classes of 8^{th} and 11^{th} standard were chosen. These standards have children of 12 and 15 years. Each class has three to four sections, and these sections were chosen for the purpose of data collection.

Pilot Study:-

A pilot study was conducted on 55 subjects using a performed proforma. It was to assess the validity and feasibility of the study.

PELLET-1



MAP OF LUCKNOW CITY

Sample size Determination:-

A pilot study was conducted on 55 subjects in order to find the feasibility of the study. Based on the prevalence of caries from pilot study (70% Prevalence) with a precision of 0.04 and 95% confidence interval, a total of 505 subjects in 15 years and 505 subjects in 12 years with a precision of 0.04 and 95% confidence interval were required."

Ethical clearance and permission:-

- Ethical clearance was obtained from the ethical clearance committee of Babu Banarasi Das University.
- Necessary permission was obtained from the government authorities and the head of the school.

Inclusion criteria:-

- Children of schools of age group 12 & 15 years in Lucknow city.
- Children who have completed their 12 and 15 year of age by January 2015.

Exclusion criteria:-

- Children with systemic diseases or prolonged illness.
- Children with handicapping condition.
- Children who had undergone or are undergoing orthodontic treatment.

Schedule of the study:-

A schedule for the study was prepared prior to the data collection. The study was carried out from the month January 2016 to April 2016. The study was conducted within the working hours of school, as per the time allotted by Principals of respective school.

PELLET-2

SCHOOL VISITED FOR DATA COLLECTION

Calibration:-

Before the start of the survey, the guide calibrated the investigator in the Department of Public Health Dentistry. A group of subjects were selected and examined who possessed collectively the full range of condition expected to assess in the survey. Subjects were re-examined on successive days using the same clinical criteria in order to check for the intra-examiner reliability. The recording clerk in the study was also trained in the same department regarding the contents of the proforma and the method of recording.

Data Collection:-

Personnel: The examinations were done by the investigator who was assisted by an alert and co-operative recording clerk. The respective class teachers were used as co-ordinate in the survey.

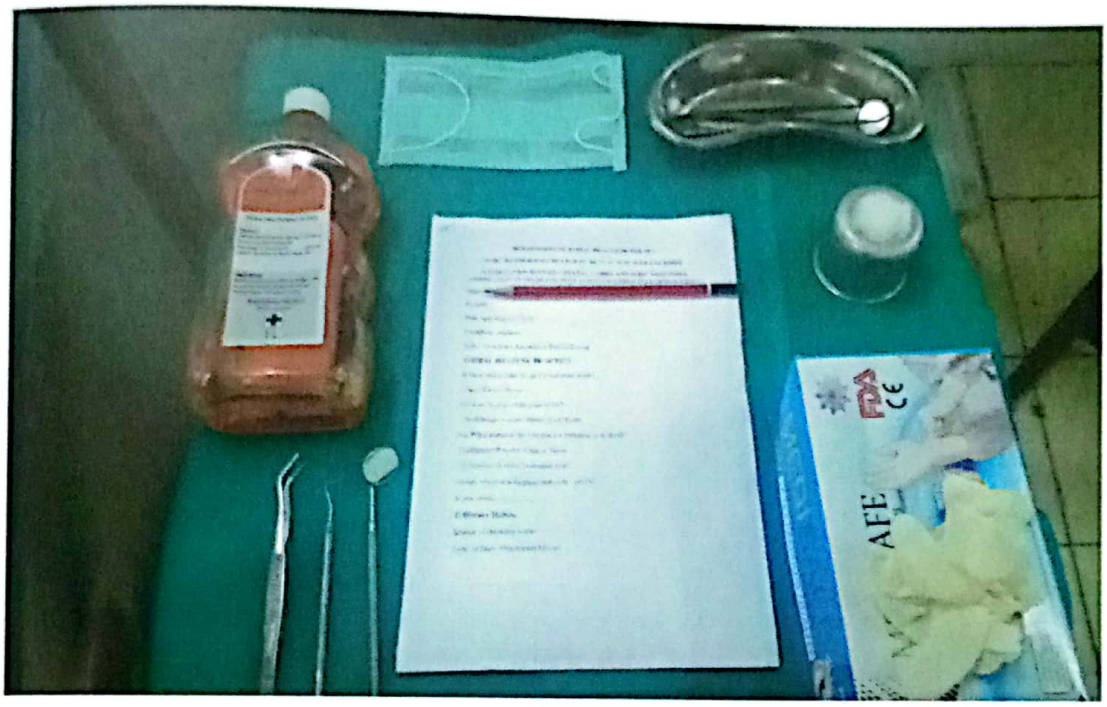
Clinical examination: Profoma assessed Dental Caries using DMFT index (WHO criteria 1997) and BMI was assessed using the classification by Centre for Disease Control and Prevention (2006)

Type III examination was carried out and examination was conducted in class room under natural light by single examiner. For examination mouth mirror and WHO periodontal probe was used.

Recording clerk: An intern posted in the Department of Public Health Dentistry was appointed throughout the survey.

Proforma: Proforma had two parts. First part consisted of a predesigned proforma that assessed the variables of the present study. Dietary habit and Oral Hygiene Practices also formed the part of the proforma.

PELLET-3



ARMAMENTARIUM

Second part of the proforma assessed Dental Caries using DMFT index (WHO criteria 1997) and BMI was assessed using the classification by Centre for Disease Control and Prevention (2006).

Armamentarium:-

- Plane mouth mirror
- WHO periodontal probe
- Tweezers
- Kidney tray
- Disposable mouth masks
- Disposable examination gloves
- Pans for sterilizing instruments and concentrated sterilizing solution.
- Sterilized gauze pads/ cotton for removing debris around the tooth.
- Towels, green cloth and soap.

Infection control:-

- Adequate numbers of instruments were carried to the site of examination, so as to avoid disturbances. The instruments were used once and were autoclaved in the Department of Public Health Dentistry next day for reuses.
- Disposable mouth masks and gloves were used for examination at the site of data collection.

Examination area and source of light:

The children were examined either in the classroom or library of the school. The place which was allotted for the examination was clean and noise free. A table was given to

PELLET-4

STUDENTS SEATED FOR EXAMINATION

EXAMINATION OF THE SUBJECT

PELLET-5

MEASUREMENT OF HEIGHT

PELLET-6

MESUREMENT OF WEIGHT

arrange the instruments, and chairs were provided for recording clerk and the child to be examined. As, natural light alone was used, the subjects were sitting so as to receive maximum illumination. The recording clerk was made to sit facing the examiner so that he could easily hear instructions and codes, and also the examiner could verify the recordings. The examination area had entry at one point and exit at the other so as to prevent crowding and to ensure smooth flow.

Immediate care and referral:-

The study subjects requiring the dental treatment were brought to notice to the teachers and parents and were referred to the BBD college of Dental Sciences, Lucknow.

Oral health education:-

Immediately after the survey, oral health education was given to the children regarding the method of tooth brushing and oral hygiene practices using posters and models. Emphasis was given on the routine preventive measures.

Courtesy reporting:-

Survey finding were reported to the concerned school authorities.

INDICES USED IN STUDY

Indices used for dental caries assessment

Dental Caries [73]:

A progressive irreversible microbial disease affecting the hard parts of the tooth. It is the most prevalent chronic disease affecting the human race. Once it occurs, its manifestations persist throughout life even the lesion is treated. It usually begins soon after the teeth erupted into the oral cavity. So, it is a post eruptive disease. It affects persons both genders, all races, all ages, all socio-economic groups.

1- Indices used for coronal caries. A- Permanent teeth. B- Primary teeth.

2- Indices used for root caries.

Permanent teeth index:

Decayed-Missing-Filled Index (DMF) which was introduced by Klein, Palmer and Knutson in 1938 and modified by WHO:

1-DMF teeth index (DMFT) which measures the prevalence of dental caries/Teeth.

2- DMF surfaces index (DMFS) which measures the severity of dental caries.

The components are:

D component:

Used to describe (Decayed teeth) which include:

1. Carious tooth.
2. Filled tooth with recurrent decay.
3. Only the root are left.
4. Defect filling with caries.

5. Temporary filling.

6. Filled tooth surface with other surface decayed.

M component:

Used to describe (Missing teeth due to caries) other cases should be excluded which are:

1. Tooth that extracted for reasons other than caries should be excluded, which include: a-Orthodontic treatment. b-Impaction. c-Periodontal disease.

2. Unerupted teeth.

3. Congenitally missing.

4. Avulsion teeth due to trauma or accident.

F component:

Used to describe (Filled teeth due to caries). Teeth were considered filled without decay when one or more permanent restorations were present and there was no secondary (recurrent) caries or other area of the tooth with primary caries. A tooth with a crown placed because of previous decay was recorded in this category. Teeth stored for reason other than dental caries should be excluded, which include:

1. Trauma (fracture).
2. Hypoplasia (cosmetic purposes).
3. Bridge abutment (retention).
4. Seal a root canal due to trauma.
5. Fissure sealant.
6. Preventive filling.

Note :

1- A tooth is considered to be erupted when just the cusp tip of the occlusal surface or incisor edge is exposed .

The excluded teeth in the DMF index are:

1- Supernumerary teeth.

2- The third molar according to Klein, Palmer and Knutson only.

2-Limitations - DMF index can be invalid in older adults or in children because index can overestimate caries record by cases other than dental caries.

Principle and rules in recoding:

1-DMFT:

1- A tooth may have several restorations but it counted as one tooth, F.

2- A tooth may have restoration on one surface and caries on the other, it should be counted as decayed D .

3- No tooth must be counted more than once, D M F or sound.

2-DMFS

Each tooth was recorded scored as 4 surfaces for anterior teeth and 5 surfaces for posterior teeth.

- Retained root was recorded as 4 D for anterior teeth, 5 D for posterior teeth.
- Missing tooth was recorded as 4 M for anterior teeth, 5 M for posterior teeth.
- Tooth with crown was recorded as 4 F for anterior teeth, 5 F for posterior teeth.

Calculation of DMFT \ DMFS:

1- For individual
DMF = D + M + F

2- For population
Mean DMF = Total DMF / Total No. of the subjects examined

Maximum score:	Minimum score = Zero
1- DMFT = 32	
2- DMFS= 100	
Total= 48 + 100 = 148 or 128	

Primary teeth index:

- dmft / dmfs Maximum scores: dmft = 20, dmfs = 88

deft / defs , which was introduced by Gruebbel in 1944

d- decayed tooth .

e- decayed tooth indicated for extraction .

f- filled tooth.

3- dft / dfs

In which the missing teeth are ignored, because in children it is difficult to make sure whether the missing tooth was exfoliated or extracted due to caries or due to serial extraction.

Mixed dentition:

Each child is given a separate index, one for permanent teeth and another for primary teeth. Information from the dental caries indices can be derived to show the:

1. Number of persons affected by dental caries (%).

2. Number of surfaces and teeth with past and present dental caries (DMFT / dmft -- DMFS / dmfs).

3. Number of teeth that need treatment, missing due to caries, and have been treated (DT/dt , MT/mt , FT/f t).

WHO Modification of DMF Index (1986):

- All third molars are included
- Temporary restorations are considered as 'D'
- Only carious cavities are considered as 'D', initial lesions (Chalky spots, stained fissures, etc) are not considered as 'D'

WHO modification of DMFT index (1997):

According to the criteria by World Health Organization (WHO, 1987), only teeth missing due to caries were included for its M- missing component. However, in 1997, WHO has stated that for individuals 30 years and older the M component should include teeth missing due to caries or any other reason,. But for subjects under 30 years of age, M component should include teeth missing due to caries. The instruments used to record dental caries are mouth mirror and the WHO periodontal probe.

Body Mass Index [74]

Body mass index (BMI) is a measure of weight adjusted for height, calculated as weight in kilograms divided by the square of height in meters (kg/m2). Although BMI is often considered an indicator of body fatness, it is a surrogate measure of body fat because it measures excess weight rather than excess fat. Despite this fact, studies have shown that BMI is correlated to more direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry.

BMI is a simple, inexpensive, and noninvasive surrogate measure of body fat. In contrast to other methods, BMI relies solely on height and weight and with access to the proper equipment, individuals can have their BMI routinely measured and calculated with reasonable accuracy.

Furthermore, studies have shown that BMI levels correlate with body fat and with future health risks. High BMI predicts future morbidity and death. Therefore, BMI is an appropriate measure for screening for obesity and its health risks. Lastly, the widespread and longstanding application of BMI contributes to its utility at the population level. Its use has resulted in an increased availability of published population data that allows public health professionals to make comparisons across time, regions, and population subgroups.

The clinical limitations of BMI should be considered. BMI is a surrogate measure of body fatness because it is a measure of excess weight rather than excess body fat. Factors such as age, sex, ethnicity, and muscle mass can influence the relationship between BMI and body fat. Also, BMI does not distinguish between excess fat, muscle, or bone mass, nor does it provide any indication of the distribution of fat among individuals.

The following are some examples of how certain variables can influence the interpretation of BMI:

•On average, older adults tend to have more body fat than younger adults for an equivalent BMI.

•On average, women have greater amounts of total body fat than men with an equivalent BMI.

•Muscular individuals, or highly-trained athletes, may have a high BMI because of increased muscle mass.

BMI is calculated the same way for adults and children, but the results are interpreted differently. For adults, BMI classifications do not depend on age or sex. For children and adolescents between 2 and 20 years old, BMI is interpreted relative to a child's age and sex, because the amount of body fat changes with age and varies by sex.

BMI Cutoff for Asians and Asian Americans	**Weight Status**	**NIH BMI Cutoff**	**Comments**
<18.5	Underweight	<18.5	Being underweight can put you at risk for developing many health problems. Talk to your healthcare provider about your ideal body weight.
18.5 - 22.9	Healthy weight range	18.5 - 24.9	Your weight is within normal range.

			Continue exercising and eating healthfully.
23 - 26.9	Overweight*	25 - 29.9	Being overweight can put you at risk for developing many chronic diseases. Talk to your healthcare provider about your ideal body weight and how to make healthy lifestyle changes.
≥27	Obese	≥30	Obesity increases the risk for developing many chronic diseases such as heart disease and diabetes, and decreases overall quality of life. Talk to your healthcare provider about your ideal body weight and how to make healthy lifestyle changes.

*NIH- National Institutes of Health.

Formula: weight (kg) / [height (m)]^2

With the metric system, the formula for BMI is weight in kilograms divided by height in meters squared. Since height is commonly measured in centimeters, an alternate calculation formula, dividing the weight in kilograms by the height in centimeters squared, and then multiplying the result by 10,000, can be used.

Statistical analysis [75]

The continuous data were summarized as Mean±SD. Dependent groups were compared by Mann Whitney U test while independent groups were compared using Independent t-test. Correlation between groups and variables was done by using Spear's rho Correlation Coefficient.

A p-value of <0.05 was considered statistically significant. All the analysis was done using SPSS version 18.

Statistics Used in the data analysis.

The Arithmetic Mean

The most widely used measure of central tendency is Arithmetic mean, usually referred to simply as the mean, calculated as:-

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

The Standard Deviation

The standard deviation(SD) is the positive square root of the variance, calculated as,

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

Chi- Square Test

The Chi- Square (X2) test is used to compare the categorical data as,

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where, Fjj is the observed frequency while fjj the expected frequency. The degrees of freedom (DF) is calculated as,

$$DF=(r-1)(c-1)$$

Independent Sample t test

The independent-samples t-test (or independent t-test, for short) compares the means between two unrelated groups on the same continuous, dependent variable.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

Mann -Whitney U test

The Mann-Whitney U test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed. The Mann-Whitney U test is often considered the nonparametric alternative to the independent t-test. The Mann-Whitney U test allows to draw different conclusions about data depending on the assumptions made about data's distribution

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n_2} R_i$$

Where

U=Mann-Whitney U test

N_1 = sample size one

N2= Sample size two

R_i = Rank of the sample size

Spear's rho Correlation Coefficient

Spearman's **Rho** is a non-parametric test used to measure the strength of association between two variables, where the value r = 1 means a perfect positive correlation and the value r = -1 means a perfect negative correlation.

Spearman's Rank correlation coefficient is used to identify and test the strength of a relationship between two sets of data. It is often used as a statistical method to aid with either proving or disproving a hypothesis.

Once the data has been collected, Excel can be used to calculate and graph Spearman's Rank correlation to discover if a relationship exists between the two sets of data, and how strong this relationship is.

The formula used to calculate Spearman's Rank is shown be

$$r = 1 - \frac{6\sum d^2}{n^3 - n}$$

(Sometimes $n^3 - n$ is written as $n(n^2 - 1)$. Both mean the same thing.)

RESULTS

RESULTS

The present study determines the co-relation between dental caries and body mass index among 12&15 years old school going children in Lucknow city. A total of 1022 children were selected randomly from different schools of Lucknow city.

Table 1. shows distribution of sample with respect to type of schools. There were 265 males(50.8%) and 250 females(49.2%) in private school. And there were 250 males(50.0%) and 250(50.0%) females in Government school. As shown in Fig 1.1.

Table 2. shows the Age – wise distribution of school children in which 12 years old were 257(49.2%) and 183(36.6%) in Private and Government Schools respectively. 15 years old were 265(50.8%) and 317(63.4%) in Private and Government Schools respectively.

Table 3. shows the overall distribution of sample according age and gender which shows no statistical significant difference among Gender population and age wise population with the application of Chi-square test. ($p>0.589$). Shown in Fig 1.2,1.3.

Fig1.1-Distribution of Children acoording to type school

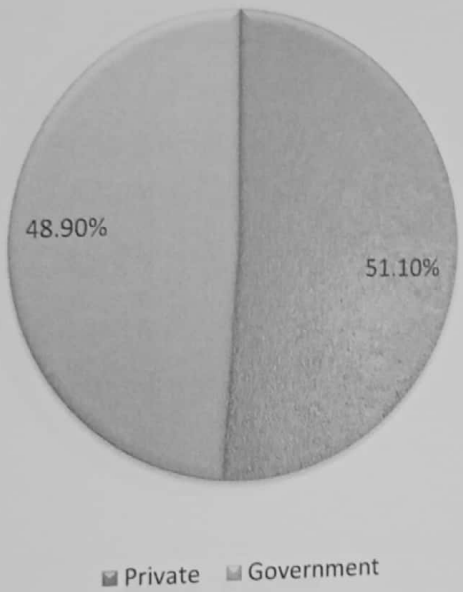


Fig 1.2-Distribution of sample according to the age group

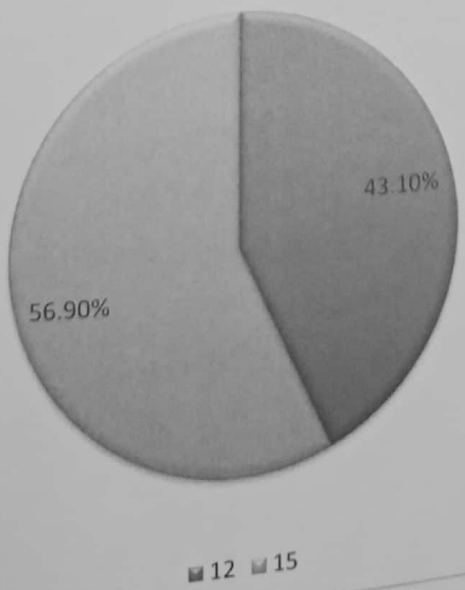
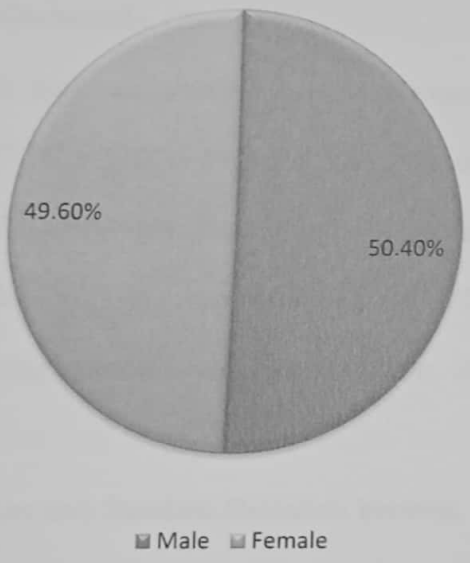


Fig 1.3 Distribution of sample according to Gender



For the calculation of Body mass index with the metric system, the formula for BMI is weight in kilograms divided by height in meters squared as used.

Table no. 4.1 shows Gender –wise distribution among the various categories – Underweight, Healthy, Overweight, Obese.

As depicted in table 4.1 under underweight, healthy, overweight and obese among Male were 51(9.9%), 296 (57.7%), 136(26.4%) and 32(6.2%) respectively. Among Female under the categories of underweight, healthy, overweight and obese were 68(13.4%), 257(50.7%), 151(29.8%),31(6.1%) respectively(Fig.2). When Chi-Square test was applied difference among gender was found to be statistically not significant (X^2=5.917;p=0.116).

Table no. 4.2 shows Mean and Standard Deviation between Gender and BMI. Males it was 21.94±2.99 and for females it was 21.84±2.99 with the application of Independent sample t-test it was found not statistically significant (p=0.6).

Table no. 5 shows Age- wise distribution of Body Mass index (Fig. 3). In which for sample constituted of age 12 years, n=440; with mean and standard deviation of 22.79±3.19. And for age 15 years, n=582; with mean and standard deviation of 21.21±2.64 reveals significantly different Body Mass Index among the groups($p<0.001$) which was revealed by applying Independent sample t test.

For the assessment of dental caries, Decayed-Missing-Filled teeth Index (DMFT) which was introduced by Klein, Palmer and Knutson in 1938 and modified by WHO was used. The DMF values were categorized under 0, 2, 3, ≥4 scores.

Table 6.1 shows distribution of DMFT scores gender wise(Fig. 4). Among males , samples with the score 0,1,2,3,≥4 were 215 (41.7%), 98 (19.0%),111(21.6%),54(10.5%),

37(7.2%) respectively. Among females, sample with the score 0,1,2,3,≥4 were 221 (43.6%), 122 (24.1%), 88 (17.4%) ,47 (9.3%), 29 (5.7%) respectively. The chi-square shows no significant association between the two groups. (X^2=6.752; p=0.15)

Table 6.2 shows Mean and Standard Deviation between Gender and DMFT. Which was found to be after the application of Mann- Whitney U test was 1.27±1.41 for males and 1.16±1.41 for females (p=0.153).

Table no. 7 shows Age- wise distribution of DMFT scores among the samples (Fig. 5). For age group 12 years; n=440 Mean and standard deviation were 1.14±1.40 and for age group 15 years; n=582 Mean and standard deviation were 1.27±1.41. With the application of Mann-Whitney U Test, the association between both the groups were found statistically non-significant (p=0.064).

Table 4.1. Gender –wise distribution among the various categories of Body Mass Index – Underweight, Healthy, Overweight, Obese.

		BMI							
		Underweight		Healthy		Overweight		Obese	
		N	%	N	%	N	%	N	%
Gender	Male	51	9.9%	296	57.5%	136	26.4%	32	6.2%
	Female	68	13.4%	257	50.7%	151	29.8%	31	6.1%
X^2=5.917; p=0.116; NS									

Table 4.2 . Mean Distribution of BMI gender wise

	Gender				p-value
	Male		Female		
	Mean	SD	Mean	SD	
BMI	21.94	2.99	21.84	2.99	0.6; NS

*Independent sample t-test

Table 5. Age- wise distribution of Body Mass index

	age						p-value
	12			15			
	Mean	SD	N	Mean	SD	N	
BMI	22.79	3.19	440	21.21	2.64	582	<0.001; Sig

*Independent sample t-test

Table 6.1 Distribution of DMFT scores gender wise

		Dmft									
		0		1		2		3		≥4	
		N	%	N	%	N	%	N	%	N	%
Gender	Male	215	41.7%	98	19.0%	111	21.6%	54	10.5%	37	7.2%
	Female	221	43.6%	122	24.1%	88	17.4%	47	9.3%	29	5.7%
X^2 =6.752; p=0.15; NS											

Table 6.2 Mean Distribution of DMFT scores gender wise

	Gender				p-value
	Male		Female		
	Mean	SD	Mean	SD	
DMFT	1.27	1.41	1.16	1.41	0.153; NS

*Mann- Whitney U test

Table7. Age- wise distribution of DMFT scores

	Age						p-value
	12			15			
	Mean	SD	N	Mean	SD	N	
DMFT	1.14	1.40	440	1.27	1.41	582	0.064; NS

*Mann- Whitney U test

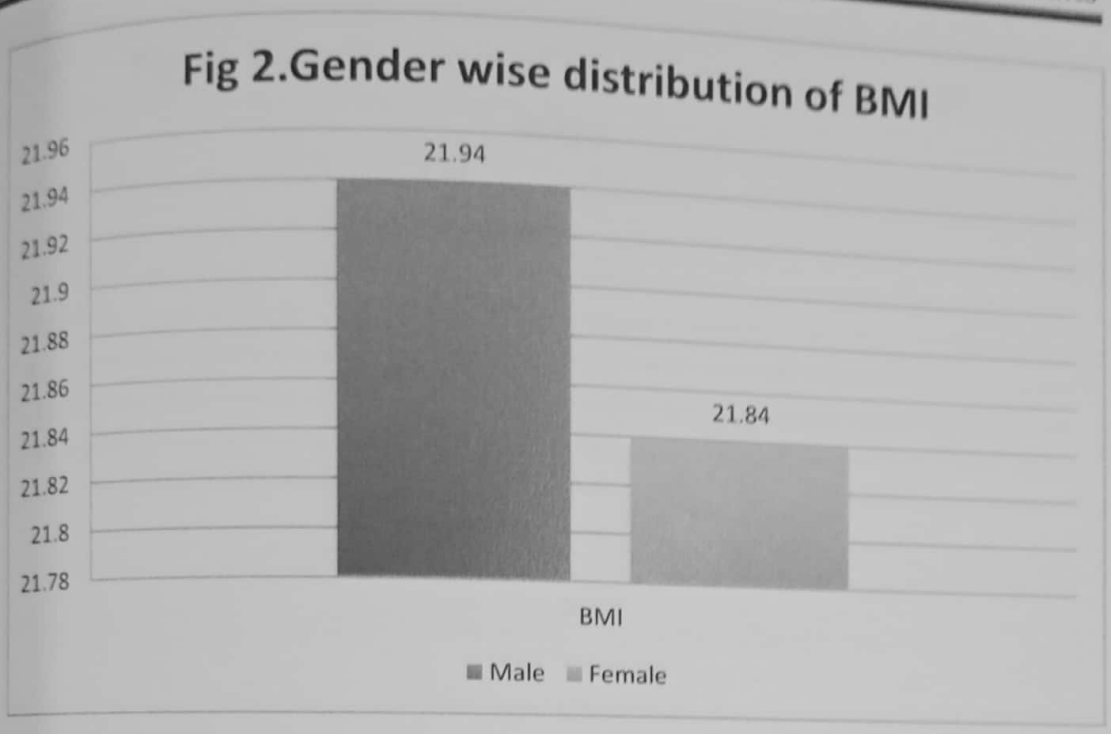


Fig 2.Gender wise distribution of BMI
21.96
21.94
21.92
21.9
21.88
21.86
21.84
21.82
21.8
21.78
21.94
21.84
BMI
Male
Female

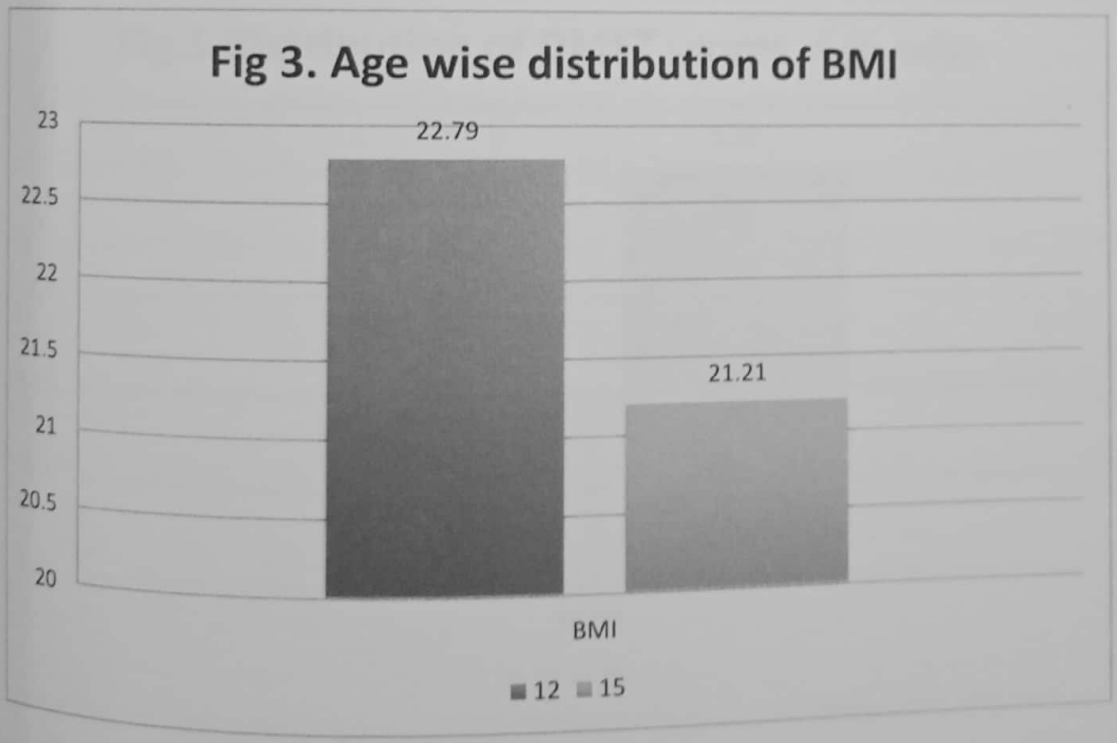


Fig 3. Age wise distribution of BMI
23
22.5
22
21.5
21
20.5
20
22.79
21.21
BMI
12
15

Fig.4 Distribution of DMFT scores gender wise

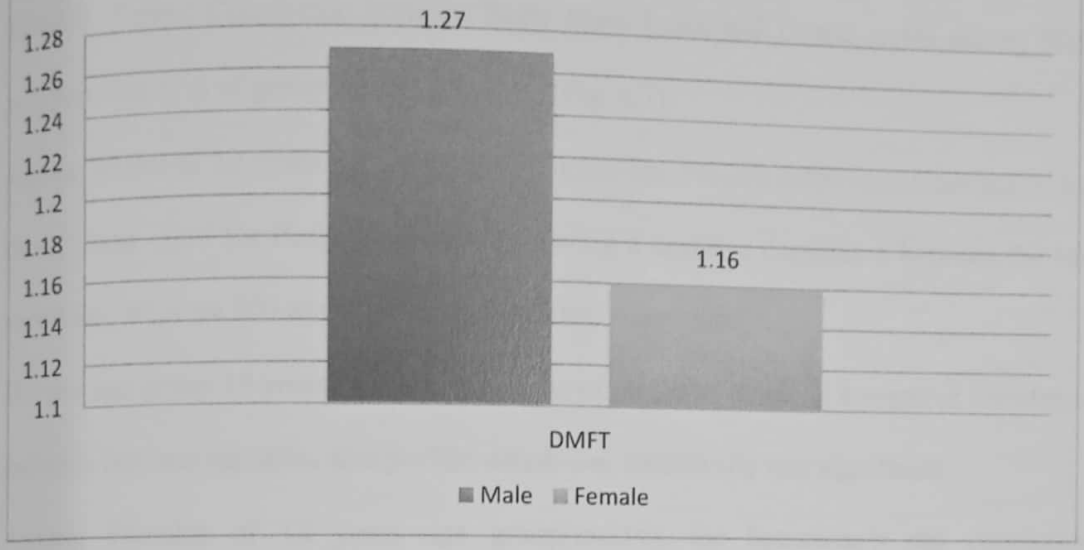
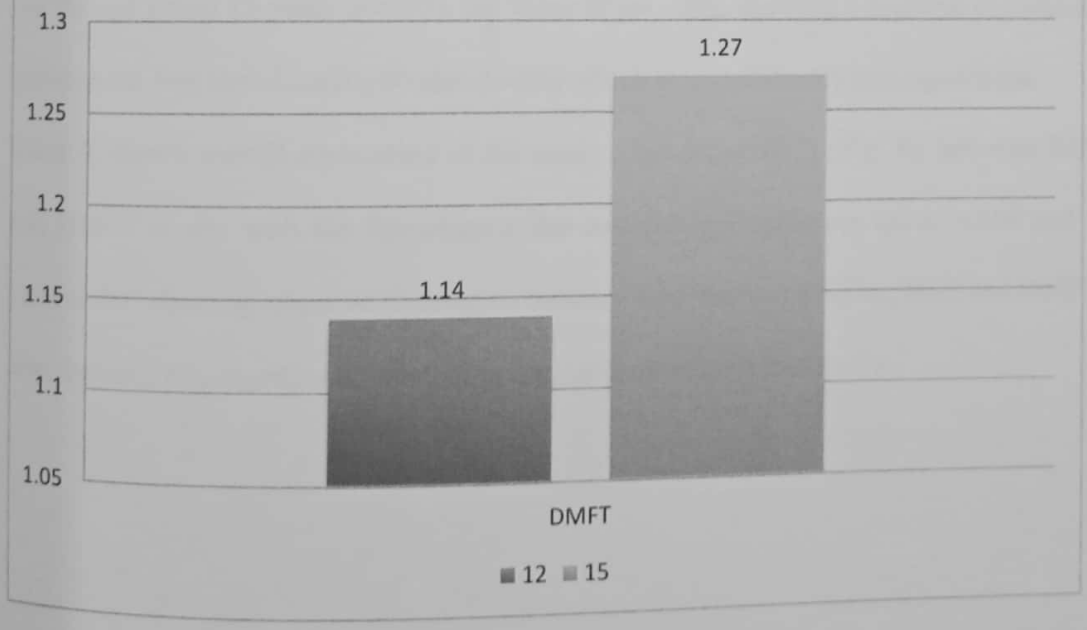


Fig.5 Distribution of DMFT scores Age-wise



For the calculation of correlation between the Body mass index and Dental Caries was done by implementing, Spearman's Correlation test.

Table 8. Shows Correlation between Body Mass Index and Dental caries among Male and Females of Age group 12 and 15 years. (Fig. 6,7)

Among Males of 12 years age group (n=226), the Spearman's correlation Coefficient i.e. rho (ρ) was -.026 for Body Mass Index showing a negative correlation between the two variables. With p=.700 non significant statistical association.

For the age group 15 years (n=289), the value of ρ= -.032, showing a negative correlation between the two variables also p=.586 which was statistically non significant.

Among Females of 12 years age group(n=214), the Spearman's rho correlation Coefficient (ρ) was -.009 for Body Mass Index showing a negative correlation between the two variables (Fig.9). With p=.899 non significant statistical association.

For the age group 15 years (n=293), the value of ρ= -.026, showing a negative correlation between the two variables(Fig.9) also p=.653 which was statistically non significant.

Table 9. shows overall correlation of the study subjects(n=1022) (Fig. 8), between BMI and DMFT scores with the Spearman's rho correlation Coefficient (ρ) of -.016 and p value= .600 showing negative correlation between both the variables ie., BMI and DMFT also showing non significant association during correlation respectively.

Table no. 8: Correlation between DMFT scores and BMI among males and female of 12 and 15 years of age group

Gender	age			DMFT
Male	12	BMI	Spearman's rho Correlation Coefficient	-.026
			p-value	.700; NS
			N	226
	15	BMI	Spearman's rho Correlation Coefficient	.032
			p-value	.586; NS
			N	289
Female	12	BMI	Spearman's rho Correlation Coefficient	-.009
			p-value	.899; NS
			N	214
	15	BMI	Spearman's rho Correlation Coefficient	-.026
			p-value	.653; NS
			N	293

Table no. 9: Correlation between DMFT scores and BMI among overall school going children

		Dmft
Bmi	Spearman's rho Correlation Coefficient	-.016
	p-value	.600; NS
	N	1022

Fig. 6. Graph showing correlation between DMFT Scores and BMI in Males

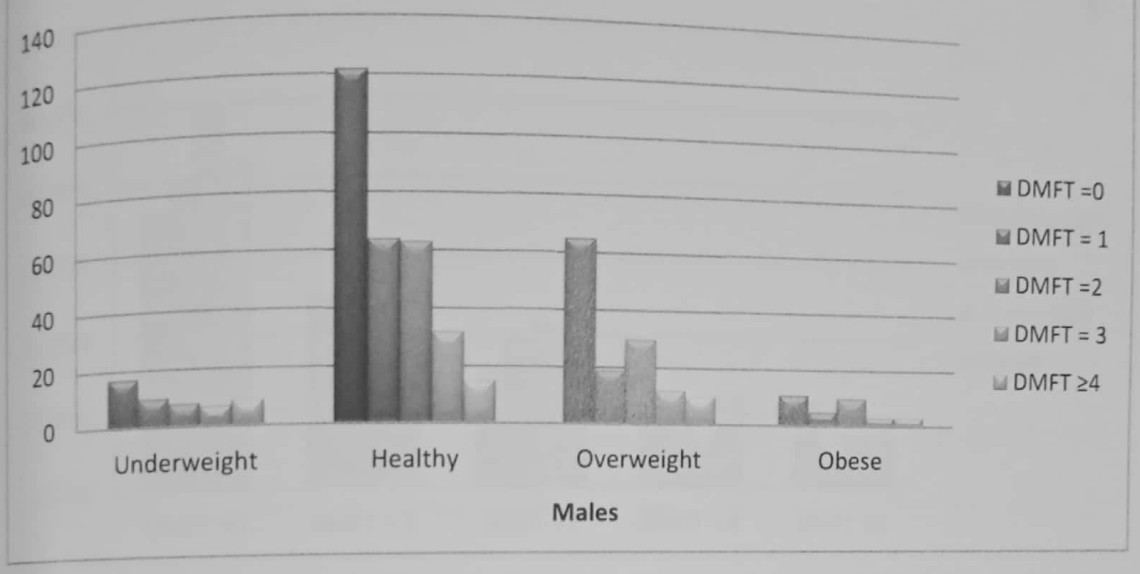
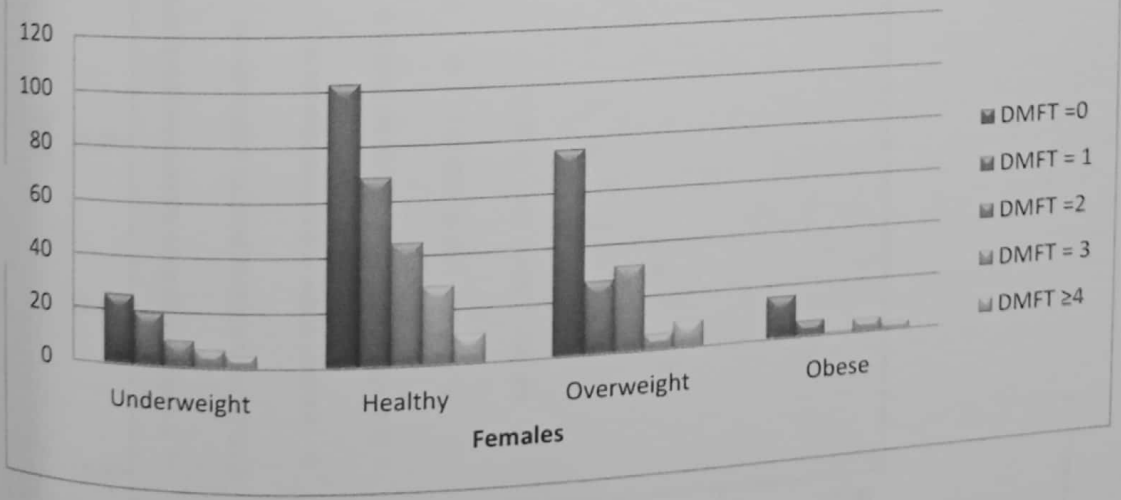


Fig.7. Graph showing correlation between DMFT Scores and BMI in Females



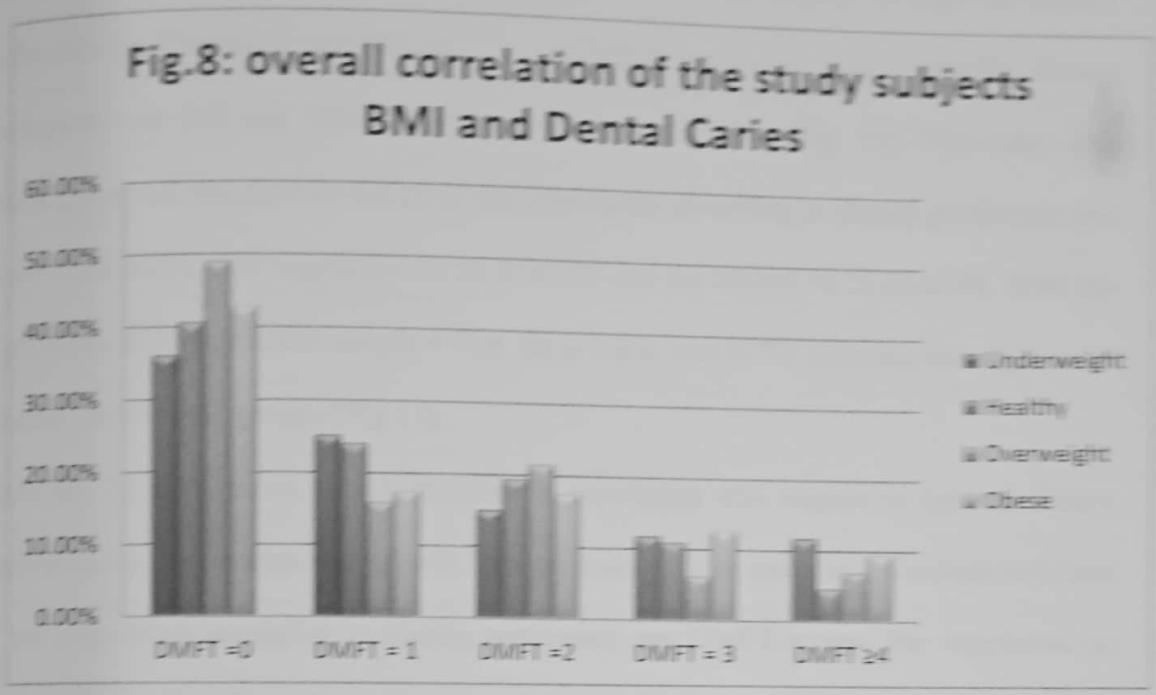


Fig. 9:Correlation between BMI and DMFT according to age group.

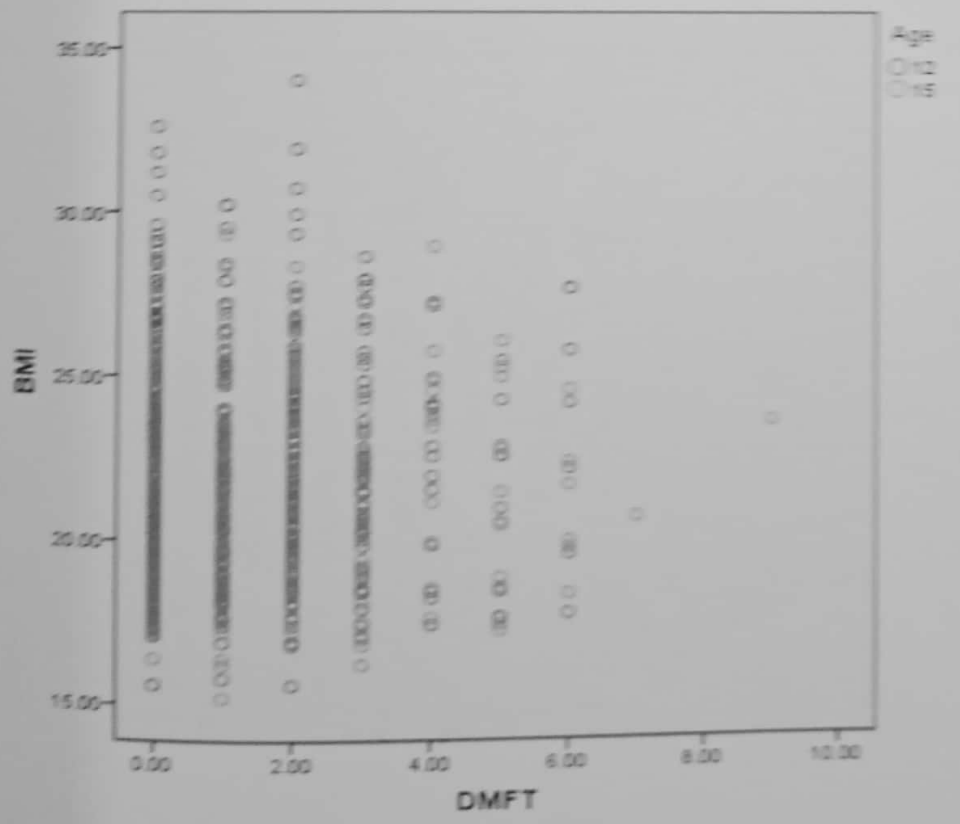


Table no. 10 shows the distribution of population with respect to type of dietary preference i.e. Vegetarian and Mixed in which population with vegetarian dietary preference was 548 and Mixed dietary preference was 474 (Fig. 10). This table also shows mean and standard deviation of the population according to dietary preference and Body Mass Index. For vegetarian its 21.91±3.00 and for Mixed its 21.86±2.98. With the application of Independent sample t Test the p value was 0.776 showing non significant relation between the groups (Fig 11).

Table no. 11 also shows the distribution of population with respect to type of dietary preference i.e. Vegetarian and Mixed. This table also shows mean and standard deviation of the population according to dietary preference and DMFT scores. For vegetarian its 1.27±1.47 and for Mixed its 1.15±1.34. With the application of Mann- Whitney U test the p value was 0.289 showing non significant relation between the groups (Fig 12).

Table no. 10: Distribution of population with respect to type of dietary preference and mean and standard deviation of the population according to dietary preference and Body Mass Index

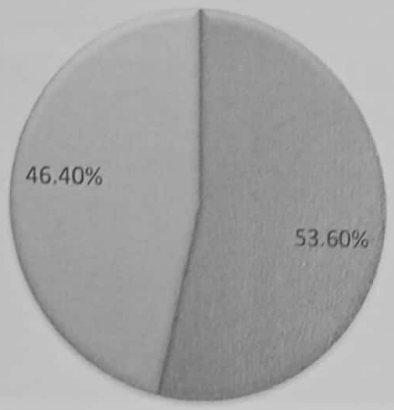
	diet						p-value
	Veg			Mixed			
	Mean	SD	N	Mean	SD	N	
BMI	21.91	3.00	548	21.86	2.98	474	0.776; NS

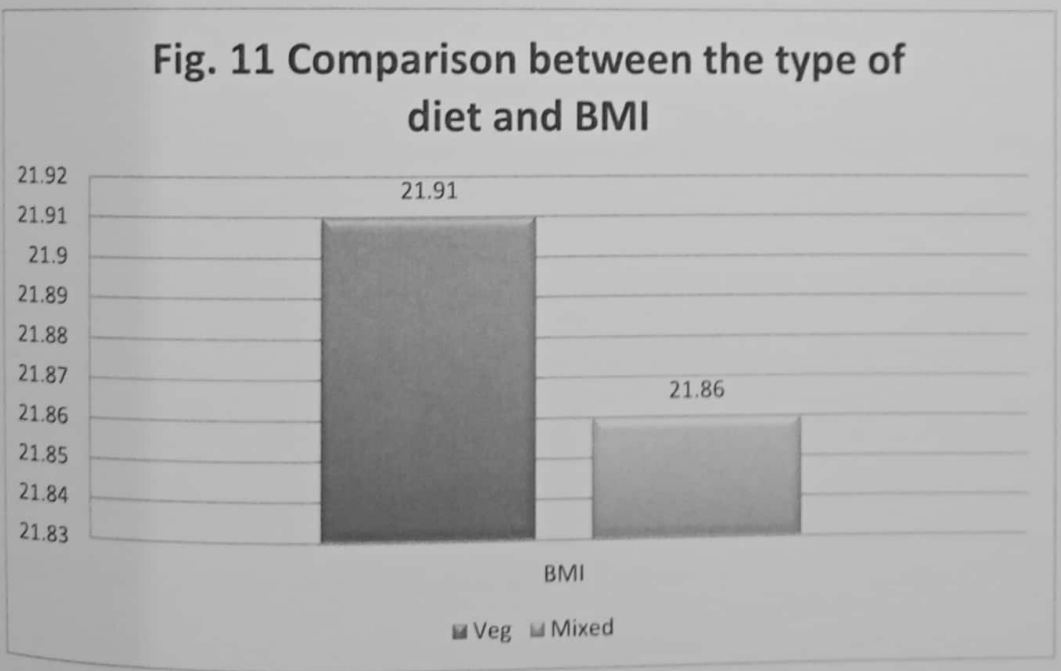
Table no. 11: Distribution of population with respect to type of dietary preference and mean and standard deviation of the population according to dietary preference and DMFT scores

	diet						p-value
	Veg			Mixed			
	Mean	SD	N	Mean	SD	N	
DMFT	1.27	1.47	548	1.15	1.34	474	0.289; NS

* Mann-Whitney U test

Fig. 10.The distribution of population with respect to type of dietary preference i.e. Vegetarian and Mixed





A self designed questionnaire was used to assess the oral hygiene practices of the study population which was a close ended 5 items questionnaire. Which included following questions:

Q1) How many time do you clean your teeth?

Once/Twice /Never

Q2) How do you clean your teeth?

Toothbrush/ Finger/ Neem stick/None

Q3) What material do you use for cleaning your teeth?

Toothpaste/Powder/ Others/ None

Q4) Visited Dentist for any treatment or consultation : Yes/No

Q5) Any other oral hygiene aids use –yes/No

Table no. 12 shows the age wise distribution of population according to oral hygiene practices.

Among 12 and 15 years, for Q1,opted for Once was 253(57.5%) ; 323(55.5%),for twice was 187(42.5%); 259(44.5%) ; for never 0(0%) for both the groups respectively. With the application of Chi-square test, the p-value= 0.523 which was statistically non significant.

For Q2, students who opted for using brush was 410(93.2%) ; 545(93.6%),for using finger was 28(6.4%); 35(6%) ; for using neem twig 2(.5%); 2(.5%) and for none 0(0%) for both the groups respectively. With the application of Chi-square test, the p-value= 0.935 which was statistically non significant.

For Q3, students opted for using tooth paste was 405 (92%) ; 565(97.1%),for using tooth powder was 30(6.8%); 17(2.9%) ; for other materials like using charcoal, sand etc

84.1%) ; 0 (0%), for none 0(0%) for both the groups respectively. The p value was <0.001 showing statistical significant difference between the two groups.

For Q4 , students who went for any dental treatment or consultation for the option yes 140 (31.8%) ; 131(22.5%) and for no was 300(68.2%); 451(77.5%) respectively. The p value was 0.001 showing statistically significant difference between the two groups.

For Q5, for the question use of any oral hygiene aids, students opted for yes was 58(13.2%); 133(22.9%) and for no 382(86.8%); 449 (77.1%) respectively. The p value was <0.001 showing statistically significant difference between the two groups.

Regarding the oral hygiene habits among males and females, table no. 13 shows gender wise distribution according to oral hygiene habits. For Q1,opted for Once was 229(56.9%) ; 283 (55.8%),for twice was 222(43.1%); 224 (44.2%) ; for never 0(0%) for both the groups respectively. With the application of Chi-square test, the p-value= 0.729 which was statistically non significant.

For Q2,gender wise who opted for using brush was 477(92.6%) ; 478 (94.3%),for using finger was 36 (7.0%); 27(5.3%) ; for using neem twig 2(.4%); 2(.4%) and for none 0(0%) for both the groups respectively. With the application of Chi-square test, the p-value= 0.542 which was statistically non significant.

For Q3, gender wise opted for using tooth paste was 491 (95.3%) ; 479(94.5%),for using tooth powder was 22(4.3%); 25(4.9%) ; for other materials like using charcoal, sand etc 2(.4%) ; 3 (.6%), for none 0(0%) for both the groups respectively. The p value was 0.788 showing no statistical significant difference between the two groups.

For Q4 , gender wise population who went for any dental treatment or consultation for the option yes 139 (27.0%) ; 132 (26.0%) and for no was 376(73.0%); 375(74.0%)

respectively. The p value was 0.73 showing no statistically significant difference between the two groups.

For Q5, for the question use of any oral hygiene aids, gender wise opted for yes was 89(17.3%) male ; 102 (20.1%)female and for no 426 (82.7%) males; 405 (79.9%) females respectively. The p value was 0.254 showing no statistically significant difference between the two groups.

Table no. 14 shows over all distribution of study population regarding oral hygiene practices (Fig 13).

Table no. 12: Age wise distribution of population according to oral hygiene practices.

		Age				p-value
		12		15		
		N	%	N	%	
Q1	Once	253	57.5%	323	55.5%	0.523; NS
	Twice	187	42.5%	259	44.5%	
	Never	0	.0%	0	.0%	
Q1_2	Brush	410	93.2%	545	93.6%	0.935; NS
	Finger	28	6.4%	35	6.0%	
	Neem	2	.5%	2	.3%	
	none	0	.0%	0	.0%	
Q1_3	Paste	405	92.0%	565	97.1%	<0.001; Sig
	Powder	30	6.8%	17	2.9%	
	other	5	1.1%	0	.0%	
	none	0	.0%	0	.0%	
Q1_4	Yes	140	31.8%	131	22.5%	0.001; Sig
	No	300	68.2%	451	77.5%	
Q1_5	Yes	58	13.2%	133	22.9%	<0.001; Sig
	No	382	86.8%	449	77.1%	

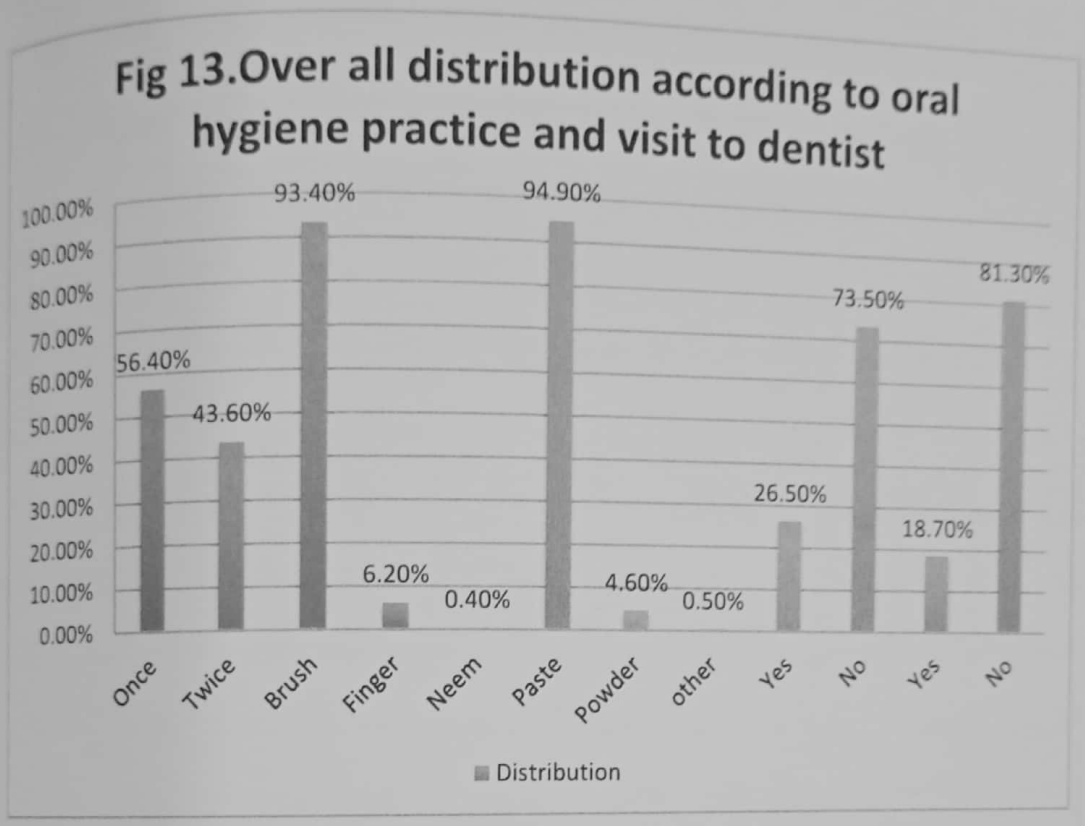


Fig 13.Over all distribution according to oral hygiene practice and visit to dentist
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
56.40%
43.60%
93.40%
6.20%
0.40%
94.90%
4.60%
0.50%
26.50%
73.50%
18.70%
81.30%
Once
Twice
Brush
Finger
Neem
Paste
Powder
other
Yes
No
Yes
No
Distribution

DISCUSSION

The study of Dental caries and its associated factors remains a daunting task to the health care professional due to its multifactorial nature. The modern concept of dental caries involves the interaction between genetic and environmental factors in which biological, social, behavioral, and psychological components are expressed in a highly complex and interactive manner. [54]

Dental caries is defined as a multi-factorial infectious disease caused by plaque bacteria, as a by-product of their metabolism of fermentable carbohydrates, which then diffuse into dental hard tissues and dissolve their mineral contents (Featherstone, 2008). The three essential factors for caries development are dental plaque (which can contain harmful bacteria), fermentable carbohydrate from the diet and susceptible tooth.

Tooth decay is the most prevalent chronic childhood disease affecting 50% of the first graders resulting in almost 52 million missed school hours. Oral health problems not only affect oral health but also have a psychological and emotional impact on the children as they interfere with learning and thus child does not grow up to the full potential.[1]

Obesity and overweight are defined as having an excess of body fat related to lean mass, With multifactorial conditions involving psychological, biochemical, metabolic, anatomic and social alterations.[55] At present obesity among children is a problem in both developed and less developed countries around the world. Furthermore, children who are at risk for being overweight during preschool years carry a greater probability of being overweight by age twelve.[56]

Overweight and obesity, defined as excess body fat compared to lean body mass, are a growing public-health problem in the world. Decreasing physical activity, increasing

sedentary lifestyles and dietary changes are factors strongly associated with the development of overweight and obesity. Studies have observed increase in being overweight in childhood and adolescence since the beginning of 2000, resulting in the increased risk of cardiovascular diseases, respiratory disorders and other chronic diseases during adulthood. Diet plays an important role in the increased prevalence of obesity due to the higher consumption of foods rich in fat and carbohydrates. [6]

Overweight in children has been associated with increased carbohydrate intake and may be related to prolong exposure to carbohydrates [57,58]. Given the causative relation between refined carbohydrates and dental caries, it is appropriate to hypothesize that overweight might also be a marker for dental caries in children and teenagers. [18]

Given that dental caries rates and BMI both measure diet-related health outcomes, an association between the two is not surprising as obesity and dental caries share common, modifiable, influences such as diet and life-style.[7] In the search for possible associations between childhood obesity and dental caries, it has been demonstrated that childhood obesity is responsible for an increase in dental caries and alterations in dental development.[14]

The type of food consumed is an important factor in the development or inhibition of Dental Caries, the frequency of food consumption is believed to be of greater significance.[59]

In the present study, a cross sectional study was performed to evaluate the association between the Dental caries and BMI among 12 and 15 years school going children of Lucknow city. The study was conducted a total of 1022 children aged 12 and 15 years (515 males and 507 females) belonging to both private and government schools were

examined for dental caries, BMI and compared with gender, type of diet preferences, and oral hygiene practices.

Oral hygiene practice of study population

Good oral health means having healthy teeth and gums along with bones and soft tissues in the mouth. Oral health contributes to physical, mental and social well being and the enjoyment of life's possibilities by allowing us to speak, eat and socialize without pain, discomfort or embarrassment (Canadian Dental Association, 2013). Oral hygiene, a key factor in maintaining good oral health, is the ability to maintain a clean mouth, free of plaque and tartar (hardened plaque) [67]. Oral hygiene is the practice of keeping the mouth and teeth clean to prevent dental problems, most commonly, dental caries, gingivitis, periodontal (gum) diseases and bad breath. [68]

In the present study, basic questions were asked about the oral hygiene practices to the students under study, the questions included how many times in a day they brush and materials used for brushing. Among 12 and 15 years of students, 57.5% (n= 253) and 55.5% (n=323) brushed their teeth once daily respectively. While among males and females 56.9% (n=293) and 55.8% (n=283) brushes their teeth once daily. These findings were found in accordance to the study conducted by Avinash J et al (2010) [69], in which 59.0% of males and 55.5% of females of 12 years brushed their teeth Once daily and 47.9% of males and 45.9% of females of 15 years brushes their teeth once daily.

For the question about materials using for brushing daily, among 12 and 15 years, 93.2% (n=410) and 93.6% (n=545) uses tooth brush and 92.0% (n= 405) and 97.1% (n= 565) uses tooth paste respectively. Considering gender wise distribution for the same, 92.6% (477) males and 94.3% (478) females uses tooth brush to maintain the oral hygiene. Also

95.3% (491) males and 94.5% (479)b females uses tooth paste. These findings was also find to be in accordance to study conducted by Avinash J et al (2010)[69] in which 94.9% of 12 year of males and 98.5% females uses tooth paste and 98.6% and 95.5% of male and female among 15 years respectively uses tooth paste. In a study conducted by M Priya et al [70] found 36.1% of study population brushes their teeth once daily while in present study 56.4% of study subjects brushes their teeth once daily. Use of tooth paste for oral hygiene in present study was 93.4% which was found in accordance to M Priya et al [70] in which 98.0% of study subject used tooth paste.

Question regarding visiting to dentist for any dental advice or treatment was also asked for which among study population had to give answer in "Yes or No". Among 12 and 15 years, only 140 (31.8%) and 131 (22.5%) said "yes" respectively while maximum of the study population i.e. 300 (68.2%) among 12 years and 451 (77.5%) among 15 years had never visited any dentist. This difference was found to be statistically significant (p=0.001).

Also Question regarding use of any other oral hygiene aids like mouth washes, tongue cleaner, dental floss etc. was also asked from the study population for which again they have answered in "yes or no". Among 12 and 15 years, only 58 (13.2%) and 133 (22.9%) said "yes" respectively while maximum of the study population i.e. 382 (86.8%) among 12 years and 449 (77.1%) among 15 years didn't use any oral hygiene aids other than tooth paste or powder. This difference was found to be statistically significant (p <0.001).

Influence of diet on BMI and Dental caries

The nutritional factors also have the definite influence on the oral health of the individuals. So there are 2 main groups.

1) Vegetarian diet group

2) Mixed diet group

These groups were divided on the basis of the daily intake of the food of the individuals. Human dentition is suitable for the vegetarian diet more over than the mixed diet. It is suitable for the vegetarian food more likely because of the broad surface of the molars which are more likely suitable to chew the fibrous food. The salivary pH also changes fast in the mixed diet people and saliva is somewhat acidic by pH. But in the vegetarian people the saliva is almost neutral by pH. Diet has a strong association with the body weight of the persons. [62,63]

In the present study, mean BMI related to type of diet intake was found to be 21. 91±3.00 among vegetarian (n= 548) and 21.86±4.98 (474). No statistical significant difference was found between the two (p=0.776). Our finding was found to be in accordance to the study conducted by Nihlani et al found association between BMI and type of diet in which mean and standard deviation between the two were 23.5173± 3.3713 among vegetarian and 22.9455± 3.2706 among mixed diet. [62] While in another study conducted by E A Spencer et al [66] BMI was significantly different between the diet groups, being highest in the meat-eaters (24.41 kg/m^2 in men, 23.52 kg/m^2 in women) and lowest in the vegans (22.49 kg/m^2 in men, 21.98 kg/m^2 in women).

In the present study, mean DMFT and type of diet found to be 1.27±1.47 among vegetarian and 1.15±1.34 among mixed diet with no statistically significant difference (p=0.289) while in a study conducted by Chopra et al [64] based on type of diet done on same age group, it was found that vegetarians had higher mean DMFT (1.72) as compared to children having mixed diet. In a study conducted by Ranjith Shetty et al in

adult population, it was found showed statistically significant differences between the two groups. The study revealed that the percentage of root caries was higher among the vegan diet (45%) compared to the mixed diet (26%). The mean root caries index (RCI) was found to be 11.31± 2.34.[65]

Prevalence of dental Caries and BMI

In the present study, mean BMI for the study population was, for 12 years 22.79±3.19 (n=440) and for 15 years 21.21±2.64 (n=582). Mean BMI was found to be significantly higher in 12 years of study population as compared to 15 years $p<0.001$. Although maximum population was under the "Healthy" category, i.e. 296 males (57.7%) and 257 (50.7%) females. 136 (26.4%) males and 151 (29.8%) females are under the "Overweight" category. In the present study 51 males (9.9%) and 68 females (13.4%) were underweight, which was found to be contradictory to the study performed by Narang R et al[1] on the similar population in which 99.1% of males and 74.53% females were found to be underweight. Also in a study conducted by Alm A et al [2] it was found that obese or overweight children were statistically higher than normal weight children. Since no statistical association between the BMI and type of Diet was found in the present study, sedentary lifestyle and inactivity may be a possible cause for overweight and obesity in the population. In present study total population under obese was 6.15% which was found in accordance with the Thippeswamy HM, et al. [3] They found 3.5% obese among overall population. In a study conducted by Sujal Mitul Parkar, Mansi Chokshi (2013)[9] found 653 (87.1%) underweight children.

For the prevalence of Dental caries, of the study population, for 12 years 1.14±1.40 (n=440) and for 15 years 1.27±1.41 (n=582) which was found to be not statistically

significant. Maximum of the population had "0" DMFT scores i.e. 215 males (41.7%) and 221 females (43.6%). Only 37 males and 29 females i.e. 7.2% and 5.7% had DMFT score "≥4". A similar study was conducted by Fotedar Shailee, GM Sogi, KR Sharma, Pruthi Nidhi [61] in which among 12 years, the mean Decayed Missing Filled Teeth was 0.62 ± 1.42 and it was 1.06 ± 2.93 at 15 years of age. Females had higher level of caries than males at both the ages. In the study conducted by Ahuja Ravindra (2014) [60] over Lucknow population in which there were 71.4% males and 28.6% females. Overall, 43.9% of the children examined had dental carries. The prevalence dental carried was lower among male children (43.3%) than females (45.2%). Average decayed teeth were 1.024±0.004, missing was 0.016±0.001 and filled was 0.002±0.000. The average DMFT was found to be 0.347±0.012.

The prevalence of caries is found low in the present study population, which was similar to the study conducted by Thippeswamy HM et al [3] in which the mean DMFT scores was found to be lower than WHO criteria. In India according to data from the National Oral Health Survey (2002-2003) the caries prevalence in children age 12 years was 53.8% and the mean DMFT was 1.8 [71] , this finding was in accordance to study. While in a study conducted by Khaled et al (2016) [19] found high prevalence of dental caries i.e. 6.55 among males. In present study, prevalence of high dental caries (DMFT score≥4) was 7.2% in males and 5.7% in females although the difference was not statistically significant but it was found slightly higher in males, which is found in accordance to a study conducted by Vázquez-Nava F[20] a slightly higher percentage of dental caries was found in boys (19.6 %) than in girls (16.4 %).

Association between BMI and Dental caries

Regarding the central issue of the study, no significant association was found between DMFT and BMI of overall study population i.e. p=.007 however Speraman Correlation Coefficient of -.026 denotes an inverse association between the two variables. Study conducted by Lempert SM et al (2014) [36] an inverse association between caries and subsequent changes in BMI was found, similarly in study of Yang F et al(2015)[44] an inverse relationship between body BMI and dmft/(dmft + DMFT) index was identified based on Pearson's correlation. In the present study no significant reverse association was found between the BMI and DMFT while a study conducted by Sujal Mitul Parkar, Mansi Chokshi (2013) [9] about 653 (87.1%) out of 750 children were underweight. There was a highly significant difference ($P < 0.001$) when the BMI and mean deft score was compared; however, when the BMI and mean DMFT score was compared the result was not reached to the significant level ($P > 0.05$). Significant correlation ($P < 0.001$) was observed between the different age groups and caries. There was a negative correlation between deft and BMI showed a significant result.

Also various studies have been reported in the literature that has not found any statistically significant association or inverse association between BMI and dental caries. Present study was found to be in accordance with Narang R et al (2010) [1] in which no significant association was found between DMFT and BMI (p=0.56),rather a negative correlation existed between DMFT and BMI (r=0.033) and was not statistically significant(p=0.42). Also, a study conducted by Naraksawat K et al (2007)[4] on 12 and 14 years school going children found a negative relationship between nutrtional status and the DMFT index, which increased when the nutritional status decreased(Spearman's rho

correlation =-0.140,p<0.001). In a systemic review performed by Alexandre Emidio Ribeiro Silva et al [6] has searched articles published between 2005 and January 2012 was performed in the Medline/PubMed, LILACS and Web of Science databases The review did not found sufficient evidence regarding the association between obesity and dental caries, and it did not clarify the possible role of diet and other possible effect modifiers on this association. In a similar, systemic review done by Merrilyn Hooley [7] All empirical papers that tested associations between body mass index and dental caries in child and adolescent populations (aged 0 to 18 years) were included published from 2004 to 2011. A non-linear association between body mass index and dental caries was found. Also study conducted by Chen W et al (1998) [16], Pinto A, Kim S, et al (2007)[17], F. Mojarad, M. Haeri Maybodi(2011) [18], Kottayi S et al (2016) [28], Freitas AR et al (2014) [32], Elangovan A, Mungara J, Joseph E(2012) [39], Tramini P et al(2009) [41], Sadeghi M, Alizadeh F (2007) [42] did not found any correlation or association between BMI and Dental Caries.

Although various studies have also reported their findings in the literature that contradict the finding of the present studies. Several studies have been conducted in India and also across the world to assesses the association between the BMI and dental caries and have found positive correlation between the two. Studies done by Alm A et al (2009) [2], Thippeswamy HM et al.(2009) [3], Forestier IB et al (2006) [5], Ali Bagherian, Mostafa Sadeghi (2013)[10] , Vineet Golchha, Pooja Sharma(2013) [15] , Khaled Alswat (2016) [19] , Aluckal E et al (2016) [26] have found a significant association between the dental caries and BMI.

LIMITATIONS AND RECOMMENDATIONS

LIMITATIONS AND RECOMMENDATION

- **Limitations**

1) The present study was a cross sectional survey, a cause-effective relationship over a limited period of time could not be established.
2) The present study was on limited sample size with narrow range of age. A larger sample with wider range of age would have depicted a clear picture of any association between dental caries and BMI overall and age wise specifically.
3) Socioeconomic status of the children would also have given a prospective to analyze nutritional status of the population.
4) The calorific value of the diet would have given an exact picture about diet influence on body weight.

- **Recommendations**

1) Obesity and dental caries are complex issues with multifactorial aetiology; our analysis was limited to type of diet preferences and demographic characteristics. Further follow-up studies are recommended to evaluate the triangular relationship between the consumption of sweet, caries and obesity.
2) It is suggested that dental professionals (pediatric dentists, general dentists, and oral hygienist) have important role in weight counseling, eating habits and food choices for the patients.
3) Public health measures should also be improved in dental care and dietary education in order to reduce the prevalence of both the diseases .

4) children found with dental caries should be appropriately dealt or referred. School nutritional programs must be included to improve the health and nutritional status of school children.

5) Further studies should be target on exploring other contributing factors to BMI like physical activity, genetic makeup of the child, and calorific quantification of dietary intake on a larger scale.

CONCLUSIONS

Form this study, it can be concluded that :-

- The correlation between the BMI and Dental Caries among school going children 12 and 15 years of Lucknow city was inversely correlated with no statistical significance.
- The study provided the evidence that majority of the children under the study was healthy.
- High mean BMI was found among females than males. Since no statistical association between type of diet and BMI was found it is suggested that high BMI may be because of inactivity and sedentary lifestyles.
- The oral hygiene practice among study population was found to be highly satisfactorily although knowledge about use of oral hygiene aids was found to be low.
- Further longitudinal studies are needed to explore the triangular association between BMI, Dental caries and nutritional status.

SUMMARY

The present study was conducted to determine the co-relation between Body mass Index and Dental Caries among 12 & 15 years school going children of Lucknow City. For the study purpose Lucknow was divided into four zones. From each zones, 5 schools were selected, i.e. a total of 20 schools which included government, aided and unaided private school.

Ethical clearance was obtained from the ethical clearance committee of Babu Banarasi Das University. Necessary permission was obtained from the government authorities and the head of the school. The study was carried out from the month January 2016 to April 2016.

A total of 1022 children were selected randomly from different schools of Lucknow city. There were 265 males (50.8%) and 250 females (49.2%) in private school. And there were 250 males (50.0%) and 250 (50.0%) females in Government school. A group of subjects were selected and examined who possessed collectively the full range of condition expected to assess in the survey. The examinations were done by the investigator who was assisted by an alert and co-operative recording clerk. Dental Caries was assessed using DMFT index (WHO criteria 1997) and BMI was assessed using the classification by Centre for Disease Control and Prevention (2006).

Among school children 12 years old were 257(49.2%) and 183(36.6%) in Private and Government Schools respectively. 15 years old were 265(50.8%) and 317(63.4%) in Private and Government Schools respectively. No statistical significant difference among Gender population and age wise population with the application of Chi-square test. ($p>0.589$) was found.

In the gender –wise distribution among the various categories – Underweight, Healthy, Overweight, Obese, underweight, healthy, overweight and obese among Male were 51(9.9%), 296 (57.7%), 136(26.4%) and 32(6.2%) respectively. Among Female under the categories of underweight, healthy, overweight and obese were 68(13.4%), 257(50.7%), 151(29.8%),31(6.1%) respectively. Difference among gender was found to be statistically not significant. Mean and Standard Deviation between Gender and BMI. Males it was 21.94±2.99 and for females it was 21.84±2.99. In the age- wise distribution of Body Mass index the mean standard deviation among 12 and 15 years were, 22.79±3.19 and 21.21±2.64 respectively which revealed statistically significant different Body Mass Index among the groups. For the distribution of dental caries among 12 years; n=440 Mean and standard deviation were 1.14±1.40 and for age group 15 years; n=582 Mean and standard deviation were 1.27±1.41 which was not statistically significant between the two groups.

The aim of the study was to find the correlation between the BMI and dental caries, for which calculation was done by implementing, Spearman's Correlation test. Among Males of 12 years age group(n=226), the Spearman's rho correlation Coefficient (ρ) was -.026 for Body Mass Index showing a negative correlation between the two variables. For the age group 15 years (n=289), the value of ρ= -.032, showing a negative correlation between the two variables. Among Females of 12 years age group(n=214), the Spearman's rho correlation Coefficient (ρ) was -.009 for Body Mass Index showing a negative correlation between the two variables. For the age group 15 years (n=293), the value of ρ= -.026, showing a negative correlation between the two variables although the association was not statistically significant. The overall correlation of the study subjects

(n=1022), between BMI and DMFT scores with the Spearman's rho correlation Coefficient (ρ) of -.016 and p value= .600 showing negative correlation between both the variables i.e., BMI and DMFT also showing non significant association during correlation respectively.

Type of diet preferences was also taken in account and an association between diet and BMI and DMFT scores were assessed. Vegetarian and Mixed in which population with vegetarian dietary preference was 548 and Mixed dietary preference was 474. Mean and standard deviation of the population according to dietary preference and Body Mass Index for vegetarian was 21.91±3.00 and for Mixed was 21.86±2.98 which was not found to be statistically significant. Standard deviation of the population according to dietary preference and DMFT scores for vegetarian it was 1.27±1.47 and for Mixed it was 1.15±1.34 which was not found to be statistically significant.

A self designed questionnaire was used to assess the oral hygiene practices of the study population. Among 12 and 15 years, for question many time do they clean their teeth, subjects who opted for Once was 253(57.5%) ; 323(55.5%),for twice was 187(42.5%); 259(44.5%) ; for never 0(0%) for both the groups respectively.

For the question. How do you clean your teeth?, students who opted for using brush were 410(93.2%) ; 545(93.6%),for using finger were 28(6.4%); 35(6%) ; for using neem twig 2(.5%); 2(.5%) and for none 0(0%) for both the groups respectively. For the question material used for cleaning their teeth, students opted for using tooth paste were 405 (92%) ; 565(97.1%),for using tooth powder were 30(6.8%); 17(2.9%) ; for other materials like using charcoal, sand etc 5(1.1%) ; 0 (0%), for none 0(0%) for both the groups respectively. For the question Visiting Dentist for any treatment or consultation,

students who went for any dental treatment or consultation for the option yes 140 (31.8%); 131(22.5%) and for no was 300(68.2%); 451(77.5%) respectively. For the question, use of any oral hygiene aids, gender wise population opted for yes was 89(17.3%); 102 (20.1%) and for no 426 (82.7%); 405 (79.9%) respectively.

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ANNEXURES

ANNEXURE-1

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES

DRPARTMENT OF PUBLIC HEALTH DENTISTRY

From

Dr. Amrita Rastogi

Post Graduate Student 1st Year

Department of Public Health Dentistry

BBD College of Dental Sciences, Lucknow

To,

The Principal,

Mr. Rakesh Chandra.

Wisdom Way Progress School.

Subject: Permission to conduct survey in school students of Lucknow City.

Respected Madam/Sir,

This is to bring to your kind notice that I wish to conduct a survey for dissertation **"CO-RELATION BETWEEN DENTAL CARIES AND BODY MASS INDEX AMONG 12&15 YEARS OLD SCHOOL GOING CHILDREN IN LUCKNOW CITY"**. The survey is being conducted for academic purpose. No invasive procedure shall be conducted.

I hereby request you to grant me permission to conduct the survey.

Thanking you

Yours Sincerely

Dr. Amrita Rastogi

Date:

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES

DRPARTMENT OF PUBLIC HEALTH DENTISTRY

From

Dr. Amrita Rastogi

Post Graduate Student 1st Year

Department of Public Health Dentistry

BBD College of Dental Sciences, Lucknow

To,

The Principal,

Mr. Arvind Yadav,

Avadh Academy, Lucknow.

Subject: Permission to conduct survey in school students of Lucknow City.

Respected Madam/Sir,

This is to bring to your kind notice that I wish to conduct a survey for dissertation **"CO-RELATION BETWEEN DENTAL CARIES AND BODY MASS INDEX AMONG 12&15 YEARS OLD SCHOOL GOING CHILDREN IN LUCKNOW CITY"**. The survey is being conducted for academic purpose. No invasive procedure shall be conducted.

I hereby request you to grant me permission to conduct the survey.

Thanking you

Yours Sincerely

Dr. Amrita Rastogi

Date:

Principal

ANNEXURE-2

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES

(A Faculty of Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow-227105

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **Co- Relation Between Dental Caries And Body Mass Index Among 12&15 Years Old School Going Children In Lucknow City** submitted by **Dr. Amrita Rastogi** Post graduate student from the Department of public Health dentistry as part of MDS Curriculum for the academic year **2014-2017** with the Accompanying proforma was reviewed by the institutional research committee present on **11th and 12th Dec 2014** at BBDCODS. The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the institutional ethics committee for granting ethical approval.

Prof. (Dr). Vivek Govila
Dean
Chairperson Institutional Research Committee

Babu Banarasi Das College of Dental Sciences
(A Faculty of Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the 3rd Institutional Ethics Sub Committee Meeting

IEC Code: 14 **BBDCODS/ 14 /2015**

Title of the Project: Co- Relation Between Dental Caries And Body Mass Index Among 12 & 15 Years Old School Going Children In Lucknow City.

Principal Investigator: Dr. Amrita Rastogi **Department:** Public Health Dentistry

Name and Address of the Institution: BBD College of Dental Sciences Lucknow

Type of Submission: New, MDS Protocol

Dear Dr. Amrita Rastogi

The Institutional Ethics Sub Committee meeting was held on 09-01-2015. The sub committee comprises following four members :

1.	Dr. Amrit Tandon Member	Prof. & Head, Deptt. of Prosthodontics BBDCODS, Lucknow.
2.	Dr. Jiji George Member	Prof., Deptt. of Oral Pathology & Microbiology, BBDCODS, Lucknow.
3.	Dr. Ashish Saini Member	Reader, Department of Periodontology, BBDCODS, Lucknow.
4.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Deptt. of Biochemistry, BBDCODS, Lucknow.

The committee reviewed and discussed your submitted documents of the research study in the meeting. The proposal was reviewed and thoroughly revised.

Decisions of the IEC : As per the recommendations I.E.C. has taken following decisions for the current protocol of study "Co- Relation Between Dental Caries And Body Mass Index Among 12 & 15 Years Old School Going Children In Lucknow City. "

The committee approved the above proposal from ethics point of view.

Lakshmi Bala 19/2/15
(Dr. Lakshmi Bala)
Member-Secretary IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences

Forwarded by:
(Dr. Vivek Govila)
Dean

DEAN
BBD College of Dental Sciences

ANNEXURE-3

DEPARTMENT OF PUBLIC HEALTH DENTISTRY

BABU BANARSI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW

"CO-RELATION BETWEEN DENTAL CARIES AND BODY MASS INDEX AMONG 12&15 YEARS OLD SCHOOL GOING CHILDREN IN LUCKNOW CITY."

Date: Serial no.:

Gender:

Date and Place of birth:

Complete Address:

Type of School Attending- Govt./Private

1) ORAL HYGIENE PRACTICE

i) How many time do you clean your teeth?

Once/Twice /Never

ii) How do you clean your teeth?

Toothbrush/ Finger/ Neem stick/None

iii) What material do you use for cleaning your teeth?

Toothpaste/Powder/ Others/ None

iv) Number of visits to dentist/year:

v) Any other oral hygiene aids use –yes/No

If yes, what.....

2) Dietary Habits:

Source of drinking water:

Type of Diet: Vegetarian/Mixed

3) **Body Mass Index:**

i)Weight(in kilograms):

ii)Height (in meters):

Formula for calculating BMI = $\frac{\text{Weight (kgs)}}{\{\text{Height(meters)}\}^2}$

1. underweight- defined as BMI for age<5th percentile.

2. normal weight-defined as BMI for age≥5th percentile but <85th percentile.

3. at risk of overweight-defined as BMI for age ≥85th percentile but <95th percentile.

4. overweight-defined as BMI for age ≥95th percentile.

BMI calculated=.....

Result-.....

4) Caries Index:

17	16	15	14	13	12	11	21	22	23	24	25	26	27
47	46	45	44	43	42	41	31	32	33	34	35	36	37

DT= ☐ MT= ☐ FT= ☐ DMFT score= ☐