ASSESSMENT OF FACTORS RELATED TO MOUTH BREATHING AND ITS EFFECTS ON CRANIOFACIAL STRUCTURES OF GROWING CHILDREN

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PEDIATRIC AND PREVENTIVE DENTISTRY

BY

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DECLARATION BY THE CANDIDATE

I hereby declare that dissertation entitled **"ASSESSMENT OF FACTORS RELATED TO MOUTH BREATHING AND ITS EFFECTS ON CRANIOFACIAL STRUCTURES OF GROWING CHILDREN"** is a bonafide and genuine research work carried out by me under the guidance of **DR. MONIKA RATHORE**, Professor and Head, Department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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DR. SADIA SALMAN

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ABSTRACT

Background: Mouth breathing is a form of breathing that replaces nasal breathing. It may be due to genetic factors, poor oral habits, or nasal obstruction, not only limited to adenoid/tonsil hypertrophy, nasal polyps and nasal septum The influence of mode of breathing on dentofacial growth and development has been a widely debated and controversial issue within dentists and otolaryngology for decades. Children with mouth breathing often have "adenoid faces", which are characterized as having upper lip incompetence, a retropositioned hyoid bone, a narrow upper dental arch, retropositioned mandibular incisors, an increased anterior face height, a narrow or "V"-shaped maxillary arch, an increased mandibular plane angle, and a posterior-rotated mandible in comparison with nasal breathers. After birth, lymphoid tissue typically grows rapidly, reaching its maximum size in early childhood and beginning to recede at the age of eight or ten. Its expansion in certain children may interfere with the pharyngeal airway, which can result in breathing, sleeping, eating, speaking, and swallowing issues.

Aim: To evaluate various parameters associated with mouth breathing and its effects on the craniofacial structure and pharyngeal width of children aged between 10-14 years**.**

Materials and Methods: The present study was conducted in 162 children divided into two groups. Group-1(Mouth breathers) consisted of 81 children and Group- II (Nasal breathers) consisted of 81 children. Various factors associated with mouth breathing were evaluated with the help of self designed questionnaire (consisted of 30 questions), filled out by guardian or parents accompanying the child. A lateral cephalogram was obtained for both the groups. Various variables present on the cephalogram were recorded to assess the dentofacial changes in mouth breathers and nasal breathers. Children with mouth breathing habits were referred to ENT surgeon for evaluation of pharyngeal airway space. A Posterior Anterior view of nasopharynx radiograph was done, to record the width of upper and lower pharyngeal airway space. On the basis of the dimension of width mouth breathers were further classified as habitual or anatomical mouth breathers.

Results: Based on the response obtained from selected questions which were classified into five factors, Factor 1 showed moderately strong correlation with other four factors. Factors 2 and 3 showed a strong correlation whereas factors 4 and 5 showed a weak correlation.

While comparing the linear variables values (Nasion-Menton, Sella-Articulae and Articulae-Gonion) showed statistical significance difference in the intergroup comparison, but the values (Nasion-Anterior Nasal Spine, Anterior Nasal Spine-Menton and Sella -Gonion) showed statistical non-significance result. Comparing angular variables values (Sella nasion-Gonion-Gnathion, Sella nasion and nasion supramental lines, Sella Nasion- nasion subspinal lines, nasion-subspinal and nasion-supramental lines, Sella Nasion-Palatal Plane, Palatal plane -Mandibular Plane and Articulae Gonion- Gonion Menton) between the two groups showed statistically significant result. A statistically significant difference is found in the upper airway and in lower airway between nasal and mouth breathers

Conclusion- Mouth breathing has harmful effects upon craniofacial structure of growing children. Therefore early diagnosis and treatment is important in young age to prevent future dental and physical problems

INTRODUCTION

Respiration is one of the body's vital functions; under normal physiological conditions, breathing occurs through the nose. When a child has mixed breathing i.e., the nose is supplemented by the mouth, this breathing pattern is referred to as mouth breathing.[1]

Multiple factors such as general conditions, lifestyle, eating habits and harmful effects such as local inflammation, allergies, postural problems, facial changes, incompetent lip seal and oral states also cause mouth breathing. One of the most common causes of chronic mouth breathing in children is allergic rhinitis (AR), which disrupts the normal growth of the facial skeleton and impairs overall mental well-being. Additionally, adenoid hypertrophy (AH) and nasal septum deviation can cause blockage of the nasal airway.[2]

Children with mouth breathing often have "adenoid faces", which are characterized as having upper lip incompetence, a retropositioned hyoid bone, a narrow upper dental arch, retropositioned mandibular incisors, an increased anterior face height, a narrow or "V"- shaped maxillary arch, an increased mandibular plane angle, and a posterior-rotated mandible in comparison with healthy controls.[3]

An early diagnosis is very essential for the correction of mouth breathing and also to avoid any associated conditions. The following diagnostic tests are performed to confirm the diagnosis of mouth breathing such as Mirror test **(**A double-sided mirror is held between the nose and the mouth. Fogging on the nasal side of the mirror indicates nasal breathing while fogging on the oral side indicates mouth breathing), Massler's water holding test (The patient's mouth is filled with water, and they are instructed to hold it there for two to three minutes), Massler and Zwemer butterfly test/cotton test (Butterfly shaped cotton strands are placed between the upper lip and nostrils. On exhalation, if the fibers flutter downwards, the patient is a nasal breather and if the fibers flutter upwards, the patient is a mouth breather). Rhinometry (total airflow through the nose and mouth can be quantified using inductive plethysmography) and cephalometrics **(**used to calculate the amount of nasopharyngeal space, size of adenoids and to know the skeletal patterns of the patient by taking various cephalometric angles).[2,3]

Mouth breathing is one of the most commonly cited characteristics of sleep-disordered breathing (SDB) during childhood, but symptoms are often inadequately recognized. Many patients with obstructive sleep apnea (OSA) are mouth-breathers.[5]

Constant drying of the gingiva also occurs in mouth breathers which causes irritation. There can be an accumulation of debris increasing bacterial population. Surface drying of the mucosa in mouth-breathing children may be related to halitosis, which is one of the most common complaints of mouth-breathing individuals.[4]

Speech of the mouth breathers is influenced by multiple factors such as inappropriate tongue posture, malocclusion, and/or impairments in facial growth and development. They experience difficulties with bilabial (/p/,/b/,/m/) and fricative (/f/,/v/,/s/,/z/) phonemes.[3,5]

The influence of the mode of breathing on dentofacial growth and development has been a widely debated and controversial issue among dentists for decades. According to Moss's theory of functional matrix, nasal breathing allows proper growth and development of craniofacial and dentofacial complex. Prolonged mouth breathing leads to muscular and postural alterations which, in turn, cause dentoskeletal changes. However, the relationship between nasal obstruction and craniofacial growth is not evident.[6]

The typical features considered characteristic of persons who have difficulty breathing through their nose and therefore may be diagnosed as having nasal obstruction, is represented by the long-face syndrome. The pediatrician often refers to this as "adenoidal facies." The pattern of this condition is considered to include an increase in lower facial height, lip apart posture, narrow alar base, and frequently self-reported "mouth breathing." Intraorally, the clinician might expect to find a narrow maxillary arch with a high palatal vault and a posterior cross bite with a Class II dental malocclusion.[7,8]

Chronic nasal obstruction, however, leads to mouth breathing, resulting in an anterior or a lower position of the tongue, half-opened lips, a lowered position of the mandible, and reduced orofacial muscle tonicity to compensate for the decrease in nasal airflow and facilitate respiration. As a result, there is disharmony in the growth and development of orofacial structures, including narrowing of the maxilla, underdevelopment of the mandible, alterations in the position of the head in relation to the neck, protrusion of the upper incisors, and distal position of the mandible in relation to the maxilla. In children, the phenomenon of mouth breathing is more important because it adversely influences growth and development.[8]

The pharynx is a fibromuscular tube lined by the mucous membrane with an approximate length of 12–14 cm. It is divided into three sections namely the nasopharynx, oropharynx, and laryngopharynx. The oral part is continuous behind the oral cavity, while the laryngeal

portion is localized behind the laryngeal inlet. Hence its dimensions are affected by the relative growth and patterns of persistent breathing mechanisms.[6]

Lymphoid tissue usually develops quickly after birth; it reaches peak size during early childhood and starts to regress at around 8 or 10 years of age. In some children, its overgrowth may obstruct the pharyngeal air tract, which may lead to respiratory, sleep, feeding, speech and swallowing disorders. The presence of any upper airway obstruction (such as nasal - sinusal pathologies or hypertrophy of Waldeyer's lymphatic ring) can lead the patient to breathe through the mouth. Mouth breathing increases the tendency towards narrow pharyngeal airway space in children.[9]

The patients who had adenoid and tonsillitis hypertrophy indicate that the absence of lip seal and lower tongue position, often found in the mouth breathers, interfere the airway permeability and could subsequently result in lymphatic-tissue increase of the pharynx and consequently result in a narrowing of the pharynx.[10]

Little attention has been paid to craniofacial and pharyngeal morphology in children with mouth breathing disorder even though there is limited information regarding why different facial morphology is seen in oral breathers.

Hence this study aimed to evaluate various parameters associated with mouth breathing and its effects on the craniofacial structure and pharyngeal width of children aged between 10 - 14 years.

AIM AND OBJECTIVES

AIM

To evaluate various parameters associated with mouth breathing and its effects on the craniofacial structure and pharyngeal width of children aged between 10-14 years.

OBJECTIVES

a) To evaluate various factors related to mouth breathing in children aged 10-14 years.

b) To evaluate and compare effect of mouth breathing upon craniofacial structure of growing children.

c) To evaluate effect of mode of breathing upon pharyngeal airway space in children aged between 10- 14 years.

REVIEW OF LITERATURE

1) **Frasson JMD, Magnani MBB, Nouer DF, Siqueira VCV, Lunardi N (2006)[11]** assessed the potential relationship between the respiratory pattern and the dimensions of the craniofacial structure, adding the angle SN-GoGn and the Y axis angle to the Tweed-Merrifield's cephalometric study as a baseline. The selected sample to this study comprised 50 teleradiographies. After the diagnosis of respiratory pattern, the sample was divided into two groups: control group, 25 teleradiographies of nasal breathers in lateral and natural positions of the head; experimental group, 25 teleradiographies of predominantly mouth breathers in lateral and natural positions of the head. The results were submitted to descriptive analysis. There was no significant difference between the group with nasal breathing and the group with predominantly mouth breathing for any of the studied variables.
2) **Abreu RR, Rocha RL, Lamounier JA, Guerra AF (2008)[12]** investigated the etiology, main clinical manifestations and other concurrent findings in mouth-breathing children aged 3 to 9 years and resident in the urban area of Abaeté (MG), Brazil. Clinical diagnosis of mouth-breathing was defined as a combination of snoring, sleeping with mouth open, drooling on the pillow and frequent or intermittent nasal obstruction. Children with a clinical diagnosis of mouth-breathing underwent nasal endoscopy, allergy skin tests and X ray of the rhinopharynx, full blood tests, eosinophil counts, total IgE assay and fecal parasitology. The main causes of mouth-breathing were: allergic rhinitis, enlarged adenoids, enlarged tonsils, and obstructive deviation of the nasal septum. The main clinical manifestations of mouth breathers were: sleeping with mouth open, snoring, itchy nose, drooling on the pillow, nocturnal sleep problems or agitated sleep, nasal obstruction, and irritability during the day.
3) **Raffat A, Hamid W (2009)[13]** evaluated the dentofacial morphology of adenoidal faces via linear and angular measurements on lateral cephalometric tracings and compared the extent of changes with the control group**.** Significant difference was seen among the readings showing a drastically vertical pattern of growth in dentofacial complex, except the palatal inclination angle. The findings suggested that the subjects with upper airway obstruction display excessive vertical dentofacial development, leading to a long-face

appearance. The condition needs to be prevented by early recognition and treatment of the causative factors.

4) **Harari D, Redlich M, Miri S, Hamud T, Gross M (2010)[14]** determined the effect of mouth breathing during childhood on craniofacial and dentofacial development compared to nasal breathing in malocclusion patients treated in the orthodontic clinic. Mouth breathers demonstrated considerable backward and downward rotation of the mandible, increased overjet, increase in the mandible plane angle, a higher palatal plane, and narrowing of both upper and lower arches at the level of canines and first molars compared to the nasal breathers group. The prevalence of a posterior crossbite was significantly more frequent in the mouth breather group than in nose breathers. An abnormal lip-to-tongue anterior oral seal was significantly more frequent in the mouth breathers group than in the nose breathers group.
5) **Izu SC, Itamoto CH, Hallinan MP, Pizarro GU, Tufik S, Pignatari S etal (2010)[15]** determined the prevalence of obstructive sleep disorders in mouth-breathing children and studied its correlation with otorhinolaryngological findings. primary snoring and OSAS are frequent findings in mouth-breathing children. The most frequent otorhinolaryngological disorder in children with OSAS was adenotonsillar hypertrophy with or without rhinitis
6) **Motta LJ, Bachiega JC, Guedes CC, Laranja LT, Bussadori SK (2011)[16]** determined whether there was a correlation between halitosis and mouth breathing in children. There was a significantly greater number of boys with the mouth-breathing pattern than girls. The occurrence of halitosis was high among the children evaluated, and there was a statistically significant association between halitosis and mouth breathing.
7) **Alves M, Baratieri C, Nojima LI, Nojima MC, Ruellas AC (2011)[17]** aimed to assess the pharyngeal airway space (PAS) in nasal and mouth-breathing children using cone beam computed tomography (CBCT). Volume, area, minimum axial area and linear measurements (PAS-NL, PAS-UP, PAS-OccL, PAS-UT, PAS-Bgo, PAS-ML, PAS- TP) of the pharyngeal airway of 50 children were obtained from the CBCT images. The means and standard deviations were compared according to sexes (28 male and 22 female) and breathers' patterns (25 nasal breathers and 25 mouth breathers). There were no statistically significant differences between all variables when compared by gender. Comparisons between nasal and mouth breathers showed significant differences only in two linear measurements.

8) **Souki BQ, Pimenta GB, Souki MQ, Franco LP, Becker HM, Pinto JA. (2012)** Aimed to report epidemiological data on the prevalence of malocclusion among a group of children, consecutively admitted at a referral mouth-breathing otorhinolaryngological (ENT) center. Non-obstructive mouth breathing was diagnosed in this sample. Posterior crossbite was detected in almost 30% of the children during primary and mixed dentitions and 48% in permanent dentition. During mixed and permanent dentitions, anterior open bite and class II malocclusion were highly prevalent. Univariate analysis showed no significant association between the type of obstruction (adenoids/tonsils obstructive hyperplasia or the presence of allergic rhinitis) and malocclusions (class II, anterior open bite and posterior crossbite).
9) **Souki BQ, Lopes PB, Pereira TBJ, Franco LP, Becker HMJ, Dauro D etal (2012)[18]** compared cephalometric values between nasal and oral breathing children and measured the upper and lower airway space in both groups. Mouth-breathing children seem to have an increase in anterior lower facial height, the hyoid bone in a more elevated position and higher tendency of having a class II malocclusion compared to nose-breathing children.
10) **Shrivastava T, Thomas M (2012)[19]** aimed to analyze the influence of mouth breathing on the head posture and to compare variations in head posture between physiologic breathing and mouth breathing groups. Craniofacial morphology in mouth breathers differs profoundly when compared to that of the physiologic breathers. There should be an early interception of mouth breathing in growing children as these postural changes if maintained for long periods, could lead to severe skeletal deformities
11) **Franco LP, Souki BQ, Pereira TBJ, Brito GM, Helena M, Becker GA etal (2013)[20]** aimed to investigate mandibular rotation and angular remodelling in mouth-breathing children compared with nasal-breathing children. The mouth-breathing children had a longer face cephalometric pattern compared with nasal-breathing children. No cranial deflection differences were observed. No changes in the vertical growth pattern were observed during the 1 year in either group. There were no statistically significant differences between the groups regarding apparent rotation. In comparison with the nasal breathers, the mouth breathers showed statistically significantly lower yearly rates of counterclockwise true rotation and angular remodelling.
12) **Mir CF, Korayem M, Heo G, Witmans M, Major PM, Major PW (2013)[21]** conducted a systematic review to consolidate the current knowledge regarding craniofacial morphological characteristics associated with obstructive sleep apnea syndrome (OSAS) in nonsyndromic pediatric patients. The authors identified nine articles. The values were

79.53 percent for the angle from the basion point to the sella nasion (SN) line, 89.54 percent for the angle between the SN and palatal plane lines and 96.82 percent for the angle between the mandibular plane and SN lines (MP-SN). Therefore, for these three variables, the authors conducted a random-effect model meta-analysis. For the remaining five variables (MP-SN, the angle from SN to Apoint, the angle from SN to B point [SNB], the angle from A point to nasion point to B point [ANB] and the angle from articulare point to gonion point to gnathion point), values were all less than 40 percent, and therefore the authors conducted a fixed-effects model meta-analysis. Three of the evaluated cephalometric variables (MP-SN, SNB and ANB) had statistically significant differences in comparison with those in a control group. Although the values of these variables were increased in children with OSAS, the results of the meta-analysis should be considered cautiously owing to the limited number of cephalometric variables included.

13) **Hitos SF, Arakaki R, Solec D, Weckx LLM (2014)[22]** assessed speech alterations in mouth-breathing children and correlated them with the respiratory type, etiology, gender, and age. Speech alterations were diagnosed in 31.2% of patients, unrelated to the respiratory type: oral or mixed. Increased frequency of articulatory disorders and more than one speech disorder were observed in males. Mouth breathing can affect speech development, socialization, and school performance. Early detection of mouth breathing is essential to prevent and minimize its negative effects on the overall development of individuals.

14) **Basheer B, Hegde KS, Bhat SS, Umar D, Baroudi K (2014)[23]** determined relevance of airway obstruction and its assumed effect on facial growth. Children with mouth- breathing habit exhibited a significant increase in lower incisor proclination, lip incompetency and convex facial profile. The presence of adenoids accentuated the facial convexity and mentolabial sulcus depth.

15) **Letıcia PF, Bernardo Q, Souki, Paula L, Tatiana BJ etal (2014)[24]** tested the null hypothesis that mouth-breathing (MB) children by distinct obstructive tissues present a similar cephalometric pattern. The cephalometric pattern of MB and NB children was not similar. Cephalometric measurements of the MB group differed according to the etiology of upper airway obstruction. Children with isolated hypertrophy of the palatine tonsils presented with a mandible that was positioned more forward and upward compared to children obstructed only by the enlarged adenoid.

16) **Romagosa DER, Gamboa MRP, Muniz YA, Oliva LMQ, Oliva DE, Naranjo ST (2014)[25]** identified risk factors associated with disfiguring oral habits, that produce occlusion disorders, language disorders, and the child's physical and emotional development, if they are maintained for long periods. There was a predominance of children with disfiguring oral habits in the female sex. At the age of 10 years, onychophagia predominated as a deforming habit. The presence of distorting oral habits was considered to be a risk for socio-biological variables of mothers and children, such as the low and overweight of the child at birth, the lack of experience of exclusive breastfeeding, and family disharmony. Family harmony, the child's birth weight, and breastfeeding experience were identified as risk factors associated with distorting oral habits.
17) **Lione R, Buongiorna M, Franchi L, Cozza P (2014)[26]** aimed of their study was to analyse the variations of maxillary arch size and palatal morphology in subjects with prolonged mouth-breathing due to allergic rhinitis when compared with control group with normal breathing pattern by using a three-dimensional analysis on digital casts. The transverse dimension of the upper arch was significantly smaller in mouth breathers thus confirming the influence of oral breathing on skeletal development with a significant constriction of the whole palate. Mouth breathers showed a higher and sharper palatal vault at the level of second deciduous molars and of first permanent molars. Children with mouth-breathing pattern showed a significant constriction of the maxillary arch and an increased palatal height when compared with subjects with normal breathing pattern.
18) **Pacheco MCT, Casagrande CF, Teixeira LP, Finck NS, Araújo MTND (2015)[27]** conducted semi-structured interviews with 110 orthodontists regarding their procedures for clinical evaluation of mouth breathing and their knowledge about sleep disorder breathing during childhood. Based on their answers, guidelines were developed and tested in 687 children aged between 6 to 12 years. Results showed that there was no standardization for clinical recognition of mouth breathing among orthodontists.
19) **Agostinho HA, Furtado IA, Silva FS, Ustrell TJ (2015)[28]** purpose of their study was to examine dental positions, skeletal effects and the pharyngeal airway space of children with chronic allergic rhinitis, when compared with a control group exhibiting a normal breathing pattern. Comparison between the allergic rhinitis and control group showed that there is an increased lower facial height, larger Frankfurt â mandibular plane angle and Sela-Nasion occlusal plane angle in children with chronic allergic rhinitis. This group also had a shorter maxillary and mandibular length, less overbite and decreased upper airway

space. Children with allergic rhinitis and mouth breathing have longer faces, shorter maxilla and mandibles and a narrowed pharyngeal airway space. No statistical differences between the groups in sagittal relationships or in dental inclinations were found.

20) **Rossi RC, Rossi NJ , Rossi NJC , Yamashita HK Pignatari SSN(2015)[29]** aimed to investigate the dental and skeletal variables associated with disturbances of craniofacial development in oral-breathing (OB) individuals and the probability that these variables were related to this condition. Based on their study dental and skeletal factors were associated with OB in children, and it seems that it becomes more severe until adolescence. But adults showed no associations between OB and skeletal factors, only in dental variables, indicating that there was no cause–effect relationship between the dental and skeletal factors and OB. The treatment of nose breathing patient should be multidisciplinary since OB remains even when dental and skeletal factors slow down.

21) **Yamaguchi H, Tada S, Nakanishi Y, Kawaminami S, Shin T, Tabata R etal. (2015)[30]** cross-sectional study evaluated the association of mouth breathing with the prevalence of various diseases in children. Preschool children older than 2 years were included. A questionnaire was given to parents/guardians at 13 nurseries in Tokushima City. After adjusting for a history of asthma and allergic rhinitis; family history of atopic dermatitis, asthma, allergic rhinitis; and nasal congestion; both mouth breathing during daytime and mouth breathing sleep were significantly associated with atopic dermatitis. In preschool children older than 2 years, both MBD and MBS may be associated with the onset or development of atopic dermatitis.

22) **Aouame AE, Daoui A, Quars FE (2016)[31]** aimed to perform a cephalometric analysis of the craniofacial parameters and natural head posture of mouth-breathers compared with control subjects, and to study the relationship between nose-breathing and the vertical dimension. Among the mouth-breathers, mandibular retrusion (SNB) in association with posterior rotation and more pronounced tilt of the mandibular plane (PP-MP) compared with the nasal breathers. These increases in anterior face height are often associated with retrognathism (and open bite).

23) **Rocha AC, Domínguez MEC, Reye AD (2017)[32]** evaluated the cephalometric differences in craniofacial structures and head posture between nasal breathing and oral breathing children and teenagers with a normal facial growth pattern. Oral breathing children showed less nasopharyngeal cross-sectional dimension, whereas other structures were similar to their nasal breathing counterparts. However, oral breathing teenagers exhibited a greater palate length (ANS-PNS), a higher vertical dimension in the lower

anterior face (Xi-ANS-Pm), and a lower position of the hyoid bone with respect to the mandibular plane (H-MP) than their nasal breathing counterparts. No statistically significant differences were found in head posture

24) **Saitoha I, Inadab E , Kaiharac Y , Nogamia Y , Murakamib D , Kubotab N et al (2018)[33]** conducted a study to clarify the relevant factors and the interrelationships between factors affecting mouth breathing disorders among children. 380 elementary school children from 6 to 12 years were surveyed. The questionnaire consisted of 44 questions regarding their daily health conditions and lifestyle habits and was completed by the guardians. Results showed factor analysis. 26 out of the 44 questions were selected, and they were classified into seven factors. Factors 1–7 were defined as "Incompetent lip seal", "Diseases of the nose and throat", "Eating and drinking habits", "Bad breath", "Problems with swallowing and chewing", "Condition of teeth and gums", and "Dry lips", respectively.

25) **Neiva PD, Kirkwood RN, Mendes PL, Zabjek K, Becker HG, Mathur S (2018)[34]** assessed the methodological quality of studies and determined if there is an association between mouth breathing and postural disorders in children. Two studies used the New York State Postural Rating Scale, seven used photography and one used motion capture to measure posture. The methods used to analyze the data included the Postural Analysis Software (SAPO), Fisiometer, ALCimagem and routines in MATLAB program. Quality assessment resulted in low scores for all the studies. The main areas of weakness were a clear description of the participants, the methods used to access posture, the principal confounders and lack of power analysis. External and internal validity were also threatened by the lack of a representative sample and blinding of the participants and assessors, respectively. The review provided low evidence that mouth-breathing pattern in children between the ages 5-14 years was associated with postural deviations.

26) **Arali V, Ajitha M, Nagarathna C (2019)[36]** evaluated the size of the adenoid and thickness of soft palate in the test group consisting of children with mouth breathing habit and compare it with the control group which included children without mouth breathing habits. Also correlated with the occurrence of pediatric obstructive sleep apnea among such children. Children with medium and large-sized adenoids had an increased susceptibility to pediatric obstructive sleep apnea.

27) **Zheng W, Zhang X, Dong J, He J (2019)**[37] carried out systematic review and meta-analysis to assessed the association between mouth breathing and facial morphological characteristics in adolescents. Mouth breathers demonstrated an increased mandibular plane angle, total and lower anterior facial height and decreased posterior facial height. Within the limitations of the study, the results indicated that mouth breathers tended to have a retrognathic maxilla and mandible, vertical growth pattern with high mandibular plane angle, downward and backward rotation of the mandible and an increase in total and lower anterior facial height and decrease in posterior facial height. Further high- quality studies were required to strengthen the evidence.

28) **Silva T. D, Valle AES, Andrade R, Souza LA, Souza H.G.R, Tamburini ABF (2019)**[38] study aimed to perform a critical review of part of the literature to explain the mechanisms as well as the importance of oral respirator diagnosis. Mouth breathing occurs by narrowing or obstruction of the airways that prevent the passage of air, causing the individual to breathe through the mouth. Hypertrophy of the tonsils and adenoids were common causes, being frequently diagnosed in children between 4 and 11 years of age. The habit of mouth breathing presents clinical manifestations peculiar to it, which imply biological, physiological, orthopedic and aesthetic alterations.

29) **E Inada, I Saitoh, Y Kaihara, D Murakami, Y Nogami, N Kubota etal. (2019)**[39] conducted a study to examine whether incompetent lip seal (ILS) influences the form of facial soft tissue. The images of the subjects' facial surface were obtained with a three-dimensional laser scanner. Coordinates of 16 facial landmarks were established and identified on the three-dimensional facial images, and the differences between children with and without Incompetent lip seal were measured. Children with incompetent lip seal had anteriorly prominent subnasales and flatter noses. The influence of incompetent lip seal on facial form begins to appear even before 3 years of age.

30) **Zheng W, Zhang X, Dong J, Jianming H (2020)**[40] this systematic review and meta-analysis were performed to assessed the association between mouth breathing and facial morphological characteristics in children and adolescents. Mouth breathers tended to have a retrognathic maxilla and mandible, vertical growth pattern with high mandibular plane angle, downward and backward rotation of the mandible and an increase in total and lower anterior facial height and decrease in posterior facial height. Further high-quality studies are required to strengthen the evidence on this subject.

31) **Finger V, Henríquez CR**, **Muñoz DA**, **Barraza A (2020)**[41] aimed to clinically characterized and determined the prevalence of mouth breathing in the pediatric population. Prevalence of mouth breathers was 18,80%, mixed breathers 17,49%, and nasal breathers 63,71%. The most common facial characteristic was the presence of eye bags and dry lips. The maximum nasal inhalation flow (PNIF) average registered in mouth breathing patients was 54,4 L/min, meanwhile in nasal breathing patients was 84,7 L/min. Early intervention of pediatricians is transcendental for the diagnosis, derivation, and treatment of this syndrome to limit future complications.

32) **Lee DW, Kim JG, Yang YM (2020)**[42] investigated the association of mouth breathing with atopic dermatitis and oral health in Korean schoolchildren aged 8-11 years. A moderate relationship was observed between mouth breathing and atopic dermatitis , whereas no association was found between mouth breathing and dental caries in children. Mouth breathing during sleep (MBS) was closely related to allergic diseases and other respiratory diseases. Furthermore, mouth breathing was associated with child's tonsillitis and was identified as a possible risk factor for class II dental malocclusion. The influence of mouth breathing on dental caries remains uncertain. An intervention trial was required to evaluate whether the prevention of mouth breathing can reduce the risk of allergic diseases.

33) **Zhao Z, Zheng L, Huang X, Li C, Liu J Hu Y (2021)**[43] purpose of this systematic review and meta-analysis was to assess the effect of mouth breathing on facial skeletal development and malocclusion in children. Mandible and maxilla rotated backward and downward, and the occlusal plane was steep. In addition, mouth breathing presented a tendency for labial inclination of the upper anterior teeth. Airway stenosis was common in mouth-breathing children.

34) **Li J, Zhao Z, Zheng L etal (2022)**[44] examined the influence of mouth breathing on maxillofacial and airway development in children and adolescents with different cervical vertebral maturation stages. Maxillofacial hard tissue, soft tissue and airway measurements were obtained using both manual and digital techniques. Independent samples t-test was performed to compare the difference between the measured indexes and the standard values. Mouth breathing had a real effect on maxillofacial and airway development, which differed among mouth-breathing children and adolescents with different cervical vertebral maturation.

35) **Lin L, Zhao T, Qin D, Hua F, He H (2022)[45]** aimed to provide a summary of recent publications about the impact of mouth breathing on dentofacial development, described their consistencies and differences, and briefly discuss potential reasons behind inconsistent findings. For more than 100 years since mouth breathing was proposed, its influence on the malocclusion and morphological and functional development of the maxillofacial region has been controversial. What remains unknown is the precise contribution of genetic and environmental factors. In recent years, new relevant studies elaborate their findings and offer different opinions. What counts is that there is no high- quality evidence elucidating the effects of mouth breathing on dentofacial development and health, which is also due to the lack of well-designed clinical studies. The mechanism of mouth-breathing impact on the development of the dental and craniofacial region is still unclear. Early screening of children's potential mouth breathing habits can help to interrupt it before their growth spurt, thus avoiding possible adverse impacts.

36) **Inada E, Saitoh I, Kaihara Y, Murakami D, Nogami Y, Kiyokawa Y etal. (2022)[46]** evaluated the relevant factors affecting mouth breathing syndrome in children and examined the influence of an incompetent lip seal on facial soft tissue form in preschool-aged children. They concluded that "incompetent lip seal" is a relevant factor affecting mouth breathing syndrome. The multiple factors such as general conditions, lifestyle, and eating habits may interact with one another. Thus, the pre-school age may represent the early stage of mouth breathing syndrome development because it is an important period of lip-closing strength. These findings indicate the importance of early diagnosis and treatment of mouth breathing syndrome

37) **Alhazmi W.A(2022)[47]** objective of their study was to determine the most common speech impairments among mouth breathing (MB) children and to assessed the relationship between them in terms of etiology, gender, clinical symptoms, clinical findings, and dental traits. Mouth breathing was associated with allergic rhinitis, Adenoid hypertrophy, functional mouth breathing, and orofacial myofunctional disorders (OMD). AR was the most common etiology, followed by FM. Further, 81.7% of the children had speech disorders such as speech sound problems, fluency disorders, and voice disorders. A statistically significant association was found between etiology, OMD, and speech alterations. Males had a statistically highly significant frequency of speech abnormalities than females. Frontal lisp was found in 36.1%, followed by stuttering (19.2%). In 10.6% of the children, two or more speech impediments occurred simultaneously. There was also

a statistically significant association between various speech abnormalities and malocclusion.

MATERIALS AND METHODS

The present study was conducted in the Department of Pediatric and Preventive Dentistry, BBDCODS, BBDU, Lucknow after obtaining ethical approval from the University ethical committee. The study was conducted with an aim to evaluate various parameters associated with mouth breathing and its effects on the craniofacial structure and pharyngeal width of growing children.

MATERIALS

- Lateral cephalogram
- Double-sided mouth mirror (Waldent)
- Cotton rolls
- Water
- Gloves (Surgi-Tech)
- Tweezer (GDC)
- Mask (Green Guavas)
- Mouth mirror (GDC)
- Explorer (GDC)
- Probe (GDC)

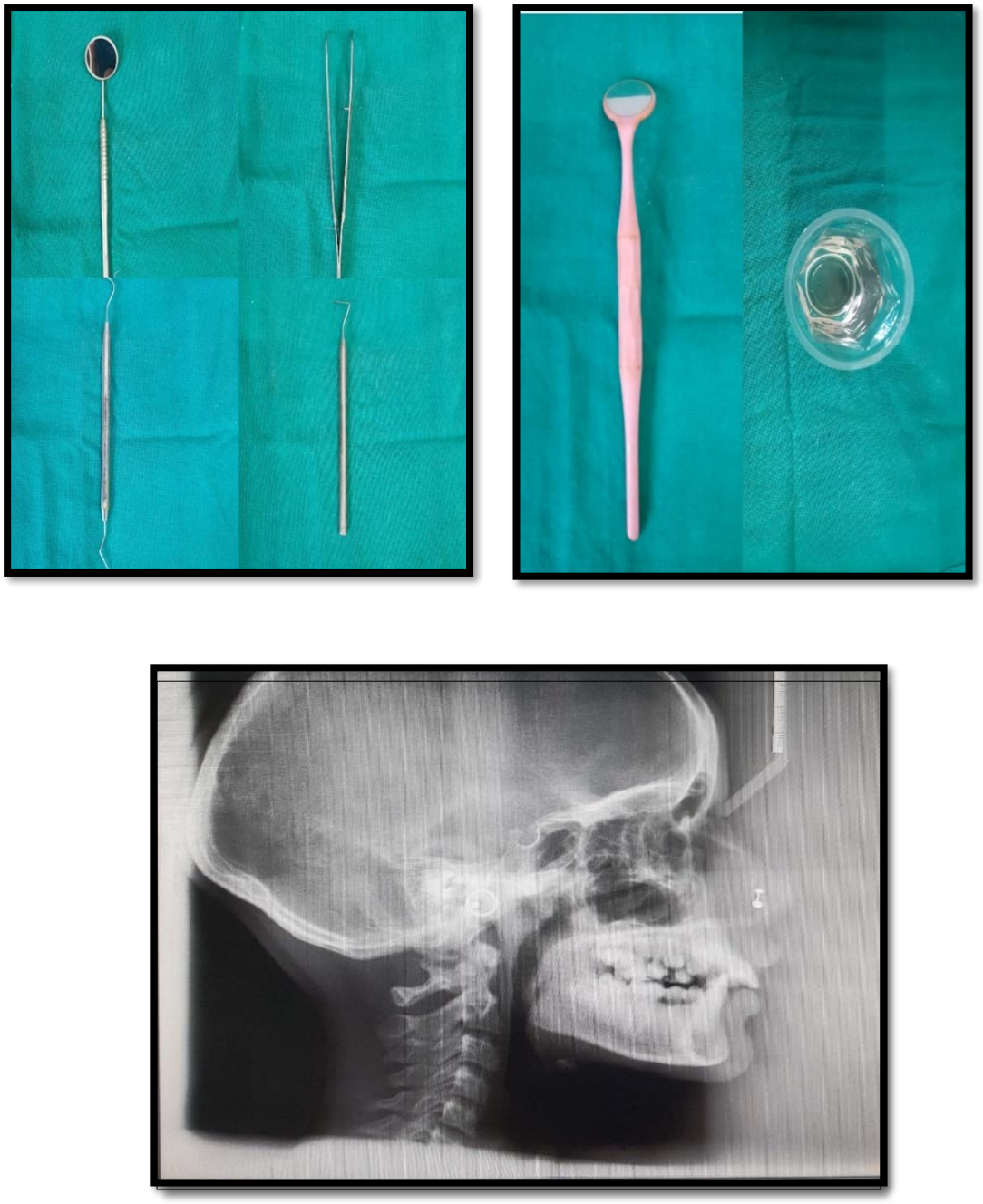


Figure-1 Dignostics

STUDY SUBJECTS- Children aged 10- 14 years including both genders.

STUDY SAMPLE AND SIZE

Healthy subjects aged between 10-14 years were included in the study. Sample size estimation was done by using **nMaster2.0 (CMC, Vellore)**

A minimum total sample size of 162 subjects was found to be sufficient for an alpha of 0.05, power of 80%

Hypothesis testing for two means (equal variances)

Standard deviation in group I = 8.2

Standard deviation in group II = 6.1

Mean difference = 2

Effect size = 0.27972027972028

Alpha Error(%) = 5

Power(%)= 80

sided = 1

Required sample size per group = 162

ELIGIBILITY CRITERIA:

INCLUSION CRITERIA:

- Healthy children aged between 10 to 14 years
- Children with normal growth pattern appearance; free of any neurologic or congenital alternations, genetic syndrome or craniofacial malformation.
- Children whose parents gave consent to participate in the study

EXCLUSION CRITERIA:

- Children with any upper airway surgery
- Children who had previous orthodontic treatment or orthopedic procedures.
- Un-cooperative children

SAMPLING METHOD

Subjects were clinically assessed for features such as lip seal, postural changes, dark circles, long face, anterior open bite, high narrow palate, and gingivitis in maxillary incisors and breathing pattern was evaluated in each subject and they were categorized as nasal breather or mouth breather. Subjects with mouth breathing patterns were included in group I and nasal breathers were included in group II.

STUDY DESIGN

The study population comprised parents and children aged 10 to 14 who had visited the outpatient Department of Pediatric and Preventive Dentistry for routine dental procedures. Consent was obtained from the parents of each subject through consent forms outlining the purpose and benefits of the study, following ethical approval.

Each subject was clinically examined for characteristics such as lip seal, postural changes, dark circles, long face, anterior open bite, high narrow palate and gingivitis in maxillary incisors. Water-holding test and double sided mouth mirror test were performed on each subject that confirmed mouth breathing habits. Based on the result of the tests children were equally divided into two groups, children with mouth breathing patterns were included in group I (consisting of 81 children) and nasal breathers were included in group II (consisting of 81 children). A lateral cephalogram was taken in both groups to evaluate various parameters associated with mouth breathing. Subjects falling in group I were referred to an ENT surgeon for evaluation of the nasopharynx pathway. Guardians of participants in each group were asked to fill self-designed questionnaire consisting of 30 questions for evaluation of factors related to mouth breathing. **(Annexure 1).**

The following items were evaluated in the study-

a) Evaluation of factors related to mouth breathing through a self-designed questionnaire
b) Effect upon craniofacial structure of growing children due to mouth breathing
c) Affect of mode of breathing upon pharyngeal airway space.

METHODOLOGY

This study was conducted on 162 children who visited the Department of Pediatric and Preventive Dentistry of BBDCODS and from various school camps. Certain characteristics like lip seal, postural changes, dark circles, long face, anterior open bite, high narrow palate and gingivitis in maxillary incisors were clinically examined. Mouth breathing diagnostic tests like water holding and double-side mirror tests were performed on each 162 subjects. During the water-holding test patient's 3/4th mouth was filled with water and he or she was instructed to hold the water in the mouth and try to breathe through the nose. Water was held in the mouth for approximately 3-4 minutes and this cycle was repeated 3 times. If the child was able to hold water comfortably for a given time during each cycle then the test was considered negative and the patient was counted as nasal breathers. If a patient was uncomfortable during the test and struggled to breathe through their nose then the test was said to be positive and the patient was considered a mouth breather**. (figure-2)** A double-sided mirror was held between the nose and the mouth. Fogging on the nasal side of the mirror indicates nasal breathing while fogging on the oral side indicates mouth breathing.[5] **(figure-3)**

Figure -2 Water holding test

Figure -3 Double sided mouth mirror

A self-designed questionnaire **(Annexure-2)** consisting of 30 questions was filled out by parents or guardians of each subject to evaluate factors related to mouth breathing. Craniofacial morphology of both mouth breathers and nasal breathers was assessed using a lateral cephalogram. The various linear and angular measurements

(Annexure- 1) present on cephalometric tracings were recorded in all the subjects to compare cephalometric variables of both groups. This helped in evaluating changes upon craniofacial of growing children with mouth breathing habits.

Mouth-breathing patients were further referred to ENT to differentiate mouth breathers as habitual or anatomical mouth breathers. The width of the pharyngeal airway was assessed.

Evaluation of factors related to mouth breathing through self-designed questionnaire. Guardians of participants were asked to fill self-designed questionnaire consisting of 30 questions. **(Figure - 4) (Annexure 1)**. Questionnaire was based on conditions that might be linked to the mouth-breathing syndrome.

Figure- 4

Children age group between 10-14 years were surveyed. Based on the answers of questions (yes, no or think so) 22 of the 30 items were classified into five factors. Factor 1 was defined as "Open Mouth and Bad Breath", based on the questions Factor 2 was defined as "Incompetent Lip seal and Diseases of Teeth" Similarly, based on the factor loading and content of the other questions, Factors 3, 4, 5, were defined as "Problem with sleep", " stuffed nose", and Difficulty in eating and chewing" respectively.

The results of the questionnaire suggested the importance of early diagnosis and treatment of mouth breathing syndrome.

Evaluation of effects of mouth breathing on craniofacial structure of children. Cephalometric analysis was done to evaluate the effects of mouth breathing on the craniofacial structure. The cases were selected for the present study having no history of

orthodontic, oral or nasal surgical treatment or bone deformity and muscular dystrophy. The cases with a history of birth injuries and past illnesses were excluded from the study. Craniofacial morphology of both mouth breathers and nasal breathers was assessed using a lateral cephalogram. The lateral cephalogram was obtained using a cephalostat with the Frankfort Horizontal Plane parallel to the floor and teeth in centric occlusion with relaxed lips. X-ray film (8" × 10") with speed E, exposure at 80 Kvp; 40 mA for 2 seconds from a fixed distance of 60 inches was used following the standard technique employed in the Department of Oral Medicine and Radiology at Babu Banarasi Das College of Dental Sciences, Lucknow.

The cephalometric landmarks used in the present study are-

LINEAR VARIATIONS

I. Nasion – Menton (N-Me).
II. Nasion- Anterior Nasal Spine (N-ANS).
III. Anterior Nasal Spine- Menton (ANS-Me).
IV. Sella- Gonion (S-Go).
V. Sella- Articulae (S-Ar).
VI. Articulae- Gonion (Ar-Go).

ANGULAR VARIATIONS

I. Sella Nasion- Gonion Gnathion (SN-GoGn).
II. Sella-Nasion and Nasion-Supramental lines (SNB).
III. Sella-Nasion and Nasion-Subspinal lines (SNA).
IV. Nasion-Subspinal and Nasion-Supramental lines (ANB).
V. Sella Nasion- Palatal Plane (SN-PP).
VI. Palatal Plane – Mandibular Plane (PP-MP).
VII. Articulae Gonion- Gonion Menton (ArGo-GoMe).
VIII. Nasion- Gnathion (NS-Gn).

These landmarks were identified on tracing of cephalometric X-ray film using the roentgenographic cephalometric technique. The various linear and angular measurements of landmarks present on cephalometric tracings were recorded as nasal breathers and mouth breathers for comparison and to assessed change in craniofacial structure due to mouth breathing patterns.[50]

Influence of mode of breathing on pharyngeal airway space

Children who got positive results in mouth breathing diagnostic test were characterized as mouth breather. Subjects with mouth breathing habits were referred to ENT for otorhinolaryngologic evaluation and also to confirm the mode of respiration. Following this a PA (Posterior anterior) view nasopharynx radiograph was taken to analyze the pharyngeal airway space. This led to further classification of mouth breathers into habitual mouth breathers and anatomical mouth breathers on the basis of upper and lower pharyngeal airway width.

Upper Pharyngeal Width Point on the posterior outline of the soft palate to the closest point on the pharyngeal wall. The normal value of the upper pharynx is 15-19 mm. Mouth breathing children with a value less than 15mm were considered as anatomical mouth breathers otherwise child was a habitual breather.[11,50]

Lower Pharyngeal Width Point of intersection of the posterior border of the tongue and the inferior border of the mandible to the closest point on the posterior pharyngeal wall. The normal value of the lower pharynx is 11- 14 mm. Mouth breathing children with a value less than 11 mm were considered as anatomical mouth breathers otherwise child was a habitual breather.[11,51]

RESULTS

Table 1: Distribution of study subjects according to age

	10 years	**11-12 years**	**13-14 years**	**P value**
Group-I (Mouth Breathers)	37(46.20%)	27 (33.80%)	16 (20.00%)	**0.756 (Non-Significant)**
Group-II (Nasal Breathers)	17 (21.20%)	33 (41.20%)	30 (37.50%)	

Table1: Depicts distribution of study subjects in both the groups according to age. Among the study subjects with mouth breathing highest number was seen in children aged between 10 years i.e 37 (46.20%) whereas the lowest number was seen in children aged 13-14 years i.e 16 (20.00%). Among the study subjects with nasal breathing highest number was seen in children aged between 11- 12 years i.e 33 (41.20%) whereas the lowest number was seen in 10 years age children i.e 17 (21.20%). The result between mouth and nasal breather regarding age was statistically non-significant.

Table2: Distribution of study subjects according to gender

	Female	**Male**	**P value**
Group-I (Mouth Breathers)	36 (45%)	44(55%)	**0.429 (Non-Significant)**
Group-II (Nasal Breathers)	42 (52.50%)	38 (47.50%)	

Table 2: Depicts the distribution of study subjects in both groups according to gender. Among the study subjects with mouth breathing males were higher in number i.e 44(55%) compared to females i.e 36(45%).In group II (Nasal breathers), females were higher in number i.e 42 (52.50%) compared to males i.e 38 (47.50%). The result between mouth and nasal breather regarding gender was statistically non-significant

Table 3: Comparison of linear cephalometric variables between nasal and mouth breathers.

		Mean	**Std. Deviation**	**Std. Error Mean**	**T value**	**P value**
Nasion- Menton (N-Me)	Mouth Breathers	102.12	1.737	0.194	.494	**0.622**
	Nasal Breathers	101.92	3.025	0.338		
Nasion- Anterior Nasal Spine (N-ANS)	Mouth Breathers	44.89	2.022	0.226	-1.915	**0.057**
	Nasal Breathers	45.80	3.737	0.417		
Anteri or Nasal Spine-Menton (ANS-Me)	Mouth Breathers	58.66	2.598	0.290	-.660	**0.510**
	Nasal Breathers	58.95	2.899	0.324		

Sella- Gonion (S-Go)	Mouth Breathers	60.48	1.578	0.176	.096	**0.924**
	Nasal Breathers	60.45	2.578	0.288		
Sella- Articulae (S-Ar)	Mouth Breathers	28.00	1.382	0.154	-2.277	**0.024**
	Nasal Breathers	28.93	3.405	0.380		
Articulae-Gonion (Ar-Go)	Mouth Breathers	37.03	3.183	0.355	-1.867	**0.044**
	Nasal Breathers	**38.01**	**3.457**	**0.386**		

Table 3: Depicts the comparison of linear cephalometric variables between both the groups (Group-I and Group-II). Mean N-Me value in mouth breathers was 102.12 and in the nasal breathers it was 101.92. The mean S-Ar value in mouth breathers was 28.00 and in the nasal breathers was 28.93. The mean Ar-Go value in mouth breathers was 37.03 and in the nasal breathers was 38.01. The intergroup comparison of the above mentioned value (N-Me, S-Ar and Ar-Go) between the two groups was statistically significant**.** The mean N-ANS value in mouth breathers was 44.89, and in the nasal breathers was 45.80. The mean ANS-Me value in mouth breathers was 58.66 and in the nasal breathers was 58.95. The mean S-Go value in mouth breathers was

60.48 and in the nasal breathers was 60.45. The intergroup comparison of all the above mentioned value (N-ANS, ANS-Me and S-Go) between the two group was statistically non-significant.

Table 4: Comparison of angular cephalometric variables between nasal and mouth breathers.

		Mean	Std. Deviation	Std. Error Mean	T value	P value
Subnasale-Gonion-Gnathion (Sn-Go-Gn)	Mouth Breathers	37.77	2.146	0.239	2.744	**0.001**
	Nasal Breathers	36.51	3.510	0.392		
Sella-Nasion and Nasion-Subspinal (SNA)	Mouth Breathers	71.89	3.829	0.428	-13.393	**0.001**
	Nasal Breathers	79.01	2.812	0.314		
Sella-Nasion and Nasion Supramental lines (SNB)	Mouth Breathers	71.49	1.437	0.160	-12.759	**0.001**
	Nasal Breathers	75.88	2.719	0.304		
Nasion-Subspinal and nasion-supramental lines (ANB)	Mouth Breathers	1.49	1.209	0.135	-6.415	**0.001**
	Nasal Breathers	2.69	1.156	0.129		
Subnasale-Palatal plane (SN-PP)	Mouth Breathers	6.04	1.462	0.163	-5.893	**0.001**
	Nasal Breathers	8.22	2.968	0.331		
Palatal plane-	Mouth	24.44	1.799	0.201	-5.500	**0.001**

Mandibular plane (PP-MP)	Breathers					
	Nasal Breathers	26.84	3.458	0.386		
Articulare-Gonion Gonion-Mentton (ArGo-GoMe)	Mouth Breathers	125.41	2.910	0.325	-16.167	**0.001**
	Nasal Breathers	134.4	4.084	0.456		
Nasion-Sella Gnathion (NS-Gn)	Mouth Breathers	61.68	2.051	0.229	-11.058	**0.001**
	Nasal Breathers	66.81	3.604	0.402		

Table 4: Depicts the comparison of angular cephalometric variables between nasal breathers and mouth breathers in children aged between 10-14 years. Mean Sn-Go-Gn value in mouth breathers was 37.77 and in the nasal breathers was 36.51. The mean sella-nasion (SN) and nasion-subspinal (NA) value in mouth breathers was 71.89 and in the nasal breathers was 79.01. The mean sella-nasion (SN) and nasion-supramental (NB) value in mouth breathers was 71.49 and in the nasal breathers was 75.88. The mean nasion-subspinal (NA) and nasion-supramental lines value in mouth breathers was 1.49 and in the nasal breathers was 2.69. The mean Sella nasion-PP value in mouth breathers was 6.04 and in the nasal breathers was 8.22. The mean PP-MP value in mouth breathers was 24.44 and in the nasal breathers was 26.84. The mean ArGo-GoMe value in mouth breathers was 125.41 and in the nasal breathers was 134.4. The mean NS-Gn value in mouth breathers was 61.68 and in the nasal breathers was 66.81. The intergroup comparison of the above mentioned values (Sn-Go-Gn, SNA, SNB, ANB, SN-PP, PP- MP and ArGo-GoMe) between the two groups was statistically significant**.**

Table 5: Comparison of pharyngeal width between nasal and mouth breathers.

		Mean (mm)	Std. Deviation	Std. Error Mean	T value	P value
Upper Airway	Mouth breathers	14.775	2.110	0.235	10.943	**0.001 (Sig)**
	Nasal breathers	18.350	2.256	0.252		
Lower Airway	Mouth breathers	11.287	1.568	0.175	7.098	**0.001 (Sig)**
	Nasal breathers	13.075	1.651	0.184		

Table 5: Depicts the comparison of pharyngeal width (upper airway and lower airway) between nasal and mouth breathers. The mean upper airway space in the mouth breathers was 14.77mm and in the nasal breathers was 18.35mm. The mean lower airway space in the mouth breathers was 11.28mm and in the nasal breathers was 13.07mm. The intergroup comparison between mouth and nasal breathers was statistically significant.

Table 6: Factor analysis of mouth breathing syndrome between nasal and mouth breathers

		Open Mouth	Lip and Teeth	Sleep	Nose	Food
Factor-1	Is your mouth often	0.324			.140	-.920
"Open Mouth and Bad Breath"	open during the day?					
	Is your mouth often dry?	0.920			-	
					.140	
	Do people tell you that you have Bad breath in the morning?	0.814	.169		.442	
	Do You sleep with your mouth open?	0.143	-.963		.109	

	Do you have an over bite?	0.993	-.281		-.139	
	Do you have an anterior open bite	.963	-0.143		-.109	
Factor-2 "Incompetent Lip seal and Diseases of Teeth"	Are your lips droopy		.449		.660	-.211
	Are your teeth visible between your upper and lower lips?	.324	.449		.660	-.211
	Are your gums often swollen?	-.840	.313		.115	.216
	Are your teeth easily stained	-.840	.313		.115	.216
	Are your lips often chapped?	.143	0.963		.109	
	Is your upper lip turned upward?	-.840	.313		.115	.216
Factor-3 "Problem with sleep",	Do you get tired easily?			.970		
	Are you good riser?		-.117	.663		-.166
	Are you good at exercising?			.613		.192
	Are you a restless sleeper?			.965		
Factor-4 "Problems with nose ",	Does your nose become stuffed easily while sleeping?	-.139	-.281		.993	
	Do you often have a runny nose?	-.139	-.281		.993	
	Are you a habitual snorer?	.143	-.963		.109	
Factor-5 "Difficulty in eating and chewing"	Do your meals consist of small servings?	-.324	-.449		-.660	.211
	Do you keep your mouth closed when you eat?				-.140	.920
	Do you have food left in your mouth for a long time?	-.840	.313		.115	.216
	Do you prefer soft food?	-.143			-	.963

					.109	
	Do you drink water during meals?	.324			.449	.660
	Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.					

Table 6: Depicts the factor analysis in both the groups (Group-I and Group-II). Twenty-four out of the 29 questions were selected and classified into five factors. The Kaiser-Meyer-Olkin measure was 0.761 and Bartlett's test of sphericity yielded $P < 0.001$, showing the validity of the factor analysis. The cumulative contribution ratio was 49.87%. Factor 1 was defined as "Open Mouth and Bad Breath", based on the questions Factor 2 was defined as "Incompetent Lip seal and Diseases of Teeth" Similarly, based on the factor loading and content of the other questions, Factors 3, 4, 5, were defined as "Problem with sleep", "Problems with nose ", and Difficulty in eating and chewing" respectively

Table 7: Factor correlation matrix

Component	Open Mouth and Bad Breath (Factor1)	Problem with Lip and Teeth (Factor2)	Problem with sleep (Factor3)	Problems with nose (Factor4)	Difficulty in eating and chewing (Factor5)
Open Mouth and Bad Breath (Factor1)	1.000	0.358	0.313	0.297	0.304
Problem with Lip and Teeth (Factor2)		1.000	0.432	0.551	0.568
Problem with sleep (Factor3)			1.000	0.523	0.408
Problems with nose (Factor4)				1.000	0.137

Difficulty in eating and chewing (Factor5)					1.000

Table 7: Depicts the factor correlation matrix in both groups (Group-I and Group-II). In our study, a correlation coefficient of 0.5 or higher was interpreted as a strong correlation; a correlation coefficient of 0.2 or higher but less than 0.5 was interpreted as a moderately strong correlation; and a correlation coefficient less than 0.2 was interpreted as a weak corelation. Factor 1 had moderately strong correlation with Factors 2,3,4,5. Factor 2 had strong correlation with Factor 4 and Factor 5. Factor 3 had moderately strong correlation with Factor 1, 2 and 5. Factor 3 had strong correlation with Factor 4. The Factor 4 and 5 had the strongest correlation with the Factor 2. The Factor 4 had the strongest correlation with the Factor 2 and 3, moderately strong correlation with Factor 1 and weak correlation with Factor 5. Factor 5 had strong correlation with Factor 2, moderately strong correlation with Factor 1,3 and weak correlation with Factor 4

Table 8 : Evaluation of factors related to mouth breathing .

	Yes	**No**	Not Noticed	**P value**
Is your mouth often open during the day?	50(63.3%)	30(36.7%)		0.001
Are your lips droopy	30(38.0%)	30(38.0%)	20(24.1%)	0.312
Do you get tired easily?	38(46.8%)	42(53.2%)		0.621
Are you good riser?	50(62.0%)	30(38.0%)		0.001
Are you good at exercising?	24(29.1%)	56(70.9%)		0.001
Are you a restless sleeper ?	11(12.7%)	69(87.3%)		

				0.001
Does your nose become stuffed easily while sleeping?	18(21.5%)	42 (53.2%)	20(25.3%)	0.001
Do you sneeze often?	0 (0%)	48(59.5%)	32 (40.5%)	0.078
Do you often have a runny nose	17(21.5%)	40(49.4%)	23(29.1%)	0.001
Do you often have a sore throat	56(70.9%)	24(29.1%)		0.001
Do you often have swollen tonsils	0 (0%)	57(70.9%)	23(29.1%)	0.001
Do you often fail to listen	0(0%)	80(100.0%)	0 (0%)	0.001
Are you a habitual snorer?	56(70.9%)	24(29.1%)	0(0%)	0.001
Do your meals consist of small servings?	49(62.0%)	31(38.0%)		0.001
Do you keep your mouth closed when you eat?	29(36.7%)	34(41.8%)	17(21.5%)	0.065
Do you have food left in your mouth for a long time?	10(12.7%)	50(62.0%)	20(25.3%)	0.001
Is your mouth often dry?	29(36.7%)	31(38.0%0	20(25.3%)	0.001
Do people tell you	49(62.0%)	11(12.7%)	20(25.3%)	

that you have bad breath in the morning?				0.001
Do you sleep with your mouth open?	56(70.9%)	11(12.7%)	13(16.5%)	0.001
Can you talk clearly?	80(100%)	0(0%)		0.001
Do you prefer soft food?	24(29.1%)	39(49.4%)	17(21.5%)	0.001
Do you drink water during meals?	31(38.0%)	10(12.7%)	39(49.4%)	0.001
Are your teeth visible between your upper and lower lips?	31(38.0%)	10(12.7%)	39(49.4%)	0.001
Are your gums often swollen?	11(12.7%)	39(49.4%)	30(38.0%)	0.001
Are your teeth easily stained?	10(12.7%)	57(70.9%)	13(16.5%)	0.001
Do you have an over bite?	18(21.5%)	49(62.0%)	13(16.5%)	0.001
Do you have an anterior open bite?	23(29.1%)	57(70.9%)	0(0%)	0.001
Are your lips often chapped?	57(70.9%)	23(29.1%)	0(0%)	0.001
Is your upper lip turned upward?	10(12.7%)	70(87.3%)	0(0%)	0.001

Chi Square test with p value less than 0.05 is significant

Table 8: Depicts the evaluation of factors related to mouth breathing among the Group-I. 57 subjects (70.9%) had chapped lips, 56 (70.9%) often had sore throat, 56(70.9%) were habitual snorers, 56 (70.9%) slept with mouth open, 50 (63.3%) kept their mouth open during the day, 49 (62.0%) had meal in the small servings, 49 (62.0%) had a bad breath and 50 (62.0%) are good riser. The responses to the questions were statistically significant to the questions based on – open mouth during the day, are you a good riser, are you good at exercising, sore throat, runny nose, swollen tonsils, snaring, dietary habits, dry mouth, bad breath and teeth and gum problems. Statistically non- significant to the question are your lips droopy, do you get tired easily, do you sneeze often and do you keep mouth closed while eating.

Table 9: Evaluation of factors related to mouth breathing among nasal breathers.

	Yes	**No**	**Not Noticed**	
Is your mouth often open during the day?	38(48.0%)	42(52.05)		0.001
Are your lips droopy	28(34.7%)	52(65.3%)	0(0%)	0.001
Do you get tired easily?	51(65.3%)	29(34.7%)		0.001
Are you good riser?	42(52.0%)	38(48.0%)		0.721
Are you a restless sleeper	52(65.3%)	27(34.7%)		0.001

Does your nose become stuffed easily while sleeping?	28(34.7%)	27(33.3%)	25(32.0%)	0.654
Do you sneeze often?	29(34.7%)	0(0%)	51(65.3%)	0.001
Do you often have a runny nose	14(17.3%)	52(68.0%)	14(14.7%)	0.001
Do you often have a sore throat	0(0%)	80(100.0 %)		0.001
Do you often have swollen tonsils	15(17.3%)	42(52.0%)	23(30.7%)	0.001
Do you often fail to listen	42(54.7%)	24(30.7%)	14(14.7%)	0.001
Are you a habitual snorer?	26(32.0%)	42(53.3%)	12(14.7%)	0.001
Do your meals consist of small servings?	27(33.3%)	53(66.7%)		0.001
Do you keep your mouth closed when you eat?	50(62.7%)	30(37.3%)	0(0%)	0.001
Do you have food left in your mouth for a long time?	42(52.0%)	38(48.0%)	0(0%)	0.534
Is your mouth often dry?	31(37.3%)	49(62.7%)	0(0%)	0.001
Do people tell you that you have bad breath in the morning?	37(45.3%)	43(54.7%)	0(0%)	0.432

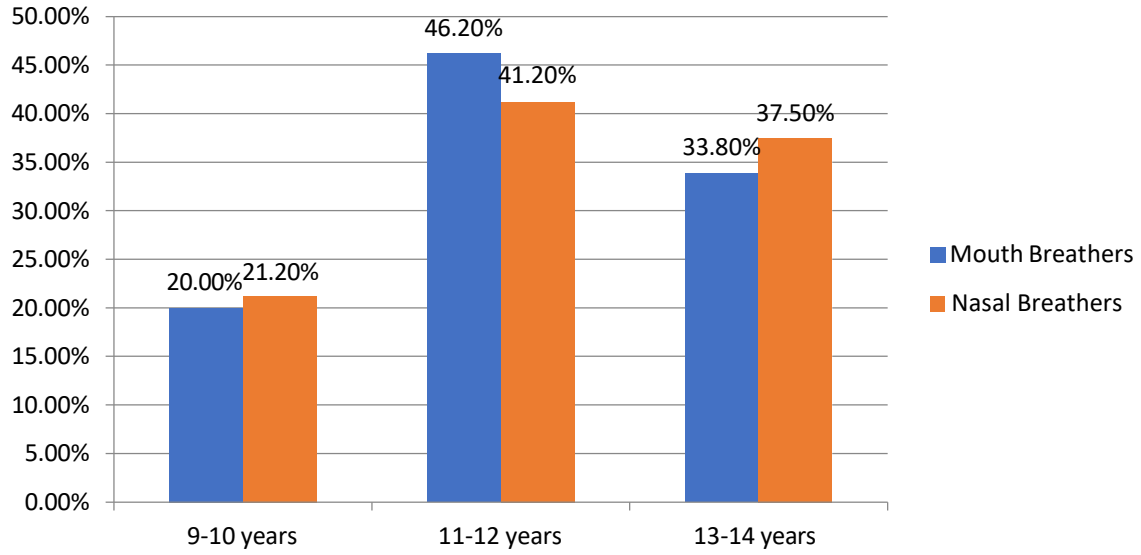
Do you sleep with your mouth open?	28(34.7%)	52(65.3%)	0(0%)	0.001
Can you talk clearly?	52(65.3%)	28(34.7%)		0.001
Do you prefer soft food?	53(66.7%)	27(33.3%)	0(0%)	0.001
Do you drink water during meals?	28(33.3%)	52(66.7%)	0(0%)	0.001
Are your teeth visible between your upper and lower lips?	58(66.7%)	16(16.0%)	16(17.3%)	0.001
Are your gums often swollen?	42(52.0%)	13(16.0%)	25(32.0%)	0.001
Are your teeth easily stained	26(32.0%)	28(36.0%)	26(32.0%)	0.873
Do you have an over bite?	13(14.7%)	55(70.7%)	12(14.7%)	0.001
Do you have an anterior open bite	15(17.3%)	52(66.7%)	13(16.0%)	0.001
Are your lips often chapped?	39(50.7%)	28(34.7%)	13(14.7%)	0.321
Is your upper lip turned upward?	40(50.7%)	27(34.7%)	13(14.7%)	0.001

Chi Square test with p value less than 0.05 is significant

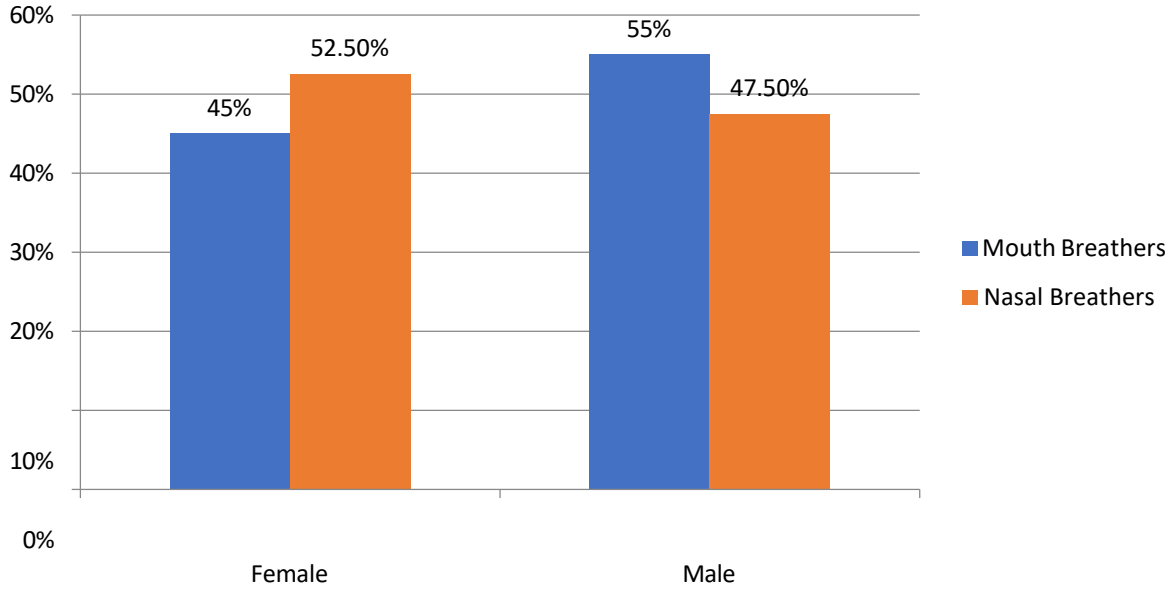
Table 9: Depicts evaluation of factors related to mouth breathing among Group-II. 53 subjects (66.7%) prefer soft food, 53(66.7%) were good at exercising, 51 (65.3%) get

tired easily, 52 (65.3%) are restless sleeper, 50(62.7%) kept your mouth closed when eating, 42 (54.7%) failed to listen, 42 (52.0%) had food left in your mouth for a long time, 39 (50.7%) had chapped lips and 40 (50.7%) had lips turned upward . The responses to the questions were statistically significant to the questions based on – open mouth during the day, droopy lips, restlessness, sore throat, runny nose, swollen tonsils, snaring, dietary habits, dry mouth, bad breath and teeth and gum problems, over bite, open bite and lips turned upwards. Statistically non-significant to the question- are you good riser, stuffed nose, bad breath, stained teeth and lips chapped.

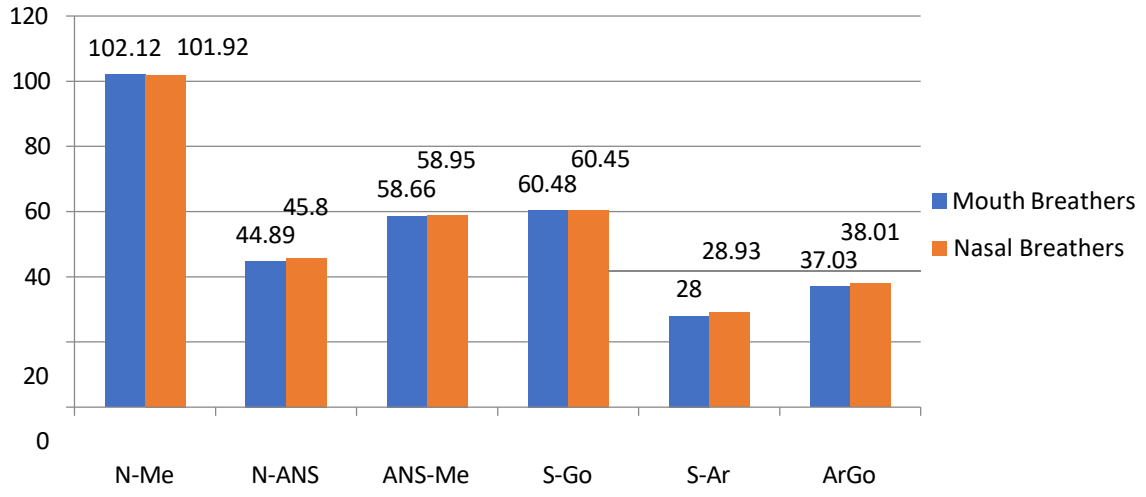
Graph- 1. Distribution of study subjects according to age



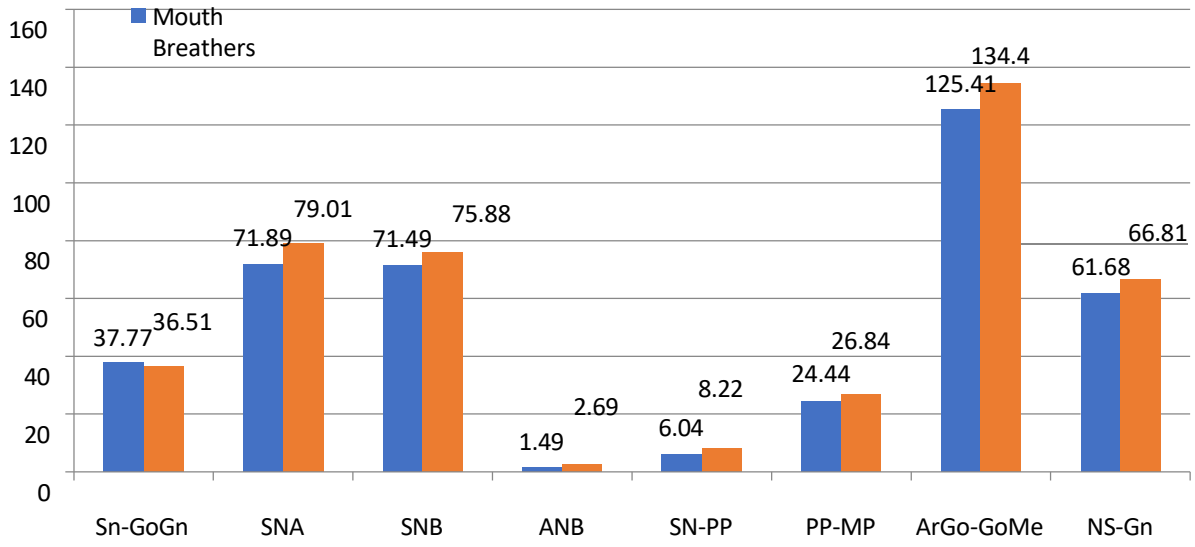
Graph 2- Distribution of study subjects according to gender.



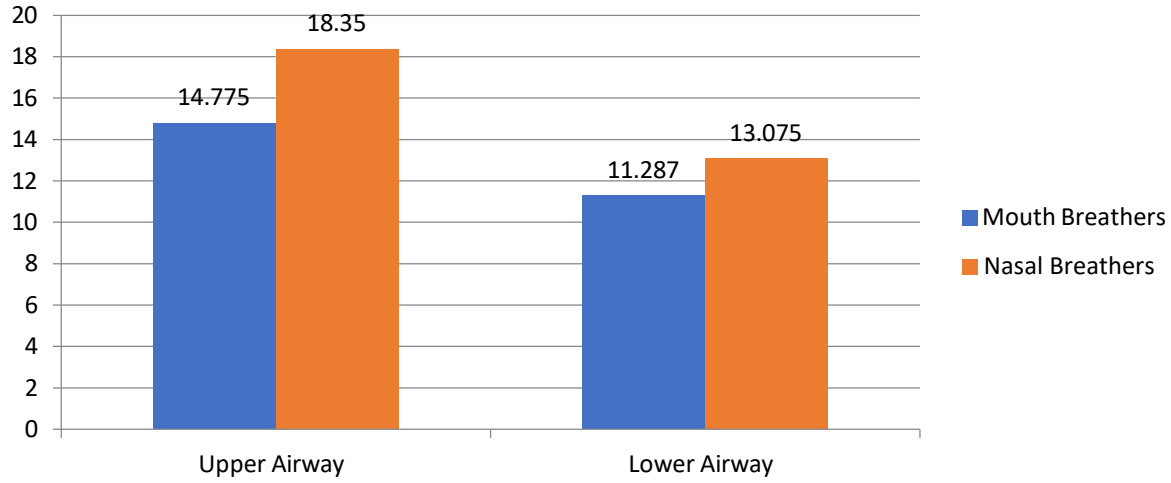
Graph-3 Comparison of linear cephalometric variables between nasal and mouth breathers



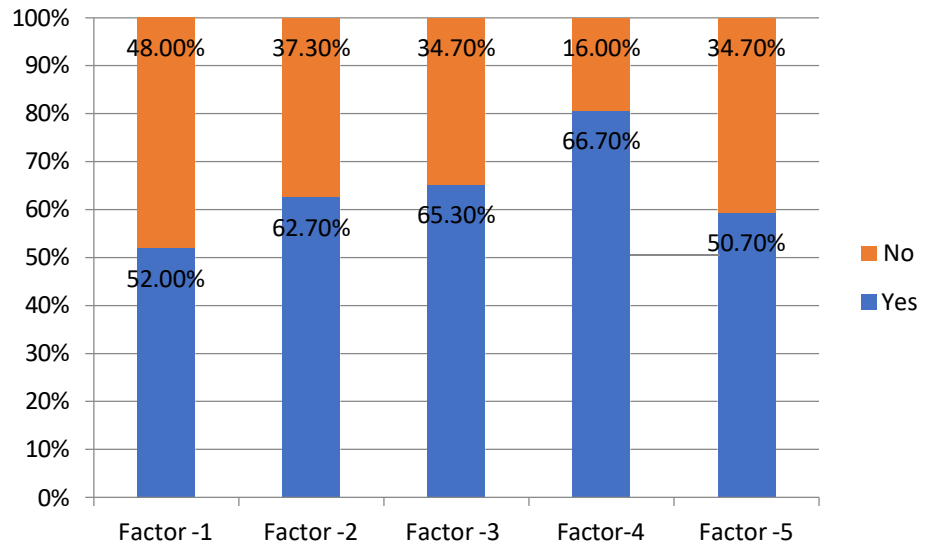
Graph-4 Comparison of angular cephalometric variables between nasal and mouth breathers



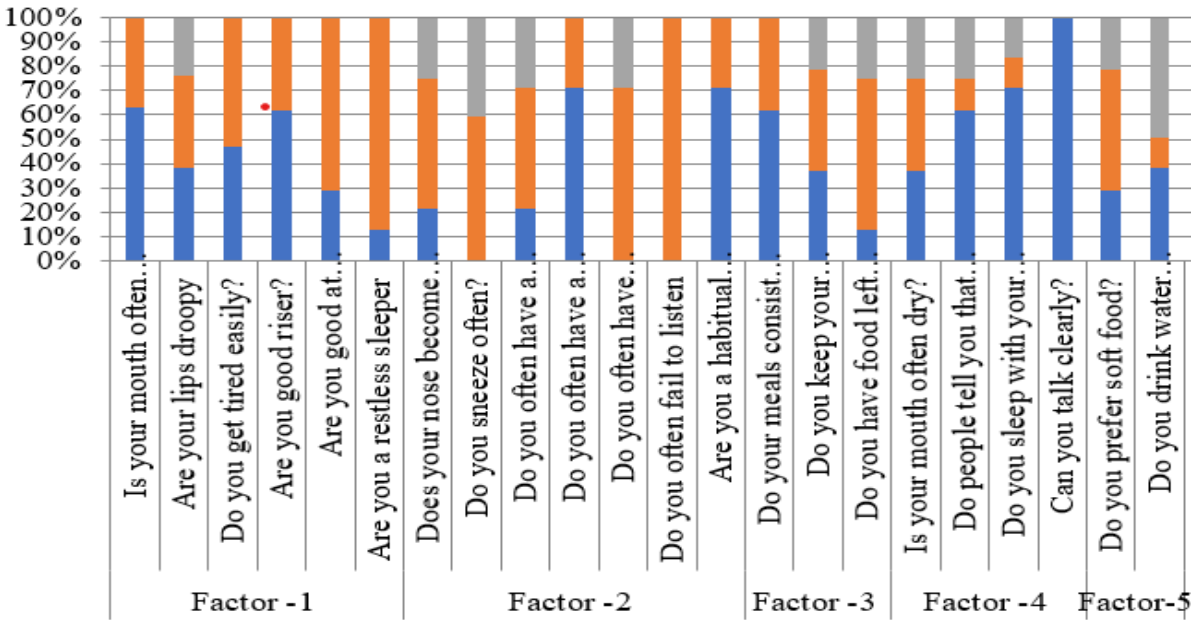
Graph-5 Comparison of upper and lower airway between nasal and mouth breathers



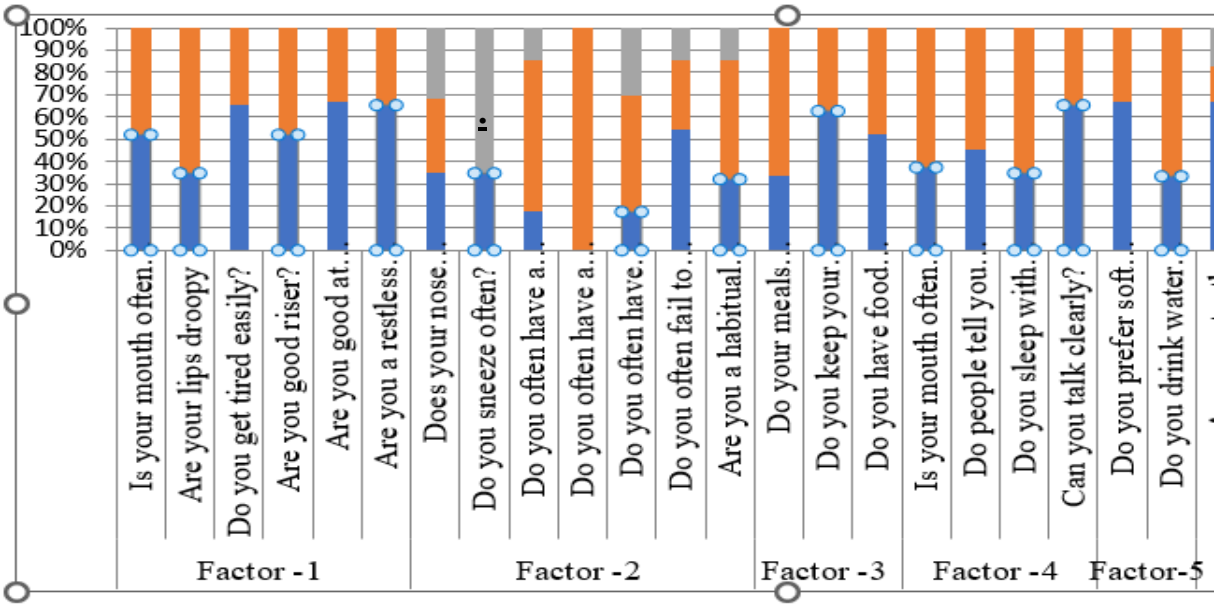
Graph-6 Pattern matrix of the factor analysis



GRAPH- 7 Responses to question among mouth breathers



GRAPH-8 Responses to question among nasal breathers



DISCUSSION

The present study was conducted to evaluate various parameters associated with mouth breathing and its effects on the craniofacial structure of growing children and to also evaluate the effect of mode of breathing upon pharyngeal airway space in children between 10-14 years of age who visited the Department of Pediatric and Preventive Department, BBDCODS, BBDU, Lucknow.

One of the body's essential processes is respiration, which happens through the nose in a healthy physiological state. Mouth breathing is the term used to describe a child's mixed breathing pattern, in which the mouth is used in addition to the nose.

Nasal breathing is replaced by mouth breathing, which has a complicated etiology. It could be caused due to genetics, bad dental hygiene, or nasal obstructions such as sinusitis, nasal polyps, turbinate hypertrophy, nasal septum deviation, and adenoid/tonsil enlargement. Furthermore, environmental factors, breastfeeding, sleeping posture, and respiratory allergies may all be associated with mouth breathing.[48]

The influence of mouth breathing on the development of oral maxillofacial bone is still controversial. Children with mouth breathing often have "adenoid faces", which are characterized as having upper lip incompetence, a retroposition hyoid bone, a narrow upper dental arch, retroposition mandibular incisors, an increased anterior face height, a narrow or “V”-shaped maxillary arch, an increased mandibular plane angle, and a posterior-rotated mandible in comparison with healthy controls. With respect to the occlusal relationship, most of the children with mouth breathing presented with Class II malocclusion, and a cross-bite is more frequent than that in those with normal nasal breathing. Mouth breathers’ maxilla was more retrognathic and the anterior lower height of the face was increased when compared to nasal breathers.[49]

Lymphoid tissue usually develops quickly after birth; it reaches peak size during early childhood and starts to regress at around 8 or 10 years of age. In some children, its overgrowth may obstruct the pharyngeal air tract, which may lead to respiratory, sleep, feeding, speech and swallowing disorders. The presence of any upper airway obstruction (such as nasal - sinusal pathologies or hypertrophy of Waldeyer’s lymphatic ring) can lead to the patient to breathe through the mouth. Mouth breathers showed a reduction in upper airway space dimensions with narrowed areas at the nasopharynx.[50,51]

The present study consisted of 160 children aged between 10-14 years including both genders who visited the Department of Pediatric and Preventive Dentistry at

BBDCODS, Lucknow.

Subjects were randomly divided into two groups, Group-I (Mouth breathers) and Group-II (nasal breathers)

The highest number of children with mouth breathing were identified in 10 years of age (46.20%) and the lowest number was seen in 13-14 years of age (20.00%). There was statistically no significant difference between mouth and nose breathers in terms of age. **(Table 1).** This could be due to adenoids actively develop at 6-7 years and tonsils develop at 2 to 5 years. After ten years, they begin to decline, and by fourteen or fifteen years, they are entirely gone.

Mouth breathing habit was observed more in males (55%) compared to females(45%) however the result was statistically non-significant. **(Table 2).** Similar findings were reported by **Damayanti Y, Soewondo W, Primarti R S (2014)** they found that the frequency distribution of mouth breathing was comparatively higher in boys when compared to girls.

In this present study, various linear and angular cephalometric variables were compared between both groups. The mean value of N-Me, S-Ar and Ar-go was higher in mouth breathers compared to nasal breathers and the difference was found to be statistically significant for these variables. Statistically, no significant differences were found between the two groups for the variables N-ANS, ANS-Me and S-Go. **(Table-3)**

The mean value of Sn-Go-Gn was higher in mouth breathers and a significant difference was found for variable SNA, SNB, ANB, SN-PP, PP-MP, ArGo-GoMe and N-Gn. **(Table-4)**

Based on these above-mentioned findings it has been concluded that mouth breathing was associated with an increase in anterior lower vertical face height and posterior facial height, an increased in lower incisor proclination, increased in mandibular plane and gonial angle and convex profile. As children with nasal breathing patterns keep their lips closed to form a sealed oral space. The tongue is positioned in contact with the palate and lingual side of the maxillary dentition. A balanced muscle strength from the internal tongue and external lips and cheek is crucial for the development of a normal upper dental arch. The change in the way of breathing leads to a change in the jaw, tongue and head position. In the mouth breathing pattern the tongue is usually shifted back and downwards and doesn't participate in the development of the hard palate, which results in the formation of a deep gothic palate. A forward head posture is developed to make easier inhalation through the mouth, the lower jaw is underdeveloped. This in turn could

cause changes in dentofacial growth and positions of the teeth.

The same outcomes were discovered by **Malhotra S, Pandey RK, Nagar A, Agarwal SP, Gupta VK (2018)** they found that mean values for N-Me, ANS-Me, SN-GoGn, PP-MP, Ar-Go-GoMe and NS-Gn were significantly higher for mouth breather. Thus, they concluded changed mode of respiration was associated with increased facial height, mandibular plane angle and gonial angle. This findings clings with **Ziyi Zhao, Leilei Zheng, Xiaoya Huang, Caiyu Li, Jing Liu, Yun Hu (2021)** they also found that in mouth-breathing children with adenoid/tonsil hypertrophy ANB, SNB, SN-PP, PP-MP was higher. They came to the conclusion that airway stenosis was common in mouth-breathing children. **Mattar SEM, Wilma T, Lima A, Valera FCP, Matsumoto MAN (2011)** further discovered that there were significant statistical differences for the SN.GoGn, PP-MP, Ar-Go and S-Go values among mouth breathers. Therefore, a decrease in the mandible inclination and an increase in the posterior facial height were seen in mouth-breathing children. **Acharya SS, Mali L, Sinha A, Nanda SB (2018)** additionally found that horizontal, vertical, and lateral dimensions there was significant differences between nasal and mouth breathers. Their investigation revealed that naso-respiratory obstruction with mouth breathing during growth periods in children has a greater tendency for clockwise rotation of the growing mandible, with an irregular increase in anterior lower vertical face height and decreased posterior facial height

In the current study, the evaluation of factors related to mouth breathing was done through the questionnaire which was filled by guardians of children. To clarify the relevant factors affecting mouth breathing syndrome in children, closely related questions about daily health conditions and lifestyle habits were grouped into their respective factors.

Based on the result 22 of the 30 items from the questionnaire were selected as mouth breathing syndrome related items in the school-age group and classified into five factors. In our study, a correlation coefficient of 0.5 or higher was interpreted as a strong correlation; a correlation coefficient of 0.2 or higher but less than 0.5 was interpreted as a moderately strong correlation; and a correlation coefficient less than 0.2 was interpreted as a weak correlation.

Moderately strong correlation was found between Factor 1 and Factor 2,3,4 and 5. Thus as the value of Factor 1 increases, there was a moderate tendency for the values of Factors 2, 3, 4, and 5 to also increase, and vice versa. Strong correlation was found between Factor 2 with Factor 4 and 5. Thus as the value of Factor 2 increases, there was

a strong tendency for values of Factor 4 and Factor 5 to increase and vice versa. Weak correlation was found between Factor 4 and Factor 5. Thus as values of Factor 4 increase, there was a weak tendency for Factor 5 to increase and vice versa**. (Table-6)**

Similar findings were observed by **Saitoha I, Inadab E, Kaiharac Y, Nogamia Y, Murakamib D, Kubotab N, Sakurai K etal (2018)** they found twenty-six out of the 44 questions were selected and classified into seven factors. Factor 1 was defined as "Incompetent lip seal", Factor 2 was defined as "Diseases of the nose and throat", Factors 3, 4, 5, 6, and 7 were defined as "Eating and drinking habits", "Bad breath", "Problems with swallowing and chewing", "Condition of teeth and gums", and "Dry lips", respectively, therefore a strong correlation was found between Factor 1 and Factor 5, a moderately strong correlation was found between Factor 1 and other factors, a weak correlation was found between Factor 2 and Factor 3. **Inada E, Saitoh I, Kaihara Y, Yamasaki Y (2021)** identified 9 of the 44 items as MBS-related items in the preschool group and classified them into four factors. Factor 1 was defined as "diseases of the nose". Factor 2 was defined as "incompetent lip seal". Factors 3 and 4 were defined as "eating habits" and "food preference. Of the 12 items identified by correlation analysis, "Are your lips droopy?" and "Do you sleep with your mouth open?" showed a strong correlation. **Leal R B; Gomes M C; Garcia A F G; Paulo S. A; and Menezes V A (2015)**. identified higher responses of mouth breathers towards the questions such as "Difficulty in breathing through the nose" "Drolls on the pillow" "open mouth during daytime and also during sleep" and "incompetents lips".

In the recent study, width of the pharyngeal airway space in both groups was evaluated. The mean upper airway space in the mouth breathers was 14.77mm whereas the lower airway space was 11.28mm. A statistically significant difference is found in the upper and the lower airway between both groups. **(Table-5)**

The muscles surrounding the pharynx (Superior Pharyngeal Constrictor Muscles, Middle Pharyngeal Constrictor Muscles, Inferior Pharyngeal Constrictor Muscles, Palatopharyngeus Muscle and Stylopharyngeus Muscle**)** play a role in maintaining its patency. Chronic mouth breathing might alter the muscle tone, potentially impacting the dynamics of the pharyngeal airway.

Thus according to our study, values of the upper and lower airway are lesser in mouth breather when compared with the nasal breather.

Similar results were seen in **Alves M, Nojima CBL, Nojima MCG, Ruellas ACO (2011)** found that the comparisons between nasal and mouth breathers showed

significant differences only in two linear measurements i.e pharyngeal airway space - Upper and Lower. Thus, the CBCT evaluation showed that pharyngeal airway dimensions were significantly greater in nasal-breathers than in mouth-breathers. **Thribhuvanan L & Saravanakumar MS (2022).** discovered that the values of their result showed a positive correlation between mouth breathers with an increase in palatal height, narrowing of the intermolar width, reduction in pharyngeal airway space and subsequently an increased incidence of Class II malocclusion. Their result suggested mouth breathing had an undeniable influence on the growth of pharyngeal airway space and was associated with dental and skeletal structures in children. **Al-Mayali AM, Al-Sheakli (2014)** identified a statistically significant relationship between the pharyngeal airway volume and the mode of respiration. The pharyngeal airway volume was larger in nasal breathers than in mouth breathers and it was larger in males than in females.

However, this study has some limitations, the present study was done in children in age group of 10-14 years. Mouth breathing is commonly seen in young age group also. Thus we recommend further studies with larger sample sizes on lower age group children.

A multidisciplinary team should collaborate to ensure early detection and suitable intervention, preventing the diseases that result from prolonged mouth breathing. Hence a joint effort by a pedodontist, orthodontist, otorhinolaryngologist and pediatrician is thus required to reduce the continuing detrimental effects of breathing impairments on facial characteristics.

CONCLUSIONS

The present study was conducted in the department of Pediatric and Preventive Dentistry, Babu Banarasi Das College of Dental Sciences, BBDU, Lucknow.

The following conclusions were drawn on the basis of observation done during the course of the study

1. In mouth breathers commonly observed features were open mouth during the day, sore throat, runny nose, swollen tonsils, snoring, dry mouth, bad breath, and gum problems.
2. A strong correlation was found between problems associated with nose, teeth and incompetent lips. A moderate correlation was found between open mouth, bad breath, sleep disorders and stuffed nose. Weak correlation was seen between stuffed nose and difficulty in eating.
3. Mouth breathing habit was associated with increased facial height, mandibular plane angle and gonial angle.
4. Pharyngeal airway width was significantly lower in mouth breathers compared to nasal breathers.

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ANNEXURE 1

BABU BANARASI DAS UNIVERSITY

BBD COLLEGE OF DENTAL SCIENCES, LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled "**Assessment Of Factors Related To Mouth Breathing And Its Effects On Craniofacial Structures Of Growing Children**" submitted by **Dr Sadia Salman** Postgraduate student in the **Department of Pediatric & Preventive Dentistry** for the Thesis Dissertation as part of MDS Curriculum for the academic year 2021-2024 with the accompanying proforma was reviewed by the Institutional Research Committee in its meeting held on **14th September, 2022** 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. Puneet Ahuja
Chairperson

Dr. Mona Sharma
Co-Chairperson

BABU BANARASI DAS UNIVERSITY
BBD COLLEGE OF DENTAL SCIENCES, LUCKNOW

BBDCODS/IEC/09/2022 **Dated: 16th September, 2022**

Communication of the Decision of the X th Institutional Ethics Sub-Committee Meeting

IEC Code: 24

Title of the Project: Assessment Of Factors Related To Mouth Breathing And Its Effects On Craniofacial Structures Of Growing Children.

Principal Investigator: Dr Sadia Salman **Department:** Pediatric & Preventive Dentistry

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

Type of Submission: New, MDS Project Protocol

Dear Dr Sadia Salman,

The Institutional Ethics Sub-Committee meeting comprising following members was held on 15th September, 2022.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry
2.	Dr. Praveen Singh Samant Member	Prof. & Head, Department of Conservative Dentistry & Endodontics
3.	Dr. Jiji George Member	Prof. & Head, Department of Oral Pathology & Microbilogy
4.	Dr. Amrit Tandan Member	Professor, Department of Prosthodontics and Crown & Bridge
5.	Dr. Rana Pratap Maurya Member	Reader, Department of Orthodontics & Dentofacial Orthopaedics

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.
The comments were communicated to PI, thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Prof. Dr. Puneet Ahuja
Principal
BBD College of Dental Sciences
BBD University, Lucknow

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

16/09/22
Dr. Lakshmi Bala
Member-Secretary
Institutional Ethics Sub-Committee (IEC)
BBD College of Dental Sciences
BBD University, Lucknow

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

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

Consent Form (English)

Title of the Study: **Assessment of factors related to mouth breathing and its effects on craniofacial structures of growing children**

Study Number……..
Subject's Full Name…….
Date of Birth/Age ……
Address of the Subject…….
Phone no. and e-mail address……
Qualification ……
Occupation: Student / Self Employed / Service /
Housewife/Other (Please tick as appropriate)
Annual income of the Subject……
Name and of the nominees(s) and his relation to the subject.....(For the purpose of
Compensation in case of trial related death).

1. I confirm that I have read and understood the Participant Information Document dated ……..for the above study and have had the opportunity to ask questions. **OR** I have beenexplained the nature of the study by the Investigator and had the opportunity to ask questions.
2. I understand that my participation in the study is voluntary and given with free will without any duress and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.
3. I understand that the sponsor of the project, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.
4. I agree not to restrict the use of any data or results that arise from this study provided sucha use is only for scientific purpose(s).
5. I permit the use of stored sample (tooth/tissue/blood) for future research. **Yes [ ] No [ ]**
6. I agree to participate in the above study. I have been explained about the complications andside effects, if any, and have fully understood them. I have also read and understood the participant/volunteer's Information document given to me.

Signature (or Thumb impression) of the Subject/Legally Acceptable Representative:……..

Signatory‘s Name……. Date …….

Signature of the Investigator…… Date……..

Study Investigator‘s Name..... Date……..

Signature of the witness…… Date……..

Name of the witness……

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

PARTICIPANT INFORMATION DOCUMENT

1.Study Title

Assessment of factors related to mouth breathing and its effects on craniofacial structures of growing children

2. Invitation Paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the study is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your treating physician/family doctor if you wish. Ask us for any clarifications or further information. Whether or not you wish to take part is your decision.

3.What is the purpose of the study?

To evaluate various parameters associated with mouth breathing and its effects on craniofacial structure of growing children.

4**. Why have I been chosen?**

You have been chosen for this study as you are fulfilling the required criteria for this study.

5. **Do I have to take part?**

Your participation in the research is entirely voluntary. If you do, you will be given this information sheet to keep and will be asked to sign a consent form. During the study you are still free to withdraw at any time and without giving a reason.

6. **What will happen to me if I take part?**

The participants will get evaluated for harmful effects of mouth breathing upon craniofacial structure.

7**. What do I have to do?**

This study requires evaluation of mouth breathing effects upon craniofacial structure. The participants should report to the institute at 9 am on the morning. He or she will be discharged in the afternoon once discharged criteria are met . Guardians will be asked to fill self-designed questionnaire consisting of 30 questions. Question in the questionnaire will help to find condition which might be linked to mouth breathing syndrome. Their lateral cephalogram will be

obtained using a cephalostat with the Frankfort Horizontal plane parallel to the floor and teeth in centric occlusion with relaxed lips.

8. What is the procedure that is being tested?

The study will be carried out to evaluate various parameters associated with mouth breathing and its effects on craniofacial structure of growing children. Questionnaire and lateral cephalogram of participants is going to be used.

9. What are the interventions for the study?

Various parameter associated with mouth breathing

10. What are the side effects of taking part?

There is no harmful effects as study is based on evaluation purpose.

11. What are the possible disadvantages and risks of taking part?

There are no disadvantages of taking part in this study.

12. What are the possible benefits of taking part?

The participant will be benefited as they will get to know about harmful effects of mouth breathing on face

13. What if new information becomes available?

If additional information becomes available during the course of the research you will be told about these and you are free to discuss it with your researcher, your researcher will tell you whether you want to continue in the study. If you decide to withdraw, your researcher will make arrangements for your withdrawal. If you decide to continue in the study, you may be asked to sign an updated consent form.

14. What happens when the research study stops?

Nothing will happen to the participants.

15. What if something goes wrong?

The problems/complaint will be handled by the HOD or the IRC. If something serious happens the institute will take care of the problems.

16. Will my taking part in this study be kept confidential?

Yes it will be kept confidential.

17. What will happen to the results of the research study?

The results of the study will be used to assess effect of mouth breathing on cranio facial structure and various parameter associated with mouth breathing.Your identity will be kept confidential in case of any report/publications.

18. Who is organizing the research?

The research is been done in the DEPARTMENT OF PEDIATRIC AND PREVENTIVE DENTISTRY, BBDCODS. The research is self -funded. The participants will have to pay for procedural charges as given by the institution.

19. Will the results of the study be made available after study is over?

Yes

20. Who has reviewed the study?

The HOD and the members of IRC/ IEC of the institution has reviewed and approved the study.

21. Contact for further information

Dr. SADIA SALMAN

Department of Pediatric and Preventive Dentistry

Babu Banarasi College of Dental Sciences.

Lucknow-227105

Mob- 9120764048

Dr. LaxmiBala

Member Secretary of Ethics Committee of the institution,

Babu Banarasi College of Dental Sciences.

Lucknow

bbdcods.iec@gmail.com

THANK YOU FOR TAKING OUT YOUR PRECIOUS TIME FOR READING THE DOCUMENTS AND PARTICIPATING IN THE STUDY.

Signature of PI……

Name…….

Date……..

ANNEXURE- V

बाबू बनारसी दास कॉलेज ऑफ डेंटल साइंसेज

(बाबू बनारसी दास विश्वविद्यालय)

बीबीडी सिटी, फैजाबाद रोड, लखनऊ - 227105 (भारत)

प्रतिभागी सूचना दस्तावेज

1.अध्ययन शीर्षक

मुह से सांस लेने से संबंधित कारकों का आकलन और बढ़ते बच्चों की क्रानियोफेशियल संरचनाओं पर इसके प्रभाव।

2. आमंत्रण पैराग्राफ

आपको एक शोध अध्ययन में भाग लेने के लिए आमंत्रित किया जा रहा है। निर्णय लेने से पहले आपके लिए यह समझना महत्वपूर्ण है कि अध्ययन क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया निम्नलिखित जानकारी को ध्यान से पढ़ने के लिए समय निकालें और यदि आप चाहें तो दोस्तों, रिश्तेदारों और अपने इलाज करने वाले चिकित्सक / परिवार के डॉक्टर के साथ चर्चा करें। किसी भी स्पष्टीकरण या अधिक जानकारी के लिए हमसे पूछें। आप भाग लेना चाहते हैं या नहीं, यह आपका निर्णय है।

3. अध्ययन का उद्देश्य क्या है?

मुंह से सांस लेने और बढ़ते बच्चों की क्रानियोफेशियल संरचना पर इसके प्रभावों से जुड़े विभिन्न मापदंडों का मूल्यांकन करना।

4. मुझे क्यों चुना गया है?

आपको इस अध्ययन के लिए चुना गया है क्योंकि आप इस अध्ययन के लिए आवश्यक मानदंडों को पूरा कर रहे हैं।

5. क्या मुझे भाग लेना है?

अनुसंधान में आपकी भागीदारी पूरी तरह से स्वैच्छिक है। यदि आप ऐसा करते हैं, तो आपको यह सूचना पत्र रखने के लिए दिया जाएगा और सहमति फॉर्म पर हस्ताक्षर करने के लिए कहा जाएगा। अध्ययन के दौरान आप अभी भी किसी भी समय और बिना कारण बताए वापस लेने के लिए स्वतंत्र हैं।

6. यदि मैं भाग लेता हूँ तो मेरा क्या होगा?

प्रतिभागियों को क्रानियोफेशियल संरचना पर मुंह से सांस लेने के हानिकारक प्रभावों के लिए मूल्यांकन किया जाएगा।

7. मुझे क्या करना होगा?

इस अध्ययन के लिए क्रानियोफेशियल संरचना पर मुंह से सांस लेने के प्रभाव के मूल्यांकन की आवश्यकता है। प्रतिभागियों को सुबह 9 बजे संस्थान को रिपोर्ट करना चाहिए। छुट्टी दिए जाने के बाद उसे दोपहर में छुट्टी दे दी जाएगी। अभिभावकों को 30 प्रश्नों से युक्त स्व-डिज़ाइन की गई प्रश्नावली भरने के लिए कहा जाएगा। प्रश्नावली में प्रश्न उस स्थिति को खोजने में मदद करेगा जो मुंह श्वास सिंड्रोम से जुड़ी हो सकती है। उनके पार्श्व सेफलोग्राम को फ्रैंकफर्ट क्षैतिज विमान के साथ एक सेफलोस्टैट का उपयोग करके प्राप्त किया जाएगा, जो फर्श के समानांतर है और आराम से होंठों के साथ केंद्रित रोड़ा में दांत हैं।

8. किस प्रक्रिया का परीक्षण किया जा रहा है?

मुंह से सांस लेने से जुड़े विभिन्न मापदंडों और बढ़ते बच्चों की क्रानियोफेशियल संरचना पर इसके प्रभावों का मूल्यांकन करने के लिए अध्ययन किया जाएगा। प्रतिभागियों के प्रश्नावली और पार्श्व सेफलोग्राम का उपयोग किया जा रहा है।

9. अध्ययन के लिए क्या हस्तक्षेप हैं?

मुंह से सांस लेने से जुड़े विभिन्न पैरामीटर।

10. भाग लेने के दुष्प्रभाव क्या हैं?

कोई हानिकारक प्रभाव नहीं है क्योंकि अध्ययन मूल्यांकन उद्देश्य पर आधारित है।

11. भाग लेने के संभावित नुकसान और जोखिम क्या हैं?

इस अध्ययन में भाग लेने के कोई नुकसान नहीं हैं।

12. भाग लेने के संभावित लाभ क्या हैं?

प्रतिभागी लाभान्वित होंगे क्योंकि उन्हें चेहरे पर मुंह से सांस लेने के हानिकारक प्रभावों के बारे में पता चल जाएगा।

13. क्या होगा यदि नई जानकारी उपलब्ध हो जाती है?

यदि शोध के दौरान अतिरिक्त जानकारी उपलब्ध हो जाती है तो आपको इनके बारे में बताया जाएगा और आप अपने शोधकर्ता के साथ इस पर चर्चा करने के लिए स्वतंत्र हैं, आपका शोधकर्ता आपको बताएगा कि क्या आप अध्ययन में जारी रखना चाहते हैं। यदि आप वापस लेने का निर्णय लेते हैं, तो आपका शोधकर्ता आपकी वापसी की व्यवस्था करेगा। यदि आप अध्ययन जारी रखने का निर्णय लेते

हैं, तो आपको एक अद्यतन सहमति फॉर्म पर हस्ताक्षर करने के लिए कहा जा सकता है।

14. जब शोध अध्ययन बंद हो जाता है तो क्या होता है?

प्रतिभागियों को कुछ नहीं होगा।

15. अगर कुछ गलत हो जाए तो क्या होगा?

समस्याओं/शिकायतों को एचओडी या आईआरसी द्वारा नियंत्रित किया जाएगा। अगर कुछ गंभीर होता है तो संस्थान समस्याओं का ध्यान रखेगा।

16. क्या इस अध्ययन में मेरे भाग लेने को गोपनीय रखा जाएगा?

हां इसे गोपनीय रखा जाएगा।

17. शोध अध्ययन के परिणामों का क्या होगा?

अध्ययन के परिणामों का उपयोग क्रैनियो चेहरे की संरचना और मुंह से सांस लेने से जुड़े विभिन्न मापदंडों पर मुंह से सांस लेने के प्रभाव का आकलन करने के लिए किया जाएगा। किसी भी रिपोर्ट/प्रकाशन के मामले में आपकी पहचान गोपनीय रखी जाएगी।

18. शोध का आयोजन कौन कर रहा है?

यह शोध बाल चिकित्सा और निवारक दंत चिकित्सा विभाग, बीबीडीसीओडीएस में किया गया है। शोध स्व-वित्त पोषित है। प्रतिभागियों को संस्था द्वारा दिए गए प्रक्रियात्मक शुल्क का भुगतान करना होगा।

19. क्या अध्ययन समाप्त होने के बाद अध्ययन के परिणाम उपलब्ध कराए जाएंगे?

हां

20. अध्ययन की समीक्षा किसने की है?

संस्थान के एचओडी और आईआरसी/आईईसी के सदस्यों ने अध्ययन की समीक्षा की और उसे मंजूरी दी।

21. अधिक जानकारी के लिए संपर्क करें

डॉ.सादिया सलमान

बाल चिकित्सा और निवारक दंत चिकित्सा विभाग

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105

मोब- 9621402256

डॉ. लक्ष्मीबाला

संस्था की आचार समिति के सदस्य सचिव,

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

ANNEXURE- VI

CHILD INFORMATION DOCUMENT

Study title: — Assessment of factors related to mouth breathing and its effects on craniofacial structures of growing children

Introduction

What will you have to do?

This study requires evaluation of mouth breathing effects upon craniofacial structure. The participants should report to the institute at 9 am on the morning. He or she will be discharged in the afternoon once discharged criteria are met . Guardians will be asked to fill self-designed questionnaire consisting of 30 questions. Question in the questionnaire will help to find condition which might be linked to mouth breathing syndrome. Their lateral cephalogram will be obtained using a cephalostat with the Frankfort Horizontal plane parallel to the floor and teeth in centric occlusion with relaxed lips

Risks and discomforts

There is no foreseen significant risk / hazard to your health, if you wish to participate in the study. If you follow the directions of the dentist in charge of this study and you are injured due to any procedure given under the study plan, the institute will take care.

Benefits

The participant will be benefited as they will get to know about harmful effects of

mouth breathing on face

Confidentiality

Information about you will be collected and stored in files with an assigned number, and not directly with your name. All documents related to the study will only be accessed by the study investigator, sponsor, the Ethics Committee and the Regulatory authority.

Your parent / guardian will have the right to access personal information about you at any time with the study doctor and the right to correct this personal information. Your parent / guardian can take away your authorization to collect process and disclose data about you at any time.

Right to refuse or withdraw

You do not have to take part in this research if you do not wish to do so. You may stop participating in the research at any time you wish. The study investigator may decide to withdraw you from the study if he/she considers it is in your best interest

You will be informed of important new findings developed during the course of the study so you will be able to consider your participation in the study in light of new information.

Parents responsibilities

It is the responsibility of your parent / guardian to come along with you to the centre during the study period for all the visits unless you withdraw or are prematurely discontinued from the study. It is also your responsibility and your parent / guardian to report any expected or unexpected reactions (side effects) that you notice during the study period.

We expect your co-operation throughout the study.

ANNEXURE-VII

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Title of the project: **Assessment of factors related to mouth breathing and its effects on craniofacial structures of growing children**

1. Name of the department/ address of the investigator: **Department Of Pediatric And Preventive Dentistry**
2. Name of Faculty (Guide/Co-Guide) with designation and department: **Dr. MONIKA RATHORE, Department of Pediatric and Preventive Dentistry**
3. Date of approval by Institutional Research Committee (IRC) (Pl enclose approval letter along with finally approved research proposal):
4. Sources of funding: **Self**
5. Study related information:

(i) Place of Study:

(a) BBDU

(ii) *In-vitro studies on human subjects*: Please specify if it is body fluid blood/tissues/ teeth.

(a) Bile, Saliva etc.

(b) Teeth, please specify type

[ ]

(c) Tissue, please specify type

[ ]

(d) Use of stored or left over specimens

[ ]

(e) Any other

[ ]

(iii) *In-vivo* study on human subjects:

(a) Intervention [√]

(b) Drugs [ ]

(c) Implants [ ]

(d) Any other e.g. X-rays/ultrasound/etc [ ]

(vi) Vulnerable subjects.

(a) Pregnant Woman [ ]

(b) Elderly [ ]

(c) Terminally ill [ ]

(d) Physically/ mentally challenged [ ]

(e) Children under 18 [√]

(f) Students [ ]

(g) Orphans [ ]

(vii) Survey of human subject:

(a) Verbal questionnaire [√]

(b) Non- invasive examination [ ]

(c) Invasive procedures [ ]

(viii) SEA (Sereve Adverse Events) reporting:

(a) Is there a plan for reporting of adverse events [ ]

If yes it will be done to Institution (s) [ ] IEC [All]

[

6. Ethical issues involved in the study:

Less than minimal risk/ minimal risk/ more than minimal risk to the study subjects (for guidance please consult ICMR guidelines 2006)

7. Do you need exemption from obtaining Informed Consent from study

subject – if so give justifications

In following cases exemption can be requested:

a. Audits of educational practices.
b. Research on microbes cultured in the laboratory.
c. Research on immortalized cell lines.
d. Computer Simulation and Dental Materials
e. Analysis of data freely available in public domain.
f. Any other.

8. Whether Consent forms and Participant Information Document in English and in Hindi are enclosed?
9. Conflict of interest for any other investigator(s) (if yes, please explain in brief)
10. We the undersigned, have read and understood this protocol and hereby agree to conduct the study in accordance with this protocol and to comply with all requirements of the ICMR guidelines (2006)

Signature of the Investigator: Date:

Signature of the Guide & Co- Guide of the Department: Date:

Signature of the Head of the Department: Date

(Note: The investigator must provide information to the subjects in a simple language, and it should address the subjects, in a dialogue format)

ANNEXURE VIII
Questionnaire

Conditions which might be linked to Mouth Breathing Syndrome.

Question item

Factor 1

Is your mouth often open during the day?

Are your lips droopy

Do you get tired easily?

Are you good riser?

Are you good at exercising?

Are you a restless sleeper?

Factor 2

Does your nose become stuffed easily while sleeping?

Do you sneeze often?

Do you often have a runny nose?

Do you often have a sore throat?

Do you have swollen tonsils?

Do you often fail to listen?

Are you a habitual snorer?

Factor 3

Do your meals consist of small servings?

Do you keep your mouth closed when you eat?

Do you have food left in your mouth for a long time?

Factor 4

Is your mouth often dry?

Do people tell you that you have bad breath in the morning?

Do you sleep with your mouth open?

Can you talk clearly?

Factor 5

Do you prefer soft food?

Do you drink water during meals?

Factor 6

Are your teeth visible between your upper and lower lips?

Are your gums often swollen?

Are your teeth easily stained

Do you have an over bite?

Do you have an anterior open bite

Factor 7

Are your lips often chapped?

Is your upper lip turned upward?

Factor 1 as “Incompetent lip seal”, based on the questions “Are your lips droopy?” and “Is your mouth often open during the day?”

Factor 2 was defined as “Diseases of the nose and throat” based on the strong factor loading of “Does your nose become stuffed easily (during the day, while sleeping)?” and “Do you often have a sore throat?”

Factors 3, 4, 5, 6, and 7 were defined as “Eating and drinking habits”, “Bad breath”, “Problems with swallowing and chewing”, “Condition of teeth and gums”, and “Dry lips”, respectively

ANNEXURE IX

Cephalometric point

Sella (S) Midpoint of sella turcica.

Nasion (N) Most anterior point on fronto-nasal suture.

Point (A) Position of deepest concavity on anterior profile of maxilla (subspinal).

Point (B) Position of deepest concavity on anterior profile of mandible (supramental).

Gonion (Go) Most posterior inferior point on angle of mandible

Pogonion (Pg) Anterior most point in the mandibular symphysis.

Menton (Me) Point located in the intersection between cortical external mental portion and cortical inferior mandible portion. Lowest point on the mandibular symphysis.

Posterior Nasal Spine (PNS) Median point formed by the union of the posterior borders of both palatine bones.

Anterior Nasal Spine (ANS) Point located at the end of the anterior nasal spine. Porion (Po) Upper most point on bony external auditory meatus.

Gnathion (Gn) Most anterior and lowest point on the mandibular symphysis determined by bisecting of the angle formed between the mandibular plane and a perpendicular line of it tangentially to the most anterior region of the symphysis.

Articulae (Ar) Point located at the cross-section of posterior contour of the mandibular condyle with the occipital bone base.

Basion (Ba) The point at the front border of the foramen magnum in the median plane.

Orbitale (Or) Most inferior anterior point on margin of orbit.

Cephalometric angular & linear measurments

SNB angle Determined by the intersection between the sella-nasion (SN) and nasion-supramental (NB) lines. This angle expresses the degree of protrusion or retrusion of the mandible in relation to the cranial base.

SNA angle Determined by the intersection between the sella-nasion (SN) and

nasion-subspinal (NA) lines. This angle expresses the degree of protrusion or retrusion of the maxilla in relation to the cranial base.

ANB angle Determined by the intersection between the nasion-subspinal (NA) and nasion-supramental lines and corresponding to the difference between the SNA and SNB angles. This angle determines the anteroposterior relationship between the maxilla and mandible.

E line (Aesthetic line) Line connecting the nasal tip and the most prominent anterior point of the soft tissue chin (Pogonion).

ANS-Me Linear measurement determined by the union of the anterior nasal spine and mental points corresponding to the lower anterior facial height.

Go-Gn Linear measurement determined by the union of the gonial and gnathion points corresponding to the mandibular plane (Steiner).

Y axis angle Formed by the Y axis, from point (S) to point (Gn), with the Frankfurt horizontal plane.

S-Go Linear measurement determined by the union of the sella and gonial points corresponding to the total posterior facial height.

N-Me Linear measurement determined by the union of the nasion and mental points corresponding to the total anterior facial height.

Go-Gn to SN Angle Determined by the intersection of mandibular plane (Go-Gn) with the S-N line. Gives the inclination of the mandibular plane relative to anterior base of the skull

PLAGIARISM REPORT

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Submission Information

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Title	ASSESSMENT OF FACTORS RELATED TO MOUTH BREATHING AND ITS EFFECTS ON CRANIOFACIAL STRUCTURES OF GROWING CHILDREN
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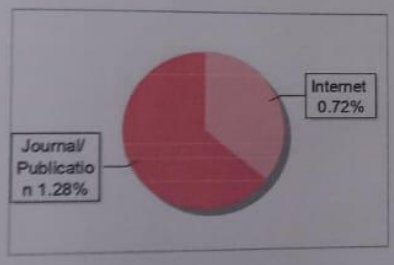

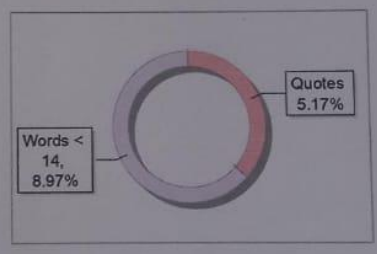

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