ORIGINAL ARTICLE

Correlation between of nasopharyngeal dimensions and craniofacial structure in 8–15-year-olds: a cross-sectional study

Chantyka Rosady[1]
Mimi Marina Lubis[2*]

[1]Undergraduate Study Program, Faculty of Dentistry, Universitas Sumatera Utara, Indonesia
[2]Department of orthodontic, Faculty of Dentistry, Universitas Sumatera Utara, Indonesia

* Correspondence:
mimimlbs@yahoo.com

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ABSTRACT

Introduction: Nasopharyngeal dimensions are closely associated with craniofacial structures. Changes in the nasopharynx during facial growth may influence craniofacial development. This study aimed to analyze the correlations between nasopharyngeal dimensions and craniofacial structures in children aged 8–15 years. **Methods**: This study used a cross-sectional design, based on lateral cephalometry in 66 children aged 8–15 years who attended the Orthodontic Clinic, Universitas Sumatera Utara, from June-December 2022. All participants had skeletal and dental Class I relationships, no harmful habits, and were not on long-term medication. The study measured nasopharyngeal dimensions, including the mean and standard deviation of bony and soft tissue components, and craniofacial structures such as maxillary length, mandibular length, and lower anterior facial height. Data were analyzed using the Shapiro-Wilk test for normality and Pearson's correlation test. **Results**: The posterior height of the nasal cavity had the highest mean value among nasopharyngeal measurements (53.99 ± 4.30 mm). Among soft tissue parameters, AD1–PNS showed the greatest mean (24.99 ± 4.70 mm) compared with PTV–AD and AD2–PNS. The mandibular length exceeded the maxillary length, and the lower anterior facial height averaged 117.74 ± 8.57 mm. Pearson's correlation analysis showed significant correlations ($p<0.05$) between nasopharyngeal dimensions and craniofacial structures. The nasal floor length, posterior height of the nasal cavity, bony nasopharynx height and depth, and soft tissue measures (AD1–PNS, PTV–AD) were significantly correlated with maxillary and mandibular lengths and lower anterior facial height. **Conclusion**: The posterior height of the nasal cavity demonstrated the highest average value, and mandibular length was greater than maxillary length. In children aged 8–15 years, nasopharyngeal dimensions were correlated with craniofacial structures, with the exception of the nasopharyngeal depth angle and roof angle of the bony nasopharynx.

KEYWORDS
Craniofacial structures, lateral cephalogram, nasopharyngeal dimensions

INTRODUCTION

The pharynx is a tubular upper respiratory tract that extends from the base of the skull to the inferior plane of the sixth cervical vertebra.[1] The pharynx can be divided into the nasopharynx (epipharynx), oropharynx (mesopharynx), and laryngopharynx (hypopharynx).[2] The nasopharynx is the part of the pharynx located outside the nasal cavity and extends from the base of the skull to the inferior tip of the soft palate.[2] The dimensions of the nasopharynx consist of hard and soft tissues. The development of hard and soft tissues of the nasopharynx affects the development and size of the nasopharyngeal airway.[3] The dimensions of the pharyngeal airway are influenced by age, gender, skeletal maturity, anatomy, and puberty.[4-5] Kim et al., reported that upper airway dimensions increased from 8 to 15 years of age and showed a positive correlation with age.[6] Chianchitlert et al., found differences in the size of the upper airway between children aged 7 and 14 years.[7] Gender is a natural factor that can affect craniofacial growth such as maxillary length, mandibular length, and facial height. Maxillary and mandibular growth in males tends to be greater than in females.[8]

The dimensions of the nasopharynx, which are associated with the growth of craniofacial structures, are influenced by a normal breathing pattern that promotes harmonious craniofacial development.[9-10] The adenoid gland begins to regress during and after puberty.[11] Symptomatic adenoid hypertrophy can lead to upper airway obstruction in the nasal cavity, this airway obstruction may result in breathing difficulties, characterized by a lowered tongue posture, reduced sagittal depth of the nasopharyngeal bony tissues, retroclination of the maxillary incisors, a narrow maxillary dental arch, and an increased mandibular plane angle.[12-13] Such adenoid hypertrophy contributes to an increase in both lower and total facial height.[14] Vertical facial growth patterns also have an impact on the morphology and volume of the pharyngeal airway.[15]

The growth of craniofacial structures is a critical factor in establishing an accurate diagnosis and planning appropriate treatment.[16] This includes the development of the maxilla, mandible, and the anterior lower facial height. The growth rate of the maxilla increases up to approximately 11 years of age. The growth spurt of the anterior lower facial height takes place during puberty, around 12-15 years of age in males, and approximately two years earlier in females, between 10 and 13 years of age.[17]

Lateral cephalometric radiography is a standard radiographic method used to assess the relationship between the teeth, jaws, and facial skeleton. The use of lateral cephalometric radiography is non-invasive, with lower cost and reduced radiation exposure for patients.[18] Several studies have confirmed that this radiograph has good diagnostic accuracy and high reliability in detecting adenoid hypertrophy.[19]

The study by Al-Jewair et al., investigated the correlation between craniofacial structures, anthropometric measurements, and both bony and soft tissue dimensions of the nasopharynx. The average nasopharyngeal bony tissue dimensions in males were greater than those in females. The average maxillary length, mandibular length, and anterior lower facial height were also larger in males than females. A weak to moderate correlation was found between maxillary length, mandibular length, anterior lower facial height, and several nasopharyngeal parameters. A strong correlation was observed between the posterior nasal cavity height and maxillary length in females. The posterior nasal cavity height, nasopharyngeal vertical angle, and adenoid height were correlated with mandibular growth. Anterior lower facial height showed a significant correlation with several nasopharyngeal bony tissue dimensions.[20]

Diwakar et al., conducted a study on the impact of craniofacial morphology on the volume of the pharyngeal airway measured using Cone-Beam Computed Tomography (CBCT). The study reported that nasopharyngeal volume is significantly correlated with craniofacial structural parameters. A significant relationship was found between the dimensions of the nasopharynx and the lengths of the maxilla and mandible.[21]

The study by Fathi et al, assessed the growth of craniofacial structures and the airway in children aged 9-11 years with normal occlusion. Children aged 9-11 years exhibited significant increases in maxillomandibular length, posterior facial height, total anterior facial height, and anterior upper facial height, whereas the anterior lower facial height showed no significant increase. The results of the study indicated that the upper and lower nasopharyngeal bony tissues exhibited no significant decrease relative to maxillary length.[22]

However, there is a notable gap in the literature regarding specific, quantitative analysis of nasopharyngeal dimensions and their correlation with craniofacial structures specifically in children aged 8–15 years. The novelty of this study lies in analyzing the relationship between nasopharyngeal dimensions including both bony and soft tissue components with craniofacial structures, including the maxilla, mandible, and lower anterior facial height, in children aged 8–15 years presenting to the clinic.

Although this age range is referenced in several studies, there is insufficient emphasis on it as a distinct group with unique diagnostic relevance. Therefore, this study aimed to analyze the correlations between nasopharyngeal dimensions and craniofacial structures in children aged 8–15 years.

METHODS

This was a descriptive analytical study with a cross-sectional design aimed at assessing the relationship between nasopharyngeal dimensions and craniofacial structures in children aged 8-15 years. The research was carried out on patients aged 8-15 years at the Orthodontic Clinic of the Faculty of Dentistry, University of Sumatera Utara, from June to December 2022.

The inclusion criteria included skeletal and dental Class I, no history of orthodontic treatment, absence of harmful habits, age 8-15 years, and a normal Body Mass Index (BMI). The determination of skeletal Class I samples was conducted through cephalometric analysis, while dental Class I was identified using the patients' medical records. The exclusion criteria were patients with systemic diseases and those on long-term medication.

This study measured the dimensions of the nasopharynx, namely bony and soft tissue components, and craniofacial structures: maxillary length, mandibular length, and lower anterior facial height. The measurements were performed using CorelDRAW X8 software, and calibration was carried out using an inter-examiner method.

Data analysis was initially performed using the Shapiro-Wilk test to assess data normality. For normally distributed data, Pearson's correlation test was applied.

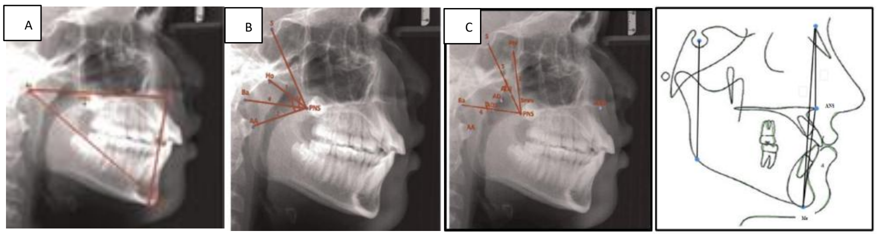

Figure 1. A. Landmark Bony Nasopharynx B. Landmark Soft tissue Nasopharynx C. Landmark Craniofacial Structures D. Landmark Lower Anterior Facial Height

RESULTS

The study was carried out at the Orthodontic Clinic of the Faculty of Dentistry, University of Sumatera Utara, with a sample size of 66 lateral cephalometric radiographs, consisting of 41 females and 25 males with skeletal and dental Class I, aged 8-15 years. The samples were collected from patient data at RSGM USU and met the inclusion criteria established for this study. Based on the measurements performed on the samples, the mean and standard deviation of the nasopharyngeal dimensions and craniofacial structures in children aged 8-15 years are presented.

Table 1. Bony and Soft Tissue Nasopharyngeal Dimensions and Craniofacial Structures in Children Aged 8-15 Years

Parameter		Mean	Standard Deviation
Bony Tissue of the Nasopharynx	AA-PNS (mm)	35.99	4.30
	S-PNS (mm)	53.42	3.99
	PNS-HO (mm)	35.48	3.41
	Ba-PNS (mm)	51.91	4.40
	Ba-S-PNS (°)	58.06	5.04
	Ba-Ho-PNS (°)	110.86	4.50
Soft Tissue of the Nasopharynx	PTV-AD (mm)	17.38	6.80
	AD1-PNS (mm)	24.99	4.70
	AD2-PNS (mm)	18.67	4.36
Craniofacial Structures	Ar-ANS (mm)	97.33	6.40
	Ar-Gn (mm)	117.74	8.57
	ANS-Me (mm)	73.40	5.55

The dimensions of the nasopharyngeal bony tissue include the measurements of AA-PNS, S-PNS, PNS-HO, Ba-PNS, Ba-S-PNS, and Ba-HO-PNS. According to Table 1, S-PNS had the largest mean, measuring 53.42± 3.99. The angle Ba-HO-PNS showed a larger mean than Ba-S-PNS, measuring 110.86 ± 4.50. The dimensions of the nasopharyngeal soft tissue consist of PTV-AD, AD1-PNS, and AD2-PNS. The mean of AD1-PNS is larger than that of PTV-AD and AD2-PNS, measuring 24.99 ± 4.70. The craniofacial structures measured include the lengths of Ar-ANS, Ar-Gn, and ANS-Me. The mean of Ar-Gn is larger than both Ar-ANS and ANS-Me, measuring 117.74 ± 8.57.

As shown in Table 2, the mean values of nasopharyngeal dimensions and craniofacial structures varied between females and males. The mean values of S-PNS, Ba-PNS, Ba-Ho-PNS, Ar-ANS, and ANS-Me were higher in males compared to females. The mean values of AA-PNS, PNS-Ho, Ba-S-PNS, PTV-AD, AD1-PNS, AD2-PNS, and Ar-Gn are greater in females than in males.

Data were initially analyzed using the Shapiro-Wilk test to assess normality. The results of the Shapiro-Wilk test showed that all data were normally distributed; therefore, Pearson correlation analysis was applied.

As shown in Table 3, the results of the Pearson correlation analysis indicate a significant relationship ($p<0.05$) between nasopharyngeal dimensions and craniofacial structures in several parameters, including AA-PNS, S-PNS, PNS-HO, Ba-PNS, PTV-AD, AD1-PNS, and AD2-PNS with Ar-ANS. AA-PNS, S-PNS, PNS-HO, Ba-PNS, PTV-AD, AD1-PNS, and AD2-PNS also demonstrated a significant correlation with Ar-Gn. Furthermore, S-PNS, PNS-HO, Ba-PNS, and PTV-AD were found to be significantly correlated with ANS-Me.

The results of the Pearson correlation analysis in Table 4 show a significant relationship ($p<0.05$) between nasopharyngeal dimensions and craniofacial structures in female children aged 8–15 years. AA-PNS, S-PNS, Ba-PNS, PTV-AD, and AD1-PNS showed a significant correlation with Ar-ANS. A significant relationship was also identified between AA-PNS, S-PNS, PNS-HO, Ba-PNS, PTV-AD, and AD1-PNS with Ar-Gn.

Table 2. Nasopharyngeal Bony and Soft Tissue Dimensions and Craniofacial Structures in Children Aged 8–15 Years by Sex

Parameter		Sex	Mean	Standard Deviation
Bony Tissue of the Nasopharyx	AA-PNS (mm)	Female	36.80	3.85
		Male	35.19	4.93
	S-PNS (mm)	Female	53.23	3.52
		Male	53.73	4.71
	PNS-HO (mm)	Female	35.66	3.09
		Male	35.18	3.94
	Ba-PNS (mm)	Female	51.64	4.07
		Male	52.35	4.94
	Ba-S-PNS (°)	Female	58.22	4.86
		Male	57.80	5.41
	Ba-Ho-PNS (°)	Female	110.83	5.03
		Male	110.90	3.55
Soft Tissue of the Nasopharynx	PTV-AD (mm)	Female	17.95	6.96
		Male	16.44	6.55
	AD1-PNS (mm)	Female	25.45	4.75
		Male	24.25	4.61
	AD2-PNS (mm)	Female	18.96	4.14
		Male	18.18	4.76
Craniofacial Structures	Ar-ANS (mm)	Female	97.11	5.96
		Male	97.70	7.18
	Ar-Gn (mm)	Female	118.11	7.56
		Male	117.12	10.16
	ANS-Me (mm)	Female	72.63	5.47
		Male	74.67	5.54

Table 3. Relationship Between Bony and Soft Tissue Dimensions of the Nasopharynx and Craniofacial Structures in Children Aged 8–15 Years

Parameter		Craniofacial Structures					
		Ar-ANS (mm)		Ar-Gn (mm)		ANS-Me (mm)	
		r	p-value	r	p-value	r	p-value
Bony Tissue of the Nasopharyx	AA-PNS (mm)	0.50	0.0001*	0.43	0.0001*	0.23	0.065
	S-PNS (mm)	0.56	0.001*	0.63	0.0001*	0.44	0.0001*
	PN-SHO (mm)	0.47	0.0001*	0.55	0.0001*	0.32	0.009*
	Ba-PNS (mm)	0.61	0.0001*	0.52	0.0001*	0.33	0.007*
	Ba-S-PNS (°)	0.13	0.29	0.00	0.94	-0.08	0.548
	Ba-Ho-PNS (°)	0.10	0.42	0.03	0.79	-0.02	0.885
Soft Tissue of the Nasopharynx	PTV-AD (mm)	0.57	0.0001*	0.52	0.0001*	0.28	0.025*
	AD1-PNS (mm)	0.57	0.0001*	0.47	0.0001*	0.17	0.179
	AD2-PNS (mm)	0.47	0.0001*	0.47	0.0001*	0.15	0.231

Note: r <0.20: very weak; r 0.20-0.39: weak; r 0.40-0.59: moderate; r 0.60-0.79: strong; r >0.80: very strong

Table 4. Relationship Between Bony and Soft Tissue Nasopharyngeal Dimensions and Craniofacial Structures in Female Children Aged 8–15 Years

Parameter		Craniofacial Structures					
		Ar-ANS (mm)		Ar-Gn (mm)		ANS-Me (mm)	
		r	**p-value**	**r**	**p-value**	**r**	**p-value**
Bony Tissue of the Nasopharyx	AA-PNS (mm)	0.43	0.005*	0.31	0.049*	0.21	0.189
	S-PNS (mm)	0.37	0.016*	0.50	0.001*	0.30	0.060
	PNS-HO (mm)	0.23	0.143	0.40	0.009*	0.26	0.108
	Ba-PNS (mm)	0.50	0.001*	0.37	0.017*	0.26	0.095
	Ba-S-PNS (°)	0.17	0.288	-0.05	0.770	0.04	0.817
	Ba-Ho-PNS (°)	0.14	0.390	0.001	0.995	0.00	0.985
Soft Tissue of the Nasopharynx	PTV-AD (mm)	0.52	0.001*	0.47	0.002*	0.18	0.274
	AD1- PNS (mm)	0.55	0.0001*	0.40	0.011*	0.06	0.720
	AD2- PNS (mm)	0.31	0.050*	0.26	0.097	0.01	0.976

Note: r <0.20: very weak; r 0.20-0.39: weak; r 0.40-0.59: moderate; r 0.60-0.79: strong; r >0.80: very strong

Table 5 presents the results of the Pearson correlation analysis, indicating a significant relationship (p<0.05) between nasopharyngeal dimensions and craniofacial structures in male children aged 8–15 years. AA-PNS, S-PNS, PNS-HO, Ba-PNS, PTV-AD, AD1-PNS, and AD2-PNS were significantly correlated with Ar-ANS. A significant correlation was also found between AA-PNS, S-PNS, PNS-HO, Ba-PNS, PTV-AD, AD1-PNS, and AD2-PNS with Ar-Gn. Additionally, S-PNS, PNS-HO, Ba-PNS, PTV-AD, AD1-PNS, and AD2-PNS showed a significant relationship with ANS-Me.

Table 5. Relationship Between Bony and Soft Tissue Nasopharyngeal Dimensions and Craniofacial Structures in Male Children Aged 8–15 Years

Parameter		Craniofacial Structures					
		Ar-ANS (mm)		Ar-Gn (mm)		ANS-Me (mm)	
		r	p-*value*	r	p-*value*	r	p-*value*
Bony Tissue of the Nasopharyx	AA-PNS (mm)	0.61	0.001*	0.53	0.006*	0.33	0.105
	S-PNS (mm)	0.76	0.0001*	0.76	0.0001*	0.63	0.001*
	PNS-HO (mm)	0.74	0.0001*	0.68	0.0001*	0.45	0.023*
	Ba-PNS (mm)	0.74	0.0001*	0.70	0.0001*	0.40	0.045*
	Ba-S-PNS (º)	0.09	0.687	0.07	0.749	-0.23	0.275
	Ba-Ho-PNS (º)	0.03	0.874	0.10	0.648	-0.07	0.727
Soft Tissue of the Nasopharynx	PTV-AD (mm)	0.68	0.0001*	0.61	0.001*	0.52	0.007*
	AD1-PNS (mm)	0.57	0.003*	0.57	0.003*	0.43	0.033*
	AD2- PNS (mm)	0.68	0.0001*	0.69	0.0001*	0.40	0.046*

Note: r <0.20: very weak; r 0.20-0.39: weak; r 0.40-0.59: moderate; r 0.60-0.79: strong; r >0.80: very strong

DISCUSSION

Bony and soft tissues of the nasopharynx are related to craniofacial structures. The nasopharynx is a part of the pharynx located behind the nasal cavity and above the soft palate. The roof of the nasopharynx is covered by a mass of lymphoid tissue known as adenoid tissue, which may undergo hypertrophy. Adenoid hypertrophy can result in changes to craniofacial structure.[14-23] This study aimed to investigate the relationship between nasopharyngeal tissue dimensions and craniofacial structures in children aged 8-15 years.

The mean posterior nasal cavity height (S-PNS) and nasopharyngeal depth (Ba-PNS) were larger in males compared to females, while the mean nasopharyngeal depth angle (Ba-S-PNS) was larger in females than in males (Table 2). The results of this study align with those of Al-Jewair et al., who conducted research on children undergoing puberty. This study also aligns with Ponnada et al., who discovered that the mean nasopharyngeal depth angle (Ba-S-PNS) in females was larger than in males.[24] Al-Jewair et al. found a difference in nasopharyngeal dimensions between the sexes, with males exhibiting larger nasopharyngeal bony tissue dimensions compared to females.[20] This difference is attributed to anatomical variations between males and females, where the nasopharyngeal airway diameter is smaller in females compared to males.[25]

Based on Table 2, the mean maxillary length in males was greater than in females. The results of this study align with findings by Lubis et al., which was conducted on the Batak ethnic group aged 9-15 years. Regarding mandibular length, females have a larger mandibular length compared to males, which differs from the findings of Lubis et al., who reported the opposite pattern.[26] This study does not align with the research by Sihombing et al., who found that the mandibular length in males was greater than in females.[27] The mean anterior lower facial height in males was greater than in females, which aligns with the study by Lindawati et al., who found that the anterior lower facial height in males was larger than in females.[28]

Hormones can be a significant factor affecting craniofacial structure, such as estrogen deficiency. Estrogen can influence bone size, as it plays a role in bone metabolism by regulating the activity of osteoclasts and osteoblasts. This is related to the rate of bone resorption and formation.[29] Disruptive factors, such as malnutrition and harmful habits, were controlled in this study sample. The subjects included in this study did not have any harmful habits and were not malnourished, as assessed by their Body Mass Index (BMI).

Based on Table 3, there was a weak, moderate, and strong correlation between the nasopharyngeal dimension parameters and craniofacial structure, with the largest r value found in the relationship between the posterior nasal cavity height and mandibular length. These weak to strong correlations illustrate the extent to which nasopharyngeal parameters may influence craniofacial structure parameters in children aged 8-15 years. The larger the r value, the stronger the relationship observed, while the smaller the p-value obtained, the stronger the relationship between the nasopharyngeal dimensions and craniofacial structure.[30]

The results of the study show a significant relationship between the floor of the nose length (AA-PNS), posterior nasal cavity height (S-PNS), nasopharyngeal bony tissue height (PNS-HO), nasopharyngeal depth (Ba-PNS), soft tissue nasopharynx and maxillary length (Ar-ANS) and mandibular length (Ar-Gn). Posterior nasal cavity height (S-PNS), nasopharyngeal bony tissue height (PNS-HO), nasopharyngeal depth (Ba-PNS), and PTV-AD had a significant correlation with anterior lower facial height (ANS-Me). The results of this study align with the findings of Al-Jewair et al.

The study by Anandarajah et al., conducted on children aged 8-16 years, found a significant relationship between nasopharyngeal dimensions and craniofacial structure.[31] Alterations in the normal function of the nasopharynx, such as adenoid hypertrophy during facial growth, can affect craniofacial structure development. Adenoid hypertrophy leads to airway obstruction and a tendency to breathe through the mouth, influencing maxillary length, mandibular length, and anterior lower facial height.[14] The results of this study do not align with the research by Fathi et al., which showed that the upper and lower nasopharyngeal bony tissue dimensions did not significantly affect maxillary length.[22]

This study found no significant relationship between the nasopharyngeal depth angle (Ba-S-PNS), the hard palate angle of the nasopharynx (Ba-Ho-PNS) and the maxillary length (Ar-ANS), mandibular length (Ar-Gn), and anterior lower facial height (ANS-Me). These results do not align with the research by Al-Jewair et al., possibly because the samples used in their study represented a different race or ethnicity.[20]

This study showed a significant relationship, with a $p<0.05$, between nasopharyngeal dimensions and craniofacial structures in males aged 8-15 years, including nasal floor length (AA-PNS), posterior nasal cavity height (S-PNS), bony tissue nasopharynx height (PNS-Ho), nasopharyngeal depth (Ba-PNS), and several soft tissue nasopharyngeal parameters such as PTV-AD, AD1-PNS, and AD2-PNS and maxillary length (Ar-ANS). However, in females, differences were observed, where a significant relationship occurred between nasal floor length (AA-PNS), posterior nasal cavity height (S-PNS), nasopharyngeal depth (Ba-PNS), and several soft tissue nasopharyngeal parameters such as PTV-AD, AD1-PNS and maxillary length (Ar-ANS).

These results do not align with the research by Anandarajah et al., who did not find any differences between males and females.[31] In females, there was a significant relationship between nasal floor length (AA-PNS), posterior nasal cavity height (S-PNS), bony tissue nasopharyngeal height (PNS-Ho), nasopharyngeal depth, and several soft tissue nasopharyngeal parameters such as PTV-AD, AD1-PNS and mandibular length (Ar-Gn).

In males, nasal floor length (AA-PNS), posterior nasal cavity height (S-PNS), bony tissue nasopharyngeal height (PNS-Ho), nasopharyngeal depth (Ba-PNS), and several soft tissue nasopharyngeal parameters such as PTV-AD, AD1-PNS, and AD2-PNS had a significant relationship with mandibular length (Ar-Gn). This study does not align with the research by Mehta et al., who found no significant relationship between nasopharyngeal dimensions and mandibular length in subjects with normal mandibles. This discrepancy may be due to the different sample ages; Mehta et al., study used samples aged 15-30 years, while this study focused on samples aged 8-15 years.[32]

In females, there was no significant relationship between the bony and soft tissues of the nasopharynx and the anterior lower facial height (ANS-Me), with a p-value > 0.05. Furthermore, the results of this study are consistent with those of Fathi et al., who found that the anterior lower facial height increased, but not significantly.[22] In males, however, the posterior height of the nasal cavity (S-PNS), the bony tissue nasopharynx height (PNS-Ho), nasopharyngeal depth (Ba-PNS), and several soft tissue nasopharyngeal parameters, such as PTV-AD, AD1-PNS, and AD2-PNS were significantly correlated with the anterior lower facial height (ANS-Me). The results of this study align with the research by Al-Jewair et al. Therefore, the relationship between the nasopharyngeal dimensions and anterior lower facial height in females differed from that in males.[20]

Further research with larger and more diverse samples is recommended to confirm these findings and explore their clinical implications. Further research is needed on the relationship between nasopharyngeal dimensions and craniofacial structures using other radiographic techniques such as Cone Beam Computed Tomography (CBCT) and Magnetic Resonance Imaging (MRI).

This study has limitations that should be considered for future research. One limitation is the insufficient sample size for each age group, which limited the dimensions of the bony and soft tissues of the nasopharynx, maxillary length, mandibular length, and anterior lower facial height in each age group have not been fully represented.

CONCLUSION

There were correlations between nasopharyngeal dimensions and craniofacial structures in children aged 8–15, with notable gender differences. These results suggest that nasopharyngeal morphology may indeed influence craniofacial development and is relevant in clinical assessments.

The implications of this study support the refinement of diagnostic accuracy and orthodontic treatment planning, particularly in determining the most appropriate timing for orthodontic interventions associated with nasopharyngeal dimensions and craniofacial structures in children aged 8–15 years.

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