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# Comparison Of Morphometry Of Sella Turcica To The Skeletal Jaw Classification – An Institutional Study

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**Conflicts of interest:** The authors declare that there are no conflicts of interest associated with this work.
**Author contributions:** Jebarani Jeevitha- conceptualization, data curation, formal analysis, investigation, methodology, and writing (original draft); Prasanthi Sitaraman - conceptualization, supervision, validation, visualization, and writing (review and editing).

***Abstract***

***Introduction:***

*The sella turcica, a saddle-shaped anatomical structure in the skull, houses the pituitary gland, which is crucial for endocrine function. Variations in the sella turcica's dimensions can be indicative of pituitary disorders [1] and other craniofacial anomalies. This study aims to measure the size and describe the morphology of the sella turcica across different age groups, genders, and skeletal classifications.*

***Materials and Methods:***

*Lateral cephalometric radiographs of 40 subjects (20 males, 20 females), aged 16 to 35 years, were analyzed. The subjects were grouped into four age brackets (16-20, 21-25, 26-30, 31-35 years) and classified into skeletal classes I, II, and III. Measurements were taken for length, depth, and anteroposterior diameter of the sella turcica.*

***Results:***

*The study found that older individuals (mean size: 11.38mm) had significantly larger sella turcica dimensions compared to younger individuals (mean size: 10.43mm). Depth was significantly greater in females (p=0.048), while no significant gender differences were observed in length and anteroposterior diameter. Class II subjects exhibited larger sella turcica sizes compared to Class III subjects. No significant correlations were found between age, gender, and skeletal type with the sella turcica dimensions.*

***Conclusion:***

*The sella turcica shows significant size variations with age and gender, with older individuals and females having larger and deeper structures. Class II skeletal patterns were associated with larger sella turcica sizes compared to Class III. Despite these variations, overall shape remained normal in 61% of subjects. These findings enhance the understanding of sella turcica morphology and its clinical relevance.*

***Keywords:***

*Sella turcica, cephalometric radiographs, skeletal classification, pituitary gland, craniofacial morphology.*

## INTRODUCTION:

The sella turcica, a saddle-shaped anatomical structure located in the sphenoid bone of the human skull, plays a crucial role in housing the master endocrine gland – the pituitary. This gland is pivotal in regulating various hormonal functions critical to the body's homeostasis. Given its importance, understanding the variations in the size and shape of the sella turcica is essential, particularly as these variations can be indicative of pathological conditions such as pituitary neoplasms. Despite its significance, there remains a notable gap in comprehensive data concerning the dimensions and morphological variations of the sella turcica across different skeletal jaw classifications [2]. Such variations can potentially influence diagnostic and treatment approaches in craniofacial and orthodontic practices. The current literature primarily focuses on isolated cases or generalized measurements, often overlooking

the nuanced differences that might exist within specific populations and age groups. This study aims to bridge this gap by systematically measuring the size and describing the morphology of the sella turcica in a cohort of subjects with varied skeletal types, thus providing a more detailed understanding of its anatomical diversity. By analyzing lateral cephalometric radiographs of subjects [3] categorized into different skeletal classes and age groups [4], this study seeks to establish a correlation between the dimensions of the sella turcica and skeletal patterns, offering insights that could enhance clinical assessments and interventions in orthodontics and endocrinology. Furthermore, this study aims to contribute to the existing body of knowledge by providing a comprehensive analysis that may inform future research and clinical practices, thereby improving patient outcomes in the diagnosis and treatment of craniofacial and endocrine disorders.

## MATERIALS AND METHODS:

### Study Design and Sample Selection

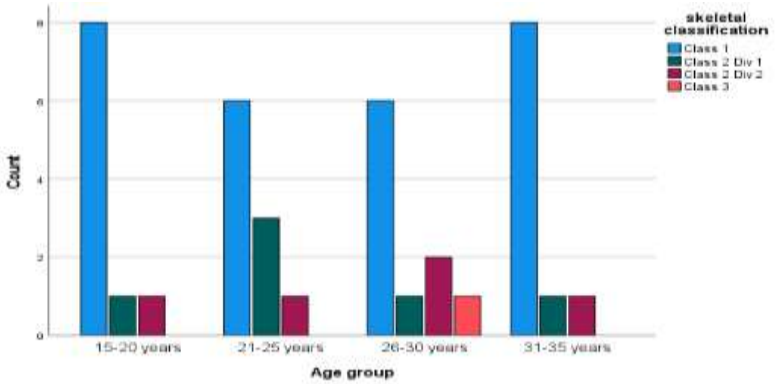
This retrospective study was conducted using lateral cephalometric radiographs of 40 subjects, including 20 males and 20 females, aged between 16 and 35 years. The subjects were divided into four distinct age groups: 16-20 years, 21-25 years, 26-30 years, and 31-35 years. Each age group contained five male and five female subjects, ensuring an even gender distribution. Subjects with any known major illness or medical conditions that could potentially affect skeletal development were excluded from the study.

### Skeletal Classification

The skeletal classification of each subject was determined based on their cephalometric measurements. Subjects were classified into one of four skeletal classes: Class I, Class II Division 1 (Class 2 Div 1), Class II Division 2 (Class 2 Div 2), and Class III [5]. The classification was determined through an analysis of the ANB angle, which defines the relationship between the maxilla and mandible. In cases where the ANB angle alone was insufficient, Wits analysis was performed to verify skeletal class. This skeletal classification process helped to account for skeletal variances across different age groups and genders.

### Age Grouping and Skeletal Classifications

The study samples were categorized into four different age groups: 16-20 years, 21-25 years, 26-30 years, and 31-35 years. The skeletal classes (Class I, Class 2 Div 1, Class 2 Div 2, and Class III) were distributed across these age groups, and the distribution was analyzed. Graph 1 illustrates the prevalence of different skeletal classifications within each age group. The results showed that Class I was the most common classification in the 15-20 year age group, while Class III was only observed in the 26-30 year age group. This suggests that skeletal classification may vary with age, indicating potential developmental or age-related factors that influence skeletal morphology.




*Graph 1: Distribution of skeletal classification in the study population based on age*

### Gender-Based Analysis of Skeletal Classifications

The study also examined gender differences in skeletal classification distribution, as shown in Graph 2. Skeletal classifications were not evenly distributed between males and females. Class I had a higher prevalence in females, while Class 2 Div 1, Class 2 Div 2, and Class III were more common in males. This analysis highlights the potential role of gender-specific factors in skeletal development.

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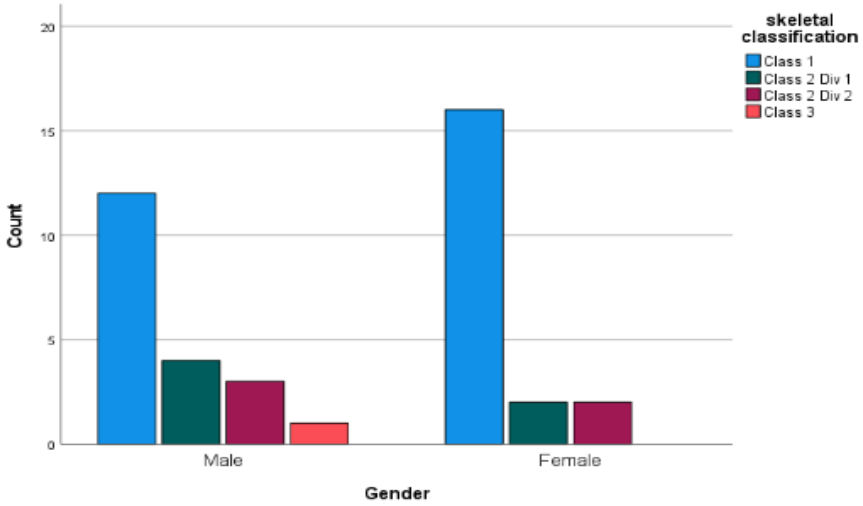



*Graph 2: Distribution of skeletal classification in the study population based on age*

**Measurement of Linear Dimensions**

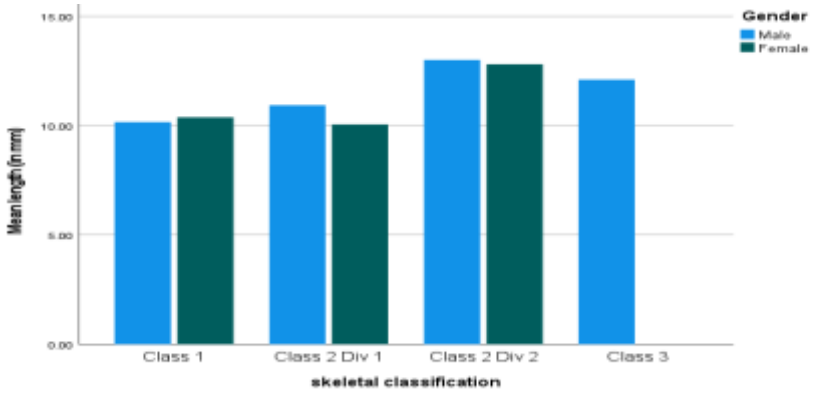
Linear dimensions of the sella turcica, including length, depth, and anteroposterior diameter (APD), were measured for each subject using digital sliding calipers [2]. These measurements were performed following the method described by Silverman and Kisling. The length of the sella turcica was measured from the tuberculum sella to the tip of the dorsum sella. The depth was measured perpendicularly from the floor of the sella turcica to the line between the tuberculum and dorsum sella [6]. The anteroposterior diameter (APD) was defined as the distance from the tuberculum sella to the posterior inner wall of the fossa.

**Measurement Protocol**

Each radiograph was traced on acetate paper under optical illumination to clearly outline the structure of the sella turcica. The tracings were performed by a single operator to maintain consistency across the measurements [7]. To ensure accuracy and reproducibility, 10 radiographs were randomly selected and retraced by the same operator on two separate occasions, with a minimum interval of 3 weeks between tracings. The measurement errors were estimated using Dahlberg's formula, and the reliability of the retraced measurements was assessed [8]. The results indicated a high degree of reliability, with a coefficient of 0.84-1.00.

**Gender Differences in Linear Dimensions**

The study explored potential gender-related differences in the linear dimensions of the sella turcica, as illustrated in Graphs 3, 4, and 5. These graphs compare the mean length, depth, and anteroposterior diameter across different skeletal classes and genders. For instance, females generally exhibited greater sella turcica dimensions (length, depth, and APD) in Class I, while males showed larger dimensions in Class 2 Div 1 and Class 2 Div 2. Notably, Class III was exclusively present in males, highlighting a possible gender-related disparity in its occurrence [9].




*Graph 3: Distribution of mean length of sella turcica based on gender and skeletal classification*

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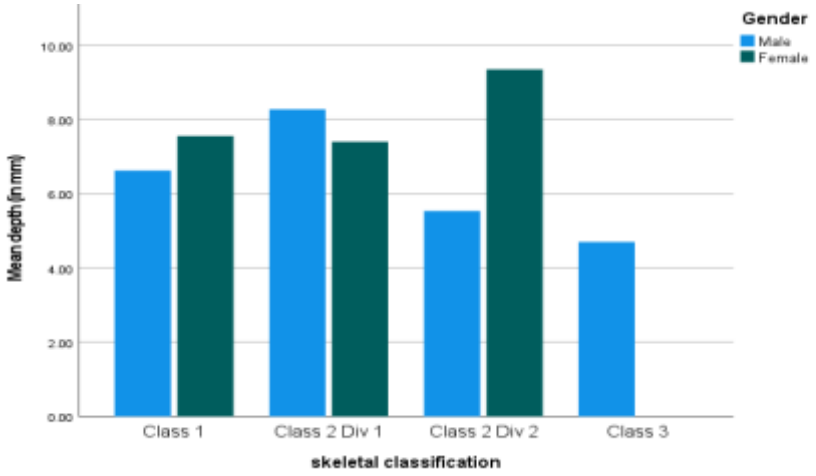
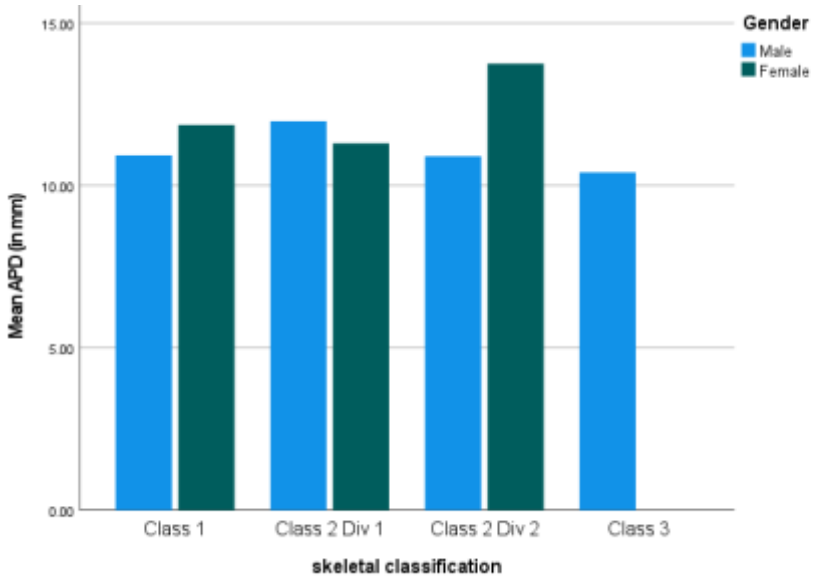



*Graph 4: Distribution of mean diameter of sella turcica based on gender and skeletal classification*




*Graph 5: Distribution of mean APD of sella turcica based on gender and skeletal classification*

**Statistical Analysis**

Data from the linear dimension measurements were compiled and analyzed using SPSS (version 15.0) [10]. A Student's t-test was used to assess the mean differences in the length, depth, and APD of the sella turcica between males and females. One-way ANOVA was applied to evaluate the relationship between skeletal type, age group, and sella turcica dimensions [11]. Regression analysis was performed to investigate the interrelationship between age, gender, and skeletal class, along with their impact on the linear dimensions of the sella turcica. Statistical significance was set at a p-value of 0.05.

**RESULTS:**

The Analysis of the lateral cephalometric radiographs across the study's four age groups (16-20, 21-25, 26-30, 31-35 years) revealed significant variations in skeletal classifications. When examining skeletal Class I, the results showed that this classification was most prevalent in the younger age group of 16-20 years. As this age group exhibited a higher number of Class I cases compared to other age groups, it suggests that skeletal balance is more common during the earlier stages of development. In contrast, the presence of Class I significantly decreased with age, particularly in the older age groups, indicating a shift in skeletal morphology over time.

Class II Division 1, on the other hand, demonstrated a subtle increase in the 21-25 year age group compared to the other age groups. This suggests that the prevalence of skeletal Class II Div 1 increases during early adulthood. The trend continued into the 26-30 year group but tapered off in the 31-35 year group. This pattern could indicate that skeletal growth patterns related to Class II Div 1 stabilize by the mid-20s. Conversely, Class II Division 2 showed minimal presence across all age groups, with a slight uptick in the 26-30 year range. This subtle increase may indicate a delayed skeletal manifestation in this class, though its overall prevalence remained low throughout the study.

Class III, which was exclusively present in the 26-30 year age group, demonstrated a strong age association. This result highlights that Class III is less likely to be detected in younger or older subjects but is strongly correlated with individuals in their late 20s. The absence of Class III in the 31-35 year group might suggest that any skeletal imbalances related to this classification could either stabilize or shift into other classifications as individuals age.

When gender differences were analyzed, distinct patterns emerged across all skeletal classifications. Females exhibited a higher prevalence of Class I than males, indicating that skeletal balance may be more common among female subjects. The gender disparity in Class I was most pronounced in the 16-20 year age group, suggesting that females may develop more balanced skeletal structures earlier than males. This pattern persisted, though with less significance, across the older age groups.

Males, however, demonstrated a higher prevalence of both Class II Division 1 and Class II Division 2 compared to females. This was particularly evident in the 21-25 year age group, where males exhibited a marked increase in the number of cases in these classifications. The results suggest that skeletal Class II, particularly its divisions, may be more commonly associated with male subjects, highlighting potential gender-based differences in skeletal development patterns. In contrast, females exhibited only a marginal increase in Class II Div 1 and Div 2 cases across all age groups, implying a lower overall occurrence of these skeletal imbalances in females.

Class III was notably absent in females, as all observed cases were found exclusively in male subjects. This gender-exclusive occurrence of Class III points to a potential biological predisposition for males in developing more pronounced Class III skeletal patterns, especially in their late 20s. The absence of Class III in females across all age groups underscores a significant gender-related distinction in skeletal morphology.

The linear dimension measurements further supported these gender-based differences. The mean length of the sella turcica in Class I was significantly higher in females compared to males, particularly in the 16-20 year age group. This suggests that females tend to exhibit greater skeletal growth in the anteroposterior direction during early developmental stages. In contrast, males showed higher mean lengths in Class II Div 1, particularly in the 21-25 year age group, although the difference between genders was less pronounced than in Class I.

In terms of depth, females again exhibited significantly higher measurements in Class I, particularly in the younger age groups. This gender disparity was also observed in Class II Div 2, where females showed a greater mean depth compared to males. However, males demonstrated slightly higher mean depths in Class II Div 1, suggesting that males may experience greater vertical growth in certain skeletal classes, particularly in early adulthood.

The mean anteroposterior diameter (APD) measurements aligned with the other linear dimensions, with females generally exhibiting larger APD values in Class I. This was particularly true in the younger age groups, indicating a broader anteroposterior skeletal dimension in females during early development. Males, on the other hand, exhibited slightly larger APD values in Class II Div 1, although the differences were less pronounced. In Class II Div 2, females again exhibited larger APD values, while Class III was absent in females altogether, further reinforcing the idea that Class III is predominantly a male classification.

Overall, the results demonstrate clear age- and gender-related differences in both skeletal classifications and linear dimensions of the sella turcica. The data suggest that skeletal balance (Class I) is more prevalent in females and younger individuals, while skeletal imbalances, particularly Class II Div 1 and Class III, are more common in males and tend to manifest later in adulthood. These findings provide important insights into the influence of both age and gender on craniofacial skeletal development.

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| Skeletal classification | Male | | | | Female | | | |
|---|---|---|---|---|---|---|---|---|
| | 16-20 years n (%) | 21-25 years n (%) | 26-30 years n (%) | 31-35 years n (%) | 16-20 years n (%) | 21-25 years n (%) | 26-30 years n (%) | 31-35 years n (%) |
| **Class 1** | 4 (20) | 2 (10) | 2 (10) | 4 (20) | 4 (20) | 4 (20) | 4 (20) | 4 (20) |
| **Class 2 div 1** | 0 | 2 (10) | 1 (5) | 1 (5) | 1 (5) | 1 (5) | 0 | 0 |
| **Class 2 div 2** | 1 (5) | 1 (5) | 1 (5) | 0 | 0 | 0 | 1 (5) | 1 (5) |
| **Class 3** | 0 | 0 | 1 (5) | 0 | 0 | 0 | 0 | 0 |

*Table 1: Distribution of study population on the basis of age, gender and skeletal type*

| | Gender | n | Mean | Standard deviation | Standard error of mean | p-value |
|---|---|---|---|---|---|---|
| Length (in mm) | Male | 20 | 10.84 | 2.656 | 0.594 | 0.754 |
| | Female | 20 | 10.59 | 2.332 | 0.521 | |
| Depth (in mm) | Male | 20 | 6.70 | 1.754 | 0.392 | 0.048* |
| | Female | 20 | 7.72 | 1.390 | 0.311 | |
| APD (in mm) | Male | 20 | 11.11 | 1.819 | 0.407 | 0.080 |
| | Female | 20 | 11.99 | 1.245 | 0.278 | |

*Table 2: Linear dimensions of sella turcica (in mm) based on gender*

| | Age group | n | Mean | Standard deviation | Standard error of mean | p-value |
|---|---|---|---|---|---|---|
| Length (in mm) | 16-20 years | 10 | 10.43 | 2.414 | 0.763 | 0.494 |
| | 21-25 years | 10 | 9.84 | 2.257 | 0.714 | |
| | 26-30 years | 10 | 11.19 | 2.010 | 0.636 | |
| | 31-35 years | 10 | 11.38 | 3.130 | 0.990 | |
| Depth (in mm) | 16-20 years | 10 | 7.58 | 1.724 | 0.545 | 0.882 |
| | 21-25 years | 10 | 7.13 | 1.137 | 0.360 | |
| | 26-30 years | 10 | 7.09 | 1.555 | 0.492 | |
| | 31-35 years | 10 | 7.03 | 2.203 | 0.697 | |
| APD (in mm) | 16-20 years | 10 | 11.55 | 1.407 | 0.445 | 0.952 |
| | 21-25 years | 10 | 11.67 | 0.923 | 0.292 | |
| | 26-30 years | 10 | 11.68 | 0.924 | 0.292 | |
| | 31-35 years | 10 | 11.30 | 2.713 | 0.858 | |

Statistically not significant at p<0.05, One-way ANOVA

*Table 3: Linear dimensions of sella turcica (in mm) based on age group*

| | Class | n | Mean | Std. Deviation | Standard error of mean | 95% Confidence Interval for Mean | | Min. | Max. | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound | | | |
| | **Class 1** | 28 | 10.28 | 2.520 | 0.476 | 9.3 | 11.6 | 4.60 | 14.90 | 0.159 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Length (in mm)** | **Class 2 div 1** | 6 | 10.63 | 2.448 | 0.999 | 8.1 | 13.2 | 7.10 | 14.60 | |
| | **Class 2 div 2** | 5 | 12.92 | 1.133 | 0.506 | 11.5 | 14.3 | 11.70 | 13.90 | |
| | **Class 3** | 1 | 12.10 | . | . | . | . | 12.10 | 12.10 | |
| | **Total** | 40 | 10.71 | 2.470 | 0.390 | 9.9 | 11.5 | 4.60 | 14.90 | |
| **Depth (in mm)** | **Class 1** | 28 | 7.16 | 1.568 | 0.296 | 6.5 | 7.8 | 3.60 | 10.90 | 0.301 |
| | **Class 2 div 1** | 6 | 7.98 | 1.393 | 0.569 | 6.5 | 9.4 | 6.40 | 10.50 | |
| | **Class 2 div 2** | 5 | 7.06 | 2.210 | 0.988 | 4.3 | 9.8 | 4.90 | 9.40 | |
| | **Class 3** | 1 | 4.70 | . | . | . | . | 4.70 | 4.70 | |
| | **Total** | 40 | 7.21 | 1.646 | 0.260 | 6.6 | 7.7 | 3.60 | 10.90 | |
| **APD (in mm)** | **Class 1** | 28 | 11.46 | 1.677 | 0.317 | 10.8 | 12.1 | 5.30 | 14.20 | 0.776 |
| | **Class 2 div 1** | 6 | 11.75 | 1.506 | 0.615 | 10.2 | 13.3 | 10.20 | 14.60 | |
| | **Class 2 div 2** | 5 | 12.04 | 1.587 | 0.710 | 10.1 | 14.0 | 10.70 | 14.10 | |
| | **Class 3** | 1 | 10.40 | . | . | . | . | 10.40 | 10.40 | |
| | **Total** | 40 | 11.55 | 1.604 | 0.253 | 11.0 | 12.1 | 5.30 | 14.60 | |

*Table 4: Linear dimensions of sella turcica (in mm) based on skeletal classification*

**DISCUSSION:**

The present study provides substantial evidence of significant variations in the size of the sella turcica across different age groups, as well as between genders [11]. Consistent with the findings from previous research, we observed that the size of the sella turcica increases with age. The older subjects in our study displayed significantly larger dimensions in all three aspects—length, depth, and anteroposterior diameter—when compared to their younger counterparts. This enlargement may be attributed to the continuous growth and developmental changes that occur in craniofacial structures as individuals age, particularly during late adolescence and early adulthood. The findings align with the broader understanding that skeletal structures, including the sella turcica, undergo morphological changes as a function of age [12].

One of the key findings from our study was the statistically significant difference in the depth of the sella turcica between the two genders ($p<0.005$). Females, in particular, exhibited greater sella depth compared to males. This difference may indicate that females experience more vertical skeletal growth in certain craniofacial structures during specific developmental stages. However, it is important to note that while the depth of the sella turcica varied significantly between genders, the differences in length and anteroposterior diameter were not statistically significant [13]. These findings suggest that gender-specific variations in the sella turcica may be more pronounced in the vertical dimension, whereas the horizontal and anteroposterior dimensions appear to be more uniform between males and females.

In comparison to our findings, a study by Shah et al reported no statistically significant differences in all three dimensions of the sella turcica [5]. This discrepancy could be attributed to variations in sample size, methodology, or population demographics between the two studies. Shah et al's findings suggest that in some populations, the size of the sella turcica may remain relatively stable across individuals, regardless of age or gender. However, when the size of the sella turcica was compared across different skeletal classifications, our results showed significant differences between subjects with Class II and Class III skeletal patterns. Specifically, the size of the sella turcica was larger in subjects with Class II skeletal patterns, a finding that mirrors the results reported by Shah et al. This may indicate that individuals with

Class II skeletal configurations experience greater enlargement of the sella turcica, which could be linked to the overall morphology of the craniofacial structures characteristic of Class II individuals [14].
Interestingly, our study diverges from the findings of Sathyanarayana et al, who reported the presence of an enlarged sella turcica exclusively in Class III individuals. In contrast, our data showed that while Class II subjects exhibited significantly larger sella dimensions, the prevalence of an enlarged sella turcica was not limited to Class III subjects alone. This difference underscores the importance of considering population-specific factors when examining skeletal patterns and sella turcica morphology. Our findings suggest that the relationship between skeletal classification and sella turcica size may be more complex than previously understood, with variations depending on the specific skeletal characteristics of each population [15].
With regard to the shape of the sella turcica, our study revealed that a normal shape was observed in 61% of the subjects, a finding that is consistent with the results reported by Sathyanarayana et al. This agreement suggests that the majority of individuals, regardless of skeletal classification, exhibit a normal morphological appearance of the sella turcica. However, it is important to highlight that a substantial proportion of subjects in both studies exhibited non-standard sella turcica shapes, indicating that morphological deviations are not uncommon [16]. These variations in shape could potentially have clinical implications, particularly in the context of skeletal development and orthodontic treatment planning.

## CONCLUSION:

This study highlights significant variations in sella turcica size and morphology across different age groups, genders, and skeletal classifications. Older individuals exhibited larger sella dimensions (11.38mm) compared to younger subjects (10.43mm), while females had significantly greater sella depth (p=0.048) compared to males. A significant difference in sella size was found between Class II and Class III skeletal patterns, with Class II subjects having larger sella structures. Despite these findings, no statistically significant correlation was observed when age, gender, and skeletal type were jointly analyzed in relation to the dimensions of the sella turcica. Additionally, the shape of the sella turcica was normal in 61% of subjects, indicating that while variations exist, most individuals exhibit a typical sella morphology.

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