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RESEARCH ARTICLE

The Pituitary Gland's Size and Volume in Relation to Age and Gender: MRI Study

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ABSTRACT:

Introduction: The pituitary gland is an essential organ in the human body, and a thorough comprehension of its anatomy and physiological alterations in size and shape is critical. The present study aimed to investigate the normal pituitary gland's size using magnetic resonance imaging (MRI) and assess the mean normal volume concerning age and gender.

Methods: The study was conducted from January 2016 to December 2016, including 250 patients who had undergone brain MRIs in the Radio-diagnosis department at B.J. Medical College and Sassoon General Hospital, Pune. T1-weighted images were used to measure the gland's height, width, and length, while the post-contrast T1 MRI images were used to determine the volume and shape index.

Results: The patients' mean age was 46.3 years, ranging from 18 to 88 years, with 132 females and 118 males. The results of the study showed a notable reduction in the thyroid gland's volume as age increased ($p>0.05$), while the shape index remained stable ($p=0.01$). Age had no significant correlation with the gland's size, length, or volume. The study also found that the gland was larger in males than in females.

Conclusion: This study provides insight into the morphological changes of the pituitary gland as individuals age and the size differences between genders. These observations are essential in diagnosing pathological conditions and will be helpful in future studies.

Keywords: Magnetic resonance imaging, Postmenopausal, Puberty, Pituitary Gland.

Introduction

It is essential to adopt a methodical approach in evaluating the pituitary regions, considering the subtle nature of its findings. It is essential to have a thorough awareness of the pituitary gland's usual structure and the physiological changes in its size and form across different age groups in both males and females in order to ensure a thorough examination of the gland [1]. The pituitary gland's complicated hormonal physiology has changed, as evidenced by variations in size, shape, and intensity. In order to accurately determine pituitary gland measurements across different age groups and diagnose associated pathologies, frequently seen borderline pituitary abnormalities, such as inconspicuous microadenoma, physiological gland hypertrophy, inflammation, increased lobule margins, and empty sella, must be taken into account [1].

Magnetic resonance imaging (MRI) is a dependable diagnostic modality for assessing pituitary gland dimensions. However, there is a dearth of previous research on the assessment of height and muscle volume across diverse age cohorts and both genders of the Indian population, emphasizing the need for further investigation in this area.

Sanjay SC et al. conducted the only analogous study in the Indian population, utilising radiographic techniques to examine the diversity in size and shape of normal adult female pituitary glands [2]. The study found that the pituitary glands' most frequent shape is flat, and its height decreases with age, except for the age group of 40 to 49 years [2]. This study, however, was limited to female patients and did not take the gland's volume into consideration. The current study assessed the mean normal volume of the pituitary gland in relation to

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age and gender in order to analyze the size and form of the normal pituitary gland in various age groups of both genders using MRI.

MATERIALS AND METHODS

This retrospective observational study was conducted in the Radiology department of B.J. Medical College and Sassoon General Hospital, Pune after approval from the institutional ethics committee. The study spanned from January 2016 to December 2016, and 250 patients who had undergone brain MRIs in the Radio-diagnosis department were included in the study. Patients with significant endocrine disorders, head injuries, and genetic syndromes, and those who were pregnant or breastfeeding at the time of examination were excluded from the study.

The MRI data were collected using a GE Signa Explorer 1.5-T MRI scanner manufactured by GE Healthcare, India. Standard imaging protocols were utilized to obtain axial T1-weighted, T2-weighted, and post-contrast T1-weighted images. Two skilled radiologists, who were blinded to clinical information, individually assessed the MRI images. The height, width, and length of the pituitary gland were measured on T1-weighted images (Figure 1), while the post-contrast T1-weighted images were used to determine the volume and shape index (Figure 2). The shape index was computed as the height divided by the average of the width and length.

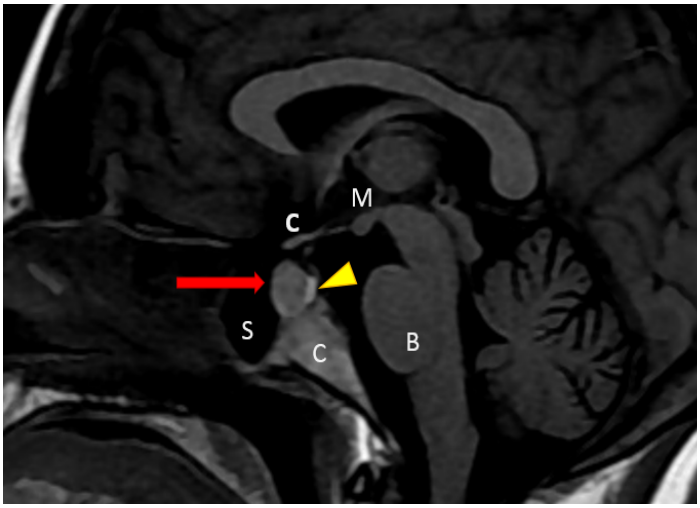

Figure 1: This is an imaging report of a 29-year-old pregnant female. The sagittal T1-weighted non-contrast image of the pituitary fossa demonstrates the anterior pituitary tissue (indicated by the red arrow) visible within the sella, along with the posterior pituitary bright spot (indicated by the yellow arrowhead) located behind it. Additionally, the suprasellar region displays the optic chiasm, C, and mamillary bodies, M. Other notable structures observed in the image include the brainstem (B), sphenoid air sinus (S), and clivus (CL).

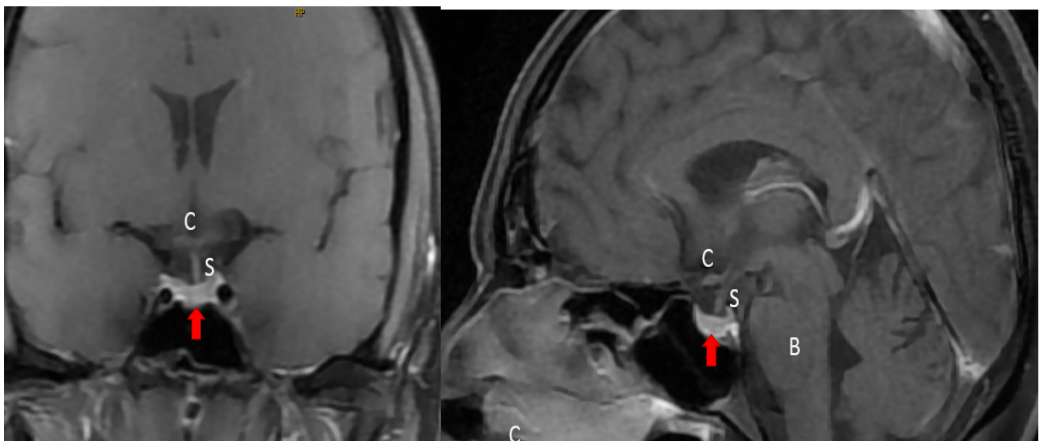

Figure 2: The patient, a 36-year-old female, underwent imaging of the pituitary fossa using sagittal and coronal T1-weighted post-contrast techniques. The imaging revealed the presence of enhancing pituitary tissue (indicated by a red arrow) within the Sella, along with the posterior pituitary bright spot (indicated by a yellow arrowhead) located behind it. Other notable structures observed in the imaging include the optic chiasm, denoted by C, the pituitary stalk indicated by S, and the brainstem, indicated by B.

Statistical Analysis:

The statistical analysis was performed using Open Epi version 3, a software designed for epidemiological and statistical calculations. The pituitary height measurements were calculated in millimeters and the mean and standard deviations were determined. In addition, the volume measurements were calculated in cubic millimeters for different age groups. ANOVA and Chi-square tests were used to investigate the relationship between average height and age, as well as volume and age. AP value-threshold of 0.05 was used to determine the statistical significance.

Results:

The mean age of the patients was 46.3 years (range, 18–88 years), and there were 132 women and 118 men. The mean height, width, and length of the pituitary gland were 7.8±1.6 mm, 8.2±1.7 mm, and 9.7±1.9 mm, respectively. The mean volume of the pituitary gland was 0.51±0.14 cm^3, and the mean shape index was 0.77±0.06.

The dimensions of the pituitary gland were significantly larger in men than in women, except for the height of the gland (Table 1). There was a significant decrease in the volume of the pituitary gland with increasing age ($p<0.05$), while the shape index remained stable (Table 2). There was no significant correlation between age and the height, width, or length of the pituitary gland (Table 3).

Table 1: Comparison of Pituitary Gland Dimensions by Sex

	Height (mm)	Width (mm)	Length (mm)	Volume (cm^3)
Women (n=132)	7.8±1.6	8.2±1.7	9.7±1.9	0.51±0.14
Men (n=118)	7.9±1.7	8.5±1.8	9.9±2.0	0.54±0.15*

Note: Values are mean ± standard deviation. *$p<0.05$ for comparison between men and women.

Table 2: Relationship between Age and Pituitary Gland Volume and Shape Index

	Age (years)	Volume (cm^3)	Shape Index
Overall	46.3±19.3	0.51±0.14	0.77±0.06
<40	31.5±6.8	0.61±0.12	0.77±0.06
40-59	49.6±5.7	0.51±0.14	0.77±0.06
≥60	71.2±7.1	0.41±0.11*	0.77±0.06

Note: Values are mean ± standard deviation. *$p<0.05$ for comparison between <40 and ≥60 age groups.

Table 3: Correlation between Age and Pituitary Gland Dimensions

	Age (years)	Height (mm)	Width (mm)	Length (mm)
Pearson r	0.04	0.01	-0.04	0.02
p-value	0.64	0.87	0.50	0.78

Note: Values are Pearson correlation coefficient (r) and p-value for the correlation between age and each pituitary gland dimension.

Discussion:

In this study endeavor, we conducted an assessment of the normal pituitary gland's size and shape by utilizing MRI technology. Additionally, we explored age and sex-related modifications in its dimensions. Our findings provide evidence of noteworthy sex-based variations in the pituitary gland's dimensions, where males demonstrated larger dimensions than females, however, other studies have shown either no significant difference in either sex or female preponderance [3]. It is widely recognized that the pituitary gland experiences its initial growth spurt during puberty, as evidenced by previous research sources (Figure 3) [4-9]. Additionally, previous studies have established that a reduction in pituitary gland height occurs as part of the aging process [5-7, 9-11].

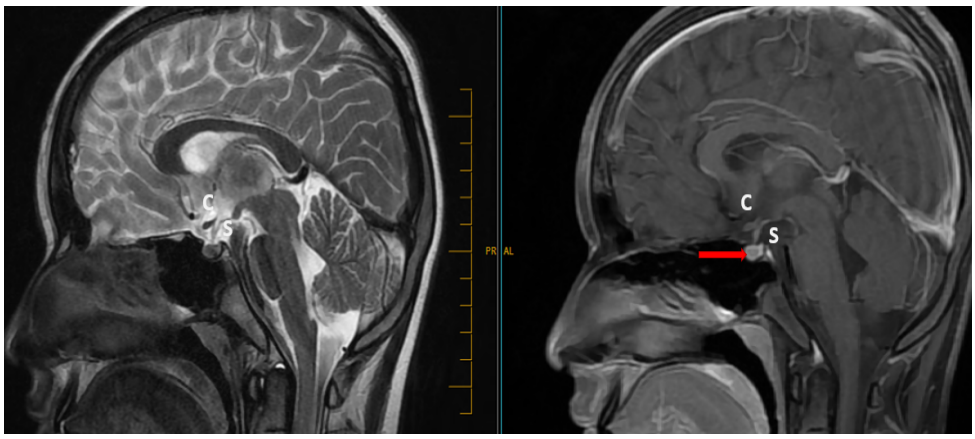

Figure 3: 18 year male; sagittal T2 and T1 weighted post-contrast image of the pituitary fossa shows enhancing pituitary tissue (Red arrow), the optic chiasm, C and pituitary stalk.

Moreover, we discovered a significant decline in pituitary gland volume with age progression. (Figure 4) This result is in accordance with earlier research that reported age-related changes in pituitary gland dimensions. The decreasing volume with increasing age may arise from the reduction in the number of hormone-producing cells within the pituitary gland or the reduction in individual cell size [12].

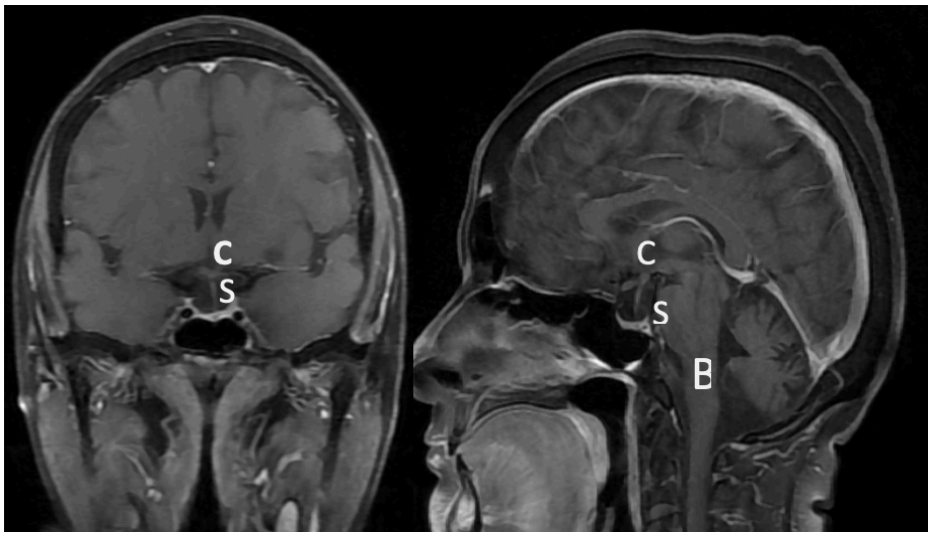

Figure 4: 56 years female; Sagittal and coronal T1 weighted post-contrast images of the pituitary fossa show enhancing pituitary tissue (Red arrow) with a significantly reduced height of pituitary gland; The optic chiasm, C, pituitary stalk, S and B – brainstem.

Furthermore, we found that the shape index remained stable across different age groups in our study. This discovery aligns with earlier studies, which also reported a stable shape index in normal pituitary glands. The shape index's stability suggests that it may be an advantageous parameter in assessing pituitary gland morphology [13].

Pituitary measures and age showed a moderate connection, according to a study by Naik D et al. that evaluated pituitary gland volume in an Indian teenage population. But it's important to remember that their research only looked at adolescents as a whole [14].

The research done by Sanjay SC et al. produced important results in regard to the morphometric features of the pituitary gland. The research found that the gland's average dimensions were 6.27±0.56 in height, 9.10±0.78 in length, and 11.22±0.82 in width. The researchers also discovered a relationship between age and height, whereby the height of the gland shrank with age. However, the 40-49-year-old age group showed a slight gain in height [2].

The present study is subject to several limitations that need to be taken into account. Firstly, the sample size used in the study was relatively small and may not be representative of the general population. Secondly, we did not evaluate the functional status of the pituitary gland, which could have impacted its size and shape. Lastly, the assessment of the pituitary gland was exclusively conducted using MRI, whereas other imaging

methods could potentially provide additional insights into the gland's morphology.

Despite these limitations, the study provides valuable information regarding age- and gender-related changes in the size and shape of the pituitary gland in normal populations. These findings may have significant clinical implications for the evaluation of pituitary morphology in various conditions, including pituitary adenomas and other related disorders.

Conclusion:

The results of our investigation indicate noteworthy modifications in the dimensions of the pituitary gland in the normal population, with particular regards to gender and age. Our findings suggest that the gland is larger in males than in females, and its volume decreases significantly as age increases. Nevertheless, the shape index remains constant across different age categories. These results hold substantial clinical importance in evaluating the morphology of the pituitary gland in various pathological conditions and lay a solid foundation for future research. Further inquiry is needed to gain a more comprehensive comprehension of the functional and clinical ramifications of these discoveries while ensuring originality in our research.

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