

# Study the Shape and Size of the Pituitary Gland using Magnetic Resonance Imaging

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**Abstract:** Using magnetic resonance imaging (MRI) examine the shape, size, and the average normal volume of the pituitary gland which is normal in various age ranges in both genders. To be aware with the pituitary gland's typical structure as well as the physiological variations in order to diagnose diseases in the pituitary gland. A retrospective analysis included 250 patients who had undergone MRI of brain in Radio-diagnosis department. Cases with endocrine or disorders of pituitary were not included in the study. Philips 3 Tesla scanner was used to capture MRI images. A p-value of 0.05 or lower was deemed as significant. Average pituitary height was  $6.3 \pm 1$  mm. Except for the range of 1 to 10 & 11 to 20 years, the average height of the pituitary in females in each group was higher compared to males of same age range. The most prevalent shape was flat, followed by convex and concave. To measure the abnormal growth in size, one must be familiar with physiological variance in the pituitary glands shape, size compared to the typical range of height and volume in both sexes and various age groups in the Indian population.

**Keywords:** Pituitary gland, MRI image, physiological variations, adolescence, Indian Population

## 1. Introduction

In order to conduct a thorough evaluation of the gland we need to be aware with the pituitary gland's typical structure as well as the physiological changes in shape & size among various age ranges in both the genders. The gland undergoes morphological changes and changes in its signal intensity, which are a result of the complex physiology of the gland. Borderline pituitary anomalies, such as physiological enlargement of gland, lobulated borders enlargement, inflammatory conditions, empty sella & micro-adenoma (mild) are frequently observed.

## 2. Literature Survey

Sanjay SC et al work's "Variation in size and shape of normal adult female pituitary gland: A Radiological Survey" [1], is the only example of a study of this kind that was conducted in the Indian population. [1] According to the study, flat is the most typical shape for pituitary glands, and their height declines with age, with the exception of people between the ages of 40 and 49. [1] This study only examined female cases and did not account for the gland's volume. Consequently, the current study was done to measure the mean volume of the pituitary gland in relation to age, sex and to examine the shape and size of normal gland in various age group of both the sexes using Magnetic Resonance Imaging.

## 3. Problem Definition

Because certain discoveries in the pituitary region are somewhat delicate, a systematic approach is crucial. To diagnose pathologies pituitary gland's normal measurements for different age is useful. MRI has shown to be a reliable diagnostic tool for evaluating pituitary gland function.

## 4. Methodology

The study was performed in the radiology department at the D.Y. Patil Medical College, Hospital and Research Institute, Kolhapur, and is a retrospective observational type of study. The study was carried out from November 2021 to November 2022, 250 patients who had underwent brain MRIs. The patients included were with genetic syndromes, significant endocrine disorders, head injuries and prepartum or postpartum cases (132 males & 118 females, ranging in age from infancy to 75 years old). Patients who had partially empty sella or sella which was filled completely with cerebrospinal fluid or a gland that was shorter than average were excluded from the study. A Gland of height less than 2 mm were considered as empty sella and was excluded from this research & analyses that followed. For both genders, all study participants were categorized into six age groups in years: 1 to 10, 11 up to 20, 21 up to 30, 41 up to 50, and over 50.

Philips 3 Tesla scanner was used for the MRI exams. The midline plane of both sagittal spin-echo T1-weighted images (T1WI) and coronal spin-echo T2-weighted images (T2WI) were used to display the coronal and sagittal perspectives. The sagittal MRI technique used a field of view of 220x220 mm and slices that were 5 mm thick. The coronal MRI protocol used a field of view of 185x145mm, and slices that were 5 mm thick.

Pituitary gland's diameter in Anterior-Posterior (AP) & height (H) (Superio-Inferior) was measured using the mid-sagittal image T1 weighted image [Fig-1a]. On coronal T2WI along the stalk of pituitary, the glands breadth [Transverse (TS)] was measured [Fig-1b].  $V = \text{Anterior-Posterior diameter} \times \text{Superio-Inferior diameter} \times \text{Transverse diameter} \times 0.52$  ( $AP \times H \times TS \times 0.52$ ) was the formula used to calculate the pituitary gland volume. This number is derived from the cubic volume calculation and the sphere volume equation coefficient:  $(4/3\pi) (r^3)/(2r)^3 = 3.1416/6=0.52$ . The mid-sagittal T1WI revealed the form of the pituitary gland. The superior surface of the gland was found to be either flat, convex, or concave in shape.

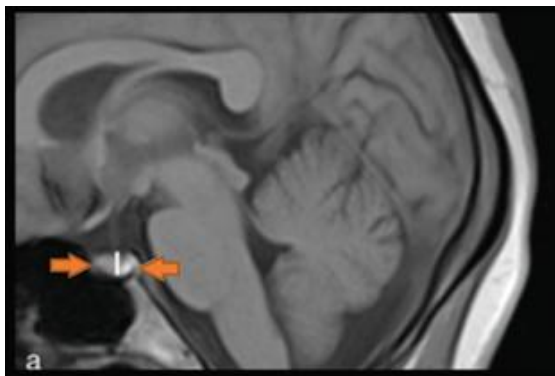


Figure 1 (a): pituitary gland (CC) and length (AP) are indicated by arrows

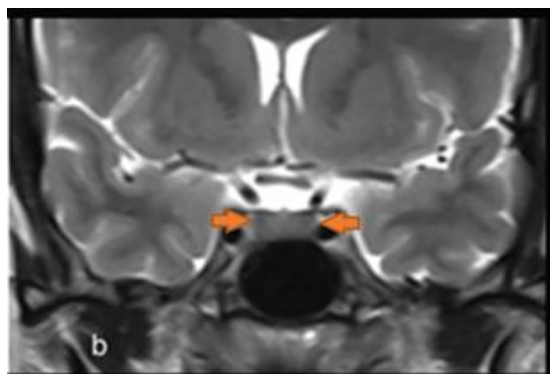


Figure 1 (b): Coronal T2W MR image- pituitary gland breadth (T) is indicated by the arrows

For statistical analysis, Software OpenEpi Version 3 was used to do statistical computations for epidemiological studies. Pituitary height was measured in millimeters (mm), and its mean and standard deviation were computed. Volume was determined using an mm<sup>3</sup> scale for various age groups. ANOVA and Chi-square tests were used to determine the relationship between mean height and age and the correlation between volume and age, with a p-value of < 0.05 being considered significant.

## 5. Results & Discussion

In our study group, 6.3±1 mm was the average height of pituitary gland. In the age range of 1 to 10 years, the mean pituitary height measured 5.3±1.5 mm. The average pituitary height was 6.3±1.2 mm among the age group 11 to 20 years, 6.7±1.8 mm among the age group 21 to 30 years, 6.3±1.8 mm among the age group 31 to 40, 6.6±1.4 mm among the age group 41 to 50, and 7.1±1.9 mm among the age group above 50 [Table 1]. Pituitary height and age were correlated, with a p-value of 0.18 between male age groups that were statistically not significant, but a p-value of 0.001 that was significant among female age groups. Average pituitary volume and height in various age group and gender information was provided in [Table 2/Graph 1 and 2]. For both male and female categories, p-value 0.001 (0.05) in relative to age with volume came statistically significant between the age groups. Therefore, except the age groups in years of 1 to 10 and 11 to 20 the mean pituitary gland height of the in females in all age groups was higher than compared to males in the same age range. However, age groups in years of 21 to 30, 31 to 40, and 50 above showed significant differences in the mean pituitary heights. Pituitary gland height decreased in the year 1 to 10 age group as depicted in Table-2/Graph 1 and 2, increased throughout puberty [Fig-3], peaked in the 21-30 year age group, and then began to drop in the 30-50 year age group and older age groups, with the exception of women 50 years of age and older, where the mean pituitary height increased once more [Fig-4]. The most prevalent shape was flat, which was present in 47.2% of individuals across all age categories and both sexes (n=118), 31.6% (n=79) showed convex shape as in [Fig-5] and lastly concave shape in 21.2% (n=53) as shown in [Fig-6].

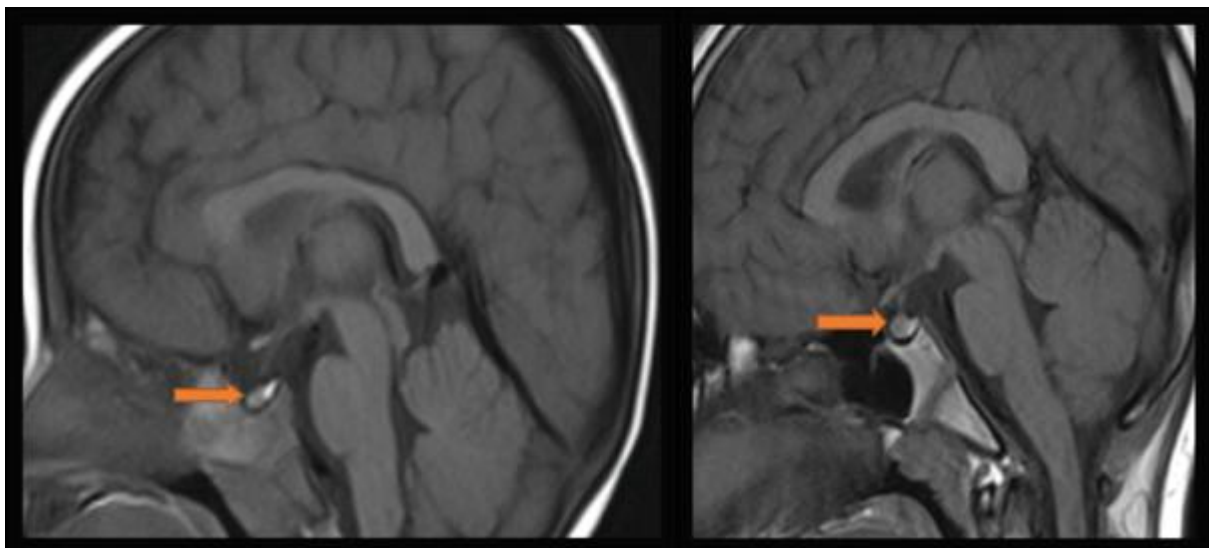
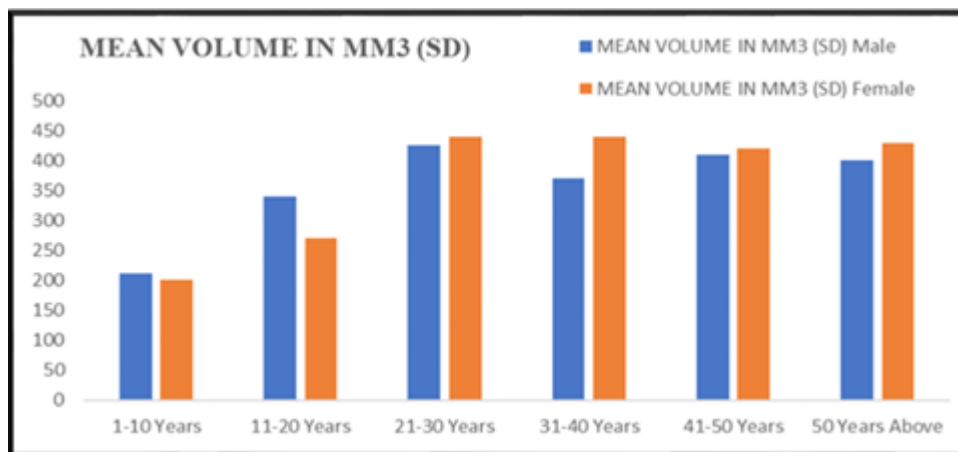
Table 1: Mean pituitary gland height and volume among various age range

Age Groups (in years)	Mean Pituitary Height & SD (in mm)	Mean Pituitary Volume & SD (in mm <sup>3</sup> )
1 to 10	5.3(±1.5)	201(±0.70)
11 to 20	6.3(±1.2)	329(±140)
21 to 30	6.7(±1.8)	440(±115)
31 to 40	6.3(±1.8)	390(±150)
41 to 50	6.6(±1.4)	420(±180)
More than 50	7.1(±1.9)	410(±160)

Table 2: Graph 1 and 2- Mean pituitary gland height values & volume among various age groups & in both sexes

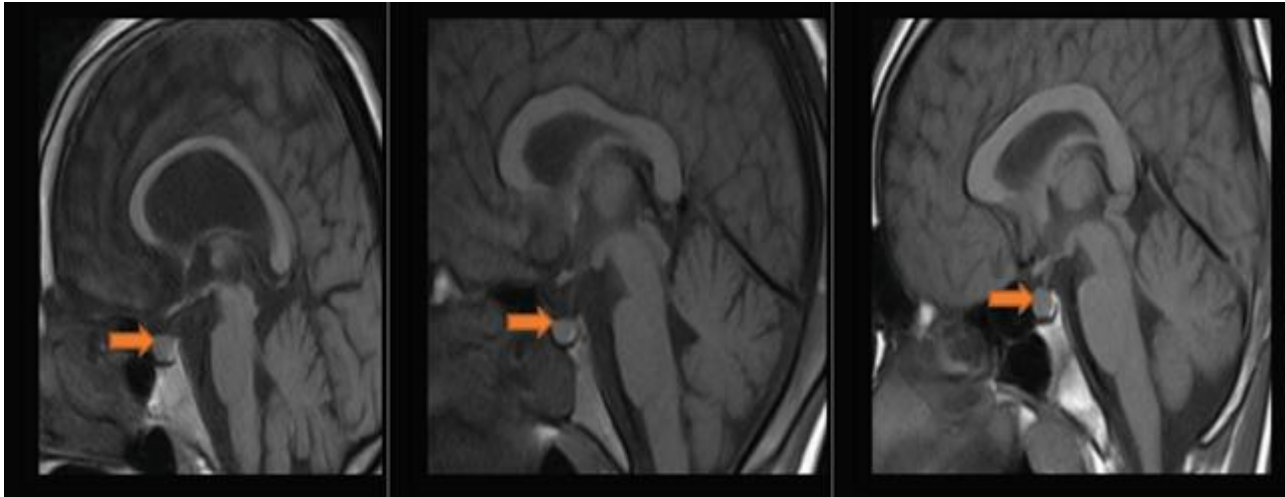
Age Groups (in years)	Sex (M/F)	Mean Pituitary Height & SD (in mm)	Mean Pituitary Volume & SD (in mm <sup>3</sup> )
1 to 10	M	5.4(±1.6)	211(±0.74)
	F	5.0(±1.2)	201(±0.73)
11 to 20	M	6.3(±1.7)	340(±126)
	F	6.0(±1.8)	270(±133)
21 to 30	M	6.6(±1.4)	425(±126)
	F	7.0(±1.7)	440(±180)
31 to 40	M	6.3(±1.5)	370(±160)
	F	6.6(±1.6)	440(±121)
41 to 50	M	6.2(±1.4)	410(±150)
	F	6.4(±1.2)	420(±120)
More than 50	M	6.1(±1.6)	400(±188)
	F	6.5 (±2.1)	430(±162)

Graph 1 and 2 shows Mean Value of pituitary height and pituitary volume in different age groups and in both sexes



**Figure 2:** In a 1-year old infant, the Pituitary Gland was tiny and had a concave upper border (arrow). The pituitary height was 2.9 mm

**Figure 3:** Pituitary Gland in a female girl aged 10 years, showed a convex upper border (arrow). The pituitary height was 8.5 mm



**Figure 4:** Pituitary Gland height measured at 9.8 mm is also slightly higher in post menopausal age group (arrow)

**Figure 5:** The upper edge of the Pituitary Gland is flat (arrow). The pituitary's height was 5.6mm.

**Figure 6:** Pituitary height measures 10 mm, and the Pituitary Gland is substantial in size with a convex top border (arrow)

The most notable of the numerous findings that were combined throughout this study was that females' pituitary gland height grows again in that of 50-59 age range. Pituitary height increases for the first time during adolescence.<sup>[2-7]</sup> and prior research have also shown that pituitary height decreases with ageing<sup>[3-5, 7-9]</sup> Previous research indicates that such alterations in pituitary shape may be brought on by changes in hormone levels. The increased synthesis of the growth hormone, luteinizing hormone (LH) during puberty may be responsible for the aforementioned increase in pituitary height. Additionally, young patient's substantially taller pituitaries, both in men and women, may be related to physiological variations in among the young and elderly patients in the neuroendocrine hormones. The pituitary glands height declines with the advancing age, which reflects pituitary gland's physiological shrinkage and changes in endocrine condition. After puberty and into the fifth decade of life, the baseline values of LH and Follicle Stimulating Hormone (FSH) dropped.<sup>[10]</sup> However, due elevated levels of the gonadotropin-releasing hormones and an age-related decrease in circulating gonadal steroids hormones, values of the hormones starts to raise in 5<sup>th</sup> and 6<sup>th</sup> decades in females.<sup>[10]</sup> According to the findings of our study, females in the same age group have a higher pituitary height (i.e., 50 years and above). According to earlier research<sup>[3]</sup>, the rise in pituitary height seen in aged patients may be the result of compensatory hypertrophy following a noticeably diminished gonadal steroid feedback effect. Our study found that post-menopausal females had a notable rise in pituitary height. Previous studies<sup>[2-5, 7, 8]</sup> have shown a link between young people's increasing pituitary gland height. According to earlier research, the height of the pituitary gland peaks between the ages of 10 and 19 for both sexes<sup>[2, 5, 7]</sup>, or between 20 and 29<sup>[4]</sup> which was also supported by our data. According to Sanjay SC et al., the pituitary gland had a mean height of 6.270.56, a mean length of 9.100.78, and a mean width of 11.220.82. They also noticed that height declines with age, but there was a slight rise in height in the 40-49 age group.<sup>[11]</sup> Since gland length and width are unaffected by ageing, changes in pituitary size are primarily caused by variations in gland height. Future research might rationally rely just on pituitary height, with results from mid-sagittal T1WI acting as a sole indicator of

pituitary glands' size, as recommended by Lurie SM et al.<sup>[11]</sup> The gland is most commonly concave in shape in its superior portion, as demonstrated in our work, and since it wouldn't be apparent in thick and a single sagittal image, which instead may only reveal the raised lateral edges of the pituitary gland. Pituitary gland height measurements may become inaccurate as a result of this. Despite the increased height of the pituitary, this can result in a diminished gland (since the measurement was taken from the lateral aspect). A similar issue can be seen in partially empty sellae, where the gland tissue can be seen extending all the way to its lateral edges, which can cause measurement errors. Our study's findings were based on an assessment of 250 patients' pituitary sizes. According to the findings of this study, both males and girls' pituitary gland height showed peak in the 20 to 29 years age range, and then began to fall in the age groups that followed. Pituitary heights of 8 mm or 9 mm in the 20 to 29 age range or higher should be regarded as abnormal. The pituitary height in females increased significantly once more in the 50 to 59 years age range, which occurs due to hypertrophy following more pronounced postmenopausal loss of the gonadal steroid feedback system. This information ought to aid in the ongoing analysis of pituitary morphology in a range of neuro-endocrinal illnesses. A pituitary gland volume assessment concluded moderate correlation between pituitary glands parameters in the study conducted by Naik D et al. in the typical Indian teenage population.<sup>[12]</sup> It was discovered that the most typical shape of the pituitary gland, as in our study, was flat. Our study provided offer information on the mean pituitary gland height and volume among the Indian population across all the age ranges. Age and gender have an impact on typical pituitary gland sizes. In the age group of 21 to 30 years, pituitary height peaked. Pituitary height >9 mm with in the age range of 21 to 30 years and >8 mm in other age groups was regarded as abnormal. Females who are of perimenopausal age have a rise in pituitary height once more, which may be caused by the absence of gonadal steroid feedback. The assessment of pituitary morphology is aided by this examination that normal changes in pituitary configuration occurs in neuroendocrine disorders.

## 6. Conclusion

Pituitary gland size can precisely be assessed by MRI, and for further correlation, it should be compared to the patient's age and sex. During puberty, the pituitary gland grew larger and now entirely covers the pituitary fossa. Age-related decreases in gland size are a result of physiological shrinkage and ageing endocrinology. Pituitary glands that are borderline abnormal in size and shape should have a dynamic contrast MRI examination performed to further assess them. This study gives the average height and pituitary gland volume for both sexes over a range of age groups in the Indian population.

## 7. Future Scope

The absence of prior measurements of volume and height of pituitary gland among such wide age groups & for both the genders within a specified Indian population makes this study necessary. Limitation for the study was absence of volunteers for the study due to usage of expensive investigation.

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