

# MORPHOMETRIC STUDY OF PITUITARY GLAND WITH CORRELATION OF AGE AND GENDER USING MAGNETIC RESONANCE IMAGING

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## ABSTRACT

### Introduction

The pituitary gland is the master gland of the body. Its size varies with age and gender. MRI is the safest and effective diagnostic tool for pituitary gland examination.

### Objectives

This study was aim to determine the anteroposterior, height and transverse dimensions of normal pituitary gland in different age groups of both sex with MRI.

### Methodology

It was a descriptive cross-sectional study. It consisted of 567 images of individuals (242 males and 325 females) of various age from 20 to 70 years from the Department of Radio-diagnosis, Dhulikhel Hospital.

### Result

The mean anteroposterior, height and transverse dimension of pituitary gland is  $9.74 \pm 1.18$  mm,  $5.95 \pm 1.11$  mm and  $11.65 \pm 2.15$  mm respectively in which females have higher value. Independent sample t test showed highly significant differences ( $p < 0.05$ ) between the mean anteroposterior dimension in males and females. The present study showed the mean value of anteroposterior dimension is maximum at age group 50-59. The mean value of height, transverse dimension and volume of males and females is maximum at 20-29 age group and minimum at 70-79 age group. One way ANOVA shows that there is significant difference between in height, transverse dimension and volume at different age group ( $p < 0.05$ ).

### Conclusion

It was concluded that the height and volume of pituitary gland is maximum at second decade of life then it gradually decreases with age. The mean value of anteroposterior, height and transverse dimension showed greater value of females than males.

## KEYWORDS

Anatomy, Magnetic resonance imaging, Pituitary gland.



## INTRODUCTION

The pituitary gland is the master gland which controls almost all the activities of other gland in the body.<sup>1</sup> It is a reddish gray in color, ovoid in shape and measures about 8 mm in anteroposterior, 12 mm in transverse dimension and 5.9 mm height.<sup>2,3</sup> It is located within the hypophyseal fossa of sphenoid bone and covered by a diaphragm sellae.<sup>1,2</sup>

Magnetic resonance imaging (MRI) generate image using the nuclei of atoms inside the body which is specifically useful for soft tissues visualization.<sup>4</sup> It is considered safe for studies since it does not use any harmful ionizing radiations and provides high resolution images.<sup>5</sup> Likewise It is the most accurate and preferable diagnostic technique for pituitary gland.<sup>6,7</sup>

Studies have claimed the variation size of pituitary gland associated with age, gender and pathological condition.<sup>8,9</sup> As the size varies with age, it is very important to find the morphological dimension and correlation with age and gender. There are several disorders of pituitary gland such as pituitary adenomas, inflammation, hypertrophy etc which may affect size and shape of gland.<sup>6,10</sup> Due to variations in size and shape of pituitary with age, pituitary volume is taken as the best predictor of pituitary gland size.<sup>11</sup>

Morphometric analysis of pituitary gland has been studied by many researchers worldwide because of its importance. Knowledge of accurate anatomical measurements of it is important for clinician for better prognosis of the diseases. The data is not sufficiently available for Nepalese population. Thus, the present study was aimed to evaluate pituitary morphometry by using MRI images.

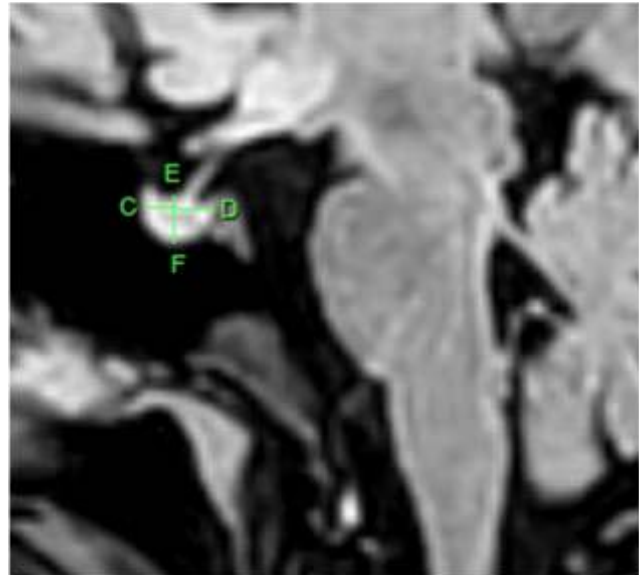
## METHODOLOGY

A descriptive cross-sectional study was conducted in the Department of Anatomy and data was collected from the Department of Radio- diagnosis, Dhulikhel Hospital/ Kathmandu University Hospital, Dhulikhel, Nepal by using images of MRI scan. MRI was performed with a 1.5 Tesla Ingenia Philips machine. The ethical clearance was obtained from IRC-KUSMS (Ref. no. 50/19). The convenient sampling technique was used for data collection. Total number of 567 images of individuals (242 males and 325 females) of various age from 20 to 70 years were taken from June 2019 to December 2020. The obtained data were studied under different age groups and each ten years were grouped as an age group. Hence, the present study consisted of 20-29, 30-39, 40-49, 50-59, 60-69 and 70-79 years age groups.<sup>3</sup> The pituitary gland dimensions were measured by lines drawn on the images using options provided in the Digital Imaging and Communications in Medicine software and the values were directly recorded from the monitor screen in millimeter (mm). The images of individuals with routine MRI images were studied showing normal anatomy. Pathological condition with history of pituitary gland or hormone disorders, infarction, raised intra cranial pressure and unclear abnormal features of gland were excluded.

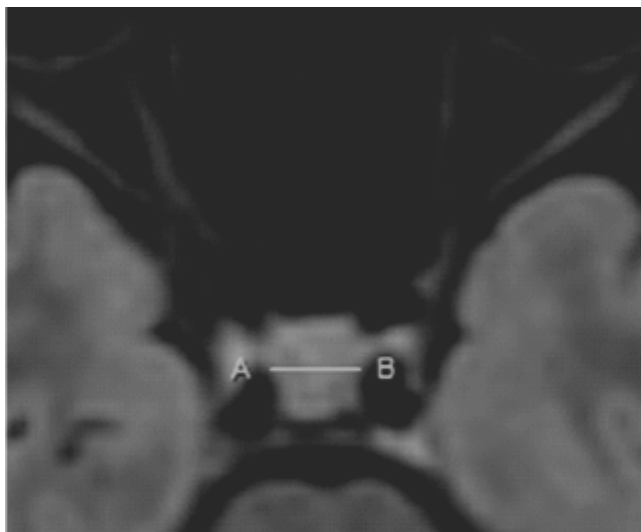
3D volumetric sagittal scan was performed and reconstruction done of axial coronal and sagittal. The mid sagittal image

measured anteroposterior dimension and height (cranio-caudal) [Figure- 1]. The coronal image measured transverse dimension [Figure- 2]. Pituitary gland volume was estimated by using formula:  $V = \text{anteroposterior dimension} \times \text{height} \times \text{transverse dimension} \times 0.52$ .<sup>8</sup>

Data was collected and entered in Microsoft excel and analyzed using the Statistical Package for the Social Sciences version 16.0 for descriptive statistical analysis. P-value was calculated to find the level of significance and P value <0.05 was considered as significant.



**Figure 1:** C-D shows measurement of anteroposterior dimension, E-F shows measurement of height.



**Figure 2:** A-B shows measurement of transverse dimension.

## RESULTS

The mean anteroposterior, height and transverse dimension of pituitary gland in which all values of females were found to be more than males is described in Table 1. Independent sample t test showed highly significant differences ( $p < 0.05$ ) between the mean anteroposterior dimension in males and females.

**Table 1:** Anteroposterior dimension, height, transverse dimension and volume of pituitary gland.

	Anteroposterior dimension (mm)	Height (mm)	Transverse Dimension (mm)	Volume (mm <sup>3</sup> )
Total (567)	9.74±1.18	5.95±1.11	11.65±2.15	352.51±107.74
Males(242)	9.62±1.08	5.87±1.10	11.56±2.14	341.17±103.29
Females(325)	9.83±1.25	6.01±1.12	11.72±2.16	360.96±110.33
p-value	0.03	0.13	0.38	0.03

Furthermore, the mean value of anteroposterior, height and transverse dimension of pituitary gland in different age group is shown in Table 2. The present study showed the mean value of anteroposterior dimension is maximum at age group 50-59 yrs. It was found that the height, transverse dimension and volume is highest at 20-29 yrs age group. One way ANOVA shows that there is significant difference between in height, transverse dimension and volume at different age group ( $p < 0.05$ ).

The mean value of anteroposterior, height, transverse dimension and volume of pituitary gland in different age group and in both sex is described in Table 3.

**Anteroposterior dimension:** The mean value of

group i.e. 5.31±1.17 mm and 5.42±1.22mm respectively (Table 3). This study coated that the mean value of height of females is greater than males in all age group except at 60-69 yrs age group.

**Transverse dimension:** The mean value of transverse dimension of males and females is maximum at 20-29 yrs age group 12.18±1.95 mm and 12.07±1.89 mm respectively and minimum at 70-79 yrs age group 9.24±2.95 mm and 10.87±1.75 mm respectively (Table 3). The present study showed that the mean value of transverse dimension of males at 20- 29 yrs and 50- 59 yrs age group is greater than females.

**Volume:** The mean value of volume of males and females is maximum at 20-29 yrs age group (377.5 ± 94.94 mm<sup>3</sup> and

**Table 2:** Pituitary gland in different age groups.

Age Group (yrs)	Anteroposterior dimension (mm)	Height (mm)	Transverse dimension (mm)	Volume (mm <sup>3</sup> )
20-29	9.82±1.21	6.30±1.07	12.11±1.91	751.47±205.75
30-39	9.71±1.13	6.00±1.17	11.93±2.07	696.72±215.85
40-49	9.66±1.28	5.77±0.98	11.80±2.16	659.50±188.45
50-59	9.90±1.14	5.66±1.00	10.78±2.10	602.81±165.89
60-69	9.47±0.97	5.61±1.21	11.21±2.28	592.92±185.43
70-79	9.51±1.18	5.35±1.16	9.84±2.64	504.30±200.27
P-value (one way ANOVA)	0.25	0.00	0.00	0.00

anteroposterior dimension of males is maximum (10.05±0.97 mm) at 50-59yrs age group and minimum (9.32±1.15 mm) at 70-79 yrs age group. Similarly, the mean value of anteroposterior dimension of females is maximum (10.01±1.31 mm) at 20-29 yrs age group and minimum (9.40±1.05 mm) at 60-69 yrs age group. The mean values of females is larger in all group except 50-59 yrs and 60-69yrs age group (Table 3).

**Height:** The mean value of height of males and females is highest at 20-29 yrs age group i.e. 6.19±0.99 mm and 6.38±1.13 mm respectively and lowest at 70-79 yrs age

401.42 ± 115.16 mm<sup>3</sup> respectively) and minimum at 70-79 yrs age group (236.95 ± 96.08 mm<sup>3</sup> and 305.58 ± 110.18 mm<sup>3</sup> respectively). The differences between the mean volume in males and females at all groups were found to be insignificant except at 20-29 yrs age group where it is highly significant ( $p < 0.05$ ) (Table 3). The conducted study showed that the mean value of volume at 50- 59 yrs age group had higher value for males than females. The mean volume of gland shows significant association with puberty age with maximum value at 20-29 yrs age group which is gradually decreasing with the age.

**Table 3:** Pituitary gland in different age group in both sex.

Age Group (yrs)	Sex	Anteroposterior dimension (mm)	p-value	Height (mm)	p-value	Transverse Dimension (mm)	p-value	Volume (mm <sup>3</sup> )	p-value
20-29	Males	9.58±1.04	0.08	6.19±0.99	0.14	12.18±1.95	0.71	377.5±94.94	0.02
	Females	10.01±1.31		6.38±1.13		12.07±1.89		401.42±115.16	
30-39	Males	9.51±1.15	0.15	5.90±1.28	0.49	11.84±2.08	0.72	344.36±113.32	0.19
	Females	9.84±1.11		6.06±1.10		11.99±2.08		373.86±110.91	
40-49	Males	9.49±1.23	0.78	5.66±1.02	0.38	11.60±1.45	0.52	328.09±89.91	0.41
	Females	9.78±1.33		5.83±0.93		11.90±2.55		351.72±102.03	
50-59	Males	10.05±0.97	0.38	5.59±1.05	0.42	10.99±1.87	0.17	322.11±90.69	0.36
	Females	9.89±1.25		5.72±0.95		10.69±2.29		310.33±82.04	
60-69	Males	9.57±0.88	0.53	5.73±1.09	0.54	10.85±2.77	0.33	310.03±111.85	0.91
	Females	9.40±1.05		5.52±1.31		11.48±1.85		307.07±85.36	
70-79	Males	9.32±1.15	0.45	5.31±1.17	0.85	9.24±2.95	0.20	236.95±96.08	0.19
	Females	9.79±1.27		5.42±1.22		10.87±1.75		305.58±110.18	

## DISCUSSION

Pituitary gland is very important neuro endocrine organ which secrete hormones that is essential for life.<sup>2</sup> MRI is most preferable diagnostic technique for the examination of soft tissues.<sup>6,7</sup> It is therefore important to get normal pituitary gland value of MRI images. Pituitary gland variations are noted among individuals from different part of the world.<sup>8,9</sup> Change in the shape and size often affected by age and gender. The variations in size also reflects hormonal function imbalance.<sup>10</sup>

In our study the overall mean height was 5.95±1.11 mm which is lesser than the study done by Yadav et al., Lamichhane et al. and Kumar.<sup>3,8,12</sup> In contrast, the finding of Suzuki et al. has lower mean value than our study.<sup>9</sup> Fewer study done by Mohammad et al., Kato et al., Shayma et al. and Grams et al. showed the mean value of height almost comparable with our study.<sup>13-16</sup>

Many studies done in different places showed there is maximum increase of height of pituitary gland in their second decade of life which is similar with our study.<sup>14,15,17</sup> This suggest the change of hormonal levels which cause changes in morphology of the gland.

The decline in the height of gland with age also shows the hormonal changes with aging and physiological atrophy. In our study minimum mean height (5.35±1.16 mm) was found in the age group of 70-79 yrs which was supported by the study done by Lamichhane et al. and Sinclair et al.<sup>3,17</sup>

Studies reveal that the gland height is significantly greater among the adolescent women than men which is physiological hypertrophy.<sup>10</sup> Consequently, the mean height of gland in females was greater than that of males in the same age group except in the age group 60-69 yrs. In present study the mean value of height of males and females is maximum at 20-29 yrs age group (6.19 ± 0.99 mm and 6.38 ± 1.13 mm respectively and minimum at 70-79 yrs age group (5.31 ± 1.17 mm and 5.42 ± 1.22 mm respectively). Study done by Suzuki et al. and Kato et al. reported maximum mean height in females was found at 20-30 yrs age group which supported our study.<sup>9,14</sup> However the study done by Kumar and Muhammad et al. also reported the greatest

mean value at 20-30 yrs age group but the males had higher values.<sup>12,18</sup>

In our study the total mean height for females (6.01±1.12 mm) is greater than males (5.87±1.10 mm) which is similar with the study done among Japanese, Scottish, Nigerian population.<sup>14,17,19</sup>

Many studies have reported the value of anteroposterior dimension is greater than our study (9.74±1.18 mm).<sup>13,14,16</sup> Lamichhane et al., Sinclair et al. and Shayma et al. also studied the anteroposterior dimension and their results are remarkably similar with the data produced in this study with a mean value of 9.90±1.14 mm maximum at 50-59 yrs age group.<sup>3,15,17</sup>

The present study observed that the mean values of anteroposterior dimension of males(9.62±1.08 mm) and females (9.83±1.25 mm) is lower than the study conducted by Kato et al., Sinclair et al. and Ibinaiye et al.<sup>14,17,19</sup>

The result from this study give a mean value of 11.65±2.15 mm for transverse dimension of gland which is comparatively smaller than the value reported by other studies.<sup>3,16,17</sup> A study done by Sinclair et al. showed similar result with a maximum mean transverse dimension of pituitary gland of 12.11±1.91 mm for 20-29 yrs age group.<sup>17</sup>

In this study the total mean transverse dimension for females (11.72±2.16 mm) is greater than males (11.56±2.14 mm) which agreed the study done by Kato et al., Sinclair et al. and Ibinaiye et al.<sup>14,17,19</sup>

The present study showed that the mean value of volume to be 352.51±107.74 mm<sup>3</sup> similar finding was observed among the Sudanese population.<sup>15</sup> A study done on Inedial Indian population showed the lower mean value than ours.<sup>20</sup>

Generally, the volume were higher at the early puberty age than in the declining years. The present study revealed the maximum mean value is for the age group 20-29 yrs (751.47±205.75 mm<sup>3</sup>) then it gradually decrease with age. Similar the study done among Sudanese, Indian, Nepali, Nigerian and Kashmiri population showed maximum volume at 20-29 yrs age group which supported our study.<sup>3,8,12,15,19</sup>

A study done in India revealed the value of mean volume of



females ( $360.96 \pm 110.33 \text{ mm}^3$ ) is greater than that of males ( $341.17 \pm 103.29 \text{ mm}^3$ ) which is similar to our study.<sup>11</sup> In contrast, Ibinaiye et al. reported larger values in male.<sup>19</sup>

## CONCLUSION

The present study showed the height and volume of pituitary gland is maximum at second decade of life then it gradually decreases with age. The mean value of anteroposterior, height and transverse dimension showed greater value of females than male. It could also establish normal reference values for MRI of pituitary gland which may be used in diagnosis and treatment of diseases.

## RECOMMENDATIONS

It is highly recommended to conduct similar study including large population to see the sexual dimorphism in Nepalese population.

## LIMITATIONS OF THE STUDY

Study could not include the population from other part of the country so the result obtained from this study could not be generalized to other population.

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## CONFLICT OF INTEREST

None

## FINANCIAL DISCLOSURE

None

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