



AGE AND GENDER-RELATED CHANGES IN DIMENSIONS AND VOLUME OF PITUITARY GLAND: ORIGINAL ARTICLE

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Abstract

Background: The pituitary gland is the master gland of the body. Due to its high soft tissue contrast, multi-planar capabilities, and lack of ionizing radiation, MRI is currently the preferred examination for pituitary evaluation.

Aim: To study Age and gender related changes in dimensions & Volume of pituitary gland using MRI.

Study design: prospective observational type.

Material and Method: Assessment of 150 subjects in which 100 subjects were included with age ranging from 10-70 years in which 44 were males and 56 females. for measurement of gland based T1 MPRAGE sequence is used in all 3 aspects AP dimension, height, width of pituitary gland. The statistical analysis done by SPSS version 23. Independent t test, one way ANOVA and Pearson correlation of parameters were calculated.

Result: Mean height of pituitary in female patients of each age group was greater as compare to males in all age group. the max height of gland reached in 31 to 40 in both genders. the maximum height of pituitary volume was noted between 10-20 years in females $406.68 \pm 65.41 \text{mm}^3$ and least was noted in age 61 to 70 years $358.04 \pm 63.60 \text{mm}^3$.

Conclusion: - This study provides changes in dimension & volume of normal pituitary gland across the different age groups in both genders. patient between age group of 31-40 years have highest pituitary gland height and lowest in 61-70 years. due to high physiological need of harmonies females have higher pituitary gland volume and height as compare to males.

Keywords.: pituitary gland, MRI, MPRAGE, volume

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INTRODUCTION

The necessity of the study arises from the lack of previous instances of evaluation of age and gender related changes in dimensions and volume of pituitary gland in designated region. the similar study that was carried out in Indian population by Pratiksha Yadav et al the study was MRI evaluation of size and shape of normal pituitary gland: age and sex related [1]. The present study was conducted to study age & gender related changes in dimension and volume of pituitary gland in both genders of different age groups using MRI north western Uttar Pradesh India.

Method and material

The study was clinical based prospective study observational type which was conducted at Department of Radiology and imaging technology, college of paramedical sciences Teerthanker Mahaveer university, Moradabad, U.P. the study duration was 20 march 2022 to 21 march 2023. The study population was western UP. The source of data is patients that were referred to Radiology department of MRI examination of the head. The total sample size was of 150 patients in which 100 subjects were included.

Inclusion criteria: -

- The patients having normal MRI report of brain, subjects between 10-70 years both the genders were included in the study.

Exclusion criteria: -

- The patient having any endocrine disorders, head injury, Patients who were pregnant or breastfeeding at the time of examination, empty Sella and patients having Sella which was filled with cerebrospinal fluid with a pituitary gland having a height less than 2mm were regarded as empty.

- the patient below the age of 10 years.
- The patient above the age of 70 years. Patients with claustrophobia are contraindicated and they were excluded.

The study was conducted after ethical clearance. MRI scans were performed using Siemen's Magnetom® Avanto 1.5 Tesla scanner. Through OSIRIX the patient data was transferred to Radiant Dicom viewer Software for the measurements. All 3-plane reconstruction is done with MPR in Radiant Dicom viewer. midsagittal t1 weighted images were used to obtain all Pituitary gland height (Craniocaudal) and anterior-posterior (AP) dimensions showing Fig 1a , 1b.1c .

Fig 2a, 2c 2b showing technique of measurement. Pituitary gland width (transverse) Is measured in a coronal plane by reconstruction of image in the Coronal plane by 3d MPRAGE sequence through pituitary Stalk Formula for estimating pituitary volume

$$V = V = AP \times CC \times T \times 0.52$$

where; AP = Antero-posterior dimension, CC = Craniocaudal dimension, T = Transverse dimension., V = Volume of Pituitary gland (Scale of measurement is mm).

(This factor is obtained from the sphere volume equation coefficient and cubic volume calculation: $(4/3\pi)(r^3)/(2r)^3 = 3.1416/6 = 0.52$).[1]

Pituitary gland shape is obtained in the mid-sagittal T1 weighted neuroshield MPRAGE sequence. The shape of the superior surface of the gland is observed as flat, convex, or concave.

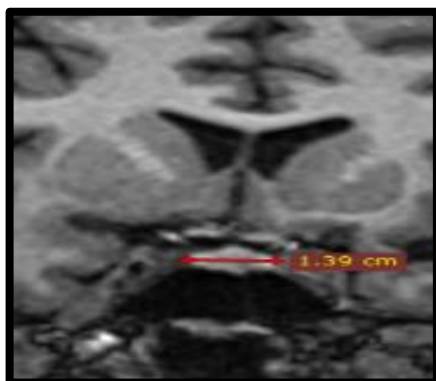


Fig 1a pituitary gland height

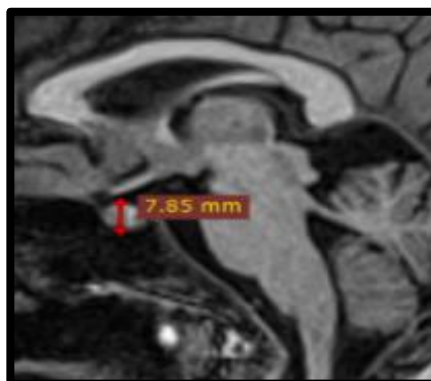


Fig 1b Pituitary gland AP dimension

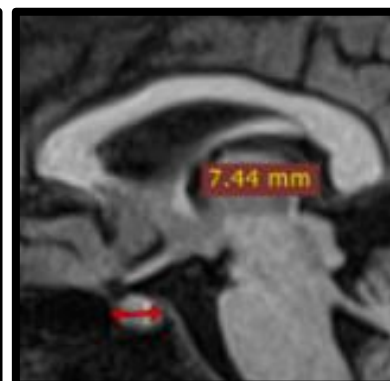


Fig 1c pituitary gland width Coronal plane

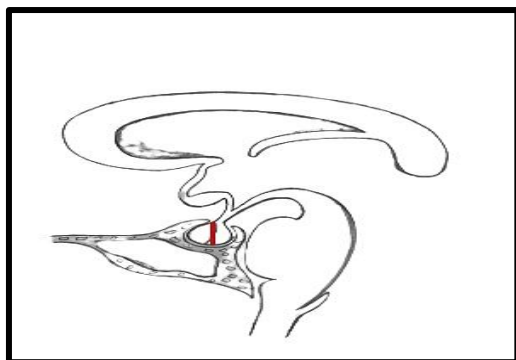


Fig 2a : Red line showing pituitary gland height

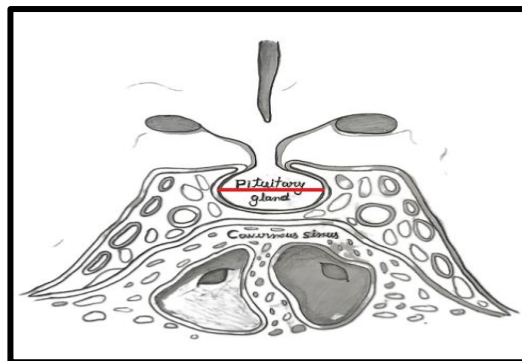


Fig 2b : red line showing pituitary gland AP dimension

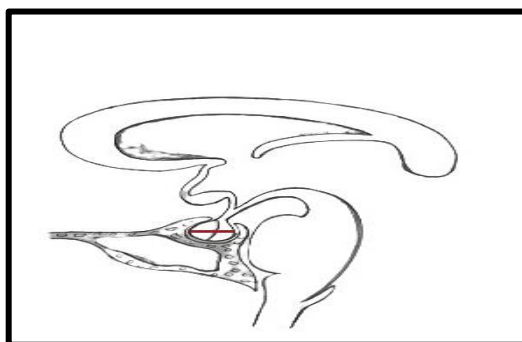


Fig 2c : red line showing pituitary gland width Coronal plane

STATICAL ANALYSIS

All the data collected is compiled in Microsoft Excel work sheet. The statistical analysis is calculated by using SPSS (statistical package for the social services) version 23. Total mean and SD of the Antero-posterior dimension, Craniocaudal dimension, Transverse dimension., Volume of Pituitary gland are calculated respectively. Independent t test, one way ANOVA and Pearson correlation coefficient of different parameters was calculated. The significance level was (P=0.05).

RESULT

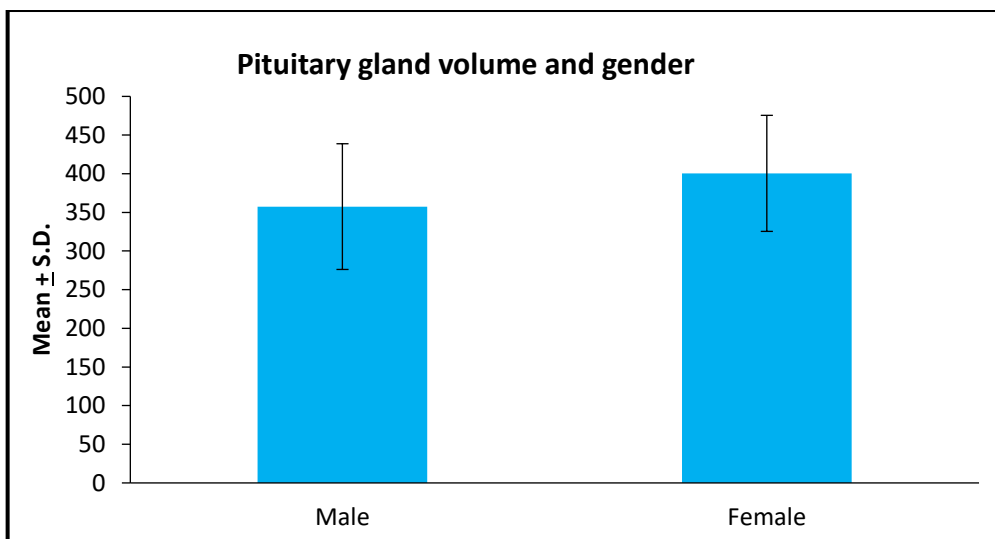
The other dimensions antero posterior aspect and pituitary gland width were not statically significant but the pituitary gland volume and pituitary gland height showed a significant result.

The Pearson correlation coefficient, “r” was used to find the relation between height, Antero-posterior dimensions, pituitary gland width, pituitary gland volume. Pituitary gland volume was a positively correlated ($p < 0.05$) with height, Antero-posterior dimensions, and pituitary gland width. Also, there was a negative correlation ($p < 0.05$) between height and Antero-posterior dimensions.

The Independent sample “t” test was used to compare the pituitary gland volume according to gender for each age group. There was a difference ($p < 0.05$) in the pituitary gland volume between males and females among the age group 10 to 20 years (Table 1 and graph 1). In 10-20 years of age group females have higher pituitary gland volume.

Pituitary gland volume		Mean(mm)	S. D	"F"	p value
10-20	Male	341.22	82.40	-2.428	0.022*
	Female	406.68	65.41		
21-30	Male	386.75	80.38	-0.427	0.674
	Female	403.32	103.06		
31-40	Male	365.19	61.23	-1.856	0.106
	Female	444.86	60.47		
41-50	Male	351.52	111.15	-0.776	0.452
	Female	389.29	76.33		
51-60	Male	366.47	70.23	-0.460	0.653
	Female	381.81	58.83		
61-70	Male	318.17	67.06	-0.863	0.421
	Female	358.04	63.60		

Table 1: Pituitary gland volume according to gender for each age group



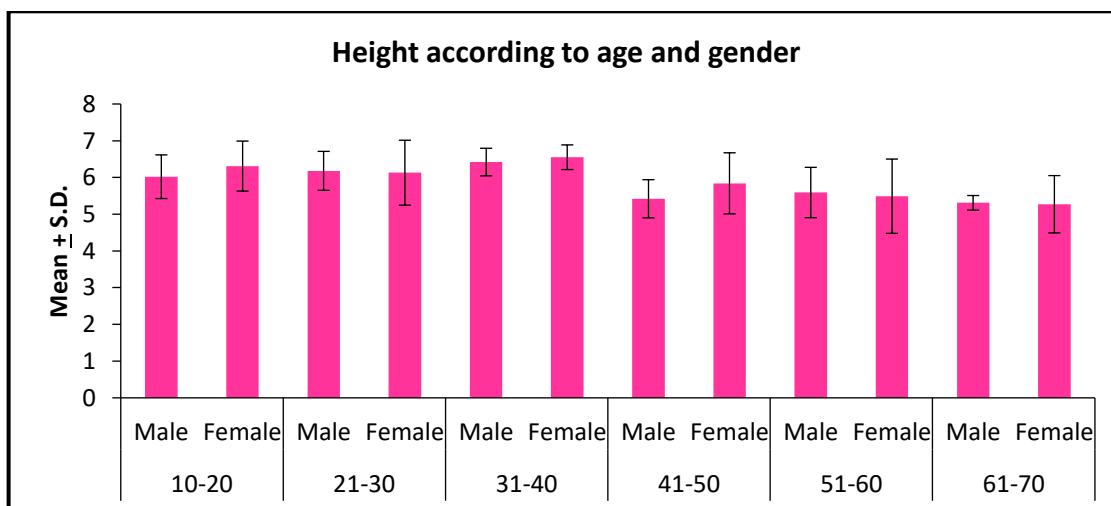
Graph 1 comparison of volume of pituitary gland of males and female

(* Significant) The height (Cranio-Caudal) according to age for each gender was compared using the one-way ANOVA test. Both females & males had different heights depending on their age group (p 0.05). The pituitary gland height is seen increased in 31-40. In age group of 31- 40 males have higher pituitary gland (Table 2). The graph 2 showing the comparison

pituitary gland height in different age groups in males and females between 31-40 have maximum pituitary gland height and patients between 61-70 have least height in both the genders the peak pituitary gland height was in the females in comparison of both gender of age group of 31-40

Height (Cranio- Caudal)		Mean(mm)	S.D	"F"	p value
Male	10-20	6.02	0.59	3.297	0.014*
	21-30	6.18	0.53		
	31-40	6.42	0.38		
	41-50	5.42	0.52		
	51-60	5.59	0.69		
	61-70	5.31	0.20		
Female	10-20	6.31	0.68	2.589	0.037*
	21-30	6.13	0.88		
	31-40	6.55	0.34		
	41-50	5.84	0.83		
	51-60	5.49	1.01		
	61-70	5.27	0.78		

Table 2: Height (Cranio- Caudal) according to age for each gender



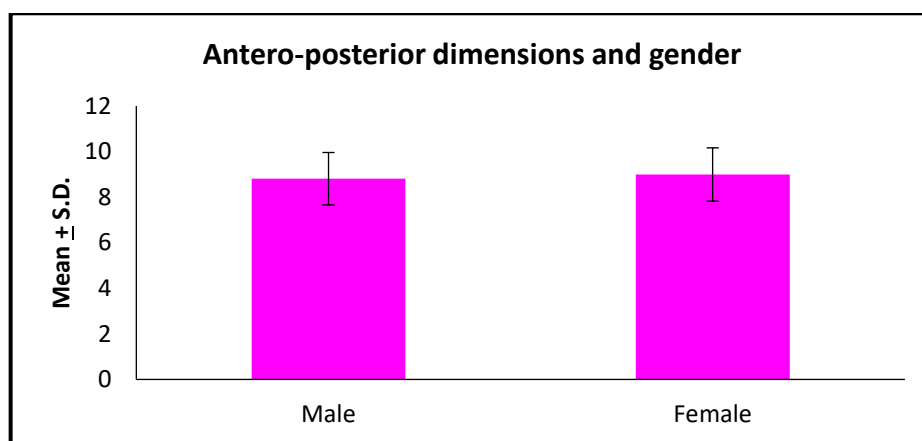
Graph 2 represents comparison of pituitary gland height in different age groups of male In males and females

• The Independent sample “t” test was used to compare the Antero-posterior dimensions according to gender for each age group. There was no difference ($p > 0.05$) in the Antero-posterior dimensions between males and females for entire

age groups 9 (Table 3). The graph 3 showing the difference in pituitary gland Antero-posterior dimensions between both genders. and the females having higher pituitary gland Antero-posterior dimensions as compares to males.

Antero-posterior dimensions		Mean	S.D	"F"	p value
10-20	Male	8.27	1.07	-1.900	0.068
	Female	8.93	0.85		
21-30	Male	8.71	1.01	-0.172	0.865
	Female	8.81	1.74		
31-40	Male	9.19	0.83	0.676	0.521
	Female	8.93	0.40		
41-50	Male	9.32	1.69	0.920	0.374
	Female	8.62	1.26		
51-60	Male	9.34	0.97	-0.538	0.600
	Female	9.63	1.09		
61-70	Male	8.72	0.82	-1.016	0.349
	Females	9.38	1.00		

Table 3 : Antero-posterior dimensions according to gender for each age group



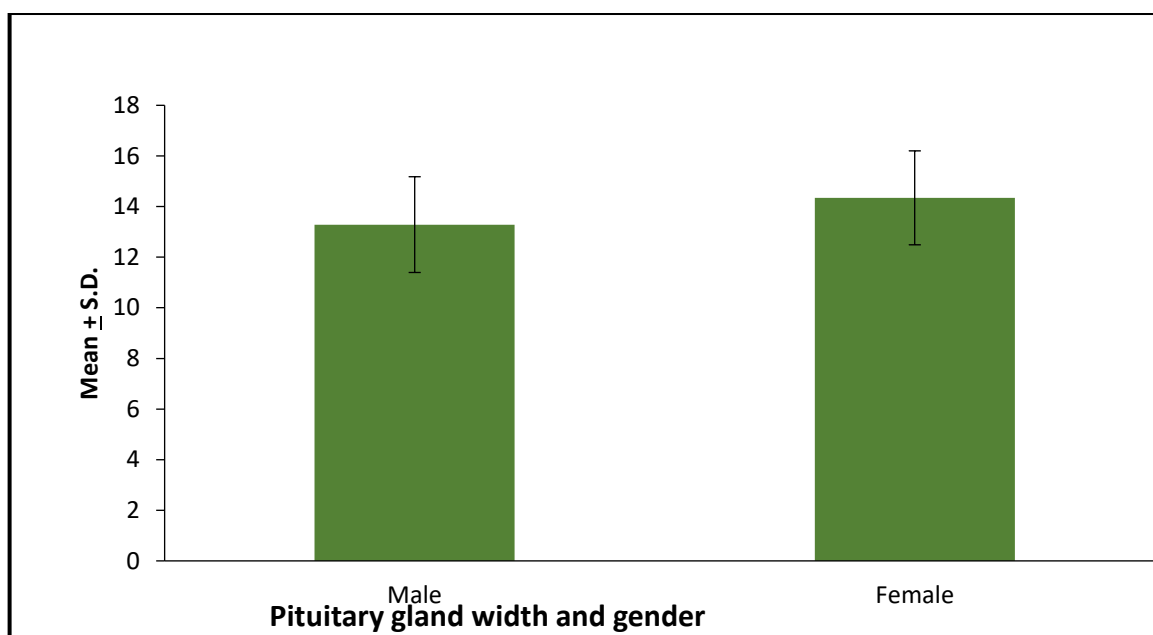
Graph 3 comparison of Antero-posterior dimensions of pituitary gland of males and females

• The Independent sample “t” test was used to compare the pituitary gland width according to gender for each age group. There was no difference ($p > 0.05$) in the pituitary gland width between males

and females for entire age groups (Table 4). The graph 4 showing the difference in pituitary gland width between both genders. and the females having higher pituitary gland width as compares to males.

Pituitary gland width		Mean	S.D	"F"	p value
10-20	Male	13.13	1.66	-1.394	0.174
	Female	13.89	1.35		
21-30	Male	13.62	1.21	-1.186	0.249
	Female	14.63	2.57		
31-40	Male	12.13	2.12	-2.173	0.066
	Female	14.60	1.34		
41-50	Male	13.35	3.11	-1.265	0.228
	Female	14.94	1.62		
51-60	Male	13.53	1.80	-0.646	0.530
	Female	14.22	2.30		
61-70	Male	13.23	2.39	-0.546	0.605
	Female	14.08	2.00		

Table 4 : Pituitary gland width according to gender for each age group



Graph 4 comparison of width of pituitary gland of males and females

DISCUSSION

This study provides the changes in the volume and size of the normal pituitary gland across a range of age groups in the western up population. Because of general aging-related atrophy and a decline in the body's basal metabolic rate, people between the ages of 31 and 40 have the greatest height of the pituitary gland, while those between 51 and 60 and those between 61 and 70 have the least. Due to their higher physiological need for hormones than males, females have larger pituitary glands in height and volume than males. Pituitary gland height and volume in females between the ages of 10 and 20 years, while it is lowest in females between the ages of 51 and 60.

A study done by **Deepti Naik et al** In a study done by Deepti Naik et al pituitary gland assessment by MR volumetry in a normal Indian adolescent population in a study done by Deepti Naik et al pituitary gland assessment by MR volumetry in a normal Indian adolescent population in a study done by Deepti Naik et al pituitary gland assessment by MR volumetry in a normal Indian adolescent population [2]

taking this into account in our study we found that females have greater pituitary gland height compared to males and females between the age of 10-20 years have greater pituitary volume than males.

Pratiksha Yadav et al in their study found that pituitary gland height is maximum at age of 20-29 but in our study, the pituitary gland height was maximum at age 31- to 40 after that, there was a decline in pituitary gland height from subsequent age groups. in their study, they found that females between the age group of 50 to 59 have a slight

increase in height [1] but in our study, the pituitary gland height was least at 51- 60.

Philips oluleke ibinaiye et al in their study found that pituitary gland height was maximum in the age group of 11-20 years and females and the value was higher in females as compared to males [3]. in our study, the maximum height of the pituitary gland was noted in ages between 31-40 but similarly, the values were higher in females

A. Tsunoda et al in a study found that the pituitary gland height was significantly greater in females as compared to males. however, statistical significant differences were obtained in 10- 19-year-old age groups, 20 – 29 years groups, and 50- 59-year-old group. the pituitary gland peaked at the 20 -29 years age group [4] and in our, the pituitary gland height peaked at age 31- 40 year. in their study, the decline of pituitary gland height was in age 70- 79 years age groups, and in females, the decline of the pituitary gland was between the 50 -59 age groups similarly in our study the decline in pituitary gland height 51-60 years, and 61- 70 years the decline in pituitary height with age may also reflect the endocrinology of aging and physiological pituitary atrophy.

Masayuki Suzuki et al. in their study found that the maximum pituitary gland height was obtained in the age groups of 10-19 of both male and females with increasing height after 20 in their study The pituitary glands average height was higher than that of males. [5]. The maximum height was observed in 22-year females whereas in our study the maximum pituitary gland height is noted in ages between 31- 40

S.N Lurie et al. In their study found that the person correlation rate Pituitary gland height and width did not correlate, but height of pituitary gland did correlate with cross-sectional area & estimated volume [6]. In this investigation, pituitary gland volume was positively linked ($p < 0.05$) with height, anterior-posterior dimensions, & pituitary gland width.

Muhammad Faisal et al. In a study, it was found that females between the ages of 11 and 20 had an increase in pituitary gland height. Our study also revealed that females between the ages of 10 and 20 had an increase in pituitary gland height. In Their study maximum pituitary gland height was noted between 11 – 20 years in males and females, and the peak height was noted between 21-30 years.[7]

Koichi Takano et al. In their study they found that the pituitary gland volume is higher in females in comparison to males in the teenage group and similarly in our study the pituitary gland volume was found raised in females in the age group of 10 -20 which reflects menarche.[8] That's why while evaluating the pituitary gland age and gender must be correlated with the pituitary gland.

C. Cem DENK et al. in their study observed that the height of pituitary gland was greater in a 11- 20 years age group and after 21 there is a drop in height of pituitary gland and the gland was substantially increased in the age group of 51- 60. during puberty, in females the pituitary gland was highest, and in age groups of 21 – 40, in females the

pituitary gland was highest females. these observations are compatible with the need for hormonal activities for pregnancy and breastfeeding for women of childbearing age. [9] the same way in our study, the peak height of the pituitary gland was noted between 31- 40 years of age groups.

Kunihiko Kato MD et al. According to their study's findings, those aged 20 to 49 had pituitary glands that were larger than those in other age groups. in their study, the variation between female and male height was not significant.[10] in our study pituitary gland was highest in the 31- 40 age groups. In their study, the result showed that the greatest height was shown between age groups of 20- 24 females.

P. Muralli et al. found that inverse correlation of age with height of pituitary gland area but not the length of the pituitary for all subjects. pituitary area correlated well with pituitary height and the area in their result in the pituitary gland height decline between ages 20 & 65. this relationship was nonlinear beyond 65 years. pituitary height between for women between the age groups Of 20- 40 was larger than in other age groups. Pituitary height revealed significantly more variation in women aged 30-39, 40-49, & 60-69 than in men of the same age. Pituitary gland height in the male subject decreased from 20 to 65. The difference between the groups of 20–40, 41–64, & 65+ did not reach statistical significance.[11] The table 5 & 6 showing the comparison of pituitary gland height and volume from different studies.

Table 5 Comparison of mean pituitary height of different studies(mm)

Philip Ouleke Ibinaiye (mm)			A Tsunoda(mm)			Prtiksha Yadav(mm)			Our Study(mm)		
Age Group	Male	Female	Age Group	Male	Female	Age Group	Male	Female	Age Group	Male	Female
11-20	7.62±2.0	7.8±1.6	10-19	5.10(1.17)	6.05(1.06)	1-10	5.4(±1.5)	5.1(±1.5)	10-20	6.02(±0.59)	6.31(±0.68)
21-30	7.0±1.5	6.9±1.3	20-29	5.63(1.00)	6.48(0.95)	11-20	6.2(±1.2)	6.0(±1.6)	21-30	6.18(±0.53)	6.13(±0.88)
31-40	6.7±1.7	5.9±1.7	30-39	5.40(1.06)	5.68(1.10)	21-30	6.6(±1.5)	7.0(±1.9)	31-40	6.42(±0.38)	6.55(±0.34)
41-50	5.9±1.3	5.9±1.2	40-49	4.89(0.87)	5.19(1.10)	31-40	6.3(±1.4)	6.5(±1.7)	41-50	5.42(±0.52)	5.84(±0.83)
51-60	6.3±1.4	6.4±1.7	50-59	4.80(1.03)	5.44(1.18)	41-50	6.1(±1.5)	6.4(±1.3)	51-60	5.59(±0.69)	5.49(±1.01)
61-70	5.1±2.9	5.0±0.4	60-69	4.78(1.05)	4.88(1.07)	50 Above	6.0(±1.9)	6.7(±1.9)	61-70	5.31(±0.20)	5.27(±0.78)

Philip Ouleke Ibinaiye (mm)			Pratiksha Yadav(mm)			Our study(mm)		
Age group	Male	Female	Age Group	Male	Female	Age group	male	Female
11-20	370.8 ±85.4	378.6±192.4	1-10	210(±0.73)	200(±0.75)	10-20	341.22±82.40	406.68±65.41
21-30	354.6±137.6	359.3±93.3	11-20	340(±127)	200(±0.75)	21-30	386.75±80.38	403.32±103.06
31-40	348.6±145.7	345.3±160.7	21-30	430(±116)	280(±123)	31-40	365.19±61.23	444.86±60.47
41-50	347.5±128.0	332.7±133.7	31-40	380(±140)	440(±111)	41-50	351.12±111.15	389.29±76.33
51-60	334.6±169.7	298.1±49.3	41-50	400(±159)	420(±116)	51-60	366.47±70.23	381.81±58.83
61-70	217.4±200.5	292.3±123.5	50 Above	410(±168)	420(±174)	61-70	318.17±67.06	358.04±63.60

Table 6 Comparison of mean pituitary volume of different studies (mm3)

CONCLUSION

This study provides age and gender related changes of dimensions and volume of the normal pituitary gland in various age groups in the western up population. As observed in our study in the pituitary gland volume is majorly affected by the height of the pituitary gland. as seen from Pearson correlation test which shows a positive correlation between pituitary gland volume and height of pituitary gland. The atrophy due to general aging and fall in BMR of the body leads to a decrease in the dimension of the pituitary gland that's why the subjects between the ages 31-40 years have max height and 51-60 years and 61-70 years have the least. The females have greater pituitary gland height as compared to males due to their high physiological demand for hormones. females between the age of 10-20 years have greater pituitary volume as compared to males. Pituitary gland dimensions and volume can be precisely determined with the help of magnetic resonance imaging and should be correlated with gender and age for the evaluation must be used for the further correlation.

LIMITATIONS OF STUDY

- The study was done on small sample size for further evaluation the study must be conducted on large sample size.
- We were unable to study healthy individuals due to the expensive nature of the examination. This led to the selection of patients who had various diseases but no clinical or imaging signs of neuroendocrine or neuropsychiatric dysfunction.
- Slight error in measurement from one system to another (e.g., osirix to radiant).

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