Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

ORIGINAL RESEARCH

Magnetic Resonance Imaging Determination of Normal Dimensions of Pituitary: Differences between Age Groups and Sexes

[1]Dr. Mahesha B.M., [2]Dr. Soumya, [3]Dr. Mahadev M., [4]Dr. Keshav P. Raichurkar, [5]Ms. Spoorthi Mahesh

[1]Associate Professor, [2]Senior Resident, Department of Radiology, Adichunchanagri Institute of Medical Sciences, Bellur, Karnataka, India
[3]Professor, Department of Radiology, Chamarajanagar Institute of medical sciences, Yadapura, Karnataka, India
[4]Consultant, Department of Radiology, Excel Diagnostics, Mysore, Karnataka, India
[5]Medical Student, Adichunchanagri Institute of Medical Sciences, Bellur, Karnataka, India

Correspondence:
Dr. Mahesha B.M.
Associate Professor, Department of Radiology, Adichunchanagri Institute of Medical Sciences, Bellur, Karnataka, India

Received: 16 September, 2022 Accepted: 20 October, 2022

Abstract

Background: In this study, we wanted to determine the dimensions of normal pituitary gland using T1-weighted magnetic resonance images (MRI) and their relationship with age and sex.

Materials and methods: This was a hospital based prospective, observational study conducted among 156 patients who presented with MRI of brain to the Department of Radio-diagnosis, Vikram Hospital Private Limited, Yadavagiri, Mysore, Karnataka, from June 2017 to May 2018 after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

Results: There was no statistically significant difference with regard to height, length, width and volume of pituitary gland both in males and in females. There was no significant difference with regard to age both in males and females. There was no significant association between gender and upper surface of pituitary gland. Correlation between age and height was statistically significant.

Conclusion: The height of the gland is larger in females than males. In addition, pituitary height showed significant correlation in both sexes among ages that extended from the second to fifth decade of life. Generally, young adults have larger pituitary gland than older individuals. Hormonally active individuals (puberty/pregnancy) have the largest glands. These plump glands completely fill the pituitary fossa, and have a convex upper border. These changes of the dimensions of the gland reflect not only the relation of the age and gender to the gland, but also the complex hormonal environment and the activity of the gland. The decline in pituitary dimensions with age may reflect the process of aging and a physiological pituitary atrophy.

Keywords: Magnetic Resonance Imaging, Determination of Normal Dimensions of Pituitary, Age Groups and Sexes.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Introduction

The pituitary gland was first described anatomically by a Belgian scientist Andreas Vesalius in 1543. It is a small sized gland with master functions; hence, its size and morphology have been a source of interest for many researchers.[1,2] In routine magnetic resonance imaging (MRI) reporting, radiologists commonly visually evaluate the shape and size of the pituitary gland which may occasionally be deceptive due to variations of pituitary gland dimensions established on the hormonal status, age, sex, and even race of the individual.[1,3]Therefore, there is a requirement for quantitative evaluation of the pituitary gland dimensions.[3,4]Also, the size of the bony sella is not a sensitive indicator of pituitary gland abnormality since an empty sella can lead to an enlarged fossa. Hence, there is a need for quantitative assessment.[2]

MRI presently supersedes computerized tomography (CT) and plain radiographs in the investigation of the sella, parasellar, and suprasellar regions.[2,5-7] MRI allows detailed visualization of the anterior and posterior lobes, pituitary infundibulum, optic chiasma, and other parasellar structures.[2] The coronal image is considered as the best single view for imaging the pituitary gland, while the sagittal image best assesses the relationship of the midline structures.[8]

Aims and Objectives

1. To determine the dimensions of normal pituitary gland using T1-weighted magnetic resonance images.
2. To determine their relationship with age and sex.

Materials and methods

This was a hospital based prospective, observational study conducted among 156 patients who presented with MRI brain to the Department of Radio-diagnosis, Vikram Hospital Private Limited, Yadavagiri, Mysore, Karnataka, from June 2017 to May 2018 after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

Inclusion Criteria

Patients who were referred to the Department of Radiodiagnosis for MRI brain.

Exclusion Criteria

1. Any history related to the pituitary gland or hormonal disorders, pituitary surgeries, treated by exogenous hormonal/steroid/drugs like reserpine, phenothiazine, sulpride therapy, pregnancy and lactation, and gross pathology of the pituitary gland noted during the scan were excluded from the study.
2. Postmenopausal oestrogen/progesterone replacement, with a suspected increase in intracranial pressure on the basis of head MR images.

Statistical Methods

Data was entered into Microsoft excel data sheet and was analysed using Statistical Package for Social Sciences (SPSS 22) version software. Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and SD. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.

ANOVA (analysis of variance) was the test of significance to identify the mean difference between more than two groups for quantitative data.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Pearson's correlation was done to find the correlation between two quantitative variables and qualitative variables respectively.

Statistical Analysis

MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyse data. EPI Info (CDC Atlanta), Open Epi, Med calc and Medley's desktop were used to estimate sample size and reference management in the Study (47- 50).

Results

			Count	**%**
Sex Distribution	Gender	Female	78	50.0 %
		Male	78	50.0 %
		Total	**156**	**100.0 %**
			Count	**%**
Age Distribution	Age	11 to 20 years	16	10.3 %
		21 to 30 years	29	18.6 %
		31 to 40 years	26	16.7 %
		41 to 50 years	26	16.7 %
		51 to 60 years	23	14.7 %
		61 to 70 years	20	12.8 %
		71 to 80 years	16	10.3 %
		Total	**156**	**100.0 %**

Table 1. Demographic Distribution

Equal proportion of males and females were included in the study. 156 patients were stratified into age quartiles with an interval of 10 years. 10.3 % were in the age group 11 to 20 years, 18.6 % in 21 to 30 years, 16.7 % in 31 to 40 years and 41 to 50 years respectively, 14.7 % in 51 to 60 years, 12.8 % in 61 to 70 years, 10.3 % in 71 to 80 years. Majority of the patients were in 21 to 30 years age group (18.60 %). Least number of patients were seen in the age groups 11 to 20 years and 71 to 80 years age groups (10.30 %).

	Mean	**Median**	**SD**	**Maximum**	**Minimum**
Height	5.40	5.40	1.34	9.7	1.8
Length	10.64	10.40	1.58	15.2	7.0
Width	13.43	13.40	2.10	19.6	8.0
Volume	403.86	392.82	136.64	796.66	80.62

Table 2: Mean Distribution of Height, Length, Width and Volume of Pituitary among Subjects in the Study

	Gender			
	Female		**Male**	
	Minimum	**Maximum**	**Minimum**	**Maximum**
Height	1.8	9.7	3.1	8.9
Length	7.0	15.2	7.6	14.7
Width	8.0	19.6	8.5	17.3
Volume	80.6	766.1	154.6	796.7

Maximum and Minimum Pituitary Dimensions - Comparison between Females and Males

	Gender						**P value**
	Female			**Male**			
	Mean	**SD**	**Median**	**Mean**	**SD**	**Median**	
Height	5.50	1.51	5.45	5.31	1.14	5.20	0.356
Length	10.81	1.71	10.60	10.47	1.43	10.20	0.356

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Width	13.60	2.35	13.50	13.27	1.81	13.30	0.321
Volume	419.94	141.75	408.22	387.78	130.26	383.63	0.142

Pituitary Dimensions Comparison between Females and Males

		Height		
		Mean	**SD**	**Median**
Age	11 to 20 years	6.04	1.18	6.35
	21 to 30 years	6.20	1.43	5.90
	31 to 40 years	5.18	1.16	5.10
	41 to 50 years	4.99	1.22	5.15
	51 to 60 years	4.86	0.93	4.70
	61 to 70 years	5.40	1.12	5.60
	71 to 80 years	5.17	1.80	5.55

Height of Pituitary Comparison with Respect to Age Group

	ANOVA				
	Height				
	Sum of Squares	**df**	**Mean Square**	**F**	**P value**
Between groups	38.120	6	6.353	3.937	0.001*
Within groups	240.426	149	1.614		
Total	278.547	155			

Table 3

Mean height of pituitary was 5.40 ± 1.34 mm, mean length of pituitary was 10.64 ± 1.58 mm, mean width of pituitary was 13.43 ± 2.10 mm and mean volume of pituitary was 403.86 ± 136.64 mm^3. Maximum value for the height, length, width and volume of pituitary gland obtained were 9.7 mm, 15.2 mm, 19.6 mm, 796.66 mm^3 respectively and minimum value obtained were 1.8 mm, 7.0 mm, 8.0 mm, 80.62 mm^3 respectively.

No male patients had a pituitary height less than 3.1 mm or greater than 8.9 mm; a width less than 8.5 mm or greater than 17.3 mm; a length less than 7.6 mm or greater than 14.7 mm and volume less than 154.6 mm^3 or greater than 796.7 mm^3. Whereas no female patients had a pituitary height less than 1.8 mm or greater than 9.7 mm; a width less than 8.0 mm or greater than 19.6 mm; a depth less than 7.0 mm or greater than 15.2 mm and volume less than 80.6 mm^3 or greater than 766.1 mm^3.

There was no significant difference in height, length, width and volume of pituitary between females and males. Mean height of pituitary were 5.50 ± 1.51 mm and 5.31± 1.14 mm for females and males respectively, mean length of pituitary were 10.81 ± 1.71 mm and 10.47 ± 1.43 mm for females and males respectively, mean width of pituitary were 13.60 ± 2.35 mm and 13.27 ± 1.81 mm for females and males respectively, mean volume of pituitary was 419.94 ± 141.75 mm^3 and 387.78 ± 130.26 mm^3 for females and males respectively. However, all the parameters were higher in females compared to males.

Mean pituitary height was highest in the age group of 21 to 30 years (6.20 ± 1.43) mm and lowest in the age group of 51 to 60 years (4.86 ± 0.93) mm. However, there was significant difference in height of pituitary with respect to age distribution. The height of the gland increased from 6.04 mm in second decade of life to 6.20 mm in the third decade and progressively decreased to 4.86 mm in the sixth decade of life with second peak at seventh (5.40 mm) decade again.

		Gender					
		Female			Male		
		Height			Height		
		Mean	**SD**	**Median**	**Mean**	**SD**	**Median**
Age	11 to 20 years	6.4	1.2	6.8	5.7	1.1	5.5

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

	21 to 30 years	6.3	1.3	5.9	6.0	1.6	5.8
	31 to 40 years	5.1	1.4	4.9	5.3	1.0	5.2
	41 to 50 years	5.2	1.4	5.3	4.7	0.9	4.9
	51 to 60 years	5.4	1.1	5.6	4.6	0.8	4.7
	61 to 70 years	4.7	1.3	4.7	5.8	0.8	5.9
	71 to 80 years	4.9	2.3	4.5	5.4	1.3	5.7
	P value		0.038*			0.014*	

Height Difference with Respect to Age Distribution among Females and Males

			Length	
		Mean	**SD**	**Median**
Age	11 to 20 years	10.14	1.93	10.35
	21 to 30 years	10.31	1.29	10.50
	31 to 40 years	10.77	1.94	10.60
	41 to 50 years	10.48	1.44	10.10
	51 to 60 years	10.89	1.65	10.60
	61 to 70 years	11.17	1.48	11.20
	71 to 80 years	10.76	1.20	10.40

Length of Pituitary Comparison with Respect to Age Group

		ANOVA			
		Length			
	Sum of Squares	**Df**	**Mean Square**	**F**	**P Value**
Between Groups	15.697	6	2.616	1.048	0.397
Within Groups	371.883	149	2.496		
Total	**387.579**	**155**			

		Gender					
		Female			Male		
		Length			Length		
		Mean	**SD**	**Median**	**Mean**	**SD**	**Median**
Age	11 to 20 years	10.5	2.4	10.5	9.8	1.4	9.9
	21 to 30 years	10.2	1.1	10.5	10.5	1.6	10.4
	31 to 40 years	11.2	1.8	10.6	10.3	2.0	10.8
	41 to 50 years	10.7	1.7	10.5	10.1	0.9	10.1
	51 to 60 years	11.4	1.8	10.4	10.7	1.6	10.6
	61 to 70 years	11.2	2.1	10.8	11.1	1.1	11.4
	71 to 80 years	11.3	1.5	11.4	10.3	.6	10.1
	P value		0.515			0.478	

Length Difference with Respect to Age Distribution among Females and Males

			Width	
		Mean	**SD**	**Median**
Age	11 to 20 years	12.61	2.01	12.30
	21 to 30 years	14.35	1.76	14.40
	31 to 40 years	13.67	2.39	13.80
	41 to 50 years	13.45	2.60	13.50
	51 to 60 years	13.28	2.09	13.20
	61 to 70 years	12.73	1.64	12.50
	71 to 80 years	13.29	1.40	13.40

Width of Pituitary Comparison with Respect to Age Group

		ANOVA		

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

		Width			
	Sum of Squares	**Df**	**Mean Square**	**F**	**P Value**
Between Groups	47.431	6	7.905	1.853	0.093
Within Groups	635.572	149	4.266		
Total	**683.003**	**155**			

Table 4

Among females, mean height of pituitary was highest among 11 to 20 years (6.4 ± 1.2 mm) subjects and lowest among 61 to 70 years (4.7 ± 1.3 mm) subjects. There was significant difference in mean height of pituitary with respect to age distribution (P value - 0.038). Among males, mean height of pituitary was highest among 21 to 30 years (6.0 ± 1.6 mm) subjects and lowest among 51 to 60 years (4.6 ± 0.8 mm) subjects. There was significant difference in mean height of pituitary with respect to age distribution (P value - 0.014).

Mean pituitary length was highest in the age group of 61 to 70 years (11.17 ± 1.48 mm) and lowest in the age group of 11 to 20 years (10.14 ± 1.93 mm). However, there was no significant difference.

Among females, mean length of pituitary was highest among 51- to 60-year-old (11.4 ± 1.8 mm) subjects and lowest among 21- to 30-year-old (10.2 ± 1.1 mm) subjects. There was no significant difference. Among males, mean length of pituitary was highest among 61- to 70-year-old (11.1 ± 1.1 mm) subjects and lowest among 11 to 20 year old (9.8 ± 1.4 mm) subjects. There was no significant difference.

Mean pituitary width was highest in the age group of 21 to 30 years (14.35 ± 1.76 mm) and lowest in the age group of 11 to 20 years (12.61 ± 2.01 mm). However, there was no significant difference.

			Gender				
			Female			Male	
			Width			Width	
		Mean	**SD**	**Median**	**Mean**	**SD**	**Median**
Age	11 to 20 years	12.4	2.7	12.2	12.8	1.2	12.5
	21 to 30 years	14.6	1.9	14.7	13.8	1.3	13.4
	31 to 40 years	13.4	2.8	13.8	14.0	2.0	13.8
	41 to 50 years	14.0	2.5	13.6	12.6	2.7	13.0
	51 to 60 years	13.8	2.6	13.0	13.0	1.9	13.2
	61 to 70 years	12.5	1.7	11.7	12.8	1.6	12.6
	71 to 80 years	12.7	1.5	12.6	13.9	1.1	13.8
	P value		0.165			0.363	

Width Difference with Respect to Age Distribution among Females and Males

			Volume	
		Mean	**SD**	**Median**
Age	**11 to 20 years**	404.52	141.57	360.19
	21 to 30 years	477.05	136.38	476.47
	31 to 40 years	390.78	115.62	376.39
	41 to 50 years	377.47	154.43	379.52
	51 to 60 years	363.90	99.15	372.57
	61 to 70 years	402.63	125.70	411.30
	71 to 80 years	393.68	165.19	416.99

Volume of Pituitary Comparison with Respect to Age Group

		ANOVA			
		Volume			
	Sum of Squares	**Df**	**Mean Square**	**F**	**P Value**

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Between Groups		216304.817		6	36050.803	2.006	0.068
Within Groups		2677615.460		149	17970.574		
Total		**2893920.277**		**155**			
				Gender			
			Female			**Male**	
			Volume			**Volume**	
		Mean	**SD**	**Median**	**Mean**	**SD**	**Median**
Age	11 to 20 years	429.7	157.0	384.7	379.4	129.8	330.2
	21 to 30 years	482.1	100.7	485.8	467.4	193.4	438.0
	31 to 40 years	384.4	114.3	336.2	397.1	121.2	380.6
	41 to 50 years	416.1	169.4	382.6	315.7	107.4	281.4
	51 to 60 years	430.4	96.9	392.4	334.8	87.7	332.5
	61 to 70 years	345.5	123.5	327.5	433.4	120.3	436.9
	71 to 80 years	384.0	212.6	384.5	403.4	114.3	417.0
	P value		0.324			0.073	
Volume Difference with Respect to Age Distribution among Females and Males							
				Upper Surface			
		Concave		**Convex**		**Flat**	
		Count	**%**	**Count**	**%**	**Count**	**%**
Age	11 to 20 years	2	12.5 %	11	68.8 %	3	18.8 %
	21 to 30 years	4	13.8 %	19	65.5 %	6	20.7 %
	31 to 40 years	7	26.9 %	7	26.9 %	12	46.2 %
	41 to 50 years	9	34.6 %	4	15.4 %	13	50.0 %
	51 to 60 years	13	56.5 %	1	4.3 %	9	39.1 %
	61 to 70 years	6	30.0 %	5	25.0 %	9	45.0 %
	71 to 80 years	7	43.8 %	7	43.8 %	2	12.5 %
Comparison Between Upper Surface and Age Distribution							
χ 2 = 42.73, df = 12, p < 0.001*							
Table 5							

Among females, mean width of pituitary was highest among 21- to 30-year-old (14.6 ± 1.9 mm) subjects and lowest among 11 to 20 year old (12.4 ± 2.7 mm) subjects. There was no significant difference. Among males, mean width of pituitary was highest among 31- to 40-year-old (14.0 ± 2.0 mm) subjects and lowest among 41 to 50 year old (12.6 ± 2.7 mm) subjects. There was no significant difference

Mean pituitary volume was highest in the age group of 21 to 30 years (477.05 ± 136.38 mm^3) and lowest in the age group of 51- to 60-year-old (363.90 ± 99.15 mm^3). However, there was no significant difference.

Among females, mean volume of pituitary was highest among 21- to 30-year-old (482 ± 100.7 mm^3) subjects and lowest among 61 to 70 year old (345.5 ± 123.5 mm^3) subjects. There was no significant difference. Among males, mean volume of pituitary was highest among 21- to 30-year-old (467.4 ± 193.4 mm^3) subjects and lowest among 41 to 50 year old (315.7 ± 107.4 mm^3) subjects. There was no significant difference.

In the age group of 11 to 20 years, 12.5 % had concave surface, 68.8 % had convex surface and 18.8 % had flat surface. In the age group of 21 to 30 years, 13.8 % had concave surface, 65.5 % had convex surface and 20.7 % had flat surface. In the age group of 31 to 40 years, 26.9 % had concave surface, 26.9 % had convex surface and 46.2 % had flat surface. In the age group of 41 to 50 years, 34.6 % had concave surface, 15.4 % had convex surface and 50.0 % had flat surface. In the age group of 51 to 60 years, 56.5 % had concave surface, 4.3 % had convex surface and 39.1 % had flat surface. In the age group of 61 to 70 years, 30.0 %

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

had concave surface, 25.0 % had convex surface and 45.0 % had flat surface. In the age group of 71 to 80 years, 43.8 % had concave surface, 43.8 % had convex surface and 12.5 % had flat surface. Among age group of 11 to 20 years and 21 to 30 years, majority had convex upper surface. Among age group of 31 to 40 years, 41 to 50 years and 61 to 70 years, majority had flat upper surface. Among age group of 51 to 60 years, majority had concave upper surface. Among age group of 71 to 80 years, 43.8 % each had convex and concave upper surface.

There was significant association between age and upper surface.

		Upper Surface					
		Concave		Convex		Flat	
		Count	%	Count	%	Count	%
Gender	Female	22	28.2 %	32	41.0 %	24	30.8 %
	Male	26	33.3 %	22	28.2 %	30	38.5 %
Comparison between Upper Surface and Gender Distribution							
χ 2 = 2.852, df = 2, p = 0.240							

		Correlations				
		Age	Height	Length	Width	Volume
Age	Pearson Correlation	1	-0.256**	0.151	-0.087	-0.146
	P value		0.001	0.060	0.281	0.069
	N	156	156	156	156	156
Correlation between Age and Pituitary Dimensions Overall						
		Age	Height	Length	Width	Volume
Age	Pearson Correlation	1	-0.345**	0.192	-0.106	-0.202
	Sig. (2-tailed)		0.002*	0.093	0.355	0.076
	N	78	78	78	78	78
		a. Gender = Female				
Correlation between Age and Pituitary Dimensions among Females						
		Age	Height	Length	Width	Volume
Age	Pearson Correlation	1	-0.128	0.146	-0.039	-0.054
	Sig. (2-tailed)		0.265	0.202	0.736	0.637
	N	78	78	78	78	78
		a. Gender = Male				
Correlation between Age and Pituitary Dimensions among Males						

Table 6

Among females, 28.2 % had concave upper surface, 41 % had convex surface and 30.8 % had flat surface and among males, 33.3 % had concave upper surface, 28.2 % had convex surface and 38.5 % had flat surface. There was no significant association between gender and upper surface of pituitary gland. Among females, most of them had convex upper surface and males had flat upper surface.

There was negative correlation between age and height, width and volume i.e. with increase in age, there was decrease in height, width and volume and vice versa, there was positive correlation between age and length of pituitary i.e. with increase in age, there was increase in length of pituitary. Correlation between age and height was statistically significant.

Among females, there was negative correlation between age and height, width and volume i.e. with increase in age, there was decrease in height, width and volume and vice versa. There was a positive correlation between age and length of pituitary i.e. with increase in age, there was increase in length of pituitary. Correlation between age and height was statistically significant.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

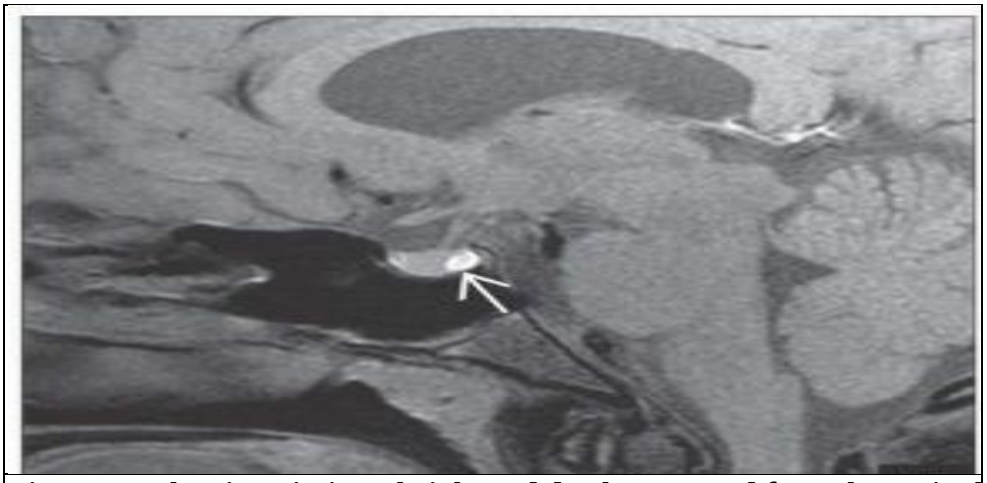

Figure 2 : showing pituitary height and depth measured from the sagittal plane, using a midline image at a section where the cerebral aqueduct is visible

Figure 2 : showing pituitary height and depth measured from the sagittal plane, using a midline image at a section where the cerebral aqueduct is visible

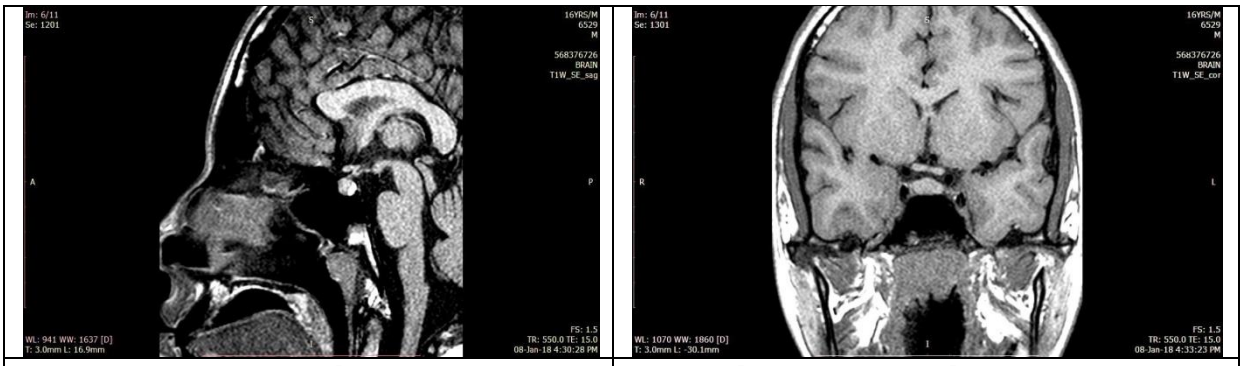

Image 3a: T1WI sagittal section

Image 3b: T1WI coronal section

Image 3: Case 2 .MRI of pituitary gland of 16 yrs. old male patient showing large pituitary gland with convex uppersurface- signifies Physiological hypertrophy

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

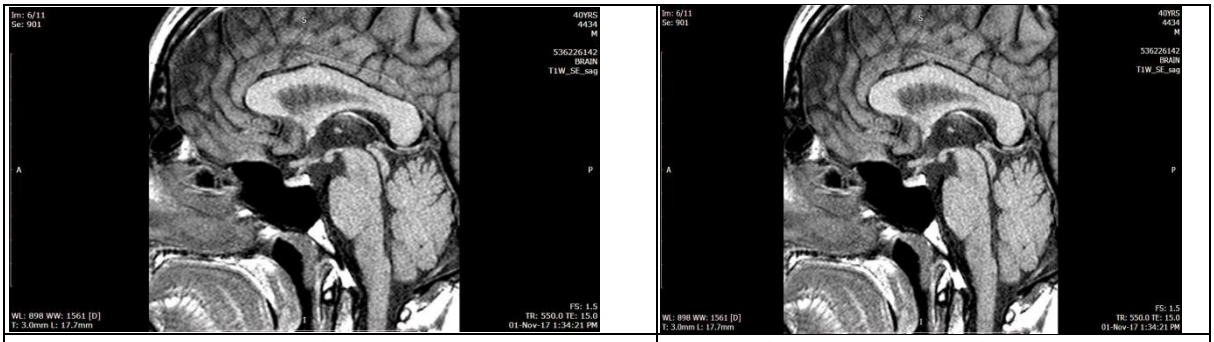

Image 4a: T1WI sagittal section.	*Image 4b: T1WI coronal section*

Image 4: Case 6. MRI of pituitary gland of 40 yrs. old male patient showing pituitary gland with flat upper surface.

Discussion

The mean pituitary gland height obtained for Indian population was 5.31 ± 1.14 mm for males and 5.50 ± 1.51 mm for females. This observation is similar to that of the study conducted by Deepti Naik et al.[9] (5.5 ± 1.6 mm and 6.0 ± 1.5 mm for males and females respectively) in Indian population , Sanobar Bughio et al.[10] (5.6 ± 0.74 mm and 5.8 ± 0.67 mm for males and females respectively) in Pakistani population, John Sinclair et al.[11] (5.52 ± 0.72 mm and 5.66 ± 0.96 mm for males and females respectively) in Scottish patients, C. Cem Denk et al.[12] (5.7 ± 0.2 mm and 6.1 ± 0.1 mm for males and females respectively), Abubaker E. Mohieldin et al.[13] (5.13 ± 0.69 mm and 5.65 ± 1.21 mm for males and females respectively) for Sudanese population.

Higher values for pituitary height has been reported by Dr. Chaitanya Tapasvi et al.[3] (7.73 ± 2.70 mm and 7.70 ± 2.56 mm for males and females respectively), Philip Oluleke Ibinaiye et al.[2] (6.45 ± 1.7 mm and 6.46 ± 1.57 mm for males and females respectively) on 100 subjects in African population and Muhammad Faisal Ikram et al.[14] (5.9 ± 1.0 mm and 6.3 ± 1.4 mm for males and females respectively).

Lower values for height has been reported by A. Tsunoda et al.[15] (4.93 ± 1.0 mm and 5.35 ± 1.2 mm for males and females respectively).

In our study, no male patients had a pituitary height less than 3.1 mm or greater than 8.9 mm. Whereas none of the female patients had pituitary height less than 1.8 mm or greater than 9.7 mm. Based on the data obtained, we recommend that a height of 9.7 mm be taken as upper limit of normal for females and 8.9 mm for males. However, this would need to be further validated by larger similar studies.

Muhammad Faisal Ikram et al. who reported that females achieved the peak heights in their second decade, while in males it was achieved in the third decade. They explained that peak height is a determinant factor for the development of puberty and this is achieved in females 5 years earlier than in their male counterparts. They believe that this fact could be responsible for early achievement of maximal height in females.

In the present study, the height of the gland increased in second decade and third decade of life and progressively decreased in the sixth decade of life with second peak noted at seventh decade again, which was greater for males than females. Some authors differ on this finding and have reported second peak values in the sixth decade (Philip Oluleke Ibinaiye et al, C. Cem Denk et al and A. Tsunoda et al. This second peak is thought to reflect the increased activity triggered as a negative feedback mechanism by the waning hormonal levels in the target organs.

In the present study, the mean pituitary gland length obtained for Indian population was 10.81 ± 1.71 mm for females and 10.47± 1.43 mm for males. This observation is similar to that of

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

the study conducted by Philip Oluleke Ibinaiye et al. (10.59 ± 1.71 mm and 10.49 ± 1.57 mm).

However, the analysis done by Sanobar Bughio et al. (12.1 ± 2.26 mm and 12.5 ± 2.21 mm), John Sinclair et al. (11.18 ± 1.1 mm and 11.09 ± 1.01 mm) and Deepti Naik et al.(14 ± 1.5 mm and 10.1 ± 1.4 mm) were higher than that of the present study.

In the present study, mean pituitary length was highest in the age group of 61 to 70 years (11.17 ± 1.48 mm) and lowest in the age group of 11 to 20 years (10.14 ± 1.93 mm). Among females, mean length of pituitary was highest among 51 to 60 years (11.4 ± 1.8 mm) subjects and lowest among 21 to 30 years (10.2 ± 1.1 mm) subjects. Among males, mean length of pituitary was highest among 61- to 70-year-old (11.1 ± 1.1 mm) subjects and lowest among 11 to 20 year old (9.8 ± 1.4 mm) subjects. However, there was no significant difference in length of pituitary with respect to age distribution.

In the present study, the mean pituitary gland width obtained for Indian population was 13.27 ± 1.81 mm for males and 13.60 ± 2.35 mm for females. Similar results have been reported by Deepti Naik et al. (13.9 ± 0.14 mm and 14.0 ± 0.24 mm for males and females respectively) and Sanobar Bughio et al. (12.8 ± 0.185 mm and 13.3 ± 0.199 mm for males and females respectively).

Lower width has been reported by Kamal Badawi et al.[16] (9.60 mm and 11.77 mm for males and females respectively), Philip Oluleke Ibinaiye et al. (9.08 ± 2.59 mm and 9.21 ± 1.86 mm for males and females respectively) and John Sinclair et al. (11.57 ± 1.42 mm and 11.91 ± 1.61 mm for males and females respectively).

In the present study, mean pituitary width was highest in the age group of 21 to 30 years (14.35 ± 1.76 mm) and lowest in the age group of 11 to 20 years (12.61 ± 2.01 mm). Among females, mean width of pituitary was highest among 21- to 30-year-old (14.6 ± 1.9 mm) subjects and lowest among 11 to 20 year old (12.4 ± 2.7 mm) subjects.

Among males, mean width of pituitary was highest among 31- to 40-year-old (14.0 ± 2.0 mm) subjects and lowest among 41 to 50 year old (12.6 ± 2.7 mm) subjects. However, there was no significant difference.

The decline in pituitary width with age may reflect the process of aging and a physiological pituitary atrophy. However, some patients with advanced ages had significantly higher pituitary width, and other elder individuals showed decrease in the pituitary width. This may be referred to other hidden co-factors (climate, race, body mass index (BMI) and the axial shape of the head).[16]

In the present study, the mean pituitary gland volume obtained for Indian population was 387.78 ± 130.26 mm^3 for males and 419.94 ± 141.75 mm^3 for females. Similar results have been reported by Philip Oluleke Ibinaiye et al. (334.1 ± 145.8 mm^3 and 328.1 ± 129.2 mm^3 for males and females respectively).

However, the analysis done by Dr. Chaitanya Tapasvi et al. (219 mm^3 and 244 mm^3 for males and females respectively) was lower than that of the present study.

In the present study, mean pituitary volume was highest in the age group of 21 to 30 years (477.05 ± 136.38 mm^3) and lowest in the age group of 51 to 60 years (363.90 ± 99.15 mm^3). However, there was no significant difference.

Our findings on pituitary volume differed slightly with respect to age and sex. The peak age was in the third decade, while the peak value was higher in males. However, this was not statistically significant. No second peak in pituitary volume was recorded. However, both pituitary height and volume declined steadily thereafter, and the lowest levels were recorded after the seventh decade in females and fifth decade in males.

Similar to other studies, our study also shows sex differences in pituitary volumes with females having slightly larger gland.[3,17,18]

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Our study is limited by small sample size and selection bias due to high cost of the examination, which did not permit us to study normal volunteers. Further, the non-availability of 3D software at our hospital might have affected the accuracy of our measurements.

Overall, in the present study, there was negative correlation between age and height, width and volume i.e. with increase in age, there was decrease in height, width and volume and vice versa. There was positive correlation between age and length of pituitary i.e. with increase in age, there was increase in length of pituitary.

Correlation between age and height was statistically significant. In addition, we also observed that among the four parameters that we studied in relation to the pituitary gland, pituitary height changed most remarkably with respect to age and sex. This is in partial agreement with the opinion that mid‑sagittal height of the pituitary gland reflects the variation in pituitary morphology more accurately.[2,19,20,21]

Conclusion

The reference values for the normal pituitary gland dimensions that may be taken as reference standard for Indian subjects, which will facilitate assessment and diagnosis in patients with abnormalities in pituitary function. The height of the gland is larger in females than males. In addition, pituitary height showed a significant correlation in both sexes among ages that extended from the second to fifth decade of life. Generally, young adults have larger pituitary gland than older individuals. Hormonally active individuals (puberty / pregnancy) have the largest glands. These plump glands completely fill the pituitary fossa, and have a convex upper border. Whereas elder individuals will have a largely empty pituitary fossa with a deflated and thinned gland, lying in the floor of the sella. These changes of the dimensions of the gland reflect not only the relation of the age and gender to the gland, but also the complex hormonal environment and the activity of the gland. The decline in pituitary dimensions with age may reflect the process of aging and a physiological pituitary atrophy. A future larger study with greater emphasis on patient categorizations such as ethnicity, pregnancy and lactation status would hopefully provide additional evidence to support the results gained from these 156 patients. Also volumetric studies of the pituitary gland with age may yield interesting results in connection with our 2D dimensional results for the pituitary gland size.

References

1. Sahni D, Jit I, Harjeet, Neelam, Bhansali A. Weight and dimensions of the pituitary in north western Indians. Pituitary 2006;9(1):19-26.
2. Ibinaiye PO, Olarinoye-Akorede S, Kajogbola O, Bakari AG. Magnetic Resonance Imaging Determination of Normal Pituitary Gland Dimensions in Zaria, Northwest Nigerian Population. J Clin Imaging Sci 2015;5:29.
3. Tapasvi C, Parmdeep S, Isha T, Anirudh S, Sukhpreet S. Quantitative Determination of Normal Anterior Pituitary Gland Dimensions in North Indian Population by Magnetic Resonance Imaging (MRI) Indian J Basic Appl Med Res 2017;6(2):535-42.
4. KumarDJU. MRVolumetry of Pituitary gland in Indian adults to establish normal reference values. International JAnatRadiolSurg 2017;6(1):36-9.
5. Bozzola M, Adamsbaum C, Biscaldi I, Zecca M, Cisternino M, Genovese E, et al. Role of magnetic resonance imaging in the diagnosis and prognosis of growth hormone deficiency. ClinEndocrinol (Oxf) 1996;45(1):21-6.
6. LoxtonAJ. Comparative morphological study of the pituitary gland by computed tomography and magnetic resonance imaging. S Afr Med J 1988;74(8):406-7.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

7. Muhr C, Bergstrom K, Grimelius L, Larsson SG. A parallel study of the roentgen anatomy of the sellaturcica and the histopathology of the pituitary gland in 205 autopsy specimens. Neuroradiology 1981;21(2):55-65.
8. Forbes K, Karis J, White WL. Imaging of the pituitary gland. Barrow Quarterly 2002;18(3):9-19.
9. Naik D, Prashanth RD, Srinath MG, Kumar AA. Pituitary gland assessment by MRVolumetry in the normal Indian adolescent population. International Journal of Medical Imaging 2015;3(6):105-9.
10. Bughio S, Muhammed A, Mughal AM. Estimation of pituitary gland volume byMRI and its correlation with sex and age. PJR 2017;27(4):304-8.
11. Sinclair J, AvinashKK, Schembri N, Sudarshan T, Guntur P. MRI measurement of normal pituitary size using volumetric imaging in Scottish patients. Curr Trends Clin Med Imaging 2017;1(3).
12. Denk CC, Onderoglu S, Ilgi S, Gurcan F. Height of normal pituitary gland on MRI: differences between age groups and sexes. Okajimas Folia AnatJpn 1999;76(2-3):81-7.
13. Mohieldin AE, Duha AM, MahmoudMZ. Effect of age and gender variation in normal pituitary gland height using magnetic resonance imaging. British Journal of Medicine & Medical Research 2016;18(6):1-8.
14. Ikram MF, Sajjad Z, Shokh I, Omair A. Pituitary height on magnetic resonance imaging observation of age and sex related changes. J Pak Med Assoc 2008;58(5):261-5.
15. Tsunoda A, Okuda O, Sato K. MR height of the pituitary gland as a function of age and sex: especially physiological hypertrophy in adolescence and in climacterium. AJNR Am J Neuroradiol 1997;18(3):551-4.
16. Badawi K, Osman AA, Seddeg Y. Radiological Study of the Normal Pituitary Gland among Sudanese population IOSR Journal of Dental and Medical Sciences 2018;17(1):64-7.
17. Argyropoulou M, Perignon F, Brunelle F, Brauner R, Rappaport R. Height of normal pituitary gland as a function of age evaluated by magnetic resonance imaging in children. PediatrRadiol 1991;21(4):247-9.
18. Suzuki M, Takashima T, Kadoya M, Konishi H, Kameyama T, Yoshikawa J, et al. Height of normal pituitary gland on MR imaging: age and sex differentiation. J Comput Assist Tomogr 1990;14(1):36-9.
19. SharafuddinMJ, Luisiri A, Garibaldi LR, Fulk DL, Klein JB, Gillespie KN, et al. MR imaging diagnosis of central precocious puberty: importance of changes in the shape and size of the pituitary gland. AJR Am J Roentgenol 1994;162(5):1167-73.
20. Hayakawa K, Konishi Y, Matsuda T, Kuriyama M, Konishi K, Yamashita K, et al. Development and aging of brain midline structures: assessment with MR imaging. Radiology 1989;172(1):171-7.
21. Yamamoto A, Oba H, Furui S. Influence of age and sex on signal intensities of the posterior lobe of the pituitary gland on T1-weighted images from 3 T MRI. Jpn J Radiol 2013;31(3):186-91.