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DETERMINATION OF NORMAL PITUITARY GLAND SIZE AND SHAPE IN INDIAN POPULATION IN BOTH GENDERS AND DIFFERENT AGE GROUPS USING MAGNETIC RESONANCE IMAGING

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Abstract

Introduction: The size of the pituitary gland varies in normal subjects according to age, sex, and other conditions. The knowledge of normal range of pituitary gland size is important to enable radiologists to suggest what might be an abnormal pituitary gland. Measurements regarding the normal pituitary gland for various age ranges are helpful in diagnosing pathologies in the pituitary gland.

Aim: To study the shape, size and mean normal volume of pituitary gland in different age groups of both genders of normal subjects with Magnetic Resonance Imaging (MRI) and to produce accurate data for the dimensions of the normal pituitary gland in 605 patients.

Materials and Methods: The study was a cross sectional study carried out in the Department of Radio-diagnosis, SSG Hospital, Vadodara, Gujarat. MRI Brain studies of 605 patients were reviewed which includes 317 males and 288 females, ranging from one year to 80 years of age. Patients with pituitary gland or other endocrine abnormalities were excluded from the study. All MRI images were acquired on GE 1.5Tesla MRI machine using standard head coil. Mid-sagittal T2 weighted image were the pituitary stalk could be seen is selected to study the shape and to measure the Anteroposterior and craniocaudal dimensions and coronal T2 FLAIR image were the pituitary stalk could be identified is selected for measuring transverse dimension. The volume of the Pituitary gland was calculated using the formula volume = Anteroposterior (AP) diameter

x Transverse (TR) diameter x craniocaudal (CC) diameter x 0.52. Statistical calculations were done by Software Open Epi Version 3 for epidemiological age groups.

Results: The observation was divided into eight groups according to the age. Mean height of pituitary gland in female subjects of each age group was greater than that of male subjects in the same group except for age group 51 to 60 years. Height of pituitary gland reached a maximum in the 11 to 20 years of age group in both males and females, after which, there was a decline in the pituitary height in the subsequent age groups. The mean pituitary height in the age group 1-10 years was 4.41±0.80 mm. In the age group 11-20 years, mean pituitary height was 6.46±1.35 mm. In the age group 21-30 years it was 6.21±1.26 mm and in 31-40 years age group it was 6.11±1.10 mm whereas in 41-50 years age group it was 6.10±1.36 mm. In 51-60 years age group it was 5.76±1.25 mm, and in 61-70 years age group it was 5.70±1.22 mm, and in individuals above 70 years of age, mean pituitary height was 5.56±1.23 mm. In all the age groups and in both sexes, the commonest shape was flat which was seen in 56% of people followed by concave shape, seen in 33% and convex shape, seen in 11% people. The mean pituitary volume in the age group 1-10 years was 150±68.40 mm^3 in males and 185±102.36 mm^3 in females and in the age group 11-20 years the mean pituitary volume in males was 355±132 $mm^3$and in females was 398±145 mm^3. In the age group 21-30 years, the mean pituitary volume in males was 364±122 mm^3 and in females was 370±105 mm^3. In the age group 31-40 years, the mean pituitary volume in males was 327±136 mm^3 and in females was 377±121 mm^3. In 41-50 age groups mean pituitary volume in males was 324±156 mm^3 and in females it was 408±147 mm^3. In the age group 51-60 years, mean pituitary volume in males was 393±173 mm^3 and in females it was 361±138 mm^3. In the age group 61-70 years, mean pituitary volume in males was 347±149 mm^3 and in females was 366±179 mm^3.In individuals above 70 years of age the mean pituitary volume in males was 326±162 mm^3 and in females it was 396±136 mm^3.

Conclusion: Normal variations in size and shape of the pituitary gland are necessary to identify the abnormal glands. The size of the pituitary gland needs to be compared with the normal range of height and volume of the pituitary gland in corresponding age and gender groups before labelling it as normal or abnormal. In cases with borderline abnormality in size and shape of the pituitary gland, further evaluation by dynamic contrast study should be carried out to look for pathological lesions**.**

Key Words: Pituitary gland, Magnetic Resonance Imaging, endocrine abnormalities.

INTRODUCTION

The pituitary gland is located within the pituitary fossa of the sphenoid bone. There is a tremendous variation in this area amongst normal individuals, which extends to the sphenoid sinus, the size of sella including depth, the size and shape of the pituitary gland. While most of this can be subjectively differentiated as normal or abnormal in most of the patients, there is a grey area in which the reporting radiologist is faced with a dilemma over whether the pituitary gland is within the normal limits or not, sometimes resulting in unnecessary further investigations. Therefore, defining "normal" more accurately is important to reduce the "grey" zone and prevent unnecessary clinical concern and investigations. This report seeks to provide

normal data on the size, in particular height and volume of normal pituitary gland using magnetic resonance imaging. Morphological changes of the pituitary gland were studied using magnetic resonance imaging which were documented in normal subjects, with emphasis on changes in the height and volume of the pituitary gland in childhood, adolescence, and middle and old age groups.

MATERIAL AND METHODS

This was a cross sectional study done in department of radiodiagnosis at Dr. S.S.G Hospital Vadodara, Gujarat, India. The study included MRI Brain examinations of 605 patients which consists of 317 males and 288 females in different age groups ranging from 1 to 80 years who all have undergone MRI Brain examinations in the department of Radio-diagnosis, SSG Hospital, Vadodara, Gujarat, India within a 1year period extending from MARCH 2018 to FEBURARY 2019 for various reasons. The patients with pituitary gland disorders or with other endocrine abnormalities are not included in the study. Patients with empty sella are excluded and MRI examinations of pregnant individuals and lactating mothers were not considered in the study. All the patients who were included in the study were divided into 8 groups based on the age -1 to 10 years, 11 to 20 years, 21 to 30 years, 31 to 40 years, 41 to 50 years, 51 to 60 years, 61 to 70 years and 70 years above and datas were analysed separately for both genders.

All MRI examinations were done with GE 1.5 Tesla MRI machine with dedicated head coils. Mid sagittal T2 Weighted image in which pituitary infundibulum joining the pituitary gland is selected to measure pituitary gland height-cranio-caudal (CC) diameter and Anterior-Posterior (AP) dimensions [Fig-1] and also to assess the shape of the gland. Coronal T2 FLAIR image where the pituitary infundibulum is seen joining the pituitary gland is selected to measure the width- transverse diameter [Fig-2]. Pituitary gland volume was estimated by using the formula: V=Antero-posterior diameter (AP) X Transverse diameter (TR) X Cranio-caudal diameter (CC) X 0.52 (This factor is obtained from the sphere volume equation coefficient and cubic volume calculation: $(4/3\pi)(r3)/(2r)3 = 3.1416/6 = 0.52$).

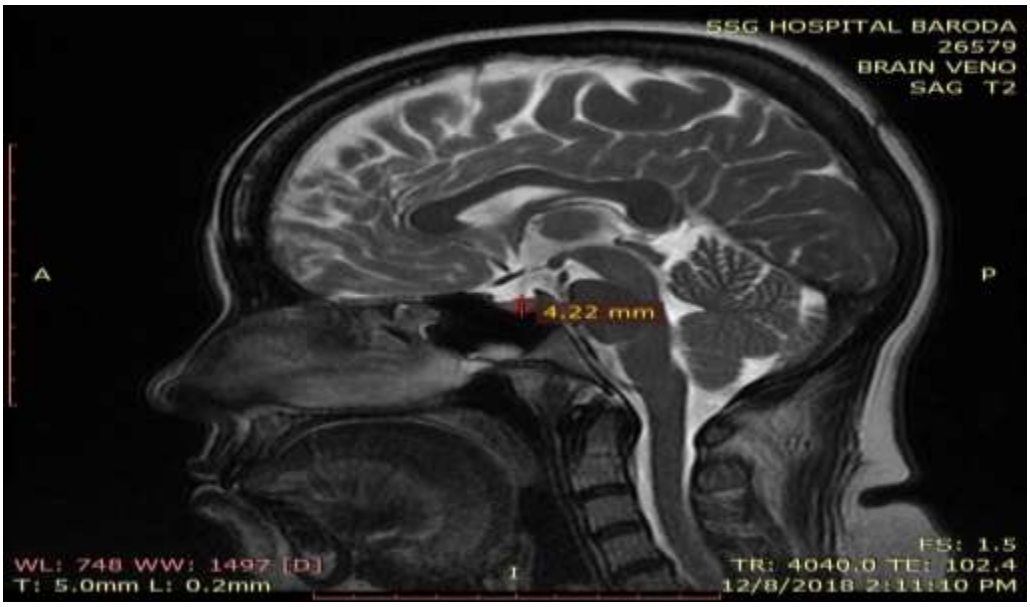

Fig-1: T2W mid sagittal section to measure pituitary height.

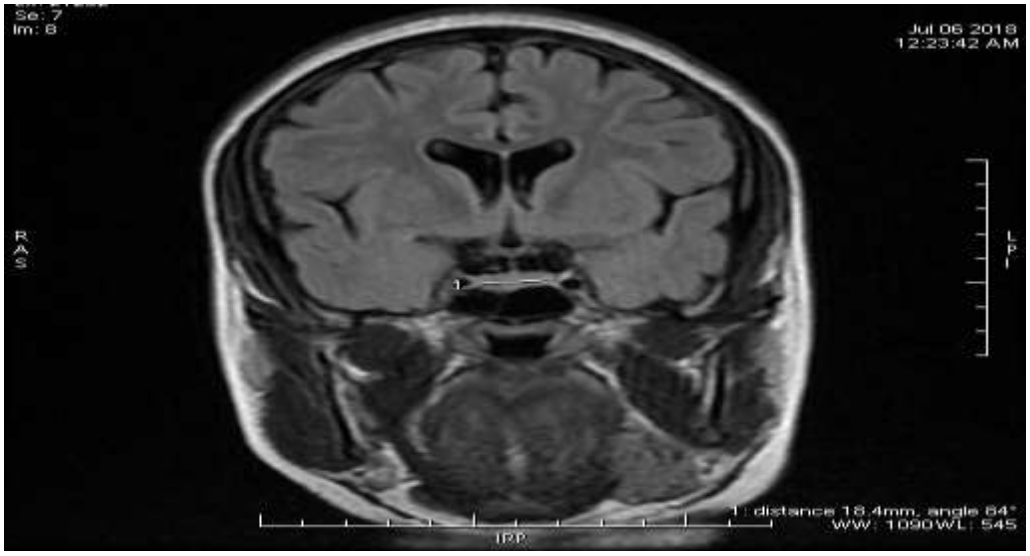

FIG-2 Coronal T2FLAIR image to measure transverse diameter.

- Shape of the Pituitary gland is assessed in the Mid sagittal T2 weighted image. Based on the superior surface of the Pituitary gland it categorized into three groups as Convex, concave and Flat.

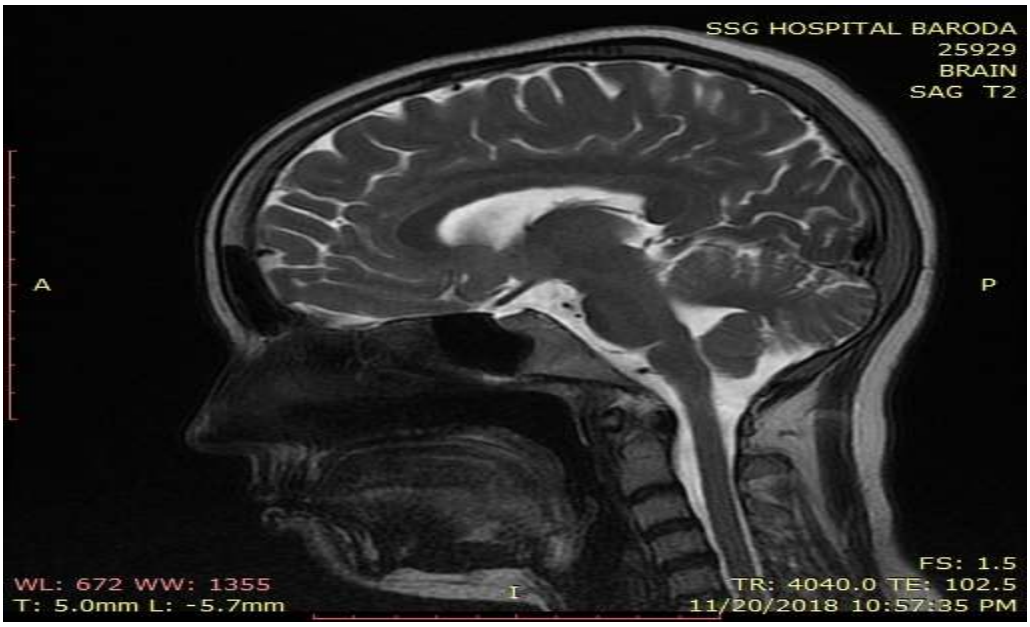

FIG-3 Upper border of pituitary is flat

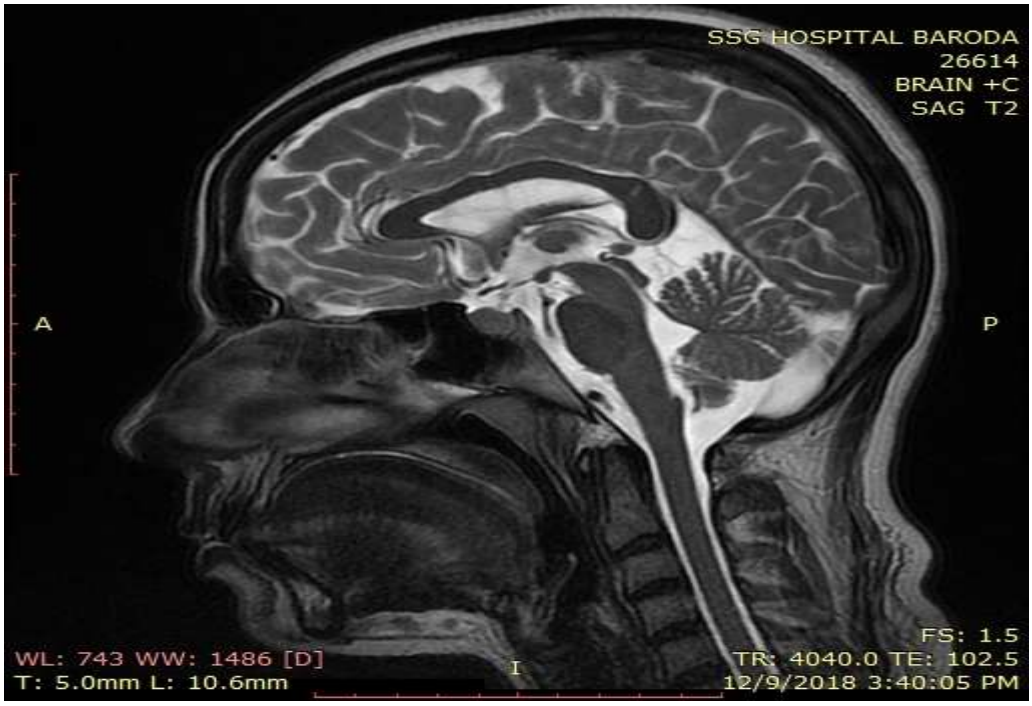

FIG-4 Upper border of pituitary is convex in shape.

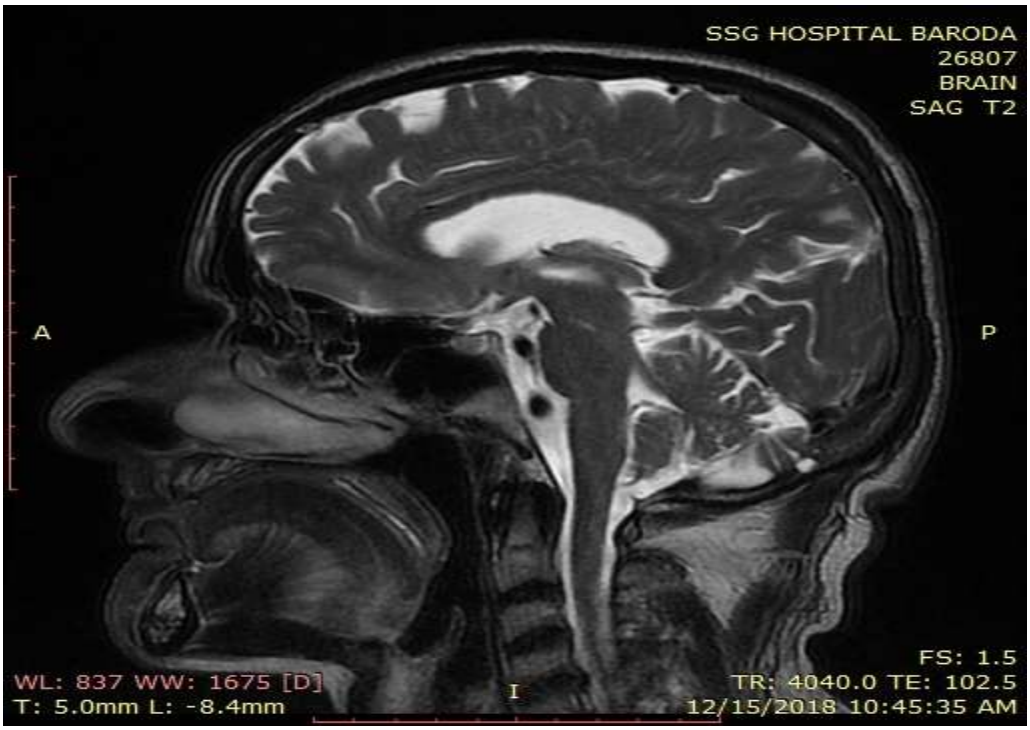

FIG-5: Upper border of pituitary is concave in shape.

STATISTICAL ANALYSIS:

The descriptive statistical analysis in the document involves calculating various statistical measures for the dimensions and volume of the pituitary gland across different age groups and sexes. The analysis includes the calculation of mean, standard deviation (SD), standard error (SE), confidence interval lower (CIL) and upper (CIU) bounds and range for the anteroposterior (AP) diameter, transverse width, craniocaudal height, and volume of the pituitary gland. Separate statistical summaries are provided for the total population, male population, and female population. Additionally, the study categorizes the shape of the pituitary gland into three groups: flat, concave, and convex, with the prevalence of each shape recorded across different demographics.

RESULTS

The mean pituitary height in our study group was 5.92±1.31 mm. The mean pituitary height in the age group 1-10 years was 4.41±0.80 mm and in the age group 11-20 years it was 6.46±1.35 mm while in the age group 21-30 years it was 6.21±1.26 mm and in 31-40 years age group it was 6.11±1.10 mm. In 41-50 years age group it was 6.10±1.36 mm, in 51-60 years group it was 5.76±1.25mm and in 61-70 years group it was 5.70±1.22mm while in the the age group above 70 years the mean pituitary height was 5.56±1.23 mm.

The mean height of pituitary gland in female patients of each age group was greater than that of male patients in the same age group except in the age group of 51-60 years. The height of pituitary gland in both males and females was less in the 1-10 years age group, increasing in puberty and reached maximum in the 11-20 years age group, and declined in 30-50 years and further in old age groups.

Table 1: Sex wise distribution

Sex	No. of Patient	%
Male	317	52.40
Female	288	47.60
Total	605	100

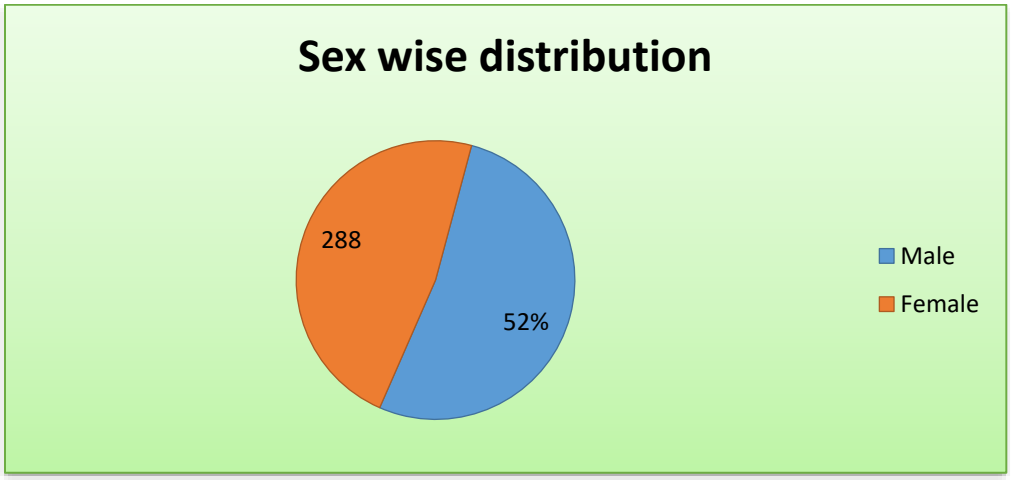

FIG: 6 Sex wise distribution

Table 2: Age wise distribution		
Age Group	No. of Patient	%
1-10 Years	36	5.95
11-20 Years	64	10.58
21-30 Years	101	16.69
31-40 Years	97	16.03
41-50 Years	105	17.36
51-60 Years	68	11.24
61-70 Years	91	15.04
70 Years Above	43	7.11
Total	605	100

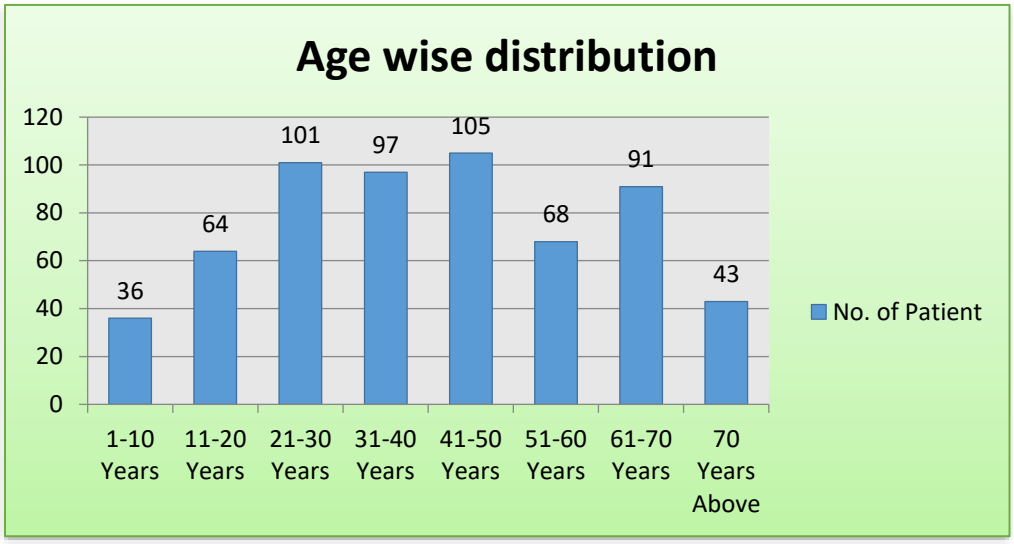

FIG 7: Age Wise Distribution

TABLE 3:TOTAL POPULATION				
Statistical Measures	AP DIAMETER	TRANSVERSE-WIDTH	CRANIOCAUDAL-HEIGHT	Volume
Mean	8.77	12.70	5.92	352.48
S.D.	1.62	3.10	1.31	148.28
S.E.	0.0657	0.1261	0.0532	6.0286
CIL	8.6414	12.4574	5.8180	340.6687
CIU	8.8990	12.9517	6.0268	364.3006
Minimum	1.05	1.00	1.37	21.97
Maximum	12.90	21.10	9.40	1035.74
Range	11.85	20.10	8.03	1013.77

TABLE 4: MALE POPULATION				
Statistical Measures	AP DIAMETER	TRANSVERSE-WIDTH	CRANIOCAUDAL-HEIGHT	Volume
Mean	8.63	12.49	5.80	336.16
S.D.	1.58	3.35	1.28	150.26
S.E.	0.0888	0.1883	0.0721	8.4394
CIL	8.4560	12.1215	5.6601	319.6171
CIU	8.8042	12.8597	5.9428	352.6991
Minimum	3.90	1.00	1.60	21.97
Maximum	12.90	21.10	9.30	1035.74
Range	9.00	20.10	7.70	1013.77

TABLE 5: FEMALE POPULATION				
Statistical Measures	AP DIAMETER	TRANSVERSE-WIDTH	CRANIOCAUDAL-HEIGHT	Volume
Mean	8.92	12.94	6.06	370.46
S.D.	1.64	2.79	1.33	144.21
S.E.	0.0968	0.1642	0.0782	8.4978
CIL	8.7346	12.6182	5.9023	353.7998
CIU	9.1142	13.2619	6.2087	387.1106
Minimum	1.05	1.30	1.37	23.88
Maximum	12.80	19.50	9.40	1035.74
Range	11.75	18.20	8.03	1011.86

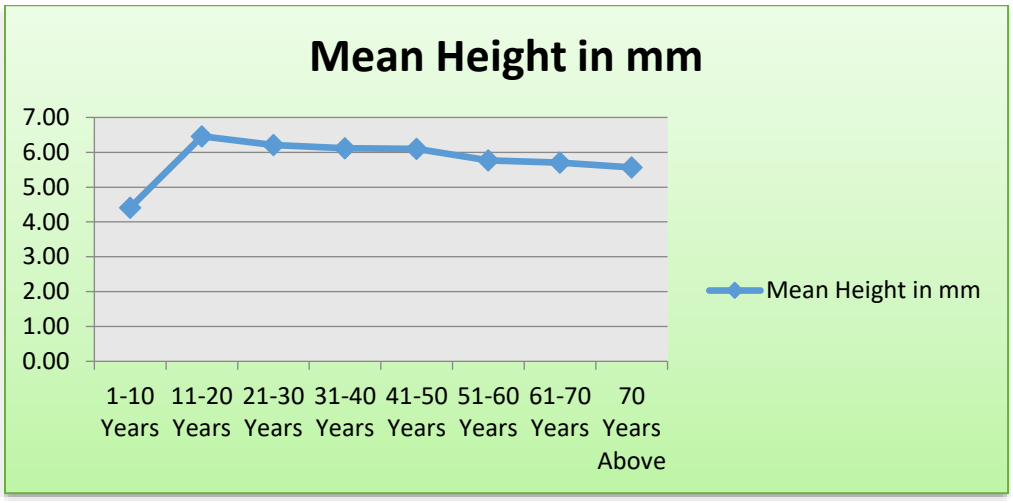

FIG 8: Mean height in mm

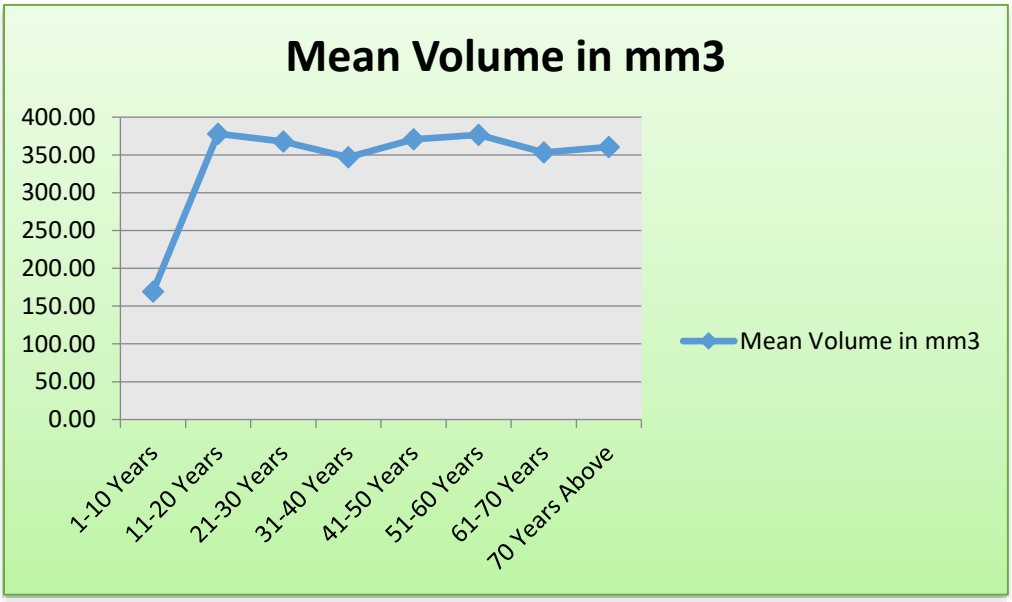

FIG 9: Mean volume in mm^3

In all the age groups and both the sexes, the most common shape was flat which was seen in 56% of people (n=337) concave shape was seen in 33% (n=200) and convex shape was seen in (n=68) 11.24%.

Table 6: Shape wise distribution		
Shape	No. of Patient	%
Plane	337	55.70
Convex	68	11.24
Concave	200	33.06
Total	605	100

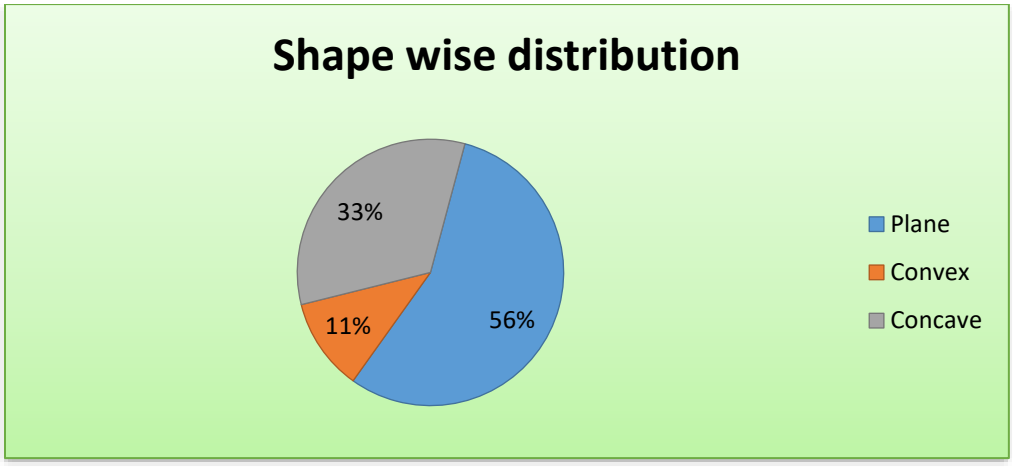

FIG 10: Shape wise distribution

DISCUSSION

One of the common examinations performed in radiology department is an MRI brain examination, in which radiologists meticulously examines the pituitary gland to assess whether it appears normal or not. It is, therefore, necessary to know what constitutes "normal" and when to raise the concern regarding further investigation or label it as abnormal. As far as the purpose of the project is concerned, it was successful in producing concise data about 'normal' pituitary dimensions by sampling a large number of 'healthy' population using the latest MRI techniques, purporting to be more accurate.

One key issue with all scientific research is that of reproducible results, and this study is no different. With regards to accurate measurements of the pituitary gland, the slightest error may constitute to a gross over or under calculation of gland dimensions. The difficulty in the accuracy and consistency of measurement techniques was better understood when measuring pituitary glands where the superior aspect was concave in shape. Alternative techniques gave grossly different measurements of height of the pituitary gland with one difference of the same gland noted to be greater than 3mm. For purposes of this study, therefore, only one technique was used to measure the gland dimensions as mentioned in the materials and methods section for purposes of scientific consistency. This further underlines the potential need for a radiological standard in the measurement of pituitary gland size. The limitation was, of course, an unavoidable limitation to this study.

CONCLUSION

The pituitary size can be accurately determined with the help of MRI and should be correlated with the age and sex of the patient for further correlation. During puberty, there is an increase in size in the pituitary gland, after which it completely fills the pituitary fossa and there is decline in size in the old age due to physiological atrophy. In cases with borderline abnormality in size and shape of the pituitary gland, MRI dynamic contrast study should be done to evaluate for any pathological lesions.

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