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# Morphometric parameters of the human pineal gland in relation to age, body weight and height

Janusz Golan, Kamil Torres, Grzegorz J. Staśkiewicz, Grzegorz Opielak, Ryszard Maciejewski

*Department of Human Anatomy, Medical University of Lublin, Poland*

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*The aim of the study was to compare the size, weight, volume and density of the pineal gland in several groups divided by age, body weight and height. 80 human pineal glands were included in the study. Obtained data were statistically analysed by means of Statistica by Statsoft to check existing differences. Obtained data show some significant differences between pineal gland morphometry in weight- and height-related groups. However, these differences do not influence pineal volume significantly. Differences between the pineal gland volume in the maximal and in the minimal weight groups may suggest some relationship between the gland's structure and body weight. No age-related changes in the morphometry of the pineal gland were observed.*

**key words: pineal gland, morphometric parameters**

## INTRODUCTION

From ancient times many scientists (e.g. Galen, Avicenna) have examined the pineal gland. Descartes in his studies located the human soul in this structure [6, 12]. Nowadays, the number of papers concerning the pineal gland is increasing [7]. The gland through its hormone — melatonin [11] — influences many functions of the human organism, like circadian rhythm [3], mood, psychiatric disorders [8, 14], sexual maturation, reproduction [5, 9] and aging [2, 10]. Scientific reports prove that the relation between the gland's function and many systemic disorders is significant. Obesity, hypertension [10] and sudden infant death syndrome [13] are examples of this. Structures like the adrenal cortex [1] are also functionally connected with the pineal gland. Few works concerning the relationship between the gland's morphometrical change, age and development index in humans can be found. The aim of the study was to evaluate these relations using the material available at the Department of Pathomorphology of the Medical University of Lublin.

## MATERIAL AND METHODS

The study was carried out on a group of 80 human cadavers (aged 16 to 76, mean 40.81 ± 13.98; 45 male and 35 female). Donors did not suffer from any chronic disease. The material was fixed in formalin. Age, weight and height were taken during autopsies. After preparation pineal glands were measured and weighted in a standard way. Volume was calculated according to the Hasegawa et al. [2] method. In individual groups mean and standard deviation were used to describe obtained results. Levene's test was used to check the variance homogeneity. Using the Shapiro-Wilk test, normal distribution in groups was examined. In individual groups normal value distribution was stated. T-Student and Cochrane-Cox tests were used to compare the significance of differences between groups.

Address for correspondence: Ryszard Maciejewski, Department of Human Anatomy, Medical University, ul. Spokojna 1, 20–074 Lublin, Poland, tel: +48 81 532 21 18

## RESULTS AND DISCUSSION

Tables 1 and 2 present values obtained in groups related to age. The lowest average length of pineal gland was observed in the group of 41–50 years. The highest was found in the group of 31–40 years. The lowest mean width was observed in the group of 31–40 years. In the group of under 30 years the mean was the highest. Minimal gland thickness was observed in the group of 41–50 years. Maximal mean value appeared in the group of 31–40 years. In the group of 31–40 years the average volume of the pineal gland was the lowest. The highest mean volume was observed in the 31–50 years group. The lowest mean weight was observed in the group of 31–50 years. In the under 30 years group the mean was the highest. The lowest average density of the pineal gland was observed in the group of 31–40 years. The highest mean value appeared in the group of over 50 years. No significant differences between the means in groups were observed.

Tables 3 and 4 present values related to body weight. The lowest average length was observed in the group of 71–80 kg. The highest mean was found in the group of over 60 kg. Values differ significantly between themselves. The lowest mean width was observed in the over 80 kg group. In the group of over 60 kg the highest mean was observed. Minimal gland thickness was observed in the group of over 80 kg. Maximal mean thickness appeared in the 61––70 kg group. The average volume of the pineal gland was the lowest in the group of over 80 kg. The highest mean volume was observed in the under 60 kg group. The weight of the gland was the lowest in the over 80 kg group. The highest mean appeared in the group of less than 60 kg. The group of over 80 kg had the lowest density values. The highest mean was found in the group of under 60 kg.

Values in groups related to height are presented in Tables 5 and 6. The lowest mean length was observed in the group of 171–175 cm. In the group of under 165 cm the mean was the highest. In the group of 171–175 cm the average pineal width was the lowest. It was significantly different from the means of the group of less than 165 cm and of the group of 166–170 cm. The highest mean was observed in the 165–170 cm group and it was also different from the total mean value. In the group of under 165 cm the mean pineal gland thickness was the lowest. The highest mean appeared in the 165–170 cm group. The group of 171–175 cm showed the lowest average gland weight. In the group of 165–170 cm the

**Table 1.** Pineal gland length, width and thickness mean values in age-related groups

| Age [years] | n | Length [mm] | | Width [mm] | | Thickness [mm] | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| < 30 | 22 | 7.54 | 1.47 | 7.12 | 1.47 | 4.39 | 0.92 |
| 31–40 | 19 | 8.21 | 1.54 | 6.37 | 0.84 | 5.61 | 1.39 |
| 41–50 | 21 | 7.26 | 1.01 | 7.05 | 0.93 | 4.01 | 0.83 |
| > 50 | 18 | 7.92 | 1.43 | 6.78 | 0.85 | 4.26 | 0.98 |

**Table 2.** Pineal gland volume, weight and density mean values in age-related groups

| Age [years] | n | Volume [mm$^3$] | | Weight [g] | | Density [mg/mm$^3$] | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| < 30 | 22 | 131.47 | 41.42 | 0.17 | 0.06 | 1.27 | 0.45 |
| 31–40 | 19 | 158.34 | 43.17 | 0.14 | 0.03 | 1.11 | 0.23 |
| 41–50 | 21 | 109.90 | 37.50 | 0.14 | 0.04 | 1.20 | 0.22 |
| > 50 | 18 | 124.07 | 39.79 | 0.16 | 0.06 | 1.39 | 0.39 |

**Table 3.** Pineal gland length, width and thickness mean values in bodyweight-related groups. The difference of means marked with the same upper index is statistically significant ($p \leq 0.05$)

| Body weight [kg] | n | Length [mm] | | Width [mm] | | Thickness [mm] | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| < 60 | 17 | 8.50 [1] | 1.63 | 7.25 | 0.66 | 4.01 | 0.79 |
| 61–70 | 23 | 7.68 | 1.04 | 7.04 | 1.05 | 4.34 | 0.83 |
| 71–80 | 24 | 7.26 [1] | 1.38 | 6.67 | 0.96 | 4.32 | 0.93 |
| > 80 | 16 | 7.66 | 1.46 | 6.61 | 0.73 | 3.86 | 0.80 |

**Table 4.** Pineal gland volume, weight and density mean values in bodyweight-related groups

| Body weight [kg] | n | Volume [mm$^3$] | | Weight [g] | | Density [mg/mm$^3$] | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| < 60 | 17 | 140.08 | 49.63 | 0.17 | 0.02 | 1.26 | 0.41 |
| 61–70 | 23 | 130.79 | 63.97 | 0.15 | 0.04 | 1.27 | 0.23 |
| 71–80 | 24 | 114.26 | 47.09 | 0.14 | 0.05 | 1.30 | 0.42 |
| > 80 | 16 | 105.67 | 39.48 | 0.13 | 0.05 | 1.14 | 0.15 |

**Table 5.** Pineal gland length, width and thickness mean values in height-related groups. The difference of means marked with the same upper index is statistically significant ($p \leq 0.05$)

| Height | n | Length [mm] | | Width [mm] | | Thickness [mm] | |
|---|---|---|---|---|---|---|---|
| [cm] | | Mean | SD | Mean | SD | Mean | SD |
| < 165 | 23 | 7.99 | 1.47 | 6.98 [1] | 0.77 | 3.93 | 0.78 |
| 165–170 | 19 | 7.69 | 1.35 | 7.56 [2, 3] | 1.51 | 4.54 | 0.96 |
| 171–175 | 18 | 7.10 | 1.51 | 6.28 [1, 2] | 0.92 | 4.09 | 0.98 |
| > 175 | 20 | 7.67 | 0.92 | 6.65 [3] | 0.67 | 4.11 | 0.76 |

**Table 6.** Pineal gland volume, weight and density mean values in height-related groups

| Height | n | Volume [mm$^3$] | | Weight [g] | | Density [mg/mm$^3$] | |
|---|---|---|---|---|---|---|---|
| [cm] | | Mean | SD | Mean | SD | Mean | SD |
| < 165 | 23 | 138.74 | 52.89 | 0.15 | 0.03 | 1.23 | 0.45 |
| 165–170 | 19 | 145.69 | 72.32 | 0.17 | 0.08 | 1.19 | 0.34 |
| 171–175 | 18 | 100.84 | 47.71 | 0.13 | 0.06 | 1.41 | 0.41 |
| > 175 | 20 | 111.18 | 32.71 | 0.15 | 0.03 | 1.20 | 0.23 |

mean was the highest and it was significantly different from the 161–165 cm group's mean value. The lowest mean volume was observed in the group of 171–175 cm. In the 165–170 cm group the mean was the highest. Minimal gland density was observed in the group of 165–170 cm. Maximal mean value appeared in the 171–175 cm group.

Obtained data show some significant differences between pineal gland morphometry in weight- and height-related groups. However, these differences do not influence pineal volume significantly.

Differences between the pineal gland volume in the maximal and in the minimal weight groups may suggest some relationship between the gland's structure and body weight. The possible mechanism of such an effect might be explained by the correlation between the pineal volume and the grade of pineal cyst formation observed by Hasegawa et al. [2].

No significant age-related changes of the pineal gland morphometry were observed. We found no aging involution, which was observed by Legait et al. [4]. This may be caused by a lack of donors with hepatic cirrhosis in our material, who represent a marked involution of the gland.

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