

# ASSESSMENT OF PERSONAL PROPORTIONS OF SCHOOL-AGE CHILDREN TASHKENT CITY IN RELATION TO THE «GOLDEN SECTION»

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## Abstract

In recent decades, work has been carried out in various fields of science, in which the question of the «golden cross-section,» which is one of the geometric principles of proportional harmony, is considered. «Golden section» is such a proportional harmonic division of a segment into unequal parts, in which the entire segment (AC) relates to the larger part (AB) as the larger part (AB) relates to the smaller part (BC) or, conversely, the smaller segment (BC) relates to the larger (AB) as the larger (AB) relates to the entire segment (AC), i.e.,  $AC/AB = AB/BC = 1.618$  or  $BC/AB = AB/AC = 1.618$ . Arithmetically, the proportion of the «golden cross-section» is expressed as 1:1.618 and the value of the «golden cross-section» is conventionally denoted by the letter  $\phi$  [6, 8]. According to a number of authors, the face plays an important role in people's social life and is the object of research not only for artists, anthropologists, ethnologists, educators, and psychologists, but also for medical professionals, as proportions and symmetry play a role in harmonizing not only the human body but also the size and shape of the face [2, 5, 9]. Considering facial proportions is of great importance in the practice of every doctor and, especially, a dentist, as one of the main reasons for seeking a dentist is the desire to improve the aesthetics of teeth and face [1, 2, 3, 4, 7, 10]. A.I. Postolaki's (2015) scientific article is devoted to reviewing 35 literary sources on this topic and is aimed at broader coverage and disclosure of basic aesthetic concepts to achieve the most objective assessment of facial harmony and smile; this article indicates that in recent years, there has been a special need for methods for analyzing facial structure that allow not only to study the position and size of teeth and jaw bones but also to assess facial harmony [8].

Based on the above, the purpose of this study was to assess the proportions of the facial section of the head in relation to the «golden section» ( $\phi=1.618$ ).

**Materials and methods of research.** The total number of examined children was 2257 people, of which 1120 were boys and 1137 were girls of Uzbek nationality - native of Tashkent city. **B** each age and sex group included from 99 to 127 children.

When the head is positioned in the Frankfurt plane, the main dimensions of the facial part of the head were studied: the full morphological and physiognomic height of the face using an electronic caliper (200 mm) with measurement accuracy up to 0.01 mm. **The full morphological height of the face** was measured between the nasion and gnathion points (**n-gn**), the physiognomic height of the face - between the trichion and gnathion points (**tr-gn**). To characterize facial proportions, an indicator was used, calculated as the ratio of facial height to its **morphological height (tr-gn/n-gn)**. Then, the deviations of the obtained numerical values

of the tr-gn/n-gn ratio from the number 1.618 were calculated. Due to the fact that the difference values (tr-gn/n-gn - 1.618) were both positive and negative, the difference result was indicated by the modulus by multiplying the numerical values with the sign - by - 1. As a result, all the obtained values were positive, which significantly facilitated the comparative analysis, which was guided by the principle: the smaller the deviation of the obtained measurements of facial proportions from the number 1.618 is, the more the anatomical structure of the human face corresponds to the principle of «golden section» [2].

**Results and their discussion.** The average values of the studied cephalometric parameters of the face of school-age children and the results of the calculated tr-gn/n-gn coefficients are presented in Table 1.

The physiognomic height of the face in 7-year-old boys averaged 15.64±0.09 cm, at 17 years - 18.20±0.15 cm. The total increase in the parameter tr-gn over the school-age period was at the level of 2.56 cm or 16.37%, with an increase of an average of 0.26 cm per year. In 7-year-old girls, the physiognomic height of the face was 15.16±0.14 cm, which increased by 2.20 cm or 14.51% during school years, reaching 17.36±0.17 cm by 17 years; the average increase was 0.22 cm per year. Intensive growth of facial physiognomic height in boys was noted at 7-8 years (0.54 cm) and from 9 to 16 years (1.91 cm). In girls, the maximum values of this parameter growth were determined from 7 to 14 years (1.99 cm). Meanwhile, in the age periods 8-9 and 16-17 years - in boys and from 14 to 17 years - in girls, the increase in the parameter tr-gn was insignificant and amounted to only 0.06-0.08 cm per year. In all age groups, the physiognomic height parameters of the face in boys were higher than in girls, and at 7, 8, 10, 12, 15, 16, and 17 years of age, the difference was significant (P<0.05-0.001).

Table 1

Average values of morphological and physiognomic heights of children's faces from 7 to 17 years old, Tashkent city

Age, years	Physical height face (tr-gn), cm		Morphological height faces (n-gn), cm		Coefficient (tr-gn/n-gn)		M-1,618
	M	±m	M	±m	M	±m	
boys							
7.	15.64	0.09	9.87	0.06	1.586	0.01	-0.03
8.	16.18	0.14	10.13	0.09	1.598	0.01	-0.02
9.	16.26	0.13	10.23	0.12	1,600	0.01	-0.02
10.	16.51	0.14	10.49	0.12	1,580	0.01	-0.04
11.	16.66	0.16	10.71	0.12	1.560	0.01	-0.06
12.	16.94	0.11	10.82	0.10	1,572	0.01	-0.05
13.	17.17	0.14	10.93	0.06	1.571	0.01	-0.05
14.	17.49	0.14	11.56	0.10	1.526	0.01	-0.09
15.	17.90	0.15	11.66	0.07	1.534	0.01	-0.08
16.	18.17	0.15	11.95	0.09	1,522	0.01	-0.10
17.	18.20	0.15	12.06	0.09	1.510	0.01	-0.11
girls							
7.	15.16	0.14	9.86	0.07	1.541	0.01	-0.08
8.	15.77	0.14	10.10	0.09	1.576	0.02	-0.04
9.	15.89	0.15	10.20	0.11	1,564	0.01	-0.05

10.	16.02	0.13	10.42	0.11	1.545	0.01	-0.07
11.	16.23	0.16	10.63	0.12	1.532	0.01	-0.09
12.	16.52	0.14	10.80	0.10	1.535	0.01	-0.08
13.	16.90	0.12	10.84	0.08	1.562	0.01	-0.06
14.	17.15	0.17	11.25	0.10	1.515	0.01	-0.10
15.	17.22	0.16	11.40	0.11	1.512	0.01	-0.11
16.	17.30	0.18	11.73	0.12	1.478	0.01	-0.14
17.	17.36	0.17	11.78	0.12	1.476	0.01	-0.14

Morphological height of the face in boys at 7 years of age was  $9.87 \pm 0.06$  cm, in girls -  $9.86 \pm 0.07$  cm; at 17 years of age -  $12.06 \pm 0.09$  and  $11.78 \pm 0.12$  cm, respectively, in boys and girls. The overall growth of this parameter in male individuals was higher than in their peers (2.19 versus 1.92 cm or 22.19 versus 19.47%). On average over 1 year, the increase in the morphological height of the face in boys was 0.22 cm, and in girls - 0.19 cm. The highest statistically significant increase in the morphological height of the face in boys was noted at 7-8 years (0.26 cm), 9-11 years (0.48 cm), and 13-16 years (1.02 cm). Maximum values of growth of the parameter **n-gn** in girls were observed at 7-12 years (0.94 cm) and at 13-16 years (0.89 cm). It was revealed that in boys of all age groups, the morphological height of the face, as well as the physiognomic height of the face, is higher compared to their peers, but by a significant amount only at the age of 14 years ( $P < 0.05$ ).

It was determined that the average values of the ratio of the physiognomic height of the face to its **morphological height** ( $tr-gn/n-gn$ ), **depending on age, varied from  $1.510 \pm 0.01$  to  $1.600 \pm 0.01$  in boys, while in girls - from  $1.476 \pm 0.01$  to  $1.576 \pm 0.01$ . In all age groups, the average values of the  $tr-gn/n-gn$  ratio values are higher in boys than in girls, but a significant difference was found in the 7, 9-12 and 16-17 age groups ( $P < 0.05-0.01$ ).**

Results of the difference in the magnitude of the ratio of the physiognomic height of the face to its morphological height and the numerical value of the «golden section» ( $tr-gn/n-gn - 1.618$ ) showed that the obtained values were negative in 56.0-96.0% of cases - among boys and 59.4-92.1% - among girls. When comparing the frequency of occurrence of the «golden cross-section» proportion in the facial structure among 2257 examined children, it was found that out of 1120 boys, none of the boys had an absolute coincidence of the numerical value of  $tr-gn/n-gn$  with the number  $\phi = 1.618$ , while out of 1137 girls, the 1st girl was 10 years old and the 1st girl was 14 years old, the values of facial parameters coincided with the «golden cross-section».

As can be seen from Figure 1, the average values of the  $tr-gn/n-gn$  ratio in children, regardless of gender, **below the number 1.618. Minimal deviations of the obtained values ratio of the physiognomic height of the face to its morphological height from the value of the «golden section» in children of both sexes were noted at 8-9 years of age (on average 0.02 units - in boys and 0.04-0.05 units - in girls), and maximal deviations - from 14 to 17 years of age (on average 0.09-0.11 units - in boys and 0.10-0.14 units - in girls). From the presented data, it can be concluded that the anatomical structure of the boy's face largely corresponds to the parameters «golden section», i.e., the proportions of the male face somewhat close to ideal, compared to the proportions of the female face.**

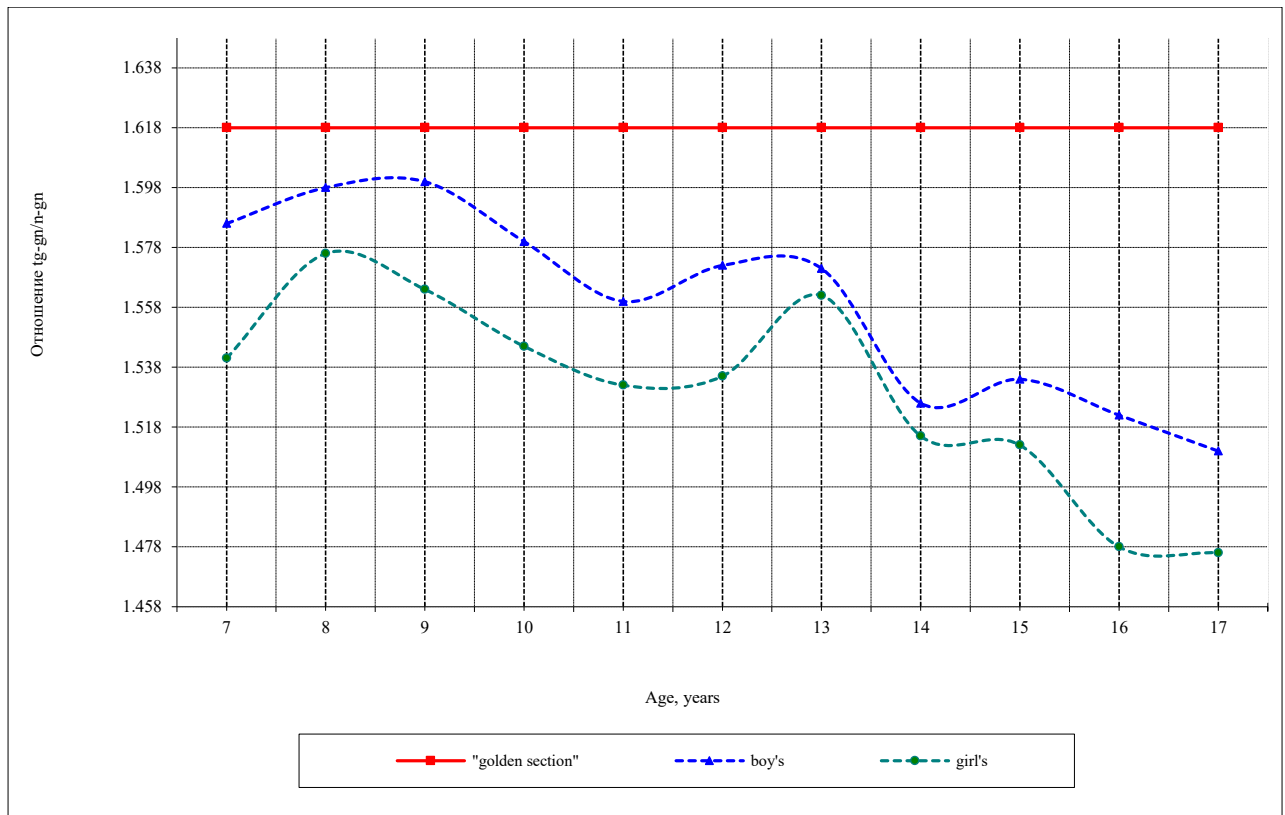


Figure 1. Deviations of the values of the ratio physiognomic **height of the face to its morphological height from the proportion of the «golden section»** among school-age children of the city of Tashkent

Further, the work revealed deviations of the numerical values of the **tr-gn/n-gn ratio from the «golden section» parameter** among boys and girls, divided into 3 age groups: 7-10, 11-14 and 15-17 years. The quantitative distribution of students, depending on the magnitude of the deviation from the number  $\varphi=1.618$  by the module, is presented in Figures 2, 3, and 4. For the quantitative distribution of children, depending on the magnitude of the modulus deviation from the number  $\varphi=1.618$ , 7 groups were formed according to the following intervals: from 0.009 and below; 0.01-0.05; 0.06-0.10; 0.11-0.15; 0.16-0.20; 0.21-0.25 and from 0.26 and above.

As can be seen from Figure 2, the proportions of the faces of younger school-age boys are closer to the «gold cross-section» than the faces of girls, as among them there were a greater number of those entering the interval  $\leq 0.009$  (5.6% versus 6.5%) and the interval equal to 0.01-0.05 (22.6% versus 35.1%). Moreover, the number of boys entering the range from 0.16 and above was 3.2 times less than the number of girls (8.0 versus 25.3%).

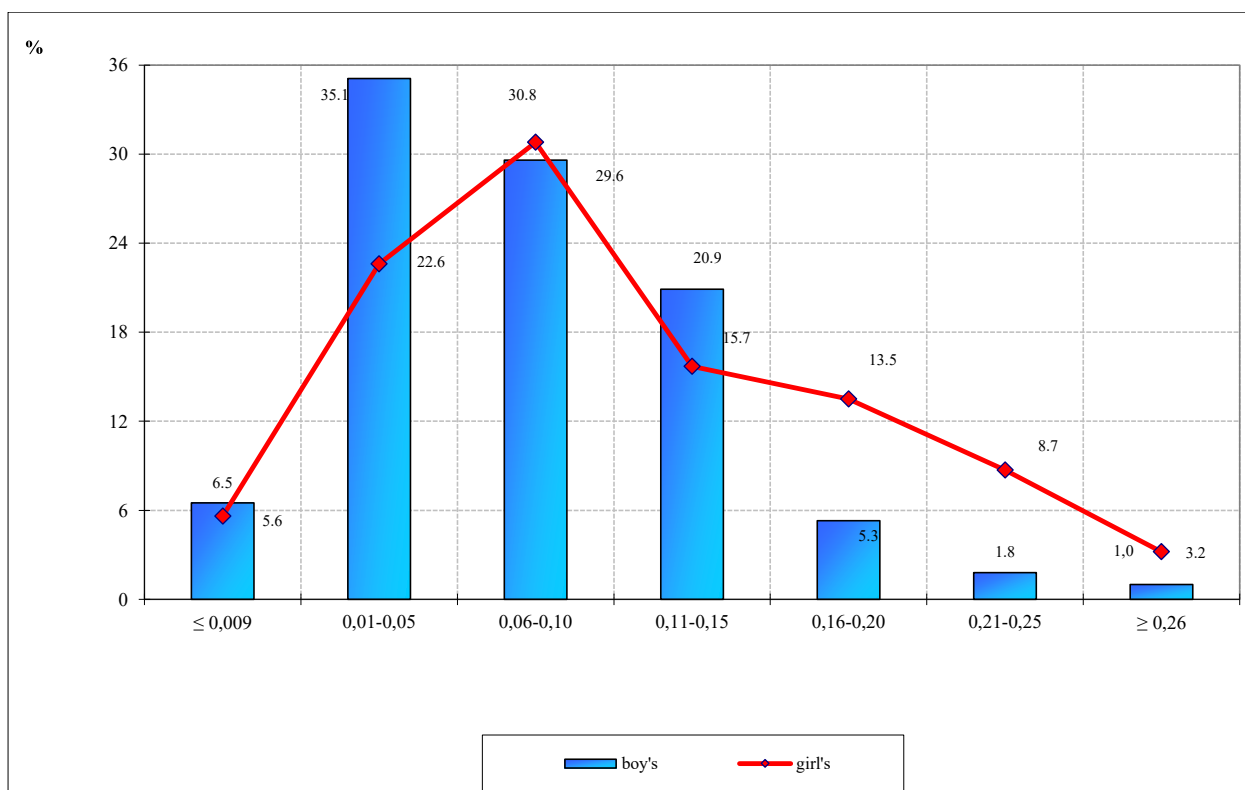


Figure 2. Deviations of the numerical values of the  $\frac{tr-gn}{n-gn}$  ratio from the parameter «golden section» among boys and girls aged 7 to 10 years, %

During the study, it was found that the facial proportions of middle school-aged boys, as well as 7-10-year-old boys, are more closely approximated to the ideal form than the faces of their peers. Thus, if the number of examined boys and girls entering the  $\leq 0.009$  interval practically did not differ (5.3 versus 5.7%), then in the 0.01-0.05 interval, boys entered 1.1 times more than girls (29.2 versus 25.9%), and in the interval from 0.16 and higher - 2.2 times less (12.1 versus 26.9%).

Analysis of the deviation of the numerical values of the  $\frac{tr-gn}{n-gn}$  ratio from the «golden section» parameter among students aged 15 to 17 showed that the proportions of the faces of older boys, as well as boys aged 7-10 and 11-14, are closer to the ideal than the faces of girls. Thus, if the number of examined boys and girls entering the  $\leq 0.009$  interval practically did not differ (2.0 versus 2.3%), then the 0.01-0.05 interval included 2 times more boys than girls (27.4 versus 13.9%), and in the interval from 0.16 and higher - 1.8 times less (21.5 versus 39.6%).

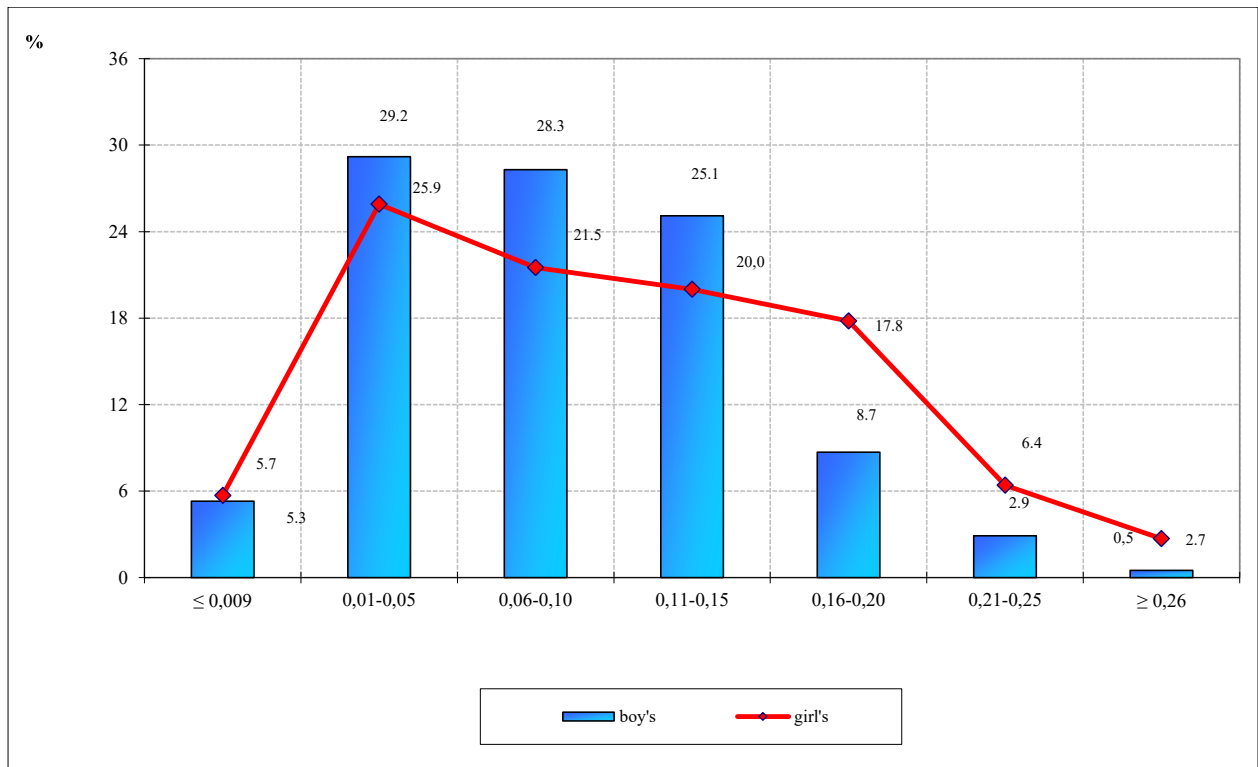
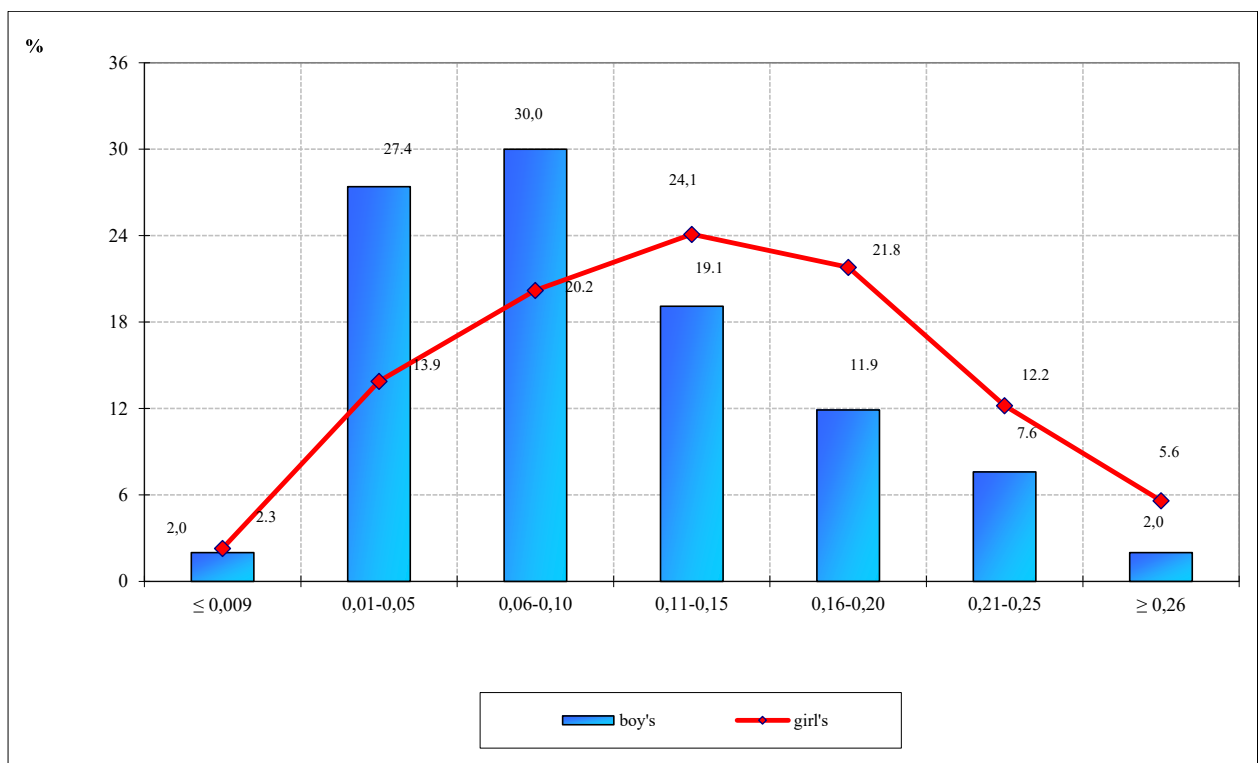


Figure 3. Deviations of the numerical values of the tr-gn/n-gn ratio from the parameter «golden section» among boys and girls aged 11 to 14, %





**Figure 4. Deviations of the numerical values of the tr-gn/n-gn ratio from the parameter «golden section» among boys and girls aged 15 to 17, %**

Due to the fact that the interval of deviation by module from the number «golden section»  $\leq 0.10$  included 71.1% of boys aged 7-10 years, 62.7% - 11-14 years, and 59.4% - 15-17 years, while girls aged 7-10 and 11-14 years were 1.2 times less (59.0 and 53.0%), and 15-17 years - 1.6 times less (36.4%), it can be concluded that facial proportions depend on age: the younger the age group of children, the closer their facial proportions are to the number  $\varphi=1.618$ . The established number of boys entering the  $\leq 0.10$  interval was 1.2-1.6 times higher than girls, which served as a basis for confirming that boys, unlike their female counterparts, have facial proportions closer to the «golden section.»

**Conclusions:**

1. During the school-age period, the total increase in the physiognomic height parameter of the face in children of both sexes is lower than the increase in the morphological height of the face (in boys 22.19 versus 16.37%, in girls - 19.47 versus 14.51%). The age periods of intensive growth of the studied facial indicators in boys and girls do not coincide.
2. In all age groups, average values of physiognomic and morphological height parameters, as well as numerical values of tr-gn/n-gn ratio in boys are higher than in girls.
3. When comparing the frequency of occurrence of the «golden section» proportion in the facial structure among 2257 examined children, it was found that only in 2 girls was the tr-gn/n-gn ratio equal to 1.618 while in the remaining children, the obtained numerical values were less in 78.6% of cases and greater in 21.3% of cases.
4. Analysis of the deviation of the numerical values of tr-gn/n-gn from the «golden section» parameter among students in 7-10, 11-14 and 15-17 years old showed that the proportions of the faces of boys in all 3 age groups are closer to the ideal than the faces of girls, i.e., the anatomical structure of the faces of boys more closely corresponds to the parameters «golden section».

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