

Characteristic of Morphometric Parameters of the Spine Column in Girls and Boys 0-7 Years Old

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Abstract The aim was to study the length parameters of the spinal column in a comparative aspect depending on gender and age in children under 8 years of age. It was found that the parameters of the spinal column in healthy girls and boys aged 0-7 years change abruptly, depending on the period of development of children. In early childhood, there was a rapid growth of the spinal column in girls 0-7 years old than in boys of the same age. The ratios of morphometric indicators of various parts of the spinal column changed with age - in the early period of childhood they were noted in the cervical and lumbar regions, and in the second period of childhood they were more pronounced in the thoracic and sacral regions of the spinal column. It has been proven that the length of the thoracic spine is more than half of the total length of the spinal column. Of all parts of the spinal column, the thoracic part in the first year of life and in subsequent years increased at a high rate, this is due to the development of the organs of the thoracic cavity and their functions.

Keywords Spine, Morphometry, Childhood, Lordosis, Kyphosis

1. Introduction

The human spine is a complexly organized receptacle of the spinal cord, nerve roots, which are responsible for the activity of all organs and muscles of a person [1,4,10].

It should be emphasized that in childhood, the spine not only performs all its inherent functions, but also is in conditions of postnatal development [3,7].

Numerous studies have proven that the spinal column is a biomechanically important, system-forming skeleton link. Its anatomical, physiological and biomechanical properties significantly affect the formation of posture and the state of human health. The spine and related structures play a leading role in maintaining and maintaining an upright posture. This task is related to anti-gravity, i.e. directed against the force of gravity, by the work of each of the elements of the spine [2,4,6,7,9].

In practical vertebrology, the most important is the study of the parameters of the physical development of the body, taking into account the morphometric parameters of the spinal column, which prevents the development of pathology in this area [5,8].

In scientific sources, there are scanty, scattered information about the anthropometric parameters of the spinal column of healthy children, depending on gender and age. The indices of the spinal column in healthy children living in our region remain completely unexplored. Therefore, the development of national standards for

changes in the spinal column depending on the age and gender of children for our region is relevant.

Purpose of the study. Study and assessment of the longitudinal parameters of the spinal column in a comparative aspect depending on gender and age in children under 8 years of age.

2. Materials and Methods

The material for the study was practically healthy children from maternity homes, pupils of kindergartens and schools in the city of Bukhara. In total, 216 girls and 230 boys under the age of 8 (0-7 years) were examined.

All girls were distributed by age as follows: newborns (n = 10); up to 1 year (n = 20); 2-year-olds (n = 20); 3-year-olds (n = 35); 4-year-olds (n = 25); 5-year-olds (n = 32); 6-year-olds (n = 34); 7-year-olds (n = 40).

In terms of age, boys were distributed as follows: newborns - n = 12; up to 1 year - n = 22; 2-year-olds - n = 20; 3-year-olds - n = 40; 4-year-olds - n = 36; 5-year-olds - n = 38; 6-year-olds - n = 28; 7-year-olds - n = 34.

Magnetic resonance imaging (MRI) images were used to measure the height of the spinal column, its parts separately, the height of the intervertebral discs and the longitudinal dimensions of the vertebral foramen.

The size of the spine of the longitudinal and transverse canals was measured on MRI images of the cervical, thoracic, lumbar and sacral regions at the level C3 C4 Th6 Th7 L2 L3 L4 S2 S3 (in mm). The measurement was taken from the anterior edge to the posterior edge of the spinal foramen. Longitudinal dimensions from the tips of the spinous

processes to the bases (in mm) were measured on MRI images. To analyze the parameters of the spinal column, the program "MLV. Ink. Philips".

The data were subjected to statistical processing by traditional methods of variation statistics on a personal computer with a Pentium-IV processor using the Microsoft Office Excel-2003 software package, including the use of built-in statistical processing functions.

3. Results and Discussion

The measurements showed that the total length of the spinal column in newborn children ranged from 21.5 cm to 27.0 cm (on average 24.25 ± 1.2 cm). The length of the cervical spine varied from 2.0 cm to 3.0 cm - on average 2.5 ± 0.3 cm (10.3% of the total length of the spinal column). The length of the thoracic region was in the range of 10.5-14.5 cm - on average 12.5 ± 0.5 cm (51.5% of the total length). The length of the lumbar spine ranged from 4.0 cm to 6.5 cm, on average 5.25 ± 0.4 cm (21.6% of the total length). The length of the sacrococcygeal region varied from 3.5 cm to 6.0 cm - on average 4.75 ± 0.3 cm (1% of the total length of the spinal column).

The longitudinal parameters of the spinal column of girls 1 year old did not change evenly. The total length of the spinal column ranged from 31 cm to 33.5 cm, which averaged 32.25 ± 1.5 cm. The length of the cervical spine varied from 2.5 cm to 3.5 cm - on average 3.0 ± 0.3 cm (9.3% of the total length of the spinal column). The length of the thoracic region ranged from 17.5 cm to 20.5 cm - on average 19.0 ± 0.5 cm (58.9% of the total length). The length of the lumbar spine ranged from 6.0 cm to 8.5 cm - on average 7.25 ± 0.4 cm (22.4% of the total length). The length of the sacrococcygeal region varied from 4.5 cm to 6.0 cm - on average, 5.25 ± 0.3 cm (16.2% of the total length).

In the second year of life of the examined girls, the total length of the spinal column ranged from 36.0 cm to 38.5 cm, averaging 37.25 ± 1.2 cm. The length of the cervical spine varied from 3.0 cm to 3.5 cm, amounting to average 3.25 ± 0.5 cm (8.7% of the total length of the spinal column). The length of the thoracic spine was within 20.5-21.5 cm, on average - 21.0 ± 0.7 cm (56.3% of the total length). The length of the lumbar spine ranged from 6.0 cm to 6.5 cm, averaging 6.25 ± 0.4 cm (16.7% of the total length). The length of the sacrococcygeal region varied from 5.5 cm to 6.2 cm, averaging 5.85 ± 0.3 cm (15.7% of the total length of the spinal column).

The total length of the spinal column of 3-year-old girls ranged from 37 cm to 39.3 cm, averaging 38.15 ± 1.2 cm. The length of the cervical spine varied from 3.5 cm to 4.0 cm, on average 3.75 ± 0.4 cm (9.8% of the total length of the vertebral column). The length of the thoracic region ranged from 21.5 cm to 22.5 cm, on average 22.0 ± 0.5 cm (57.6% of the total length). The length of the lumbar spine ranged from 6.5 cm to 7.8 cm, with an average of 7.15 ± 0.3 cm (18.7% of the total length). The length of the sacrococcygeal region

varied from 5.5 cm to 6.2 cm, averaging 5.85 ± 0.3 cm (15.3% of the total length).

It was revealed that the total length of the spinal column in 4 year old female children ranged from 36.8 cm to 47.8 cm, averaging 42.3 ± 2.42 cm. The length of the cervical spine varied from 3.5 cm to 5.96 cm, on average 4.73 ± 0.28 cm (11.1% of the total length of the vertebral column). The length of the thoracic region ranged from 15.72 cm to 29.9 cm, averaging 22.81 ± 1.14 cm (53.9% of the total length). The length of the lumbar spine ranged from 4.78 cm to 8.58 cm, averaging 6.68 ± 0.34 cm (15.7% of the total length). The length of the sacrococcygeal region varied from 5.32 cm to 9.8 cm, averaging 7.56 ± 0.43 cm (17.87% of the total length).

In the course of the studies, it was revealed that the total length of the spinal column in 5 year old female children ranged from 38.0 cm to 44.8 cm, on average 41.4 ± 2.12 cm. The length of the cervical spine varied from 4.18 cm to 6.2 cm, on average 5.19 ± 0.28 cm (12.5% of the total length of the spinal column). The length of the thoracic region ranged from 14.96 cm to 30.9 cm, on average 22.93 ± 1.14 cm (55.38% of the total length). The length of the lumbar spine ranged from 5.67 cm to 8.79 cm, with an average of 7.23 ± 0.34 cm (17.4% of the total length). The length of the sacrococcygeal region varied from 6.09 cm to 9.8 cm, averaging 7.94 ± 0.43 cm (19.17% of the total length).

Careful measurements of the spinal column showed that in 6 year old girls its length fluctuated between 40.0 cm and 50.1 cm, averaging 45.05 ± 2.64 cm. The length of the cervical spine varied from 6.0 cm to 6.8 cm, averaging 6.4 ± 0.34 cm (14.20% of the total length of the spinal column). The length of the thoracic region ranged from 17.7 cm to 30.8 cm, averaging 24.25 ± 1.53 cm (53.82% of the total length). At the same time, the length of the lumbar spine fluctuated between 7.64 cm and 8.58 cm, averaging 8.11 ± 0.4 cm (18.0% of the total length). The length of the sacrococcygeal region varied from 7.8 cm to 10.2 cm, averaging 9.0 ± 0.54 cm (19.97% of the total length of the spinal column).

The above measurements were also carried out in girls of 7 years of age. The total length of the spinal column in them ranged from 36.29 cm to 56.61 cm, averaging 46.45 ± 2.45 cm. The length of the cervical spine varied from 3.94 cm to 7.58 cm, averaging 5.76 ± 0.4 cm (12.4% of the total length of the spinal column). The length of the thoracic region ranged from 18.87 cm to 29.8 cm, averaging 24.33 ± 1.53 cm (52.37% of the total length), and the length of the lumbar region ranged from 6.2 cm to 9.2 cm, averaging 7.7 ± 0.54 cm (16.5% of the total length). The length of the sacrococcygeal region varied from 6.76 cm to 10.6 cm, averaging 8.68 ± 0.4 cm (18.68% of the total length of the spinal column).

Comparing the growth rates of the morphometric parameters of the spinal column of girls from newborn to 8 years of age, we found that the highest rate of increase in the length of the spinal column is observed in 1 and 2 years of

life, and the smallest at 3 and 7 years.

The morphometric parameters of the spinal column in the examined girls 0-7 years old are summarized in table 1.

From this table, one can judge the longitudinal parameters of the spinal region in a comparative aspect with the increase in the age of the girls studied.

An analysis of the results obtained by measuring the spinal column shows that the length of the thoracic spine is more than half of its total length. Of all the departments, the thoracic part of the spinal column in the 1st year of life and in subsequent years (at 7 years of age inclusive) increases at a

high rate.

This is apparently associated with the growth and development of the organs of the chest cavity and their functions, depending on the age of the studied female children.

We found that the rate of growth of the cervical spine up to 2 years of age was relatively slow. We argue that this is due to the function of vertical retention of the girls' heads, which are supported by the cervical vertebrae. It should be noted that at this age cervical lordosis begins to form.

Table 1. Morphometric parameters of the spinal column in girls under 7 years old

Age	total length	Cervical length	Thoracic length	Lumbar length	The length of the sacrococcygeal region
Newborn	24,25±1,20	2,5±0,30	12,5±0,5	5,25±0,40	4,75±0,3
1 year	32,25±1,5	3,0±0,30	19,0±0,5	7,25±0,40	5,25±0,3
2 year	37,25±1,2	3,25±0,50	21,0±0,7	6,25±0,40	5,85±0,3
3 year	38,15±1,2	3,75±0,40	22,0±0,5	7,15±0,30	5,85±0,3
4 year	42,3±2,42	4,73±0,28	22,81±1,14	6,68±0,34	7,56±0,43
5 year	41,4±2,12	5,19±0,28	22,93±1,14	7,23±0,34	7,94±0,43
6 year	45,05±2,64	6,4±0,34	24,25±1,53	8,11±0,40	9,00±0,54
7 year	46,45±2,45	5,76±0,40	24,33±1,53	7,7±0,54	8,68±0,4

Starting from 2 years of age in girls, the growth rate of the lumbar and sacrococcygeal spine markedly decreased. This was due to the beginning of the girl's direct walking, in which the main load falls on these parts of the spinal column.

In addition, the indicators of the growth rates of the morphometric parameters of the spinal column in girls under 8 years of age were determined in a comparative aspect (Table 2).

It was found that the growth rates of these parameters of the spinal column in girls are not the same depending on age and do not change in the same way. The relationship between the increase in the object under study and the increase in the functional activity of the girls' body was revealed.

Table 2. Indicators of growth rates of morphometric parameters of the spinal column up to 7 years of age in females, in %

Age	total length	Thoracic length	Lumbar length	The length of the sacrococcygeal region
Newborn	10,0	51,4	21,52	17,1
1 year	11,0	51,4	20,56	17,0
2 year	11,4	55,15	14,73	17,98
3 year	11,5	54,45	15,7	18,35
4 year	12,0	54,45	15,8	17,75
5 year	12,0	52,95	16,7	18,35
6 year	12,0	52,95	16,7	18,35
7 year	12,4	52,4	16,5	18,7

It was proved that the growth rate of the spinal column in girls in length at 4-7 years decreased markedly - cervical lordosis was formed, at the age of 6 lumbar lordosis was fully formed, and at the age of 7, girls developed sacral kyphosis.

We carried out practically the same studies in healthy boys of the same age (0-7 years) as the examined healthy girls.

At 1 year of life in boys, the total length of the spinal column ranged from 29.9 cm to 38.4 cm, which averaged 34.15 ± 1.70 cm. The length of the cervical spine varied from 2.14 cm to 4.0 cm, averaging 3.07 ± 0.19 cm (8.9% of the total length of the spinal column). The length of the thoracic region was in the range of 9.44-24.7 cm, averaging 17.07 ± 0.85 cm (49.9% of the total length). The length of the lumbar spine ranged from 5.22 cm to 8.90 cm, which averaged 7.06 ± 0.40 cm (20.6% of the total length). The length of the sacrococcygeal region varied from 3.97 cm to 9.89 cm, on average it was 6.93 ± 0.50 cm (20.3% of the total length). In addition, measurements were made of the spinous processes and the width of the spinal canal. The length of the spinous processes was on average 5.18 ± 0.22 mm, the width of the spinal canal was on average 4.62 ± 0.20 mm.

On the 2nd year of the children of boys' life, the total length of the spinal column ranged from 37.62 cm to 47.5 cm, which averaged 42.56 ± 2.12 cm. The length of the cervical spine varied from 2.94 cm to 6.2 cm, on average 4.57 ± 0.25 cm (10.73% of the total length of the spinal column). At the same time, the length of the thoracic region was within the range of 16.9-28, 8cm, which averaged 22.85 ± 1.25 cm (53.68% of the total length). The length of the lumbar spine ranged from 5.50 cm to 8.30 cm, which averaged 6.9 ± 0.5 cm (16.21% of the total length). The length of the sacrococcygeal region varied from 7.20 cm to 9.52 cm, averaging 8.36 ± 0.50 cm (19.64% of the total length). The curves of the spinal column were measured in the same boys 2 years of age ... The appearance of the cervical bend

(lordosis) is 148.8, the length of the spinous processes is 6.31 ± 0.31 mm, and the width of the vertebral foramen is 5.27 ± 0.26 mm. The appearance of the thoracic bend (kyphosis) is 165.4, the length of the spinous processes is 7.49 ± 0.39 mm, the width of the spinal foramen is 5.49 ± 0.27 mm, in addition, the bend (lordosis) in the lumbar region is 148.8, and the sacral flexure was 151.1.

The total length of the spinal column of 3 year old male children ranged from 39.0 cm to 48.6 cm, on average 43.8 ± 2.32 cm. The length of the cervical spine varied from 4.4 cm to 6.8 cm, averaging 5.6 ± 0.32 cm (12.78% of the total length of the vertebral column). At the same time, the length of the thoracic region ranged from 18.66 cm to 29.9 cm, averaging 24.28 ± 1.39 cm (55.43% of the total length). The length of the lumbar spine ranged from 5.16 cm to 8.58 cm, which averaged 6.87 ± 0.29 cm (15.68% of the total length). The length of the sacrococcygeal region varied from 7.0 cm to 9.8 cm, averaging 8.4 ± 0.43 cm (19.1% of the total length). Measurements of the spinous processes and the width of the spinal canal in 3-year-old boys showed the following results: the length of the spinous processes of the cervical spine was on average 5.5 ± 0.29 mm, and the width of the spinal foramen was 6.01 ± 0.35 mm; the length of the spinous processes of the thoracic region averaged 10.32 ± 0.57 mm, the width of the vertebral foramen 8.02 ± 0.49 mm; the length of the spinous processes of the lumbar spine was on average 10.16 ± 0.53 mm, the width of the spinal foramen 9.76 ± 0.50 mm; the length of the spinous processes of the sacrococcygeal spine was 4.30 ± 0.22 mm, the width of the spinal foramen averaged 4.66 ± 0.23 mm.

It was found that the total length of the spinal column of 4 year old male children ranged from 39.7 cm to 49.1 cm, on average - 44.4 ± 2.45 cm. The length of the cervical spine varied from 4.3 cm to 7.0 cm, on average 5.65 ± 0.33 cm (12.7% of the total length of the spinal column). The length of the thoracic region ranged from 19.1 cm to 29.8 cm, on average - 24.45 ± 1.48 cm (55.0% of the total length). The length of the lumbar spine ranged from 5.37 cm to 8.77 cm, on average 7.07 ± 0.40 cm (15.9% of the total length). The length of the sacrococcygeal region varied from 7.2 cm to 10.2 cm, on average 8.7 ± 0.54 cm (19.5% of the total length).

The total length of the spinal column of 5 year old male children ranged from 40.0 cm to 50.1 cm, which averaged

45.05 ± 2.64 cm. The length of the cervical spine varied from 6.0 cm to 6.8 cm, on average it was 6.4 ± 0.34 cm (14.20% of the total length of the spinal column). The length of the thoracic region ranged from 17.7 cm to 30.8 cm, on average it was equal to 24.25 ± 1.53 cm (53.82% of the total length). The length of the lumbar spine ranged from 7.64 cm to 8.58 cm, averaging 8.11 ± 0.4 cm (18.0% of the total length). The length of the sacrococcygeal region varied from 7.8 cm to 10.2 cm, averaging 9.0 ± 0.54 cm (19.97% of the total length).

The total length of the spinal column in 6 year old male children ranged from 40.0 cm to 50.1 cm, which averaged 45.05 ± 2.64 cm. The sizes of the cervical spine varied from 6.0 cm to 6.8 cm, averaging 6.4 ± 0.34 cm (14.20% of the total length of the spinal column). The dimensions of the thoracic region ranged from 17.7 cm to 30.8 cm, on average they were equal to 24.25 ± 1.53 cm (53.82% of the total length). The length of the lumbar spine ranged from 7.64 cm to 8.58 cm, averaging 8.11 ± 0.4 cm (18.0% of the total length). The length of the sacrococcygeal region varied from 7.8 cm to 10.2 cm, the average size was 9.0 ± 0.54 cm (19.97% of the total length).

Research has shown that the height of 7 year old male children, the total length of the spinal column of 7 year old male children ranged from 40.51 cm to 56.61 cm, averaging 48.56 ± 2.45 cm. The length of the cervical spine ranged from 4.64 cm to 7.58 cm, averaging 6.11 ± 0.4 cm (12.6% of the total length of the spinal column). The dimensions of the thoracic region were in the range of 21.9-29.8 cm, which was on average 25.85 ± 1.53 cm (53.23% of the total length). The length of the lumbar spine ranged from 6.2 cm to 10.2 cm, averaging 8.2 ± 0.54 cm (16.8% of the total length). Meanwhile, the established length of the sacrococcygeal region varied from 7.64 cm to 8.58 cm, averaging 8.11 ± 0.4 cm (16.7% of the total length).

Generalized average data on the morphometric parameters of the spinal column in boys aged 0-7 years are given in Table 3.

According to this table 3 it is possible to judge the changes in the size of the spinal column depending on age. In addition, comparing the given data table 2 and table 4 it is possible to reveal the intergender features of the morphometric parameters of the spinal column in healthy boys and girls, depending on age.

Table 3. Morphometric parameters of the spinal column in boys under 7 years old

Age	total length	Cervical length	Thoracic length	Lumbar length	The length of the sacrococcygeal region
Newborn	23,95 $\pm$ 1,20	2,4 $\pm$ 0,30	12,3 $\pm$ 0,5	6,9 $\pm$ 0,40	4,1 $\pm$ 0,3
1 year	34,15 $\pm$ 1,70	3,07 $\pm$ 0,19	17,07 $\pm$ 0,85	7,06 $\pm$ 0,40	6,93 $\pm$ 0,50
2 year	42,56 $\pm$ 2,12	4,57 $\pm$ 0,25	22,85 $\pm$ 1,25	6,9 $\pm$ 0,5	8,36 $\pm$ 0,50
3 year	43,8 $\pm$ 2,32	5,6 $\pm$ 0,32	24,28 $\pm$ 1,39	6,87 $\pm$ 0,29	8,4 $\pm$ 0,43
4 year	44,4 $\pm$ 2,45	5,65 $\pm$ 0,33	24,45 $\pm$ 1,48	7,07 $\pm$ 0,40	8,7 $\pm$ 0,54
5 year	45,05 $\pm$ 2,64	6,4 $\pm$ 0,34	24,25 $\pm$ 1,53	8,11 $\pm$ 0,4	9,00 $\pm$ 0,54
6 year	45,05 $\pm$ 2,64	6,4 $\pm$ 0,34	24,25 $\pm$ 1,53	8,11 $\pm$ 0,4	9,00 $\pm$ 0,54
7 year	48,56 $\pm$ 2,45	6,11 $\pm$ 0,4	25,85 $\pm$ 1,53	8,2 $\pm$ 0,54	8,11 $\pm$ 0,54

This table 3 allows us to judge the patterns of changes in the sizes of different parts of the spinal column in male children 0-7 years old, which can be determined and comparatively characterized using these growth rates of the parameters of the spinal column.

In addition, we summarized the materials on the identification of the growth rate of the morphometric parameters of the spinal column of boys 0-7 years old, which are given in table 4.

Thus, the data obtained on determining the parameters of physical development and the spinal column in boys 0-7 years old showed that growth in children aged 1-7 years increased by 1.67 times. The highest growth rate was observed at 5 and 7 years old, and the smallest at 4 and 6 years old.

The data obtained by us complement the existing ideas about the age-sex differences of anthropometric indicators, parameters of the spinal column of children in our region.

The results of studying the morphometric parameters of various parts of the spinal column in children expand the knowledge of this problem and make it possible to identify differences between these parameters.

Table 4. Indicators of the growth rates of morphometric parameters of the spinal column up to 7 years of age in males, in %

Age	Cervical length	Thoracic length	Lumbar length	The length of the sacrococcygeal region
Newborn	10,0	51,4	21,5	17,1
1 year	9,0	50,0	20,7	20,3
2 year	10,73	53,60	16,28	19,64
3 year	12,78	55,45	15,74	16,07
4 year	12,7	55,0	15,8	16,4
5 year	12,3	53,9	16,12	17,89
6 year	12,3	53,9	16,12	17,89
7 year	12,6	53,3	16,8	17,3

We were the first to study the anthropometric parameters of various parts of the spinal column of children, which change with age. It was found that in the early period of childhood there were changes in the cervical and lumbar regions, and in the second period of childhood, changes in the thoracic and sacral regions of the spinal column were more pronounced. Regularities in the relationship between growth processes and maturation stages at individual stages of ontogenesis of anthropometric indicators made it possible to identify the features of the epochal acceleration process among children in the Bukhara region.

The obtained research results are recommended to be used in the activities of pediatricians, pediatric traumatologists and orthopedists. In addition, these data can be successfully used in the educational process: when giving lectures and conducting practical classes on the subject of human anatomy (in the section on the study of bones and the spinal column) to students of medical, biological universities, physical development faculties of universities in our country.

On the basis of the conducted studies, the parameters of

the spinal column of healthy children under 8 years of age were studied and evaluated, which are recommended as a national standard for children in our region. In addition, the revealed patterns of growth and development processes at the stages of ontogenesis of the morphometric parameters of the spinal column made it possible to identify the features of the acceleration process of children in the Bukhara region.

4. Conclusions

1. It has been established that the parameters of the spinal column in healthy girls and boys aged 0-7 years change abruptly, depending on the period of development of children. In the early period of childhood, there was a rapid growth of the spinal column in girls 0-7 years old than in boys of the same age.
2. The ratios of morphometric parameters of various parts of the spinal column (cervical, thoracic, lumbar and sacrococcygeal) changed with age - in the early period of childhood they were noted in the cervical and lumbar spine, and in the second period of childhood they were more pronounced in the thoracic and sacral spine.
3. Lordosis of the lumbar spine in newborns is poorly expressed, but cervical lordosis is absent. They become pronounced by 9-12 months and are formed by 6-7 years of age, regardless of the sex of the child.
4. It has been proven that the length of the thoracic spine is more than half of the total length of the spinal column. Of all parts of the spinal column, the thoracic part in the first year of life and in subsequent years (up to 4 years of age) increased at a high rate, this is due to the growth and development of the organs of the thoracic cavity and their functions.

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