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Anthropometric Indicators In Preschool Children Living In A Rural Area Of The Mari El Republic

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ABSTRACT
To characterize the physical development of children and adolescents who belong to different ethnic groups and live in different climatic and geographic and socio-economic conditions, we must use regional standards that are the most informative standards for objective assessment of their health and development. The purpose of the paper is to study particular anthropometric indicators in preschool children living in a rural area of the Mari El Republic in order to determine developmental milestones of the children's physical development in the above-mentioned region of Russia. We conducted a cross-sectional study of somatometric indicators of physical development of children at the age of 2-6, living in a rural area of the Mari El Republic and brought up at a preschool educational institution during the daytime. We assessed the following indicators: standing height, sitting height, body mass, head circumference, and chest circumference in 82 children. When analyzing the obtained data, we used centile tables. We identified that height, as one of the physical development indicators, is at the above-average level in the children group under study, with the examined children's body length growth rate exceeding the generally accepted standards by one year. Body mass corresponds to average values according to the generally accepted scale. Chest circumference indicators are below average standard values in almost all age groups. However, in the backdrop of accelerated body length growth, it does not indicate any disorders in the child's' physical development.
Key words: *anthropometric indicators, centile tables, physical development, preschool children, regional specific features.*

INTRODUCTION
The need for anthropometric studies arises from a great variation of human body dimensions. As a rule, fluctuation limits of dimensions of people in one group go beyond fluctuation limits of dimensions of people in the other group [1, 8, 9]. This is transgressive variation that determines the necessity of quantification. The most important link in the system of monitoring of the younger generation's health is routine monitoring of children's growth and development. Children have the most flexible body. Therefore, it can rapidly change under the influence of various external and internal environmental factors. The study of the dynamics of children's anthropometric indicators allows us to assess the level of their physical development by identifying the changes in the indicators in certain age periods. This is important for health monitoring and detection of possible developmental abnormalities, which can indicate health problems such as malnutrition or over-nutrition, diseases or genetic disorders. Over the last decades, significant overweight and obesity have been observed everywhere in all age and gender groups, which is a consequence of behavioral factors related to improper nutrition and low physical activity. This circumstance is one of the leading risk factors in the development of cardiovascular diseases [2, 14, 15, 21, 22]. Early detection of physical development problems allows us to take necessary measures such as dietary intervention, physical rehabilitation or medical intervention, which can considerably improve the quality of the child's life.
Moreover, knowledge about physical development in different age groups helps develop programs aimed at improving children's health and physical activity, and it also helps adapt educational methods.
The study of physical development indicators in different age groups allows us to identify the influence of social, economic and cultural factors on children's health, which can help develop social programs and policies.
Comparative analysis: The study of anthropometric indicators of physical development in different regions and age groups allows us to perform a comparative analysis, which can help identify trends and problems requiring consideration at the level of public health.

In general, anthropometric methods are of great importance in applied anthropology. The use of regional modified regression scales, an integrated scheme and centile tables, i.e. methodologies for assessing physical development using regional standards is informative for characterizing the physical development of children's teams belonging to different ethnic groups and living in different climatic and geographic and socio-economic conditions [5]. Therefore, the study of characteristics of children's physical development in different regions of Russia has become very important [7, 12, 24].
The purpose of the paper was to study main anthropometric characteristics in preschool children living in a rural area of the Mari El Republic to develop and draw up regional standards of children's physical development.

MATERIALS AND METHODS

This study was conducted at the municipal educational institution for preschool children in the Novye Paraty village in the Mari El Republic in 2017-2020.
The studies were conducted in accordance with WHO recommendations for studying the growth and development of children [16, 26]. We assessed the dynamics of change in the main anthropometric indicators (standing height, sitting height, body mass, chest circumference, head circumference) in preschool children. Children's anthropometric indicators were assessed using centile tables. In these tables, values, that are characteristic of the half of healthy children of this gender and age – in the interval from the 25^{th} to the 75^{th} centile, are taken as average or relatively normal values. According to the instructional guidelines "Assessment of Physical Development of Children and Adolescents" of the Ministry of Health of the Russian Federation of November 21, 2017 [6], we identified the people with abnormalities in growth rate and nutrition consequences by comparison with standards provided for children at the age of 0-5 and reference values for senior age groups, specifically, for children at the age of 6-6.5.
Throughout the entire period of our work, we examined 82 children at the age of 2-6. We identified four age groups, and we additionally divided the children into boys and girls in each group. Each group included from 20 to 22 children. They were examined in September, December, and March in the first half of the day as body length decreases by 1-2 cm in connection with fallen arches, flattened intervertebral cartilages, and low muscle tone, and body mass increases almost by 1 kg on average [10] by the end of the day.
In our study, we used the anthropometric research method that is rather standardized and provides for body measurements with standard instruments.
The factual evidence obtained during the study was processed by method of variation statistics using Student's t-test. The differences were considered statistically significant at the level of $p<0.05$. Descriptive data on quantitative indicators is presented as average and standard deviation (M±SD); the mean difference and its 95% confidence interval are specified. When processing the obtained data, we used a statistical software package Statistica 13 PL (StatSoft, USA).

RESULTS AND DISCUSSION

The assessment of children's anthropometric indicators was based on the measurement of its main anthropometric data parameters changing as children get older. Height and body mass are considered the leading parameters reflecting the younger generation's physical development.
Children's height in different regions can vary significantly due to the influence of genetic, environmental and social factors. For example, studies show that in some countries the height difference among children can reach 20 cm, which indicates the importance of regional specific features in growth dynamics. Genetics definitely plays a key role in determining children's height, accounting for 60-80% of general influence on this indicator. Different ethnic groups have their own genetic predispositions, which can explain the height differences between the regions. Living conditions, including access to nutrition, medical care and sanitary conditions, also influence height growth. Of great importance are socio-economic conditions in which the child grows, such as the level of education and income of their parents, which can influence the health and nutrition of children, which, in its turn, affects their height.
Table 1 provides the indicators of the body length (standing height and sitting height) in children of

different age. Height is the most stable indicator and serves as a necessary criterion for correct assessment of some other attributes. The study results showed that almost all the indicators of the body length in the children living in this area according to the centile tables are within 75-90 centiles, which corresponds to the above-average level of physical development. In general, we can see the most active body length increase in children at the age of 4-5 when this parameter increases by 3 cm on a quarterly basis. Consequently, body length in the examined children increases one year before generally accepted standards. The gender differences were found only in September in 3-year-old children and 6-year-old children when the boys turned out to be taller than their female peers by 3-3.5 cm.

Sitting height indicators increase more evenly, and from the age of 2.5 and until the age of 4, the boys' indicators exceed the similar parameters in their female peers by 1.5 cm (Table.1) on average in a statistically reliable way.

Table 1 - Height indicators (cm, M±m) in the children living in a rural area of the Mari El Republic

Age	Month of the study	Standing height		Sitting height	
		girls	boys	girls	boys
2-3	September	90.01± 0.55	89.21 ±0.33	51.65± 0.48	52.55± 0.28
	December	92.40± 0.57[2]	92,50 ±0,36[2]	52.60± 0.45	54.04± 0.32[1,2]
	March	93.60± 0.61	93.91 ±0.37[2]	53.27± 0.31	54.54± 0.36[1,2]
3-4	September	95.22± 0.63	98.71 ±0.76[1,2]	53.32± 0.21	55.00 ±0.41[1]
	December	97.51± 0.57[2]	99.25 ±0.71	53.67± 0.25	55.08± 0.35[1]
	March	99.60 ±0.62[2]	100,55± 0,68	54.13± 0.20	55.91± 0.38[1]
4-5	September	105.92± 0.60[2]	106,90± 0.67[2]	56.53 ±0.47[2]	56.21± 0.33
	December	108.01± 0.61[2]	109,60± 0,68[2]	56.86± 0.37	57.50± 0.32[2]
	March	110.70± 0.73[2]	11,23 ±0,74[2]	57.75± 0.48	58.06± 0.43
5-6	September	112.80± 0.53[2]	114,25± 0,87[2]	58.31± 0.56	59.04± 0.48
	December	113.61± 0.51	116,90±0,65[1,2]	59.00± 0.64	60.04± 0.43
	March	115.30± 0.41[2]	118.10± 0.60[1]	60.84 ±0.71	62.91± 0.57

Notes: [1]-The significance of differences between the indicators in boys and girls (p≤0.05); [2]-The significance of differences between the indicators in age groups (p≤0.05)

Individual values of body length are related to values of other attributes by correlation dependence, the value of which ranges from 0.3 to 0.8, and in different populations the value of this correlation is not uniform and depends both on genetic peculiarities of the population and habitat conditions [8]. In our study, we established a high correlation relationship between standing height and sitting height in girls in almost all age groups and in 5-6-year-old boys (the correlation factor ranges from 0.90 to 0.97).

Among anthropometric indicators, body mass is the most flexible. This indicator might change under the influence of constitutional characteristics, neuro-endocrine disorders and somatic disorders as well as exogenic reasons (nutrition, regime). The dynamics of changes in body mass indicators in preschool children living in a rural area is presented in Table 2.

Table 2 – Body mass indicators (kg, M±m) in the children living in a rural area of the Mari El Republic

Age	Month of the study	Body mass	
		girls	boys
2-3	September	11.60± 0.32	12.62 ±0.47
	December	11.94± 0.33	13.08 ±0.46[1]
	March	12.43± 0.28	13.15 ±0.49

3-4	September	15.55± 0.58[2]	16.20 ±0.30[2]
	December	15.86± 0.62	16.55 ±0.31
	March	16.10 ±0.57	17.01± 0.39
4-5	September	17.59± 0.36[2]	17.80± 0.31
	December	18.10± 0.38	18.41± 0.29
	March	18.64± 0.31	18.90 ±0.29
5-6	September	19.09± 0.66	20.28± 0.69
	December	19.84± 0.71	21.96±0.84
	March	20.34± 0.53	22.08± 0.86

Notes: [1]-The significance of differences between the indicators in boys and girls (p≤0.05); [2]-The significance of differences between the indicators in age groups (p≤0.05)

According to the given data, there are two periods of the most active body mass increase: the first period is observed in children at the age of 3 (the body mass increased by 3 kg during the period from March to September both in boys and girls) and the second spurt is observed in 5-6-year-old boys). The centile tables show that most body mass indicators in the children living in a rural area of the republic are within 25% centiles, and they are within 25-50% centiles only in some age groups, which corresponds to the average values of physical development.

Numerous studies show that in preschool children a larger proportion is accounted for by the children with body mass excess. The World Health Organization (WHO) considers childhood obesity a serious problem of public health due to its numerous adverse health consequences. In our case, on the contrary, the values are within lower limits [3, 17, 19]. We showed that body mass deficit in children is found much more often than obesity. The causes of the development of body mass deficit in children can be diverse, including genetic characteristics; longtime nutritional deficiency in the diet; various chronic somatic and infectious diseases, etc. In our study, the authors consider that genetic characteristics could be the primary cause.

Head circumference (HC) changes are known to be conditioned mainly by brain mass increase. However, possible rachitic changes in skull bones, that also impact its general configuration, cannot be overlooked. The obtained data on the change in HC indicators in the examined children is presented in Table 3.

Table 3 Indicators of head circumference (HC) and chest circumference (CC) in the children living in a rural area of the Mari El Republic (см, M±m)

Age	Month of the study	HC		CC	
		girls	boys	girls	boys
2-3	September	47.03± 0.45	48.50 ±0,42	47.94± 0.56	48.01 ±0.54
	December	47.50± 0.34	48.95 ±0.41[1]	48.30± 0.63	49.10 ±0.62
	March	47.95± 0.31	49.30 ±0.37[1]	48.50± 0.69	50.20 ±0.68
3-4	September	48.05± 0.35	49.45 ±0.22[1]	49.08± 0.71	51.03 ±0.56[1]
	December	48.50± 0.34	49,80 ±0,21[1]	49.39± 0.52	51.50 ±0.62[1]
	March	48.90 ±0.31[2]	49,96± 0,18[1]	49.94±0.53	51.97± 0.69[1]
4-5	September	49.43± 0.32[2]	50.10± 0.33	51.94± 0.31[2]	52.15± 0.48
	December	50.10± 0.38[2]	50.30± 0.34	52.50± 0.37	52.86± 0.56
	March	50.20± 0.36[2]	50.40 ±0.31	52.96± 0.34	53.04 ±0.69
5-6	September	50.7± 0.33[2]	50.94± 0.34[2]	53.13± 0.42	53.51± 0.35[2]
	December	50.84± 0.26	51.30± 0.41	53.58± 0.39	53.96± 0.38
	March	51.02± 0.31	51.51± 0.38[2]	53.92± 0.37	54.02± 0.34

Notes: [1]-The significance of differences between the indicators in boys and girls (p≤0.05); [2]-The significance of differences between the indicators in age groups (p≤0.05)

We identified some gender differences in HC in the period from 2.5 to 4 years old. During the entire observation period, this parameter in boys exceeded the similar indicators in girls, with the significant difference during the period from 2.5 to 4 years old (the indicators in boys were 1.35 cm higher on average than those in girls of the same age). In general, HC growth is more proportional in boys. In girls, head

circumference increases more intensively during the period from 3 to 5 years old.
Chest circumference is an important indicator reflecting the extent of development of the chest, the muscle system, and the subcutaneous fat layer in the chest that closely correlates with the functional indicators of the respiratory system as well as helps assess the general level of the child's physical development. It can serve not only as an indicator of lung growth and development but also as an indicator of the general state of health.
This parameter can give an idea of the state of the respiratory system. The increase in circumference can indicate good development of lungs, while the decrease can indicate some breath problems or insufficient development.
The comparison of chest circumference with the standards for this age and gender helps detect possible developmental abnormalities. This can be useful for early detection of diseases or developmental impairments.
Physical development indicators in early childhood can predict health in later life. Healthy growth of the chest can be related to the lower risk of development of respiratory diseases and other health problems in the future.
Chest circumference increase can also indicate physical activity of a child, which is important for their general health and development.
According to the given data (Table 3), a quarterly increase in CC in 2-3-year-old boys significantly exceeds the similar indicator in their female peers by 2 cm on average. CC indicators in boys and girls are approximately at the same level only after the age of 4.
Thus, CC indicators in preschool boys increase more evenly, while in girls this parameter undergoes the greatest change at the age of 4-5 (the quarterly increase was 1 cm). While working with the centile tables, we also identified that CC in the examined children is below average values in almost all age groups. But if the children are tall, CC decrease does not always mean weakened shoulder muscles as their support is not subject to substantial reduction.
Low values of body mass can be of genetic nature, whereas body mass deficit and small chest circumference are conditioned more often by unfavorable natural or social conditions of the habitat [11, 23].

CONCLUSION

All the obtained values of anthropometric indicators in preschool children depend on individual characteristics of the body and can indicate physical development pathologies. The value of all the indicators is influenced by biological, socio-economic, lifestyle, and other factors. The hereditary factor plays a vital role in the intensity of the child's growth. The data on children's physical development in some regions at the beginning of the third millennium indicate more favorable conditions (in comparison to the socio-economic sector of the capital) in the region of residence of the children population under study as well as the advantage of influence of biological and medical and genetic factors over social and hygienic factors [18]. At the moment, to assess physical development, we more often use standards and reference values of children's anthropometric indicators in different age groups developed by the World Health Organization. It should be noted that these standards do not reflect the development of children in one or another population, but they are gold standards for how they must develop in favorable conditions with appropriate nutrition and care [24, 25]. The studied anthropometric indicators in preschool children living in a rural area of the Mari El Republic indicate that some physical development parameters have their unique features. In particular, children's height in this age category according to the centile tables is within above-average values, body mass indicators are within 25-50% centiles, and chest circumference is below average values. Conspicuous is the fact that the children in this area are tall, though some authors [4, 5, 13] note lower indicators of this parameter in children living in the village. It is most likely that the obtained results indicate regional specific features, which might be related to the changes in socio-economic and ecological situation and characteristics of the children's lifestyle. At the same time, most of the studied anthropometric indicators have normal values, which can serve as an indicator of physical development harmony, which is the key to good health of children. Thus, the physical development of children must be assessed taking into account not only their age and gender

characteristics but also their region of residence.

The obtained indicators are part of studies for developing and drawing regional standards for children's physical development. According to Skoblina [20], this part of the studies will help solve problems on statistical processing of primary anthropometric data in children to develop standards for children's physical development at a regional level.

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