

## AGE-RELATED DYNAMICS OF ANTHROPOMETRIC INDICATORS AND MORPHOTYPES IN PRESCHOOL CHILDREN

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### **Introduction**

Physical development of preschool children is a crucial indicator of public health and reflects not only biological but also socio-hygienic conditions of the environment. At the early stages of ontogenesis, the basic parameters of the morphofunctional status are established, which later determine the level of adaptation and resilience of the organism.

Modern studies in pediatric morphology emphasize the need for a comprehensive assessment of anthropometric indicators using sigma, centile, and Z-score methods, which make it possible not only to detect deviations from physiological norms but also to establish regional growth and body mass standards. For Uzbekistan, where climate–geographic and social conditions vary regionally, such studies are of particular scientific and practical importance.

### **Materials and Methods**

The study was conducted in preschool educational institutions of Tashkent. A total of 895 clinically healthy children aged 2 to 7 years participated, including 450 boys and 445 girls.

The following anthropometric parameters were measured: body length, body mass, length of upper and lower limbs, chest circumference, arm circumference, and thigh circumference.

All measurements were performed according to the ISAK protocol, in compliance with ethical principles and bioethical standards.

Physical development was assessed using sigma analysis ( $\sigma$ ), centile method, and Z-score evaluation in accordance with WHO standards (2006, 2021). Statistical processing was carried out using SPSS 23.0 and Microsoft Excel, with calculations of mean values ( $M \pm m$ ), standard deviations ( $\sigma$ ), coefficient of variation (CV%), and annual growth rates (G).

### **Results**

It was established that the highest growth rates in preschool children occur between the ages of 2–4 years, corresponding to the phase of intensive somatic and functional development.

During this period, the annual increase in body length averaged 7.2%, and body mass — about 19%, indicating an acceleration of metabolic processes and the formation of a stable motor stereotype.

After 4 years of age, the rate of growth gradually decreases, reflecting a transition to a more stable phase of physical and morphofunctional maturation.

Analysis of body proportions revealed that growth of the lower limbs (+65%) significantly outpaces the increase in upper limb length (+31%), which is associated with a shift in the body's center of gravity, gait development, and the improvement of the musculoskeletal system.

This represents a typical manifestation of heterochrony in morphogenesis, where the growth of individual body segments occurs unevenly but remains harmonized within overall somatic development.

According to the centile analysis, about 50% of the children fell within the 25th–75th centile range, which characterizes them as normosomic and indicates a harmonious ratio of body mass to height.

In 12% of cases, signs of pachysomy (a tendency toward higher body mass at moderate height) were observed, likely associated with differences in physical activity and nutrition.

Meanwhile, 10% of children exhibited leptosomic body types, marked by more pronounced linear growth and relative body mass deficiency, which may reflect increased energy expenditure or specific metabolic traits in early childhood.

The Z-score assessment showed that most children had values within  $\pm 1$  SD, indicating harmonious and physiologically balanced physical development. Children with these parameters demonstrated normal body mass-to-height ratios consistent with WHO international standards (2006; 2021). However, 3% of the children had Z-score values above +2 SD, classifying them as macrosomic. Such deviations may result from genetic factors, endocrine influences (e.g., hyperinsulinism), or excessive nutrition combined with low physical activity in urban settings.

These children require further clinical and anthropological monitoring to prevent metabolic disorders and detect early signs of the metabolic syndrome.

Thus, the obtained results confirm distinct age-related patterns of physical growth and proportional body development in preschool children and highlight the importance of regular anthropometric monitoring using centile and Z-score analysis for early detection of deviations from normal development.

### **Discussion**

The findings demonstrate the consistent nature of age-related morphological changes and confirm the presence of gender differences in body proportions.

Boys tend to have higher linear dimensions (limb length, shoulder width), while girls display more balanced mass distribution and body proportionality.

Application of the centile and sigma methods allowed for an objective assessment of individual deviations from the norm, identification of risk groups, and justification for the establishment of regional physical development standards.

Leptosomy was more common in the younger age groups, likely associated with accelerated skeletal growth and delayed weight gain. Macrosomy, on the other hand, was more frequently observed in the older subgroups and may indicate a trend toward increased body mass due to urbanization and reduced physical activity.

### **Conclusion**

1. In preschool age (2–7 years), a consistent pattern of growth is observed, with a peak of intensity between 2–4 years.

2. Morphological differences between boys and girls are minimal but indicate the onset of sexual dimorphism.

3. The use of centile charts, sigma analysis, and Z-score is an effective tool for assessing harmonious physical development and early detection of deviations.

4. The obtained data can be used to develop national standards of physical development for preschool children and to establish a “health corridor”, representing the physiological norm boundaries for Uzbek children.

**Keywords:** Anthropometry, morphotypes, physical development, preschool children, centile analysis, sigma method, Z-score, growth harmony.

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