Global Insights in Biomedical & Multidisciplinary Research (GIBMR)
Volume 01, Issue 04, June-2026
Available Online at: https://biomedglobe.com/index.php/gibmr
ISSN (Online): 3054-5900

Features Of The Somatic Pool And Dynamics Of Physical Development In Infants And Toddlers Under Various Options Of Nutritional Support

Uralov Shukhrat Mukhtarovich, Associate Professor of the Department of Propaedeutics of Childhood Diseases, Samarkand State Medical University

Article History	Abstract
Received: 28th April, 2026 Accepted: 26th May, 2026	Physical development in infants and toddlers serves as an integral marker of overall health status and is substantially determined by the pattern of infant feeding during the first year of life [1, 2, 6]. This article presents the results of a prospective cohort study investigating anthropometric parameters (body weight, length/height, and body mass index) in infants and toddlers who received exclusive breastfeeding, formula feeding, or mixed feeding [3, 4, 7]. Specific patterns of growth velocity and somatotypic characteristics were identified depending on the type of nutritional support [5, 8, 9]. It is demonstrated that formula feeding is associated with accelerated rates of weight gain and an increased risk of developing overweight in subsequent periods, thereby validating the concept of early metabolic programming [10, 12]. The necessity of personalized monitoring of physical development using WHO growth standards is substantiated [1, 13].

Keywords: infants and toddlers, physical development, breastfeeding, formula feeding, anthropometry, metabolic programming

Introduction. The physical development of an early child is recognized worldwide as a sensitive indicator of the overall well-being of the child population, reflecting both the genetic potential of a macroorganism and the influence of a complex of exogenous factors. The period of the first 1,000 days of life, from the moment of conception to the end of the second year of postnatal life, is recognized as a critical therapeutic window during which epigenetic programming of metabolism, barrier functions, and somatic status occurs. The

Volume 01, Issue 04, June-2026
Available Online at: https://biomedglobe.com/index.php/gibmr
ISSN (Online): 3054-5900

leading regulatory factor in this time interval is the nature and quality of nutritional support.

Natural feeding is recognized as the "gold standard" of pediatric nutrition, providing not only optimal intake of macro- and micronutrients, but also the delivery of bioactive factors (hormones, cytokines, oligosaccharides) that coordinate growth rates. In recent years, the concept of "protein overfeeding hypothesis" has been actively discussed in pediatrics. According to this theory, excessive protein intake, characteristic of formula-fed infants (even with the use of modern adapted milk formulas), stimulates hypersecretion of insulin and insulin-like growth factor-1 (IGF-1). This neurohumoral shift accelerates adipogenesis and proliferation of preadipocytes, leading to higher rates of body weight gain and forming long-term risks of developing obesity and metabolic syndrome in old age.

Despite the existence of WHO international standards (WHO Growth Reference), regional characteristics of the rate of weight and body length gains in children with various types of breastfeeding require continuous monitoring and refinement. Timely detection of abnormalities in somatotyping allows the pediatrician to carry out early nutritional correction and prevent the manifestation of alimentary-dependent pathology.

Materials and methods of research. In the course of a prospective cohort study conducted on the basis of children's outpatient clinics, dynamic monitoring of 150 children was carried out during the first three years of life. All patients were divided into three groups, depending on the predominant nature of nutritional support in the first year of life (during the first 6 months): group I (natural feeding) - 55 children who received exclusively or mainly breast milk; group II (artificial feeding) - 50 children who were breastfed from the first weeks of life with modern adapted milk formulas; group III (mixed feeding) - 45 children in whom the proportion of breast milk and formula was approximately equal.

Criteria for inclusion in the study: full-term children (gestational age 37-42 weeks) from a single, physiologically occurring pregnancy; an Apgar score of at least 7/8 points; the first or second group of health at birth; the presence of informed voluntary consent signed by the parents.

The exclusion criteria included prematurity or intrauterine development delay (IUD) at birth, congenital malformations, hereditary diseases, chromosomal pathology, severe perinatal lesions of the central nervous system, early onset (up to 4 months) of the introduction of dense complementary foods.

Volume 01, Issue 04, June-2026
Available Online at: https://biomedglobe.com/index.php/gibmr
ISSN (Online): 3054-5900

Anthropometric monitoring (measuring body weight with an accuracy of 5 g, body length with an accuracy of 1 mm, head and chest circumferences) was carried out according to the standard method at the prescribed time: at birth, at 3, 6, 9, 12 months, and also at the age of 2 and 3 years. The WHO Anthro software package (v. 3.2.2) was used to standardize the data obtained, objectively evaluate the individual somatotype and calculate Z-criteria (Z-score: Weight-for-age, Length/height-for-age, BMI-for-age).

Statistical data analysis was performed using IBM SPSS Statistics 26.0 and Microsoft Excel 2024 programs. Quantitative variables are represented as M±m. The normality of the distribution was checked using the Shapiro–Wilk criterion. The parametric Student's t-test or the nonparametric Mann-Whitney U–test were used to assess intergroup differences. The qualitative fractions were compared according to Pearson's chi-square ($\chi 2$) criterion. The significance level was determined by Pearson's method, for quantitative ones - the Student's t-test or the Mann–Whitney U-test. The significance level was set at $p<0.05$.

The results and their discussion. The monitoring of the main somatometric parameters revealed pronounced rate differences in the physical development of children, depending on the nature of their feeding. At birth, the average weight (within 3350±240 g) and body length (51.2±1.3 cm) in the three groups were comparable ($p>0.05$). However, starting from the 3rd month of life, statistically significant intergroup parallels manifested themselves.

Table 1.

Dynamics of Z-criteria of body mass index by age (BMI-for-age Z-score) in children with various types of breastfeeding

Monitoring period	Group I (Natural, n=55)	Group II (Artificial, n=50)	Group III (Mixed, N=45)	Significance level (p)
3 months	+0,21±0,08	+0,64±0,11	+0,32±0,09	$p_{I-II} < 0,05$
6 months	+0,12±0,07	+0,89±0,14	+0,41±0,10	$p_{I-II} < 0,01$
12 months	-0,04±0,09	+1,12±0,15	+0,52±0,12	$p_{I-II} < 0,01$
2 years old	-0,01±0,06	+1,24±0,18	+0,58±0,11	$p_{I-II} < 0,01$
3 years old	+0,05±0,08	+1,35±0,21	+0,61±0,13	$p_{I-II} < 0,01$

As can be seen from the presented data, in infants with natural feeding, the dynamics of the BMI Z-score remained stable throughout the entire follow-up period and as close as possible to the WHO median (0). On the contrary, in

children of group II (artificial feeding), there was a progressive shift in indicators to the zone of excess values. By the end of the first year of life, the average Z-score BMI in group II exceeded the critical mark of +1.0 SD, which, according to the WHO classification, is regarded as a "risk of overweight", and this trend continued in the 2nd and 3rd years of life. In group III, they occupied an intermediate position, having no significant differences from the indicators of group I in the first year, but increasing significantly by the age of 3 ($p<0.05$).
An analysis of the structure of extreme anthropometric deviations by the age of 3 years showed that the incidence of excess body weight (Z-score BMI >2.0 SD) in group II was 18.0% (9 children), while in group I this indicator was only 3.6% (2 children; $\chi 2 = 5.94$; $p=0.015$). Such features of growth shifts clearly illustrate the theory of early metabolic programming. The increased rates of weight gain in artificial children are determined by the metabolic stimuli of the protein and carbohydrate components of the adapted mixtures. High levels of circulating insulin and IGF-1 in infants in group II induce early lipid deposition in adipocytes. At the same time, breast milk contains leptin and ghrelin, which regulate appetite at the level of the hypothalamus of the macroorganism, which ensures adequate self-control of satiety in group I children and protects them from nutritional overfeeding.
Conclusion. The results of a prospective study confirm the fundamental role of the nature of nutritional support in the first year of life in programming the somatic status and pace of physical development of young children. The use of standardized WHO Z-criteria has made it possible to establish that exclusively natural feeding provides the most harmonious, evolutionarily determined growth rates, keeping the anthropometric indicators of infants within the population median. On the contrary, artificial feeding with adapted milk formulas is associated with faster growth rates of body mass index by age (BMI-for-age Z-score > +1.0 SD) and a significant increase in the frequency of overweight formation by the age of three (18.0% versus 3.6% with breastfeeding). This pattern confirms the concept of early metabolic programming and the hypothesis of protein overfeeding, requiring timely preventive and monitoring measures from the pediatric service.
Recommendations:
1. It is necessary to actively promote prenatal and postnatal exclusive breastfeeding during the first 6 months of life as an effective and non-invasive

method of reducing the risk of long-term development of obesity, diabetes mellitus and metabolic syndrome.

2. If it is absolutely impossible to maintain lactation, the choice of an adapted milk formula should be based not only on its organoleptic properties, but also on the quantitative protein content. It is advisable to give preference to modern formulas with a reduced level of the protein component (1.2–1.25 g/100 ml), which minimizes the risks of metabolic ovulation and excessive stimulation of the insulin response.

3. Assessment of the physical development of young children should be carried out strictly using the WHO percentile or Z-scales (using the WHO Anthro software), avoiding outdated empirical calculation tables. An increase in the Z-score BMI above +1.0 SD in a child on artificial feeding should be considered by a pediatrician as a marker of the "risk of overweight", requiring an immediate revision of the daily diet, the schedule of administration and the structure of complementary foods (restriction of easily digestible carbohydrates, industrial cereals with added sugar in favor of vegetable purees).

References

1. Baranov, A. A., Namazova-Baranova, L. S., Borovik, T. E., Skvortsova, V. A., Zakharova, I. N., & Netrebenko, O. K. (2021). Nacional'naya programma optimizacii vskarmlivaniya detej pervogo goda zhizni v Rossijskoj Federacii [National program for optimizing the feeding of infants in the Russian Federation]. Pediatric Pharmacology, 18(5), 412–428. doi.org
2. Baird, J., Fisher, D., Lucas, P., Kleijnen, J., Roberts, H., & Law, C. (2005). Being big or growing fast: Systematic review of size and growth in infancy and later obesity. BMJ, 331(7522), Article 929. doi.org
3. Koletzko, B., von Kries, R., Closa, R., Escribano, J., Scaglioni, S., Giovannini, M., ... & European Childhood Obesity Trial Study Group. (2009). Lower protein in infant formula is associated with lower weight up to age 2 y: A randomized clinical trial. The American Journal of Clinical Nutrition, 89(6), 1836–1845. doi.org
4. Lucas, A. (1991). Programming by early nutrition in man. The Childhood Environment and Adult Disease, 156, 38–55. doi.org
5. Netrebenko, O. K. (2018). Mladenicheskij ves i risk ozhireniya: Gipotéza belkovogo okreshivaniya [Infant weight and the risk of obesity: The

protein overfeeding hypothesis]. Voprosy Detskoy Dietologii, 16(2), 48–55. doi.org

6. Rolland-Cachera, M. F., Deheeger, M., Akrout, M., & Bellisle, F. (1995). Influence of macronutrients on adiposity development: A follow-up study of nutrition and growth from 10 months to 8 years of age. International Journal of Obesity, 19(8), 573–578.
7. Shcheplyagina, L. A., & Samokhina, E. A. (2022). Fizicheskoe razvitie detej rannego vozrasta na razlichnyh vidah vskarmlivaniya s ispol'zovaniem programmnyh kompleksov VOZ [Physical development of infants and toddlers on various types of feeding using WHO software systems]. Rossiyskiy Vestnik Perinatologii i Pediatrii, 67(4), 112–119. doi.org
8. Shukhrat, U., Kobilov, E. E., Batirov, H. F., Tukhtaev, M. K., & Agzamov, V. B. (2023, November). Clinical and anamnestic characteristics of children with chronic gastroduodenal pathology. In BIO Web of Conferences (Vol. 76, p. 01014). EDP Sciences.
9. Tounian, P. (2011). Programming of later obesity by early nutritional intake. Annals of Nutrition and Metabolism, 58(Suppl. 2), 12–16. doi.org
10. Tutelyan, V. A., Kon, I. Ya., & Gapparov, M. M. (2019). Detskaya nutriciologiya: Rukovodstvo dlya vrachej [Pediatric nutrition: A guide for physicians]. MIA.
11. World Health Organization. (2006). WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. World Health Organization.
12. World Health Organization. (2014). WHO Anthro (version 3.2.2, January 2011) and macros: Software for assessing growth and development of the world's children. World Health Organization.
13. Zakharova, I. N., Dmitrieva, Yu. A., & Machneva, E. B. (2020). Monitoring fizicheskogo razvitiya detej rannego vozrasta: Z-score kak mezhdunarodnyj instrument ocenki [Monitoring the physical development of infants and toddlers: Z-score as an international assessment tool]. Pediatria. Journal named after G.N. Speransky, 99(2), 142–151. doi.org