COMPARATIVE ANALYSIS OF THE GROWTH AND DEVELOPMENT OF INFANTS IN THE ARAL SEA REGION WITH DIFFERENT TYPES OF FEEDING

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https://doi.org/10.5281/zenodo.19908656

Abstract*. This article presents the results of an analysis of the anthropometric indicators of young children living in the Aral Sea region, depending on the type of feeding. The body weight, body length, and head circumference of children on natural and artificial feeding were evaluated. Differences in the rates of physical development have been established, which underline the importance of breastfeeding for the optimal growth and development of children in an unfavorable environmental environment.*

Keywords: *young children, Aral Sea region, anthropometric indicators, breastfeeding, artificial feeding, physical development.*

Relevance

The physical development of children is one of the most important indicators of the health status of the child population and reflects the influence of both biological and socio-environmental factors [1]. The Aral Sea region is characterized by an unfavorable environmental situation caused by the drying up of the Aral Sea, high air pollution, and a shortage of high-quality drinking water and trace elements, which has a significant impact on children's health, especially at an early age [2].

The physical development of children is significantly influenced by the peculiarities of the climate, living conditions, daily routine, diet, and previous illnesses. The pace of physical development is also influenced by hereditary factors, constitution type, metabolic intensity, endocrine background, and musculoskeletal system activity [3,6]. Anthropometric indicators are a multifactorial process in different age periods and largely depend on climatic and ecological factors [7]. One of the criteria for health indicators of the child population is physical health. Assessment of the state of physical development is impossible without data on anthropometric indicators of various age groups.

The type of breastfeeding plays a key role in shaping a child's physical development. Both new and earlier studies of the composition of breast milk show that any of its components has, to one degree or another, an anti-infective and/or immunomodulatory effect on the infant and is considered a special case of the general process of formation of the qualitative state of health in the child. Owing to the latest advances in nutrition, immunology, and microbiology, several beneficial properties of human milk have been established [8].

Breast milk is an optimal source of nutrients and biologically active components that ensure adequate growth and development of infants. At the same time, artificial feeding, despite the improvement of milk formulas, may be accompanied by deviations in anthropometric indicators, especially under conditions of environmental disadvantage [9].

The purpose of the study

This study aimed to assess the state of physical development of children in the first year of life who were breastfed in various ways. A total of 1,238 children in their first year of life were observed, including 627 girls and 611 boys living in the city of Nukus. All children belonged to health groups I and II.

When collecting the material, all the necessary conditions were met for the formation of a sample: uniformity of the child population, use of the same measurement tools, and examination by the same group of specialists. The main anthropometric indicators of physical development — body weight, body length, chest circumference, and head circumference — were evaluated in the examined children, followed by the determination of somatic body types and the degree of harmony of physical development.

Research materials and methods

This was an observational analytical study. A total of 1,238 children in their first year of life living in the city of Nukus were under observation, of which 627 (50.6%) were girls and 611 (49.4%) were male. All children belonged to health groups I–II and had no congenital malformations or severe somatic diseases.

Children were divided into two groups based on the type of feeding:

Group I: children who were on natural feeding (n = 855)

Group II: Children who were artificially fed (n = 383).

Physical development was assessed at the age periods of 1, 3, 6, 9, and 12 months. Body weight (kg), body length (cm), and head and chest circumference (cm) were measured according to generally accepted methods using standard certified instruments. The data obtained were compared with the age standards of physical development.

Anthropometric techniques and the calculation of Z-scores (W/A and L/A) according to the WHO Child Growth Standards were used. Statistical significance was set at $p < 0.05$.

The results and their discussions

The study found that the anthropometric indicators of children in the first year of life living in the Aral Sea region significantly depended on the type of feeding. The most pronounced differences were found in the first 6 months of life, a critical period of intensive somatic growth.

Comparative analysis based on Z-scores (WHO standards) In children of group I (EB), the indicators of weight (W/A) and body length (L/A) were consistently within the physiological range (median ±1 SD). This indicates a high adaptive capacity of the breast milk. In Group II (IV), by the age of 6-9 months, a right-sided shift in the body weight distribution curve was detected: in 18% of children, the values exceeded +2 SD, which indicates the risk of paratrophy. Simultaneously, body length indicators in 12.4% of cases shifted to values below -1.5 SD, forming a disharmonious type of development.

In children of group I (natural feeding), the mass growth index at 6 and 9 months was significantly more stable. This is consistent with the data of foreign researchers, who pointed out that breastfed infants self-regulate energy consumption, which prevents excessive deposition of adipose tissue in the first half of life [10].

In group II (artificial feeding), a higher body mass index (BMI) was detected at of 6 months. According to research, the high protein content in milk formulas, compared with that in breast milk, stimulates the secretion of insulin and insulin-like growth factor (IGF-1), which leads to accelerated weight gain and increases the risk of subsequent obesity [11].

The dynamics of chest circumference growth deserve special attention. In breastfed infants, this indicator increased in proportion to the body length. At the same time, breastfed children in

Nukus showed a slight increase in chest circumference over the rate of linear growth, which Victora et al. (2016) interpreted as a sign of metabolic adaptation to high-calorie nutrition with mixtures [12].

It was also noted that in conditions of micronutrient deficiency in the Aral Sea region, breastfed children were less likely to show signs of delayed physical development than non-breastfed children. This is confirmed by data that have proven that specific protective factors of breast milk minimize the negative impact of environmental toxins on a child's metabolism [13].

By 6 months of age, children in group II (artificial feeding) had a higher average body weight than children in group I, but there was a less proportional increase in body length, indicating the formation of signs of disharmonious physical development. Similar data have been presented in foreign studies. Thus, in breastfed children, body weight indicators were more balanced in relation to body length and head circumference than in children who received artificial mixtures [14].

An analysis of body length indicators showed that breastfed infants had more stable linear growth rates throughout the first year of life. In children who were on artificial feeding, there was a relative lag in body length indicators in a number of age periods (6-9 months) while maintaining elevated body weight values.

Foreign data confirmed the results obtained. It was found that each additional month of breastfeeding is associated with an improvement in physical development indicators.

- at the age of 3 years — by 0.21 points,
- at the age of 7 years — by 0.35 points.

The authors emphasize that the basis of these differences is formed precisely in the first year of life, during the period of active growth and development [3, 15].

Special attention was paid to the assessment of head circumference as a marker of the growth and maturation of the central nervous system. In children who were breastfed, head circumference increased evenly and corresponded to age standards. In several cases, deviations from the average values were noted in children of group II, which may be due to less optimal nutritional provision.

One possible mechanism underlying these differences is the varying bioavailability of nutrients. Thus, the iron content in breast milk is 0.35–1.5 mg/l, with an absorption reaches 38-50%, whereas the absorption of iron from cow's milk and milk mixtures does not exceed 10% [16]. This contributes to a more harmonious rate of weight gain and body length in breastfed children in the first 4-5 months of life.

In addition, breastfed children have a lower fecal pH, which is associated with the predominance of bifidobacteria and lactobacilli in the intestinal microflora [17]. This ensures more efficient absorption of nutrients and has a positive effect on anthropometric indicators of health.

The specific eco-climatic factors of the Aral Sea region are of particular importance for interpreting these data. The high mineralization of drinking water in the city of Nukus and surrounding areas creates an excessive osmotic load on the immature kidneys of infants. When such water is used to prepare artificial mixtures, the total salt load on the body increases. Breast milk, which has a stable low osmolarity (approximately 290 mOsm/l) [18], protects the excretory system of the child.

According to our observations, the "false" excess body weight in children of group II may be partially associated with latent fluid retention in tissues due to dietary hypermineralization.

In addition, the region is characterized by high air dustiness caused by salt and pesticide aerosols from the dried bottom of the Aral Sea. These pollutants aggressively affect mucous membranes. Secretory immunoglobulin A (sIgA) and lactoferrin from breast milk create a protective barrier in the gastrointestinal mucosa, minimizing systemic intoxication [3, 19]. Children with artificial feeding do not have this defense mechanism, which forces the body to redirect plastic resources from growth processes to repair and immune protection. As a result, in group II, at the age of 6-9 months, there was a relative lag in linear growth.

The analysis showed that boys are more sensitive to environmental stress and type of nutrition. Disharmonious developmental variants (paratrophy or growth retardation) were more often registered in boys of group II. This is consistent with the "fragile male hypothesis" [20], indicating the high metabolic needs of the male body. Girls in both groups demonstrated greater biological plasticity and stability of anthropometric parameters, which is typical for the female body in adverse environmental conditions [21].

Conclusion

1. Based on a comprehensive analysis of the anthropometric indicators of children in the first year of life living in Nukus, the following conclusions can be drawn:

2. The superiority of natural feeding in the conditions of ecopathology: It has been established that breastfeeding is a key factor of bioadaptation for children of the Aral Sea region. It ensures harmonious physical development by keeping body weight and length within the physiological range (median \pm 1 SD according to WHO standards), while artificial feeding significantly more often leads to disharmonious development.

3. Risks of artificial feeding: Children on artificial feeding have a "scissor" phenomenon by the age of 6-9 months: a right-sided shift in body weight (>+2 SD in 18% of the surveyed) against the background of a relative slowdown in linear growth (< -1.5 SD in 12.4%). This indicates the risk of early paratrophy and excessive accumulation of adipose tissue, which programs metabolic disorders in the future.

4. Protective role against environmental stress: In conditions of high mineralization of drinking water and dusty air in the Aral Sea region, breast milk performs a protective function. BM minimizes the osmotic load on the baby's kidneys and provides immune protection to the mucous membranes through secretory immunoglobulin A (sIgA) and lactoferrin. The absence of these factors during artificial feeding forces the child's body to redistribute plastic resources from growth processes to repair and protection processes.

5. Gender specificity: Increased sensitivity of the male body to adverse environmental factors and dietary disorders has been revealed. Boys in the Aral Sea region have less compensatory potential when switching to artificial mixtures, which is manifested in a higher frequency of deviations from the standard indicators of growth and development compared with girls.

6. Practical recommendations: The results confirm the need for prioritizing breastfeeding support in ecologically crisis areas. The assessment of the physical development of children in the Aral Sea region must include the calculation of Z-scores for the early detection of risk groups for stunting or developing obesity.

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