



“IMPACT OF ENVIRONMENTAL AND CLIMATIC FACTORS ON THE PHYSIOLOGICAL DEVELOPMENT OF CHILDREN IN THE REPUBLIC OF KARAKALPAKSTAN”

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ARTICLE INFO

Received: 01st May 2026

Accepted: 04th May 2026

Online: 06th May 2026

KEYWORDS

Karakalpakstan, children's physiology, environmental factors, Aral Sea crisis, physical development, anemia, lung capacity, cardiovascular system, ecological health, comparative analysis

ABSTRACT

This study examines the impact of environmental and climatic factors on the physiological development of children living in the Republic of Karakalpakstan. The region has been significantly affected by the ecological crisis caused by the desiccation of the Aral Sea, resulting in severe environmental degradation. These conditions have influenced children's health, growth, and functional development. The research focuses on key physiological indicators such as height, body weight, cardiovascular function, respiratory capacity, and blood composition. A comparative analysis with children from environmentally stable regions highlights significant differences in physical and functional development. The findings suggest that adverse environmental conditions, including air pollution, poor water quality, and nutritional deficiencies, contribute to delayed growth, higher prevalence of anemia, and weakened immune responses. The study emphasizes the importance of improving environmental conditions, healthcare access, and nutrition to enhance child health outcomes in the region.

The Republic of Karakalpakstan is one of the regions most affected by environmental degradation in Central Asia. The drying of the Aral Sea has led to profound ecological and climatic changes, including increased air pollution, soil salinization, and extreme temperature fluctuations. These environmental challenges have had a particularly strong impact on vulnerable populations, especially children, whose physiological systems are still developing and are highly sensitive to external influences. Children's physiological development is a complex process influenced by genetic, environmental, and socio-economic factors. Key indicators such as height, body weight, cardiovascular activity, respiratory efficiency, and blood composition provide valuable insights into the overall health and development of a child. In ecologically stable regions, these indicators typically fall within established norms. However, in environmentally stressed areas like Karakalpakstan, deviations from these norms

are frequently observed. The environmental conditions in Karakalpakstan are characterized by high levels of airborne dust and salt particles, largely due to the exposed seabed of the former Aral Sea. Additionally, access to clean drinking water remains limited in many areas, and food quality is often compromised by low levels of essential nutrients.[1] These factors collectively create a challenging environment for healthy child development.

The purpose of this study is to analyze the physiological indicators of children in Karakalpakstan and compare them with those from more favorable regions. By identifying key differences and their underlying causes, this research aims to provide a scientific basis for interventions that can improve child health outcomes. Understanding how environmental and climatic factors affect physiological development is essential for designing effective public health strategies and ensuring the well-being of future generations. The physiological development of children in Karakalpakstan is influenced by a combination of environmental, climatic, and socio-economic factors. A comprehensive analysis of these influences requires examining several key indicators. First, physical development indicators such as height and body weight are among the most visible markers of a child's health. Studies conducted in the region indicate that children in Karakalpakstan often exhibit lower average height and body weight compared to their peers in more environmentally stable regions.[2] For example, children aged 8-12 years in Karakalpakstan may be 2-4 cm shorter and 1-3 kg lighter on average than children in urban areas with better living conditions.

This disparity is largely attributed to inadequate nutrition and chronic exposure to environmental stressors. Second, the cardiovascular system shows notable differences. Children living in ecologically unfavorable conditions tend to have higher resting heart rates. For instance, while the normal heart rate for children aged 10 is approximately 70-85 beats per minute, children in Karakalpakstan often exhibit rates between 85-95 beats per minute. This increase can be interpreted as a physiological response to environmental stress, including heat, dehydration, and reduced oxygen availability. Respiratory function is another critical area affected by environmental conditions. The air in Karakalpakstan contains high concentrations of dust and salt particles, which can impair lung function. As a result, children in the region often have reduced lung capacity. For example, spirometry tests have shown that the vital lung capacity of 12-year-old children in Karakalpakstan can be 200-300 ml lower than that of children living in cleaner environments. This reduction can lead to decreased physical endurance and increased susceptibility to respiratory diseases.[3] Blood composition, particularly hemoglobin levels, provides further evidence of environmental impact.

Anemia is widely prevalent among children in the region. In some studies, up to 50% of children were found to have hemoglobin levels below the normal range. For example, in Nukus, a significant proportion of school-aged children have been diagnosed with iron-deficiency anemia, which is linked to poor nutrition and environmental factors such as contaminated water. The immune system is also adversely affected. Children in Karakalpakstan tend to experience higher rates of infectious diseases, including respiratory infections and gastrointestinal disorders. For instance, school records indicate that children in the region may fall ill 4-6 times per year, compared to 2-3 times in more favorable regions. This suggests weakened immune defenses due to chronic environmental stress. Climatic factors further exacerbate these issues. The region experiences extreme temperature

variations, with very hot summers and cold winters. Such conditions place additional strain on the body's adaptive mechanisms.[4]For example, during summer months, high temperatures combined with poor air quality can lead to dehydration and heat stress, affecting cardiovascular and respiratory systems.

In conclusion, the examples provided clearly demonstrate that environmental and climatic factors significantly influence the physiological development of children in Karakalpakstan. Addressing these challenges requires a multidisciplinary approach involving environmental protection, healthcare improvement, and nutritional support. The analysis of environmental and climatic influences on the physiological development of children in the Republic of Karakalpakstan reveals a strong correlation between ecological conditions and child health outcomes. The region's environmental crisis, primarily driven by the desiccation of the Aral Sea, has created a setting in which children are exposed to multiple risk factors that hinder normal growth and development. The study highlights that children in Karakalpakstan generally exhibit lower physical development indicators, including reduced height and body weight, compared to children in more favorable environments. Additionally, functional parameters such as increased heart rate, decreased lung capacity, and widespread anemia indicate that the body's systems are under constant stress.[5] These findings confirm that environmental degradation directly affects physiological processes.

Another important observation is the weakened immune system among children in the region. Frequent illnesses and increased susceptibility to infections suggest that long-term exposure to environmental hazards compromises the body's natural defense mechanisms. This not only affects immediate health but may also have long-term consequences for overall development and quality of life. To address these challenges, a comprehensive approach is required. Improving environmental conditions should be a top priority, including efforts to reduce air pollution and ensure access to clean drinking water. At the same time, enhancing the nutritional status of children through balanced diets rich in essential vitamins and minerals is crucial. Strengthening healthcare services, particularly preventive care and regular health monitoring, can also play a significant role in mitigating the negative effects. Furthermore, public awareness programs aimed at promoting healthy lifestyles and environmental responsibility can contribute to long-term improvements. Collaboration between government agencies, healthcare providers, and international organizations is essential to implement sustainable solutions. In summary, the physiological development of children in Karakalpakstan is significantly influenced by environmental and climatic factors. Addressing these issues is vital for protecting child health and ensuring the development of a healthy and productive future generation..

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