World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-29, December 2023
ISSN: 2749-3644

"INFLUENCE OF GEOGRAPHIC TERRAIN ON LOWER LIMB CIRCUMFERENCE CHANGES IN SCHOOL-AGE CHILDREN."

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Article history:

Received: October 4th 2023
Accepted: November 4th 2023
Published: December 6th 2023

Abstract:

The impact of the environment on the physiology of school-age children, such as varying levels of atmospheric pressure, low oxygen content in the air, and insolation in mountainous regions [3],[11], has a direct effect on the development of children's musculoskeletal system. Studies [1] have demonstrated that hypoxia can influence the balance between bone formation and resorption, leading to a loss of bone mass. Hypoxia can also affect osteoblast production, responsible for bone formation [8]. In particular, hypoxia may reduce the activity of specific genes involved in osteoblast differentiation and proliferation, potentially resulting in decreased bone formation [6].

Keywords: School-age children, mountainous terrain, low atmospheric pressure, low oxygen saturation, thigh circumference.

INTRODUCTION

This study aims to investigate the patterns of the influence of environmental factors (low atmospheric pressure, low oxygen saturation) and physical activity on the dynamics of changes in calf circumference in children residing in mountainous and urban areas. Yang et al., in 2017, observed a reduction in bone mineral density and increased bone resorption under the influence of high-altitude hypoxia. Their research also revealed that the decrease in bone mineral density was more pronounced in certain areas of the body, such as long bones and the spine [9].

Jein et al., in 2012, noted that low atmospheric pressure and low oxygen content in the air may contribute to conditions such as osteoporosis and delayed bone healing [7]. Zwart et al., in 2019, highlighted that individuals exposed to high-altitude hypoxia require more than six months at sea level conditions for bone tissue repair [10].

In conclusion, the influence of physical stress, low atmospheric pressure, and low oxygen saturation in the air on the development of the lower extremities in mountainous regions is currently a relevant topic [4].

MATERIALS AND METHODS

The study included school-age children (from 14 to 18 years old) from 8th to 11th grades of School No. 1 in the village of Yordon, Fergana District, Fergana Region, located in the foothills of southern Uzbekistan. The research was conducted from September to October 2022. A total of 96 children participated in the study, including 49 girls and 47 boys, aged 7 to 18, born from 2004 to 2016. For comparative analysis, children from urban areas were also selected. Anthropometric measurements of children, such as thigh and calf circumference, atmospheric pressure, and oxygen saturation, were taken. The atmospheric pressure in the village of Yordon was measured using a barometer-aneroid BAMM-1 (Figure 1.1), and it ranged from 586 to 560 mm Hg, whereas in Fergana, it reached 708 mm Hg. This indicates reduced atmospheric pressure in the mountains compared to urban areas.

Furthermore, the oxygen concentration in the mountainous region was examined using a device called the CEAH-H-CH4 gas analyzer (Figure 1.2). The readings were 20%, while in the city of Fergana, the oxygen concentration reached 21%. The partial pressure of oxygen in the inhaled air (PO2) was 115 mm Hg in the mountainous area, whereas in Fergana, it reached 140 mm Hg.

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Figure 1.1. **Meteorological Aneroid Barometer BAMM-1.**

Figure 1.2. **Gas Analyzer CEAH-H-CH4.**

Calf circumference (according to V. V. Bunak) is measured in a horizontal plane at the point of maximum development of the calf muscle (Figure 2.1). The position of the subject and the researcher remains the same as when measuring thigh circumference: the subject's legs are shoulder-width apart, and the researcher is positioned to the right of the subject, kneeling on one knee [12,13, 5].

Figure 2.1. Measurement of calf circumference.

RESULTS

The obtained anthropometric measurements of the lower extremities in school-age children were subjected to statistical analysis using specialized software, Excel, and SPSS-23.

Within the context of the study on the physical development of children in different types of terrain, differences in calf circumference measurements were identified during the periods of middle childhood and adolescence. The age range for middle childhood was 8-11 years for girls and 8-12 years for boys, while for the adolescent period, it ranged from 12-15 years for girls and 13-16 years for boys.

It is noteworthy that calf circumference measurements predominated in children living in mountainous areas compared to children from urban areas during middle childhood and adolescence. In the middle childhood period, girls from mountainous areas had a calf circumference that exceeded that of their urban counterparts by 4.5%, and in the adolescent period, this difference increased to 5.06%. Therefore, girls residing in mountainous areas have a greater calf circumference compared to their urban peers[15,16,17,18]. In the middle childhood period, boys from mountainous areas had a calf circumference that exceeded that of their urban counterparts by 7.06%, and in the adolescent period, this difference was

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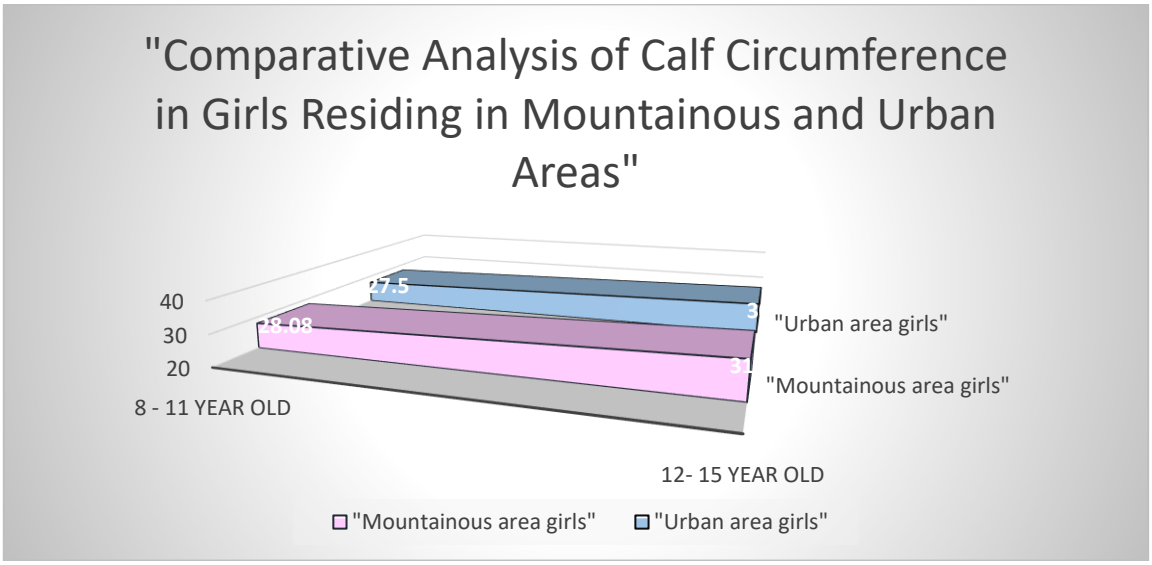
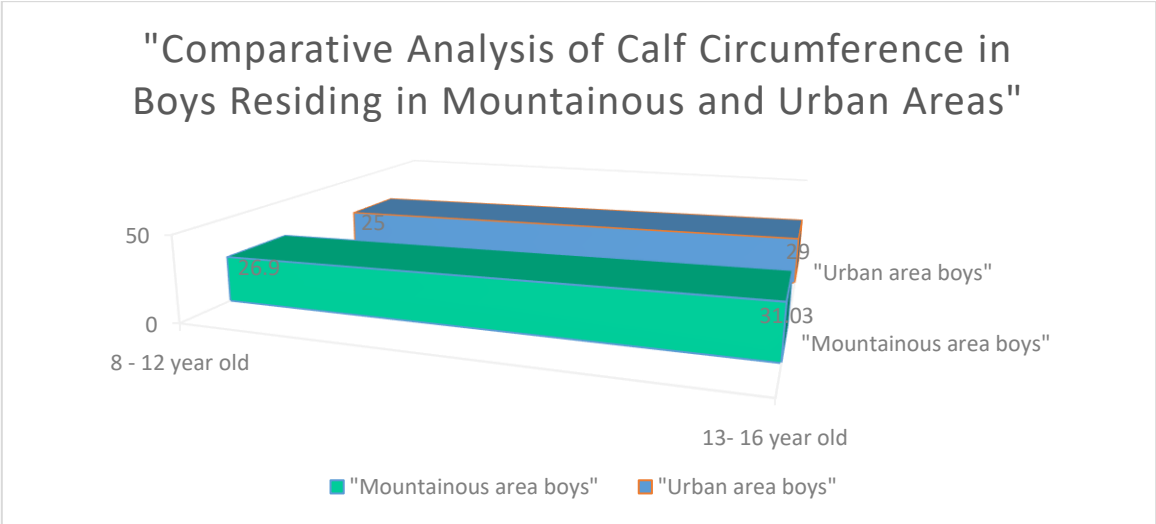
6.5%. The observed differences in calf circumference measurements between children from mountainous and urban areas may be associated with environmental factors, including geographical and climatic characteristics[11,14,19,20]. All data regarding calf circumference measurements of children from mountainous and urban areas are presented in Figures 3.1 and 3.2.



Figures 3.1.



Figures 3.2.

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DISCUSSION: The study's results confirm a connection between the living environment and the physical development of children and adolescents. The identified differences in height between urban and mountainous areas indicate the influence of factors such as quality of life, low atmospheric pressure, low oxygen saturation, and levels of physical activity on growth processes. These findings have practical implications for developing recommendations for healthy child development in different types of terrain.

The results of the study on the physical development of children in different types of terrain reveal differences in calf circumference measurements during middle childhood and adolescence. Children living in mountainous areas have higher calf circumference values compared to their urban counterparts.

An increase in calf circumference is observed in both boys and girls from mountainous areas from middle childhood to adolescence. This may be associated with physical stress on the lower extremities and the climatic characteristics of mountainous regions, such as low atmospheric pressure and low oxygen saturation.

Our research results highlight the influence of the environment on children's physical development, particularly on limb parameters. Geographic and climatic features can affect the growth and development of limbs, such as calf circumference and foot length. Physiological differences between genders may also play a role in the observed differences.

Physical stress on the lower limbs becomes more intense at higher altitudes due to the conditions of movement and activity in mountainous terrain. Children are required to navigate elevation changes, negotiate uneven terrain, and engage in active movements. This can lead to increased stress on the muscles and joints of the lower extremities, potentially negatively impacting normal physical development.

CONCLUSIONS.

Adverse environmental conditions prevalent in high-altitude regions, such as low atmospheric pressure, low oxygen content, and increased physical stress on the lower limbs, have an impact on the normal physical development of school-age children. Children residing in mountainous areas exhibit higher calf circumference measurements compared to their urban counterparts. Physiological gender differences also contribute to the observed disparities.

Furthermore, there is an overall increase in bone and muscle system parameters, reflected in increased measurements of thigh and calf circumference (boys: 7.06% and 6.5%, girls: 4.5% and 5.06%, respectively) when compared to children from urban areas.

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Volume-29, December 2023
ISSN: 2749-3644

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