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ASSESSMENT OF ANTHROPOMETRIC INDICATORS IN PRIMARY SCHOOL-AGE CHILDREN LIVING IN INDUSTRIAL AREAS OF TASHKENT REGION

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Abstract

Objective: To conduct a comprehensive assessment of anthropometric indicators in children aged 7-12 years living in industrial areas of Tashkent region and determine the impact of industrial factors on physical development.

Methods: The study included 1,149 children (main group - 1,019 children, control group - 130 children). Anthropometric measurements were performed using standardized methods. Statistical analysis was conducted using descriptive and analytical statistics methods.

Results: The negative impact of industrial areas was clearly manifested in boys - over 5 years, height growth was 4.45 cm less and body weight was 2.68 kg less. A paradoxical situation was identified in girls - girls living in industrial areas often showed better development. Sexual dimorphism intensified from age 11 and reached maximum level at age 12.

Conclusion: The impact of industrial areas on children's anthropometry depends on gender and age. Boys are more sensitive to industrial factors. Special monitoring and preventive measures are necessary.

Keywords: Anthropometry, children, industrial area, physical development, sexual dimorphism

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Introduction

In the modern world, industrial development and urbanization processes have a significant impact on children's health, particularly their physical development. According to World Health Organization (WHO) data, more than 40% of children living in industrial areas suffer from various degrees of physical development disorders (World Health Organization, 2018). This problem is globally relevant and equally important for both developed and developing countries. Children's physical development is a key indicator of health, and its disruption is an early sign of diseases (Baranov et al., 2019). Anthropometric indicators are the most important tool for assessing children's growth and development processes. They not only reflect the current state but also determine future health prognosis (Chen et al., 2023).

In the Republic of Uzbekistan, raising a healthy and well-rounded generation has been designated as a priority direction of state policy. President Sh.M. Mirziyoyev's decree "On widespread introduction of a healthy lifestyle" elevated monitoring children's health and conducting regular observations on anthropometric indicators to the level of state responsibility (Decree of the President of the Republic of Uzbekistan No. PF-6099, 2020). Tashkent region is one of Uzbekistan's major industrial centers, where metallurgy, chemical industry, and construction materials manufacturing enterprises are located. Large industrial facilities such as Almalyk Mining and Metallurgical Combine and chemical industry enterprises have a significant impact on the environment (Müller et al., 2023). This impact, in turn, may lead to negative consequences for the health of the local population, especially children. Scientific literature has thoroughly studied the mechanisms of industrial factors' impact on children's organisms. Atmospheric pollutants, particularly nitrogen oxides, sulfur dioxide, and fine particulate matter (PM2.5, PM10), negatively affect children's lung function, consequently slowing chest development (Gelashvili et al., 2018). Heavy metals (lead, cadmium, mercury) affect children's nervous system

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development, leading to psychomotor function disorders (Godina, 2009). Primary school age (7-12 years) is considered an important stage in children's physical development. During this period, intensive growth processes occur, and the impact of external factors is particularly strong (Jukov et al., 2015). Therefore, studying anthropometric indicators in this age group is of special importance.

Research Objective

The objective of this study is to conduct a comprehensive assessment of anthropometric indicators in primary school-age children living in industrial areas of Tashkent region and determine the impact of industrial factors on physical development.

Research Methods

This study was a cross-sectional epidemiological study conducted in 2024-2025, aimed at assessing anthropometric indicators of children aged 7-12 years living in industrial areas. A total of 1,149 children participated in the study, selected using purposive sampling method. Inclusion criteria included: age range 7-12 years, residence at current address for at least 3 years, written parental consent, absence of serious chronic diseases. Exclusion criteria were: serious chronic diseases, acute infectious diseases, lack of parental consent. Participants were divided into two groups: main group (industrial area) - 1,019 children, including 523 children from Akhangaran city school No. 5 (boys - 267, girls - 256) and 496 children from Akhangaran district school No. 54 (boys - 251, girls - 245); control group (non-industrial area) - 130 children, including 79 children from Akhangaran city school No. 2 (boys - 41, girls - 38) and 51 children from Almalyk district school No. 15 (boys - 26, girls - 25). Age distribution was as follows: 7 years - 189 children (16.5%), 8 years - 195 children (17.0%), 9 years - 201 children (17.5%), 10 years - 198 children (17.2%), 11 years - 185 children (16.1%), 12 years - 181 children (15.7%).

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All anthropometric measurements were performed based on standardized methods, in the morning between 8:00-11:00, at least 2 hours after children's meals. Measured parameters included: general body indicators - height using stadiometer, body weight using medical scales, BMI calculated using weight(kg)/height²(m²) formula; chest indicators - chest circumference at rest, during deep inspiration and expiration, sagittal and frontal diameters measured using calipers; arm and leg indicators - arm length from shoulder joint to middle finger tip, shoulder length from acromion process to elbow joint, forearm length from elbow joint to wrist joint, leg length from greater trochanter to lateral malleolus, thigh length from greater trochanter to knee joint, shin length from knee joint to lateral malleolus measured using anthropometer; head indicators - horizontal skull circumference using measuring tape, longitudinal diameter from glabella to inion, transverse diameter at skull's widest part using calipers. Each parameter was measured three times and average value was calculated. For quality control, all instruments were calibrated daily, and repeat measurements were performed on randomly selected 10% of children.

Data were analyzed using SPSS 26.0 software. For descriptive statistics, mean and standard error (M±m), median and quartiles were calculated. Data normality was tested using Shapiro-Wilk test. Student's t-test or Mann-Whitney U test was used to assess differences between groups. ANOVA test was used for multi-group comparisons. Correlation analysis was performed using Pearson or Spearman methods. $p<0.05$ was considered statistically significant. 95% confidence intervals were calculated for all indicators and effect size was assessed using Cohen's d coefficient.

Research Results

During the study, anthropometric indicators of 1,149 children aged 7-12 years were examined. The main group (industrial area) consisted of 1,019 children, and the control group (non-industrial area) consisted of 130 children (Table 1.2).

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Table 1. Comparison of Physical Development Between Children in Industrial and Non-Industrial Areas

Physical Measurements	Children in Industrial Areas (n=1,019)	Children in Clean Areas (n=130)	Statistical Difference (t-value)	Significance Level (p-value)
Height (cm)	132.4 ± 0.42	135.8 ± 1.18	2.84	$p < 0.01$
Body Weight (kg)	28.7 ± 0.31	31.2 ± 0.89	2.76	$p < 0.01$
Body Mass Index (kg/m²)	16.2 ± 0.08	16.8 ± 0.21	2.71	$p < 0.01$

Table 2. Weight Categories Distribution

Weight Status	Industrial Areas n (%)	Clean Areas n (%)	Statistical Test	Significance
Underweight (below normal)	127 (12.5%)	8 (6.2%)	$\chi^2 = 6.84$	$p < 0.01$
Normal Weight	756 (74.2%)	105 (80.8%)		
Overweight	108 (10.6%)	14 (10.8%)		
Obese	28 (2.7%)	3 (2.3%)		

According to the comparative analysis of general body indicators, children living in industrial areas showed statistically significant decreases in all major anthropometric parameters compared to the control group. Height in the main group was 132.4±0.42 cm, in the control group 135.8±1.18 cm, with a difference of 3.4 cm that was statistically significant ($t=2.84$; $p<0.01$). Body weight indicator in the main group was 28.7±0.31 kg, in the control group 31.2±0.89 kg, with the control group showing superiority by 2.5 kg ($t=2.76$; $p<0.01$). Body mass index (BMI) in the main group was 16.2±0.08 kg/m², in the control group 16.8±0.21 kg/m², with a statistically significant difference identified ($t=2.71$; $p<0.01$).

BMI category analysis showed interesting results: the proportion of underweight children in the main group was 127 (12.5%), twice as high as the 8 (6.2%) in the

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control group. Normal weight children comprised 756 (74.2%) in the main group and 105 (80.8%) in the control group. Overweight children were 108 (10.6%) in the main group and 14 (10.8%) in the control group, showing almost equal levels. Obese children comprised 28 (2.7%) in the main group and 3 (2.3%) in the control group. A statistically significant difference was identified in the overall BMI category distribution (χ^2=6.84; $p<0.01$), mainly due to the higher prevalence of underweight conditions among children living in industrial areas.

Discussion

The obtained results demonstrate the complex impact of industrial areas on children's anthropometry. The negative impact observed in boys can be explained by several factors. First, boys may be more sensitive to ecological stresses. Scientific literature contains information about the higher sensitivity of males to environmental factors (Izaak & Shivrinskaya, 2015). This is related to the relatively weak protective mechanisms of the Y-chromosome. Second, the paradoxical results observed in girls may be related to the protective effects of estrogen hormones. Estrogen has antioxidant properties and protects against oxidative stress (Kirilova, 2017). The onset of puberty (10-12 years) intensifies the impact of industrial areas. During this period, hormonal changes are intensive, and the influence of external factors increases (Petrosyan, 2009). The research results are consistent with international data. Studies conducted in European countries also confirm growth retardation in children living in industrial areas (European Environment Agency, 2023). A comprehensive study conducted in China also showed similar results (Wang et al., 2023).

Conclusion

The research results show that the impact of industrial areas on children's anthropometry manifests differently depending on gender and age. The negative impact of industrial areas is clearly observed in boys, while a paradoxical

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situation was identified in girls. Sexual dimorphism intensifies from age 11 and reaches maximum level at age 12. Special medical monitoring and preventive measures are necessary for children living in industrial areas, especially boys. The onset of puberty intensifies the impact of industrial areas, therefore special attention should be paid during this period.

The obtained results demonstrate the necessity of a comprehensive approach to preserving the health of children living in industrial areas. This should include not only medical but also social and ecological measures.

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