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COMPARATIVE ANALYSIS OF PHYSICAL DEVELOPMENT OF PRESCHOOL CHILDREN IN THE REPUBLIC OF KARAKALPAKSTAN

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ABSTRACT

The study assessed the physical development of 2,573 preschool children (height, limb length, foot) from urban and rural areas of Karakalpakstan. Children aged 3–5 years from the city have higher growth rates, which is associated with a favorable urban environment. At 5.5–6 years, rural children demonstrate compensatory growth acceleration. Territorial differences varied by age and gender, emphasizing the importance of environmental factors in monitoring and prevention.

Key words: preschool children, height in standing and sitting positions, length of upper and lower limbs, and length of foot.

INTRODUCTION

Physical development of young children is one of the most important indicators of health, playing a significant role at all stages of their life. Health indicators reflect the degree of physical development, biological maturation and functional state of the child's body, which is crucial for growth and development [2, 4, 6, 7].

Modern approaches in medicine emphasize the importance of monitoring physical development as an indicator of environmental and sanitary-hygienic well-being [1, 5]. Based on such data, it is possible to develop scientifically sound preventive and health-preserving technologies adapted to the age and morphofunctional characteristics of children [3].

The aim of the study: to assess the parameters of physical development (height in a standing and sitting position, length of the upper and lower limbs, as well as foot length) in preschool children and to perform a comparative analysis taking into account age, gender and territorial factors.

Material and methods of research.

The study was conducted in ten preschool educational institutions (PEIs) in Nukus and nine institutions located in the Muynak, Kungrad, Kegeyli and Chimbay districts of the Republic of Karakalpakstan. The institutions were selected using simple random sampling from the general list provided by the Ministry of Preschool Education of Karakalpakstan. This ensured that the sample was representative for each district. The study involved 2,573 children aged 3 to 6 years.

The exact age of each child was calculated based on the data provided by the PEI or parents, based on the date of birth and the date of the survey. To improve the accuracy of measurements, professional equipment was used: a stadiometer to determine body length, a Martin anthropometer to measure limb length, and a sensory plantograph to measure foot length. Before the study, all equipment was calibrated in accordance with international standards.

Permission to conduct the study was obtained from the Ministry of Preschool Education of the Republic of Karakalpakstan in 2022. Before starting the work, an explanatory conversation was held with the parents and their written consent was obtained for the children to participate in the study. The study was carried out within the framework of the grant project PZ-2021023212 (2022-2023).

Statistical processing of the obtained data was carried out using Microsoft Excel -2016. Mean values (M), standard deviations (±σ) and standard errors (±m) were calculated. To assess the significance of differences between groups, the Student's t-test coefficient for independent samples was used. The significance level was set at $p \leq 0.05$.

Results and discussion.

Analysis of standing height indicators revealed territorial and age differences among boys and girls (Table 1).

Table 1.

Distribution of children aged 3 to 6 years by body length depending on place of residence

Age, years	City			Rural district			t	p
	M	±m	±σ	M	±m	±σ		
Boys								
3	105,6	1,97	8,11	100,1	3,79	10,04	1,27	-
3,5	102,3	1,04	8,21	99,0	0,56	4,07	2,72	0,01

4	105,3	0,57	6,09	101,0	0,55	5,55	5,45	0,001
4,5	106,2	0,62	5,91	105,7	0,56	5,53	0,61	-
5	110,1	0,40	4,49	107,9	0,52	5,53	3,26	0,001
5,5	113,2	0,40	5,20	114,0	0,44	5,29	-1,26	-
6	116,0	0,43	4,73	115,7	0,48	5,30	0,58	-
Girls								
3	102,4	2,61	9,04	97,0	1,08	2,16	1,92	-
3,5	100,3	0,93	7,06	98,5	0,61	4,77	1,69	-
4	102,3	0,55	5,38	98,6	1,26	11,52	2,64	0,01
4,5	105,3	0,52	5,30	103,3	0,61	6,07	2,46	0,01
5	109,1	0,43	4,43	106,4	0,48	5,11	4,18	0,001
5,5	111,2	0,44	5,14	112,2	0,50	5,61	-1,56	-
6	114,2	0,47	4,80	114,8	0,48	5,61	-0,91	-

In boys aged 3 to 5 years, the advantage in standing height was more often observed in children from the city of Nukus. For example, at the age of 3.5 and 4 years, the standing height of boys from the city was 102.27 cm and 105.32 cm, respectively, which reliably exceeded the indicators of their peers from rural areas (99.04 cm and 101.02 cm; $p < 0.01$ and $p < 0.001$). However, by the age of 5.5 and 6 years, the differences leveled out, and in some groups, the indicators of rural boys became higher, although statistical significance was absent.

A similar trend persisted among girls. At the age of 4 and 5, the standing height of city girls (102.25 and 109.14 cm, respectively) was significantly higher than that of their peers from the districts (98.61 and 106.44 cm; $p<0.01$ and $p<0.001$). However, at 5.5 years, girls from the districts had higher standing height values (112.21 versus 111.17 cm), although the difference did not reach statistical significance. By the age of 6, there were virtually no differences between the groups.

Sitting height indicators among boys also demonstrated an advantage for city children at the early stages (Table 2). For example, at 4 years, the sitting height of city boys was 56.94 versus 55.64 cm in the districts. However, after 5.5 years, the advantage was on the side of children from the districts (61.6 versus 60.17 cm, $p<0.001$). This trend persisted at 6 years.

For girls, the advantage of urban children in sitting height was significant at the ages of 4 and 5 years (56.20 vs. 54.78 cm; 58.69 vs. 56.97 cm; $p<0.02$ and $p<0.001$). However, by the ages of 5.5 and 6 years, the indicators of rural girls exceeded those of urban girls (59.88 vs. 59.3 cm; 60.41 vs. 58.96 cm; $p<0.02$ - at 6 years).

Table 2.

Distribution of children aged 3 to 6 years by height level while sitting depending on place of residence

Age, years	City			Rural district			t	p
	M	±m	±σ	M	±m	±σ		
Boys								
3	54,8	0,97	3,99	53,9	1,82	4,81	0,47	-
3,5	54,6	0,59	4,63	55,0	0,41	2,95	-0,63	-
4	56,9	0,45	4,83	55,6	0,37	3,75	2,22	-
4,5	58,0	0,45	4,33	57,9	0,34	3,29	0,31	-
5	59,5	0,31	3,47	59,1	0,37	3,87	0,78	-
5,5	60,2	0,33	4,27	61,6	0,29	3,53	-3,25	0,001
6	60,8	0,43	4,75	61,8	0,33	3,61	-1,73	-
Girls								
3	56,3	1,07	3,72	50,8	2,98	5,97	1,73	-
3,5	57,1	0,90	6,86	54,9	0,39	3,11	2,20	0,03
4	56,2	0,48	4,71	54,8	0,38	3,50	2,29	0,02
4,5	57,3	0,39	3,95	56,3	0,56	5,57	1,47	-
5	58,7	0,39	3,99	57,0	0,31	3,3	3,45	0,001
5,5	59,3	0,34	3,95	59,9	0,43	4,85	-1,06	-
6	59,0	0,50	5,16	60,4	0,31	3,68	-2,45	0,02

Among boys, urban children demonstrated higher upper limb length at ages 3, 4, and 5 years (Table 3).

Table 3.

Distribution of children aged 3 to 6 years by the level of upper limb length depending on the place of residence

Age, years	City			Rural district			t	p
	M	±m	±σ	M	±m	±σ		
Boys								
3	82,8	1,71	7,05	78,0	3,44	9,11	1,24	-
3,5	80,2	0,92	7,26	76,6	0,41	2,96	3,59	0,001
4	81,4	0,93	9,97	77,57	1,02	10,26	2,77	0,01
4,5	83,5	0,53	5,07	81,69	0,96	9,45	1,65	-
5	86,4	0,35	3,89	82,74	1,19	12,58	2,94	0,001
5,5	89,6	0,46	5,94	89,01	0,82	9,82	0,57	-
6	91,5	0,48	5,25	91,79	0,51	5,63	-0,4	-
Girls								
3	80,1	2,34	8,11	74,5	1,04	2,08	2,18	0,05
3,5	77,5	0,78	5,91	77,0	0,53	4,14	0,57	-
4	79,6	0,70	6,81	77,6	0,71	6,45	1,96	0,05
4,5	83,0	0,52	5,36	79,5	1,13	11,22	2,53	0,01
5	86,0	0,42	4,36	82,7	0,96	10,17	3,10	0,001

5,5	88,1	0,42	4,94	88,1	0,73	8,16	0,03	-
6	90,3	0,55	5,62	90,6	0,66	7,79	-0,44	-

For example, at 3.5 years, the upper limb length of urban boys was 80.22 cm versus 76.6 cm in rural areas ($p<0.001$). At 5 years, this difference also remained (86.4 versus 82.74 cm, $p<0.001$). By 5.5 and 6 years, no differences were found between the groups. In females, similar dynamics were noted up to 5 years, when the indicators for urban girls were higher. At 4.5 years, the upper limb length of urban girls was 82.69 cm versus 79.53 cm for their peers from rural areas ($p<0.01$). However, by 6 years, the upper limb length indicators were virtually identical between the groups.

The lower limb length (Table 4) in boys aged 3 to 5 years was higher in urban children. For example, at 4 years, the indicators were 58.76 cm in the city versus 54.85 cm in rural areas ($p<0.001$). However, by the age of 5.5 and 6 years, the indicators for boys in rural areas had higher values (63.68 versus 62.85 cm at 5.5 years; 66.09 versus 64.86 cm at 6 years; $p<0.05$). For girls, the advantage of urban children remained until the age of 5, for example, at 5 years, the indicators were 61.37 cm in the city versus 58.33 cm in rural areas ($p<0.001$). But starting from the age of 5.5 years, the advantage passed to girls living in rural areas, although the differences were statistically insignificant.

Table 4.

Distribution of children aged 3 to 6 years by the level of lower limb length depending on the place of residence

Age, years	City			Rural district			t	p
	M	±m	±σ	M	±m	±σ		
Boys								
3	58,5	1,25	5,15	53,4	2,4	6,35	1,86	-
3,5	56,8	1,00	7,88	52,7	0,47	3,38	3,75	0,001
4	58,5	0,55	5,89	54,9	0,60	6,07	4,80	0,001
4,5	58,2	0,43	4,15	56,6	0,91	8,89	1,59	-
5	61,3	0,32	3,62	58,9	0,46	4,86	4,33	0,001
5,5	63,7	0,32	4,17	62,9	0,37	4,38	1,72	-
6	66,1	0,35	3,80	64,9	0,47	5,17	2,11	0,05
Girls								
3	56,4	1,84	6,37	51,8	1,55	3,1	1,94	-
3,5	55,0	0,68	5,16	52,7	0,49	3,88	2,81	0,01
4	56,4	0,41	3,95	54,3	0,79	7,17	2,38	0,02
4,5	59,4	0,63	6,48	56,9	0,61	6,00	2,78	0,01
5	61,4	0,37	3,80	58,3	0,39	4,14	5,65	0,001
5,5	63,2	0,35	4,10	62,5	0,42	4,75	1,27	-
6	65,4	0,42	4,31	64,3	0,39	4,63	1,86	-

Foot length among boys and girls (Table 5) showed interesting dynamics.

Table 5.

Distribution of children aged 3 to 6 years by foot length level depending on place of residence

Age	City			Rural district			t	p
	M	±m	±σ	M	±m	±σ		
Boys								
3	15,6	0,46	1,89	16,9	0,51	1,34	-1,92	-
3,5	16,7	0,28	2,22	16,3	0,20	1,43	1,36	-
4	16,8	0,19	2,07	16,5	0,15	1,53	1,21	-
4,5	17,2	0,21	2,01	16,8	0,13	1,28	1,56	-
5	17,3	0,17	1,90	16,9	0,13	1,37	1,81	-
5,5	17,0	0,15	1,99	17,6	0,10	1,24	-3,12	0,001
6	17,2	0,20	2,21	17,7	0,13	1,41	-2,29	0,05
Girls								
3	15,5	0,48	1,67	16,5	0,61	1,22	-1,23	-
3,5	15,9	0,25	1,94	16,2	0,17	1,36	-0,16	-
4	16,5	0,22	2,10	16,5	0,17	1,56	0,09	-
4,5	16,6	0,18	1,89	16,3	0,13	1,31	1,23	-
5	16,7	0,20	2,02	17,1	0,42	4,43	-0,87	-
5,5	17,0	0,19	2,24	17,3	0,12	1,39	-1,49	-
6	16,9	0,23	2,35	17,8	0,10	1,17	-3,5	0,001

In boys aged 3.5 to 5 years, the differences between children from urban and rural areas were minimal. However, at 5.5 and 6 years, boys from rural areas began to demonstrate a significant advantage (17.55 versus 16.97 cm; $p<0.001$ - at 5.5 years; 17.7 versus 17.15 cm; $p<0.05$ - at 6 years). In girls aged 3 to 5 years, the differences between the groups also remained minimal. By the age of 6, girls from rural areas demonstrated a significantly longer foot (17.75 cm versus 16.87 cm; $p<0.001$).

CONCLUSION

In the early preschool age (3–5 years), urban children demonstrate an advantage in most indicators, probably due to more favorable conditions of the urban environment.

In the late preschool age (5.5–6 years), children from rural areas begin to show compensatory growth acceleration, which may be related to their lifestyle and environmental conditions.

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