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Assessment of anthropometric measurements of premature children with physical developmental delays at preschool age

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Assessment of child growth and development is crucial for paediatricians, as delays in these areas have significant socio-economic implications and their treatment can be costly.

Aim. To evaluate the anthropometric measurements of premature children with physical developmental delay at preschool age.

Materials and methods. The retrospective and prospective studies were conducted. A total of 108 children participated in the study. The children were classified into three groups: the main group, the comparison group, and the control group. The average age of children in the main group was 3.9±0.20 years, in the comparison group it was 4.2±0.19 years, and in the control group — 4.1±0.15 years. The main group (group I, n=57) was further divided into two subgroups: subgroup IA comprised 45 children born with a body weight appropriate for gestational age, subgroup IB consisted of 12 children with low body weight for gestational age (LBWGA). The comparison group (group II; n=31) was also divided into two subgroups: subgroup IIA included 26 children born with a normal body weight for their gestational age, subgroup IIB consisted of five children born with a low body weight for their gestational age. The control group comprised 20 premature infants born at 29–36 weeks of gestation with relatively satisfactory antenatal and intrapartum periods and no physical developmental delays. Physical development was evaluated based on anthropometry measurements, including height and body weight.

Results. The study included 57% male and 43% female children. Among the children with physical developmental delay, 37% were from the first gestation, 44.3% from the second gestation, and 18.7% from the third gestation. When analysing the data, a significant difference was found in height (p=0.0002) and body weight (p=0.0006). In the main group, children born with low body weight for gestational age showed more pronounced growth retardation, while in the comparison group, premature children differed from full-term ones with more significant growth retardation.

Conclusions. The study revealed that children born with low birth weight for gestational age have differences in body weight and height compared to children with appropriate weight for gestational age.

The study was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Local Ethics Committee the aforementioned institution. Informed consent for the study was obtained from the parents of the children.

The authors declare no conflict of interest.

Keywords: premature child, low birth weight for gestational age, physical developmental delay, anthropometric measurements, preschool age.

Оцінка антропометричних показників у дітей, які народилися недоношеними, із затримкою фізичного розвитку в дошкільному віці

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Оцінка росту і розвитку дітей дуже важлива для педіатрів, оскільки затримка в даній галузі має соціально-економічне значення, а лікування потребує великих витрат.

Мета — оцінити антропометричні показники дітей, які народилися недоношеними, із затримкою фізичного розвитку в дошкільному віці.

Матеріали та методи. Проведено ретроспективне та проспективне дослідження. До дослідження залучено 108 дітей. Дітей поділено на 3 групи — основну, групу порівняння та контрольну. Середній вік дітей основної групи становив 3,9±0,20 року, групи порівняння — 4,2±0,19 року, контрольної групи – 4,1±0,15 року. Основну групу (I група, n=57) поділено на 2 підгрупи: до підгрупи IA увійшло 45 дітей, які народилися з масою тіла, що відповідає гестаційному віку, до підгрупи IB — 12 дітей, які народилися з низькою масою тіла для гестаційного віку. Групу порівняння (II група; n=31) також поділено на 2 підгрупи: до підгрупи IIA увійшло 26 дітей, які народилися з масою тіла, що відповідає гестаційному віку, до підгрупи IIB — 5 дітей, які народилися з низькою масою тіла для гестаційного віку. До контрольної групи увійшло 20 недоношених дітей, які народилися в терміні гестації 29–36 тижнів, мали відносно задовільний перебіг антенатального та інтранатального періоду і не мали затримки фізичного розвитку. Оцінку фізичного розвитку виконано на підставі антропометричних показників — вимірювання зросту, маси тіла.

Результати. 57% дітей, які брали участь в обстеженні, становили хлопчики, 43% — дівчатка. При цьому 37% дітей із затримкою фізичного розвитку народилися від 1-ї вагітності, 44,3% — від 2-ї вагітності, 18,7% — від 3-ї вагітності. Під час аналізу даних виявляли різницю в показниках росту (p=0,0002) і між показниками маси тіла (p=0,0006). В основній групі діти, народжені з низькою масою тіла для гестаційного віку, мали більш виражену затримку росту, а в групі порівняння діти, народжені передчасно, відрізнялися від доношених більш значущою затримкою росту.

Висновки. У результаті проведеного дослідження виявлено, що діти, народжені з низькою для гестаційного віку масою тіла, за масою тіла та зростом відрізняються від дітей, народжених із масою, що відповідає гестаційному віку.

Дослідження виконано відповідно до принципів Гельсінської декларації. Протокол дослідження схвалено Локальним етичним комітетом зазначеного в роботі закладу. На проведення досліджень отримано інформовану згоду батьків дітей.

Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: недоношена дитина, дитина з низькою масою для гестаційного віку, затримка фізичного розвитку, антропометричні показники, дошкільний вік.

Introduction

Assessment of child growth and development is crucial for paediatricians, as delays in these areas have significant socio-economic implications and their treatment can be costly. It has long been challenging to establish standards for children's physical development due to the constant influence of social factors, upbringing, changes in the ecological environment, scientific and technological progress, as well as medical care on individual physical development [2].

Causes of failure to thrive may include genetic factors, endocrine disorders, inadequate child nutrition, socio-economic status of the family, and other factors [6].

During the first year of life, healthy children may have height, weight, and head circumference measurements that exceed their genetic target range, but by preschool age, these measurements may fall below percentile values. Additionally, 81% of children with very low birth weight experience accelerated growth in their first year of life. From 85% to 90% of infants born with low birth weight for gestational age (LBWGA) show above-average growth rates after birth and achieve a normal growth pattern by 2 to 4 years of age. Previous studies have suggested that preterm infants with LBWGA are at a higher risk of experiencing physical developmental delays due to slow growth [7,9].

Children born with LBWGA form a heterogeneous group because of the variety of aetiological causes. Approximately 85–90% of children born with LBWGA show active growth in the first few years after birth, while the remaining percentage experience failure to thrive during the same period. In later life, children with LBWGA have an increased risk of developing metabolic disorders including visceral obesity, insulin resistance, cardiovascular problems, and there has been observed cases of early sexual puberty and physical development delays [3,5].

The balance between exogenous and endogenous factors is essential for normal foetal growth and development. Any disorder of nutrient and oxygen uptake for any reason (inadequate dietary intake or poor-quality maternal nutrition, placental vascular anomalies, etc.) may result in foetal reduced nutrition and growth retardation during the last weeks of gestation [3,8].

In the modern world, stunted growth not only affects a child's physical status but also has psychological implications. Children facing stunted growth often experience psychological traumas as they feel different from their peers.

Therefore, it has been established that premature children are a cohort requiring special monitoring and treatment. Numerous studies have been conducted in this area. However, despite these efforts, the issue of stunting remains relevant. In some cases, parents and paediatricians give little attention to these children, relying on later growth acceleration, which causes the social and medical problems mentioned above [1,8].

Therefore, conducting such a study is particularly important. The focus of our work was on studying this issue, as there is no similar comparative scientific study in premature children available in the literature [4].

The study ***aim*** was to assess the anthropometric measurements of premature children with physical developmental delays at preschool age.

Materials and methods of the study

A retrospective and prospective study involving 108 children was conducted.

The children were classified into 3 groups. The main group (group I) consisted of 57 premature children born at 29–36 weeks of gestation and diagnosed with growth retardation at preschool age. During the retrospective examination of the children in the main group, it was found that the gestational age of the children at birth ranged from 29 to 36 weeks, with body weights ranging from 950 to 2400 g, and heights ranging from 39 to 45 cm.

The main (I) group was divided into two subgroups: subgroup IA comprised 45 children born with a body weight appropriate to the gestational age, subgroup IB consisted of 12 children born with LBWGA. Eight children included in subgroup IA were born at 29–32 weeks of gestation, 37 children were born at 33–36 weeks of gestation. Of the 12 children in subgroup IB, 10 children were born at 33–36 weeks of gestation and two children at 29–31 weeks of gestation.

The comparison group (group II) included 31 children born at 38–40 weeks of gestation and diagnosed with developmental delays. The comparison group (II) was divided into two subgroups: subgroup IIA comprised 26 children born with a body weight appropriate to the gestational age, while subgroup IIB consisted of five children with LBWGA. The gestational age of the children in the comparison group was

38–40 weeks, and their birth weight ranged from 2000 to 3500 g. Children in this group also experienced physical developmental delays at school age.

The average age of children in the main group was 3.9±0.20 years, in the comparison group it was 4.2±0.19 years, and in the control group — 4.1±0.15 years. No significant difference was found in the ages of the children included in the groups under observation.

The control group comprised 20 premature infants born at 29–36 weeks of gestation with relatively satisfactory antenatal and intrapartum periods and no physical developmental delays. The anthropometric measurements at birth of children in the control group were similar to those of the main group. The children were discharged from the maternity hospital in satisfactory condition. Retrospective studies revealed that the physical development of the children corresponded to the indicators of the centile tables.

The studies included the following assessments: anamnestic data taking, assessing the height of patient's parents, comprehensive evaluation of physical development, anthropometry, calculating the height standard deviation scores (SDS, Standard Deviation Score). The obtained height and weight indicators were evaluated using percentile curves. The overall average and SD values were taken from the tables. The normal value was marked as 0, and the lower and upper values were -2 and +2 respectively. If a child's growth fell below -2 SDS for their age and sex, it was considered potentially pathological. Physical development was evaluated using measurements such as height and body weight. SDS was calculated to assess how a patient's height deviated from the average height in the population. The electronic floor scales used for body weighing showed a weight measurement within 0.1 kg accuracy. Parental height was assessed to estimate stunting. The father's and mother's heights were accurately estimated using percentile growth curves, and the resulting height was calculated as the target height.

Inclusion criteria: parental consent to examine their children, premature children born with birth weight appropriate for gestational age with diagnosed developmental delays.

Exclusion criteria: lack of parental consent, children with severe mental disorders, developmental abnormalities, chromosomal abnormalities.

During statistical processing of the results, differences in quantitative indicators were assessed using parametric and nonparametric methods (with Student's t-criterion and Mann–Whitney criterion, respectively). To analyse qualitative indicators, we used the χ^2 criterion (Pearson correlation coefficient). We considered differences to be significant at $p<0.05$.

The study was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Local Ethics Committee the aforementioned institution. Informed consent for the study was obtained from the parents of the children.

Results and Discussion

The anthropometric measurements of the children involved in the study were investigated both retrospectively and prospectively.

It was also examined the maternal gravidity and parity, as well as the sex of the children. Of the 57 children in the main group, there were 24 (42.1%) girls and 33 (57.9%) boys ($p>0.05$). Among the 37 children of the main group who were born with a weight appropriate for gestational age at 33–36 weeks of gestation, there were 17 (45.9%) girls and 20 (54.1%) boys. Of the eight children born at 29–31 weeks of gestation, there were three (37.5%) girls and five (62.5%) boys. It is evident that boys were predominant among the children of the main group (Table 1). Out of 31 children in the comparison group, there were 14 (45.2%) girls and 17 (54.8%) boys ($p>0.05$).

Table 1 presents that out of 20 children in the control group, seven (35%) were girls and 13 (65%) were boys.

In the main group, 23 (40.4%) children were from the first gestation and 24 (42.1%) children from the first birth. Additionally, 25 (43.9%) children were born from the second gestation, 26 (45.6%) children from the second birth, nine (15.8%) children from the third or more gestations, and seven (12.3%) children from three or more births. The statistical analysis revealed no significant difference between the indicators ($p>0.05$).

Children of the comparison group, according to the maternal gestation course and delivery, were distributed as follows: 15 (35.5%) children were born from the first gestation and 15 (35.5%) ones from the first birth, 14 (45.2%) from the second gestation and 15 (48.4%) from the second birth, and nine (15.8%) and five (16.1%) children from the third gestation and birth, respectively. Depending on the gestation course and delivery, the control group included nine (45%) children

Table 1

Distribution of children examined

Parameter	Group, abs. (%)			χ^2			p		
	main (I); n=57	comparison (II); n=31	control (III); n=20	I–II	III–I	III–II	I–II	III–I	III–II
Child's sex:									
– female	24 (42.1)	14 (45.2)	7 (35.0)	0.08	0.31	0.52	0.7822	0.5772	0.4716
– male	33 (57.9)	17 (54.8)	13 (65.0)	0.08	0.31	0.52	0.7822	0.5772	0.4716
Gravidity:									
– primigravida	23 (40.4)	11 (35.5)	9 (45.0)	0.20	0.13	0.46	0.6542	0.7166	0.4968
– secundigravida	25 (43.9)	14 (45.2)	8 (40.0)	0.01	0.09	0.13	0.9065	0.7641	0.7163
– tertio or multigravida	9 (15.8)	6 (19.4)	3 (15.0)	0.18	0.01	0.16	0.6709	0.9333	0.6904
Parity:									
– first	24 (42.1)	11 (35.5)	9 (45.0)	0.37	0.05	0.46	0.5444	0.8219	0.4968
– second	26 (45.6)	15 (48.4)	8 (40.0)	0.06	0.19	0.35	0.8033	0.6636	0.5567
– third or more	7 (12.3)	5 (16.1)	3 (15.0)	0.25	0.10	0.01	0.6153	0.7556	0.9138

Notes: I–III — difference between the main group and the comparison group; III–II — difference between the main group and the control group; III–III — difference between the control group and the comparison group.

Table 2

Assessment of anthropometric measurements in preschool children, M ± m

Parameter	Group, abs. (%)			p			t		
	main (I); n=57	comparison (II); n=31	control (III); n=20	I–II	III–I	III–II	I–II	III–I	III–II
Height at baseline:									
– cm	91.5±1.67	106.4±3.34	109.7±0.56	0.0002	0.0000	0.3380	3.84	9.72	0.96
– SDS	-3.5±0.15	-3.3±0.21	0	0.3743			0.89		
– percentiles	1.1±0.25	1.1±0.51	49.5±1.35	0.9433	0.0000	0.0000	0.07	11.80	13.02
Weight at baseline:									
– kg	12.7±0.51	18.5±1.46	17.9±0.36	0.0006	0.0000	0.7107	3.55	8.12	0.37
– SDS	-3.0±0.23	-2.8±0.25	0	0.4922			0.69		
– percentiles	3.0±1.25	3.2±1.05	45.7±2.69	0.8995	0.0000	0.0000	0.13	9.15	8.87
Maternal height, cm	157.8±0.88	157.9±1.26	160.4±0.55	0.9676	0.0171	0.0802	0.04	2.43	1.77
Paternal height, cm	171.2±1.02	170.2±1.27	172.4±0.48	0.5554	0.3083	0.1263	0.59	1.02	1.54
Target height, cm	164.9±0.97	164.0±1.64	167.1±1.41	0.6065	0.2152	0.1523	0.52	1.25	1.44
Target height, SDS	-0.8±0.13	-0.6±0.22	0	0.4774			0.71		
Predicted final height, cm	156.9±3.74	155.3±2.58	0	0.7320			0.34		
Predicted final height, SDS	-1.9±0.30	-2.0±0.41	0	0.8591			0.18		

Notes: I–III — difference between the main group and the comparison group; III–II — difference between the main group and the control group; III–III — difference between the control group and the comparison group.

from first gestation, eight (40%) children from second gestation, and three (15%) children from third or more gestation.

Consequently, the study revealed that children with physical developmental delays were mostly from the first and second pregnancies and births. It seems that low physical development indicators in children from the first pregnancy and childbirth are linked to various somatic and gynaecological health issues in their mother and the course of pregnancy and childbirth. At the same time, genetic factors may also contribute to physical development.

During the examination of children in the main group, their height, weight, parental height, and percentile charts were assessed. The baseline height of children in the main group was 91.5±1.67 cm, while in the comparison group it was 106.4±3.34 cm (p=0.0002, t=3.84). In the control group, the children's height was 109.7±0.56 cm, and there was a statistically significant difference between that of the main group (p=0.0000, t=9.72). There was no significant difference between the indicators of the comparison group and the control group, as the comparison group included full-term children.

When analysing the height (SDS) using centile tables, it was -3.5±0.15 in children of the main group and -3.3±0.21 in children of the comparison group, respectively (p=0.3743, t=0.89). The study also assessed the children's weight (SDS)

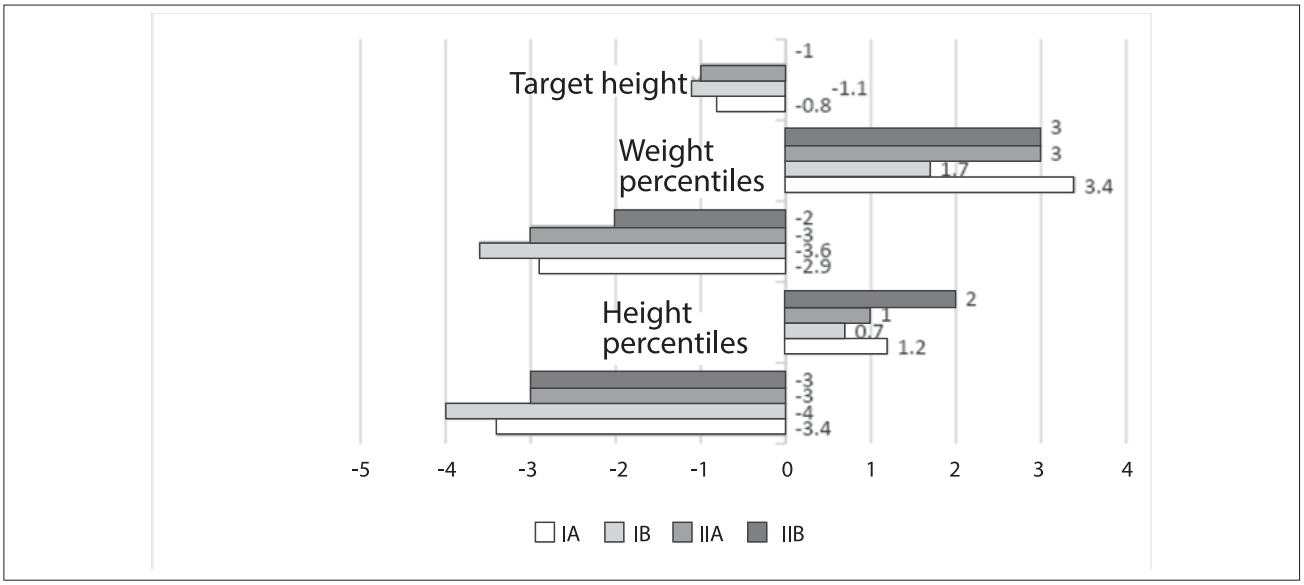

Fig. Results of the assessment of the study groups using the centile charts

using percentile tables. The value was -3.0±0.23 in children of the main group and -2.8±0.25 in children of the comparison group. No significant difference was found between the indicators (p=9433, t=0.69, respectively). The study also investigated the parental height, target height, and predicted final height of the participating children. In the main group, the average maternal height of the children was 157.8±0.88 cm, and the average paternal height was 171.2±1.02 cm. For children of this group, the target height was 164.9±0.97 cm and the predicted final height was 156.9±3.74 cm. In the comparison group, the maternal height of the children was 157.9±1.26 cm, and the paternal height was 170.2±1.27 cm. According to Table 2, there was no statistically significant difference between the children in the main group and the comparison group (p>0.05). There was no difference between the chronological age of boys and girls at the time of their first visit to an endocrinologist. For children in the comparison group, the target height was 164.0±1.64 cm, and the final height was 155.3±2.58 cm. As can be seen, the predicted final height (SDS) was -2.0±0.41. The studies showed that children in both the main and comparison groups experienced delays in physical development (see Fig.).

Both the main and comparison groups' children were also scored on the charts in subgroups. The anthropometric measurements of 45 children of subgroup IA, born with a body weight appropriate for gestational age, and 12 children of subgroup IB, born with LBWGA, were examined. It was found that the height (SDS) of children in subgroup IA was -3.4±0.17, while that of children in subgroup IB was 4.0±0.35 (p=0.1394, t=1.35). As can be seen, children with developmental delay born with LBWGA had lower SDS than children born with body weight appropriate for gestational age. The percentile charts for height at baseline showed that in subgroup IA, the average height was 1.2±0.29, while in subgroup IB, it was 0.7±0.42 respectively (p=0.3260, t=0.99). The weight (SDS) of children in subgroup IA was -2.9 ± 0.24, and in subgroup IB was -3.6±0.62 (p=0.2912, t=1.07).

The study also looked at the height of the parents of the enrolled children and found no significant difference between the groups. Additionally, the physical development of children in the comparison group was compared with those born at term diagnosed with developmental delay. It was found that the height (SDS) of the children in subgroup IIA was -3±000, and of the children in subgroup IIB was also -3±000. It is evident that there was no difference between the standard deviations of height among the children included in the study (p=0.1915, t=0.83). The weight of children (SDS) in subgroup IIA was -3±000, and in subgroup IIB was -2±000. In this study, it was found that children born with LBWGA had a greater difference in standard deviations compared to children born with a body weight appropriate for their gestational age.

The study indicated that children born with LBWGA showed variations in body weight and height compared to those born with a weight appropriate for their gestational age.

Conclusions

Based on the study results, the following conclusions can be made.

Boys constituted the majority in both the main group and the comparison group, accounting for 57%.

Among the children with physical developmental delay, 37% were from the first gestation, 44.3% from the second gestation, and 18.7% from the third gestation.

When comparing children born with low birth weight for gestational age and those born at term, there were statistically significant differences in height (p=0.0002) and weight (p=0.0006).

The study revealed that children born with low birth weight for gestational age in the main group showed more significant growth retardation during examination, while children born at term in the comparison group exhibited more severe growth retardation than prematurely born children.

The authors declare no conflict of interest.

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