

Assessment of the Physical Development of Children in Transbaikal Territory, Russian Federation

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Research Article

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Abstract

Relevance. Along with infectious diseases, allergic diseases can confidently be called one of the pandemics of the 21st century. The aim of the study was to conduct a retrospective analysis of the anthropometric data of patients with bronchial asthma over 8 years.

Materials and methods. A retrospective analysis of 972 case histories of patients with bronchial asthma who received inpatient treatment between 2017 and 2024 was conducted. The age structure is represented by children of different age groups, and the patients are grouped as follows: from 1 year to 3 years 11 months and 29 days, from 4 years to 6 years 11 months 29 days and 29 days, from 7 years to 11 years 11 months and 29 days, and from 12 years to 17 years 11 months and 29 days.

Results. Normal body weight was recorded in 48.6% of patients with bronchial asthma, malnutrition was recorded in 21.2% of children, while up to 30.2% of patients had excessive fat deposition of varying degrees. In 53.2% of the examined, the height did not exceed the limits of the norm, below average height was recorded in 7.8% of children, short stature was recorded in 3% of patients, above average height was recorded in 22.6% of the examined, and tall stature was recorded in 13.1% of children.

Conclusion. 1/3 of patients have an excess body weight or obesity, which may be one of the factors contributing to the uncontrolled or partially controlled course of bronchial asthma, requiring a comprehensive approach to patient treatment and the development of individual rehabilitation programs.

1- INTRODUCTION

Despite the increased awareness among people regarding excess body weight and obesity, weight control in children is often ignored by the public, which raises global concerns and remains a problem (1). However, undernutrition in children is also an open issue.

During the Great Patriotic War, residents of the besieged Leningrad experienced a decrease in macro- and microelements in their diets, which are involved in the main processes of growth and development, thereby affecting physical development (2). Thus, according to M.Y. Mendeleva, children born in 1941 reduced their body weight by 100 grams relative to the prewar weight; however, the peak occurred in 1942, when the body weight decreased by more than 600 grams (3). In the context of nutritional hypotrophy, infectious diseases, measles, scarlet fever, diphtheria, and whooping cough are more often reported in children of the besieged Leningrad. According to Professor L.D. Steinberg, after the liberation of the Voronezh region, 80% of young children suffer from nutritional dystrophy, whereas just two years later, malnutrition was recorded 2.5 times less frequently: in 12% of cases, a decrease in height and weight was observed in nursery groups, and up to 20% in orphanages (4).

Data from the United Nations Children's Fund (UNICEF), the WHO, and the World Bank have been published. In 1990, the prevalence of stunted growth and underweight was 39.6% and 25%, respectively; in 2000, these figures decreased to 32.7% and 20.1%, respectively. In 2015, 23.2% of children under the

age of 5 were stunted, 7.4% were underweight, and 13.9% were overweight (5). In 2020, 149 million children under the age of 5 worldwide were recorded to have stunted growth, 45 million had undernutrition, and 38.9 million were overweight (5).

Between 1990 and 2025, the incidence of obesity among the adult population doubled, whereas in pediatric practice, it quadrupled. In 2024, 35 million children under the age of 5 lived with excess body weight. In children 25 years ago, excess weight was predominantly detected in developed countries; in 2024, it was found in 12.1% of preschoolers in Africa and in every second child in Asia. The detection of overweight and obesity in children aged 5 to 19 years has increased by more than 12%; in 1990, the rate was 8%, whereas in 2022, it was 20% (6).

Childhood obesity remains a serious public health problem worldwide. The prevalence of overweight and obesity in children in Europe ranges from 15.3 to 25.6% (7). In the USA, the rate of obesity among children aged 2 to 19 years increased from 17.7% in 2011 to 21.5% in 2020 (7). Young people with obesity are more likely to experience disorders of the endocrine, cardiovascular, respiratory, nervous, immune, and digestive systems (8).

In Indonesia, the prevalence of overweight and obesity among people aged 5 to 19 years increased fourfold – from 3.9% to 15.4% – between 1996 and 2016, respectively (9). Moreover, in 2018, 10.8% and 9.2% of children aged 5–12 years were overweight and obese, respectively (10).

Studies conducted in 6 regions of the Russian Federation in 2004 revealed that overweight ranged from 5.5% to 11.8%, with obesity in 5.5% of rural children and 8.5% of urban children (11). In 2017–2019, 27% of the 7-year-old children in Moscow were surveyed. Boys and 22% of girls were overweight, whereas obesity was detected in 10% and 6%, respectively (12).

According to scientists from Stavropol, children with congenital heart defects have lower anthropometric indicators than pediatric patients without congenital heart defects (13). The mother's health affects the child's physical development. Thus, a study by L. P. Matveev et al. revealed that children born to mothers with bronchial asthma are more likely to be diagnosed with dystrophy than are children born to healthy women (14).

Adipose tissue plays an important role in maintaining the immune system (15). Depletion of fat reserves increases the risk of infectious diseases and their mortality. Since the volume of muscle mass in children is positively correlated with age, infants are particularly vulnerable to the consequences of malnutrition and associated mortality (15).

Restricting caloric and protein contents in children's diets leads to impaired lung ventilation, respiratory muscle dysfunction, structural changes in the lungs, and disruption of the defense mechanisms of the lungs (16).

Infectious diseases are most dangerous for children in the first three years of life (16), and children suffering from malnutrition are more susceptible to frequent and severe respiratory illnesses (16).

Malnutrition also leads to a decrease in adipocyte mass, which in turn contributes to a reduction in the level of circulating leptin (15).

The prevalence of stunted growth among children worldwide is 22% (17). According to WHO data, in countries with a lower-middle-income level, stunted growth accounts for 29.1% of cases; a high frequency (31.7%) is observed on the African continent, Southeast Asia (30.1%), and the Eastern Mediterranean (26.2%) (17).

Hawladar M.D. et al. reported that growth retardation is considered one of the risk factors predisposing rural children in Bangladesh to asthma; however, the exact mechanisms by which dietary factors influence the development of asthma, especially in children with growth retardation, have not been clarified (18).

Children with growth retardation are characterized by low levels of vitamin D and leptin, muscle mass deficiency, impaired growth, and reduced lung function, as well as elevated levels of IL-4 and CD23+ (15).

Excess body weight and obesity are considered unfavorable factors contributing to the comorbidity of somatic diseases. Thus, Gonchar N.V. et al. demonstrated that a severe course of juvenile idiopathic arthritis is more common in girls with excess body weight (19). Scientists from Nizhny Novgorod reported that the reversibility of bronchial obstruction during bronchodilator tests in patients with asthma associated with excess body weight and obesity is lower than that in patients with normal body weight (20). In the study by Casas, M. et al. (21), spirometry was performed on 4,435 children aged 10 years. The results showed that a lower peak expiratory flow rate is associated with body mass index and thus with reduced airway patency in patients with excess body weight and obesity.

Scientists from Novosibirsk reported that the commonly reported risk factors for excess body weight and obesity in children aged 3–11 are physical inactivity, excessive carbohydrate consumption, and disrupted sleep–wake patterns due to less than 8 hours of nighttime sleep (22). A study conducted in the East Siberian region, in the city of Angarsk, confirmed excessive consumption of sweet carbonated drinks among 36–52% of children aged 10.95 [10.26; 11.64] years; 62% of respondents stated that they do not consume seafood (1).

Nutritional deficiency is accompanied by changes in body composition and leptin levels. The hormone leptin, which is produced mainly by fat cells, is responsible for regulating metabolism, hunger, and growth processes; in addition, it plays a key role in stimulating immune function and linear growth (15). Leptin deficiency reduces the secretion of Th1 cytokines and increases the production of Th2 cytokines, including IL-4. One study demonstrated an imbalance in type 1 and type 2 immune responses in children suffering from malnutrition (23). A significant decrease in leptin levels in the blood serum led to the predominance of Th2 cytokines (24). Adipokines and other cytokines, such as interleukin 6, which is secreted by adipose tissue, can also affect the airways, causing systemic inflammation and metabolic disorders (25). Thus, the ratio of muscle to adipose tissue composition determines the activity of the body's immune system.

Thus, deviations in children's physical development can lead to a decrease in the body's protective properties, thereby increasing the incidence of acute infectious diseases, exacerbating chronic diseases, and increasing the risk of metabolic disorders manifesting and diseases developing in various organs and systems, including the bronchopulmonary system. There is an urgent need for innovative treatment methods that can slow the process of accelerated weight gain in children.

2- MATERIALS AND METHODS

2 – 1. Study Design and Participants

A retrospective analysis of 972 case histories of children hospitalized in the pulmonology department of the State Healthcare Institution "KDKB" with a diagnosis of bronchial asthma [J45–J45.9] for the period from 2017–2024 was conducted.

Inclusion criteria:

- - age 1–18 years;
- - inpatient treatment in the pulmonology department;
- - established diagnosis of bronchial asthma.

Criteria for noninclusion in the group:

- - Age under 1 year and over 18 years;
- - absence of established bronchial asthma.

The severity and scope of basic therapy for bronchial asthma were in accordance with the National Program "Bronchial Asthma in Children. Treatment Strategy and Prevention" (26) and the Global Initiative for Asthma (GINA) 2025 (27).

Physical development was assessed via the WHO "Anthro" programs for children under 5 years of age and the "Anthro Plus" program for children over 5 years of age. Mild malnutrition was diagnosed when the Z-score was < -1 SD; moderate malnutrition - was diagnosed when it was between -2 SD and -3 SD; and severe malnutrition - was diagnosed when it was < -3 SD. Normal body weight corresponded to $SD-1 + 1$; excess body weight was identified when the SD was between $+1$ and $+2$; grade 1 obesity was recorded when the SD value was $2.0-2.5$; grade 2 obesity - was identified when the SD was $2.6-3.0$; grade 3 obesity was identified when the SD was $3.1-3.9$; morbid obesity - was identified when the SD was ≥ 4.0 (28).

Short stature was recorded on the basis of $SD \leq -2$; below-average height was recorded as $SD \leq -1$ to -2 ; normal growth indicators corresponded to $SD -1 + 1$; above-average height was recorded at $SD \geq +1$ to $+2$; tall stature was recorded as $SD \geq +2$.

Short stature was recorded on the basis of SD-2; below average height was SD-1 to -2; normal growth rates corresponded to SD -1 + 1; above average growth was recorded at SD + 1 to + 2; tallness was SD + 2.

The research protocol was approved by the local ethics committee of FSBEI HE ChGMA, No. 132, dated November 24, 2025.

2–2. Statistical analysis

The data were analyzed via SPSS version 26. Continuous variables are presented as the means $\pm$ standard deviations (SDs), and categorical variables are presented as frequencies (percentages). Pearson correlation coefficients were used to evaluate associations between continuous variables. One-way analysis of variance (ANOVA) was used to compare clinical variables across pubertal stages, and the chi-square test was used for categorical variables. A two-sided p value ≤ 0.05 was considered statistically significant.

3- RESULTS

The age composition of the patients over 8 years is presented below (Table 1). A total of 42 (4.3%) children were of early age, 148 (15.2%) were preschool-aged, 449 (46.2%) were early school-aged, and 333 (34.3%) were older than school-aged. Among the early-age patients, asthma was recorded in 24 (57.1%) boys and 18 (42.9%) girls ($p \leq 0.05$). In preschool-aged and primary schoolaged children, asthma was found to be 1.4 times more common in boys than in girls ($p \leq 0.01$). Older schoolchildren with asthma did not show any sex differences ($p \leq 0.05$). Overall, children aged 7–11 years predominated over those in the other age groups ($p \leq 0.05$).

Severe bronchial asthma was the most commonly recorded condition; for every second child (50.5%), it was 1.5 times more common in boys. In 321 cases (33%), moderate-severe disease was noted, and in 160 cases (16.5%), mild disease was recorded; this was 1.3 times more common among boys, which can be explained by the department's focus and the need for hospitalization in cases of moderate and severe disease. Thus, in 83.5% of children, the administration of continuous maintenance therapy with ICSs at dosages adjusted for age and the severity of the disease is justified.

In young children, mild asthma was recorded in 4 cases (9.5%), moderate-severe asthma in 16 cases (38.1%), and severe asthma in 22 cases (52.4%). Among preschool-aged patients, mild forms of asthma were recorded in 18 children (12.1%), moderate forms in 59 children (39.9%), and severe forms in 71 patients (48%). Among the younger schoolchildren, mild asthma was diagnosed in 86 (19.1%) cases, moderate asthma was diagnosed in 144 (32.1%), and severe asthma was diagnosed in 219 (48.8%) cases. Among schoolchildren aged 12–18 years, mild asthma was reported in 52 (15.6%) cases, moderate-severe asthma in 102 (30.6%), and severe asthma in 179 (53.8%) cases.

Asthma was reported to occur 1.3 times more often in boys than in girls ($p \leq 0.05$). For children aged 4–11 years, a severe course of asthma is characteristic of 48% of cases, with a predominant registration in males ($p = 0.01$). Among patients of older school age, a severe course of asthma predominates and accounts for up to 58.3% of cases, with an equal frequency of registration among girls and boys ($p \leq 0.05$). Moreover, there were no differences in the incidence of asthma between girls and boys at an early age and high school ($p = 0.05$).

In 472 (48.6%) patients with BA, normal body weight was recorded: 24 (57.1%) young patients, 69 (46.6%) preschool-aged patients, 227 (50.6%) primary school-aged patients, and 152 (45.6%) older school-aged patients (Table 2). Normal body weight was recorded in 231 (48.9%) boys and 241 (51.1%) girls ($p \leq 0.05$).

Overweight was recorded in 172 (17.7%) cases, which was 1.5 times greater among boys than among girls ($p = 0.05$). Moreover, it is 1.8 times more common in younger (17.6%) and older (22.6%) school-age children than in preschool (9.5%) and young children (9.5%; $p = 0.01$). The majority (78.4%) of overweight patients were boys aged 7–18 years ($p = 0.05$).

Obesity was diagnosed in 122 (12.5%) children with bronchial asthma (Table 3), and it was three times less common in girls ($p \leq 0.05$). Grade 1 obesity was observed in 66 (54.1%) patients, including 45 (68.2%) boys and 21 (31.8%) girls ($p \leq 0.05$). Grade 2 obesity was less common in 28 (23%) cases, and boys were 4.6 times more likely to be diagnosed with obesity than girls were ($p = 0.05$). Grade 3 obesity was reported in 13 (10.7%) patients, morbid obesity was reported in 15 (12.2%) patients, and more than 80% of the patients were boys ($p = 0.05$). At an early age, obesity was recorded in 2 (4.8%) children, with 1 case each of grade 2 obesity and morbid obesity. Obesity was identified in 12 (8.1%) preschool-aged children: Grade 1 in 3 (25%), Grade 2 in 4 (33.3%), Grade 3 in 1 (8.4%), and morbidly obese in 4 (33.3%) patients. At school age, 66 (14.7%) children were diagnosed with obesity, including 34 (51.5%) patients with Grade 1 obesity, 16 (24.3%) with Grade 2 obesity, and 8 (12.1%) each with Grade 3 obesity and morbid obesity. Obesity was detected in 42 (12.6%) children of senior school age, of which 29 (69%) had grade 1 obesity, 7 (16.7%) had grade 2 obesity, 4 (9.5%) had grade 3 obesity, and morbid obesity was observed in 2 (4.8%) cases. Thus, every third (30.2%) child with bronchial asthma has excessive fat deposition, which may be one of the factors preventing control in patients with bronchial asthma. The peak incidence of obesity was observed in children of primary school age ($p \leq 0.05$). Up to 50% of the study participants had grade 1 obesity ($p \leq 0.05$).

Excessive fat deposition is one of the causes of uncontrolled asthma (51). Morbid obesity, which is diagnosed in 14 (1.4%) children, predominates in younger school-age children – in 8 (57.1%) cases, in preschool-age children – in 4 (28.6%) cases, and in early and older school-age children – in 1 (7.1%) child in each group. In the structure of bronchial asthma associated with morbid obesity, mild severity was recorded in 2 (14.3%) children, moderate-severe severity in 5 (35.7%) patients ($p \leq 0.05$), and severe severity in 7 (50%) of the examined individuals ($p \leq 0.05$). Morbid obesity was recorded 3.6 times more often in boys than in girls ($p = 0.003$). Thus, among patients with morbid obesity, boys of primary school

age are more commonly represented, and their BMI is directly proportional to the severity of bronchial asthma.

One in three (25.8%) children aged 1–7 years, 1.6 times more often than in the older age group, was diagnosed with body weight deficiency (Table 4), and malnutrition was distributed in the following order: young patients, 12 (28.6%); preschool, 53 (35.8%); primary school students, 77 (17.1%); and senior school-aged patients, 64 (19.2%; $p < 0.05$). Mild body weight deficit was observed in 142 (68.9%) patients, moderate deficit in 47 (22.8%) children, and severe deficit in 17 (8.3%) of the examined patients ($p < 0.001$). Mild nutritional deficiency was diagnosed in 7 (58.4%) patients aged 1–3 years, moderate deficiency in 4 (33.3%), and severe nutritional deficiency in 1 (8.4%) patient ($p \leq 0.05$). Among patients aged 4–6 years, mild nutritional deficiency was recorded more than 5 times more often (75.5%), whereas moderate and severe weight deficiency were detected in 6 (11.3%) and 7 (12.2%) patients, respectively. For patients with asthma of primary school age, mild nutritional deficiency was typical in 55 (71.5%) patients, moderate-severe deficiency was typical in 17 (22%) patients, and severe deficiency was typical in 5 (6.5%) patients ($p \leq 0.05$). Among the older schoolchildren, mild nutritional deficiency was recorded in 40 (62.5%) cases, moderate deficiency in 20 (31.2%), and severe deficiency in 4 (6.3%) cases ($p \leq 0.05$). Thus, nutritional deficiency was significantly more common in younger schoolchildren than in early-aged and preschool-aged children ($p \leq 0.05$). Among children of primary school age, moderate malnutrition (71.4%) was observed 1.9 times more often than among patients of preschool age ($p \leq 0.05$). Severe body weight deficit (6.5%) was 2.1 times more common in preschoolers than in children of primary school age ($p \leq 0.05$). Malnutrition was diagnosed 1.5 times more often in boys. A mild reduction in body mass index was detected in 142 (68.9%) patients ($p \leq 0.05$).

The height of every second (53.5%) child with bronchial asthma was within the normal range (Table 5), 76 (7.8%) were below average, 29 (3%) patients were diagnosed with short stature, 220 (22.6%) were above average, and 127 (13.1%) were tall ($p \leq 0.05$).

In young patients, growth deviation was significantly more common in the form of below- and above-average values, as was tallness ($p < 0.01$). Seventy-five (50.7%) preschoolers had normal growth, 5 (3.4%) were below average growth, and 7 (4.7%) were stunted. An above average height was found in 34 (23%) children, whereas tallness was found in 27 (18.2%) preschoolers ($p < 0.05$). In younger schoolchildren, growth was recorded within the normal range in 240 (53.6%) cases ($p < 0.05$), below average in 36 (8%) cases, shortness in 8 (1.8%) cases, above average in 108 (24.1%) cases, and tallness in 56 (12.5%) cases ($p < 0.05$). Girls of high school age were 6 times more likely to be short, whereas boys were 7.7 times more likely to be tall ($p < 0.01$).

In 12 (1.2%) patients, short stature and body weight deficiency were simultaneously detected, of whom 10 (83.3%) were girls and 2 (16.7%) were boys ($p \leq 0.05$). Thus, in preschool and early school-aged children, 1 (8.3%) case was identified; body weight deficiency and short stature were observed more than 4 times more often in older schoolchildren — in 10 (83.4%) cases ($p \leq 0.05$). Mild asthma in the group of patients with low weight and height was diagnosed in 1 (8.3%) child of primary school age, moderate-

severe asthma in 2 (16.7%) children of senior school age, and severe asthma in 1 (8.3%) of the surveyed preschool age and 8 (66.7%) of the patients of senior school age.

4- DISCUSSION

Bronchial asthma was reported to occur 1.3 times more often in boys, predominantly with moderate and severe asthma. Every second child with bronchial asthma has a normal body weight. In the study by R. N. Khramov et al., normal body weight was recorded in 18/54 (33.3%) of the examined patients with asthma, undernutrition in 5/54 (9.3%) patients, overweight in 17/54 (31.5%) children, and obesity in 14/54 (25.9%) of those included in the study. Scientists from Ryazan recorded excessive fat deposition in 30% (12/40) of cases (29). We have not found any large-scale studies involving more than 900 children with bronchial asthma; therefore, these data are not comparable with other information.

Notably, excessive fat deposition, as one of the factors contributing to the lack of control over bronchial asthma, was recorded in 294 (30.2%) patients. The highest frequency of obesity was observed in children of primary school age ($p \leq 0.05$). Up to 50% of the study participants had grade 1 obesity ($p \leq 0.05$). Among patients with morbid obesity, boys of primary school age with a severe course of bronchial asthma predominate.

Excess body weight and obesity lead not only to a reduction in the therapeutic effect of achieving control but also to underweight, thereby reducing the body's resistance to infectious diseases, which are triggers for the exacerbation of bronchial asthma. Preschool-aged children are characterized by a severe course of nutritional deficiency, whereas moderate nutritional deficiency is significantly more common in younger school-aged children ($p \leq 0.05$).

In 53.5% of the children with bronchial asthma, growth indicators corresponded to age-related norms. Thus, short stature and nutritional deficiency were recorded in girls of older school age, mainly in cases of severe bronchial asthma, compared with boys of an earlier age with a milder course of the disease ($p \leq 0.05$).

When analyzing anthropometric data in children with bronchial asthma, growth abnormalities were recorded with the same frequency among both reduced parameters in the form of shortness and below average and tallness and above average, which confirms that the use of IGCSs does not affect growth and is statistically insignificant ($p \leq 0.05$).

Thus, in patients with short stature and above-average height, severe asthma was recorded in every second child ($p \leq 0.01$); for children whose height was below average and tall, moderate-severe and severe ASTHMA occurred with the same frequency and prevailed over mild asthma ($p \leq 0.01$).

Conclusion

Up to a quarter of children with bronchial asthma have excess fat deposition of varying degrees, which in turn leads to a significant reduction in disease control and quality of life. Therefore, patients with overweight and obesity require a comprehensive approach to therapy, including monitoring of food intake — in particular, calorie consumption — and an increase in physical activity.

Declarations

Author Contribution

All authors made a proportional contribution to the writing of the manuscript.

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8 - CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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Tables

Tables 1 to 5 are available in the Supplementary Files section.

Supplementary Files

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