Оригинальная статья / Original article

Epidemiological trends of bronchial asthma symptoms in adolescent children in the Udmurt Republic. The results of long-term research

RAR — научная статья

https://doi.org/10.53529/2500-1175-2025-1-32-39

Date of receipt:19.08.2024
Date of acceptance:23.10.2024
Date of publication: 21.03.2025

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Annotation. Taking into account the spread of asthma symptoms in dynamics in different regions using proven techniques allows you to get the most complete picture of this process and identify regional features.
Materials and methods. Monitoring of the spread of asthma symptoms was carried out within the confines of the ISAAC program from 2002 to 2019–2020. The results obtained were compared with the results of 1999. Udmurt teenagers aged 13–14, studying in schools of the republic, participated in the survey, a total of 12 856 people.
Results. By 2019–2020, the prevalence of asthma symptoms increased compared to 1999 and was 10.2%. The problem of underdiagnosis of the disease persists. There is a decrease in severe forms of asthma and the frequency of recurrence of night and daytime symptoms. The number of children who responded to physical activity with difficulty breathing, as well as respondents with frequent attacks of non-infectious cough, increased significantly. In general, a negative trend is observed in the statistics of bronchial asthma symptoms.
Conclusions. Long-term observation allowed us to obtain data that are an important contribution to understanding not only the trends of BA in the Udmurt Republic, but also in their further study.

Keywords: asthma symptoms, bronchial asthma, adolescents, prevalence

Conflict of interests:
The authors declare no conflict of interest.

For citation: Matveeva L.P., Ermakova M.K., Kapustina N.R. Epidemiological trends of bronchial asthma symptoms in adolescent children in the Udmurt Republic. The results of long-term research. *Allergology and Immunology in Pediatrics*. 2024; 23 (1): 32–39. https://doi.org/10.53529/2500-1175-2025-1-32-39

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Оригинальная статья / Original article

Эпидемиологические тенденции симптомов бронхиальной астмы у детей подросткового возраста в Удмуртской Республике. Результаты многолетнего наблюдения

https://doi.org/10.53529/2500-1175-2025-1-32-39

УДК 616.248-036.22-053.2(470.51)
Дата поступления: 19.08.2024
Дата принятия: 23.10.2024
Дата публикации: 21.03.2025

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Аннотация. Изучение распространенности бронхиальной астмы с использованием стандартизованных методик в динамике позволяет сформировать наиболее полное представление о трендах заболевания в своем регионе и контролировать его дальнейшее распространение.

Материалы и методы. Проведены когортные исследования частоты проявления симптомов бронхиальной астмы среди подростков по протоколам программы «Международное изучение астмы и аллергии у детей» с 2002 по 2019–2020 годы и сравнение полученных результатов с итогами 1999 года. Всего в исследовании приняло участие 12 856 удмуртских школьников 13–14 лет.

Результаты. К 2019–2020 годам распространенность симптомов астмы увеличилась по сравнению с 1999 годом и составила 10,2%. Сохранялась проблема гиподиагностики заболевания. На фоне уменьшения тяжелых форм астмы и частоты реци% дивирования ночных и дневных симптомов было выявлено достоверное увеличение числа детей, реагирующих одышкой на физическую нагрузку, и респондентов с частыми эпизодами неинфекционного кашля. Зарегистрирован общий негаи тивный статистический тренд симптомов и диагноза «бронхиальная астма», имеющий незначительный прогредиентный рост.

Выводы. Выявленные негативные и позитивные эпидемиологические тенденции свидетельствуют об актуальности представленной проблемы в Удмуртской Республике, о необходимости дальнейшего мониторирования статистики броне хиальной астмы у подростков и совершенствованию программ ее профилактики.

Ключевые слова: симптомы астмы, бронхиальная астма, подростки, распространенность

Конфликт интересов:
Авторы заявляют об отсутствии конфликта интересов.

Для цитирования: Матвеева Л.П., Ермакова М.К., Капустина Н.Р. Эпидемиологические тенденции симптомов бронхиальной астмы у детей подросткового возраста в Удмуртской Республике. Результаты многолетнего наблюдения. *Аллергология и иммунология в педиатрии*. 2024; 23 (1): 32–39. https://doi.org/10.53529/2500-1175-2025-1-32-39

INTRODUCTION

Regular monitoring of the prevalence of bronchial asthma (BA) in different regions allows to create the most accurate picture of this process in the pediatric population. This approach helps to identify children at risk of the disease, to take timely preventive measures and to control its further spread [1, 2]. For more than 30 years, validated methods have been used to determine global trends in the prevalence of BA, which make it possible to obtain comparable data [3, 4]. A particularly accurate picture of BA prevalence trends is becoming clearer through a unique study of more than two million participants from around the world, the ISAAC (International Study of Asthma and Allergy in Children) program [5]. The results of this large-scale study are a valuable tool for assessing the dynamics of BA prevalence at the global level. Local observations conducted in different regional medical centers of the country revealed a positive dynamic pattern of asthma symptom prevalence in children of different age groups [6, 7, 8, 9, 10, 11, 12, 13, 14, 15].

The first steps to study the prevalence of allergopathology using ISAAC protocols in the Udmurt Republic were taken in 1999. At that time, the prevalence of asthma symptoms was 7,5% in first-graders and 9.3% in eighth-graders. Although the figures obtained correlated with the results of other Russian researchers, they nevertheless became an alarming signal for the

Table 1. **Quantitative characteristics of the compared groups of eighth graders (authors' table)**
Таблица 1. **Количественная характеристика сравниваемых групп восьмиклассников (табл. авторов)**

Indicator	2002	2009	2014	2019–2020
Number of schools	38	35	36	51
Number of eight-graders	3943	2788	2845	3280

republican public health service. Asthma schools were organized in the capital and cities of the republic, and in remote rural areas they were held online. A screening table developed for pediatricians made it possible to identify children at risk of BA and to organize dynamic monitoring of them, taking into account the individual characteristics of each patient [16]. The effectiveness of the conducted measures was assessed by the results of repeated monitoring of the prevalence of asthma symptoms. Thus, according to the data of the 2019-2020 survey, the prevalence of BA symptoms in first-graders was 7.7%, which indicated the stabilization of the situation among junior schoolchildren [17].

STUDY OBJECTIVE

To identify key epidemiologic trends of BA by analyzing the prevalence of the disease in dynamics over 20 years among Udmurt adolescents.

MATERIALS AND METHODS

A large-scale study of the prevalence of BA symptoms was conducted within the framework of the ISAAC program [18]. Four cohort studies were conducted: in 2002, stage III according to the methodological recommendations of the standardized program, the next three in 10, 15 and 20 years from the beginning of the first observation in 1999 (Table 1). A total of 12,856 Udmurt adolescents aged 13-14 from urban and rural schools of the republic took part in the study. The survey of schoolchildren was conducted in the fall and winter as part of the "class hour" lesson with the informed consent of parents and children themselves. The study was conducted with the approval of the local ethical committee of the Medical Academy according to the legislation, which guaranteed compliance with all ethical norms and principles of medical research.

The result of long-term observation was the creation of a database. The database was analyzed using Microsoft Excel and SPSS programs via parametric criteria. The significance of differences and reliability of the results were assessed using Student's t-test. Differences in all types of analysis were considered reliable at $p < 0.05$.

RESULTS AND DISCUSSION

The study found that in 2002, there was a 6.5% increase in the number of students with the symptom of "wheezing ever" by 6.5%, 1.3 times higher than in the first phase of the study. An important observation was that the prevalence of the symptom remained stable for 5 years, with a subsequent decrease in this rate. More detailed information on the dynamics of changes in the prevalence of asthma symptoms is presented in Table 2. The second question of the questionnaire, concerning the presence of "wheezing and rale in the chest during the last 12 months", turned out to be the key to determine the prevalence of BA symptoms among the adolescent population of the republic. Comparison of the results of this question for 2019-2020 with the 1999 premiere survey showed an increasing trend from 9.3±0.5% to 10.2±0.5% ($p > 0.05$). The observed changes were not random, they reflected a real trend of increasing prevalence of BA symptoms. It should be emphasized that the results obtained were nationwide and not limited to a particular region [19].

Overall, over the past two decades, by 2020, there has been a positive downward trend in the number of severe cases. Analysis of the database, including the results of the questionnaire, revealed a marked decline in the number of participants experiencing "severe breathing difficulties", a 1.6-fold decrease compared to 1999. This decrease is statistically significant ($p < 0.01$). Throughout the study, the majority of children surveyed favored mild manifestations of the disease, with the frequency of symptoms less than

Table 2. **Dynamics of symptoms and diagnosis of asthma in adolescents over 20 years (authors' table)**
Таблица 2. **Динамика симптомов и диагноза БА у подростков за 20 лет (табл. авторов)**

Symptoms	Monitoring period / symptom prevalence (%)				
	1999	2002	2009	2014.	2019–2020
Wheezing and rale in his chest has ever	19,9±0,7	26,4±0,7	26,1 ±0,8¤¤¤	22,9±0,8	23,5 ±0,7***
Wheezing and rale in his chest during the last 12 months (actual)	9,3 ±0,5	10,7 ±0,5	10,3 ±0,6	9,5 ±0,5	10,2 ±0,5
Nocturnal wheezing episodes less frequently than once a week during the last 12 months	2,1 ±0,3	3,6 ±0,3	3,3 ±0,3¤	2,1 ±0,3	2,5 ±0,3
Nocturnal wheezing episodes more than once a week during the last 12 months	1,7 ±0,2	1,4 ±0,2	1,7 ±0,2	1,5 ±0,2	1,1 ±0,8
Severe shortness of breath or episodes of heavy breathing during the last 12 months	3,3 ±0,3	3,8 ±0,3	2,3 ±0,3¤¤	2,9 ±0,3	2,1 ±0,3**
Diagnosed BA	2,4 ±0,3	2,1 ±0,2	3,0 ±0,3	3,2 ±0,3	3,5 ±0,3*
Shortness of breath after physical activity during the last 12 months	7,5 ±0,5	10,7 ±0,5	9,1 ±0,5¤	9,7 ±0,6	10,1 ±0,5***
Dry cough not associated with a respiratory infection during the last 12 months	7,2±0,5	10,9±0,5	10,3 ±0,6¤¤¤	12,8±0,8	13,1 ±0,6***

Note: ¤ <0,05, ¤¤ <0,01, ¤¤¤ <0,001 — significance of differences compared to 1999; * <0,05, ** <0,01, *** <0,001 — significance of differences compared to 1999.

four times a year (Fig. 1). However, the 2014 survey showed a sharp increase in moderately severe asthma compared to 2009, 3.1 times, which persisted for the second decade ($p < 0.001$). Meanwhile, the number of learners with severe asthma symptoms decreased consistently throughout the follow-up, with a 1.3-fold decrease by 2019-2020.

Another favorable downward trend was observed when comparing the frequency of nocturnal symptoms of "coughing or difficulty breathing" in interviewed children in the second research decade.

With the introduction of baseline therapy and the use of a stepwise approach depending on the severity of the disease, Udmurt adolescents achieved progress

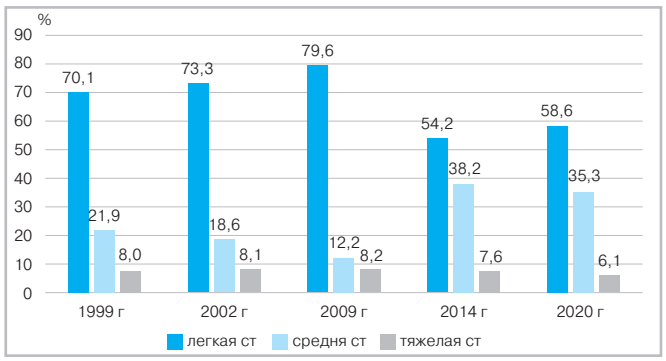

Fig. 1. **The structure of BA by severity in eighth graders, (%) (authors' ill.)**
Рис. 1. **Структура БА по степени тяжести у восьмиклассников, (%) (рис. авторов)**

in the course of AD in the form of a decrease in the frequency of exacerbation and the severity of daytime and nighttime symptoms. In addition, in our opinion, these favorable trends were a consequence of the organization of preventive measures implemented at the republican level: specially designed thematic lessons in educational institutions, adapted to the understanding of adolescents, school-wide parent-teacher meetings, contributing to raising awareness of the problem of bronchial asthma; organization of online consultations and asthma-schools, providing specialized information to patients with newly diagnosed asthmatic symptoms and build adherence to treatment. This was confirmed by the data obtained in the course of monitoring.

The ISAAC program's dynamic follow-up revealed some negative trends. As the number of respondents with severe asthma manifestations decreased, such a symptom as difficulty breathing during physical activity became a more urgent problem. Thus, in the period 2019-2020, adolescents complained about this symptom 1.6 times

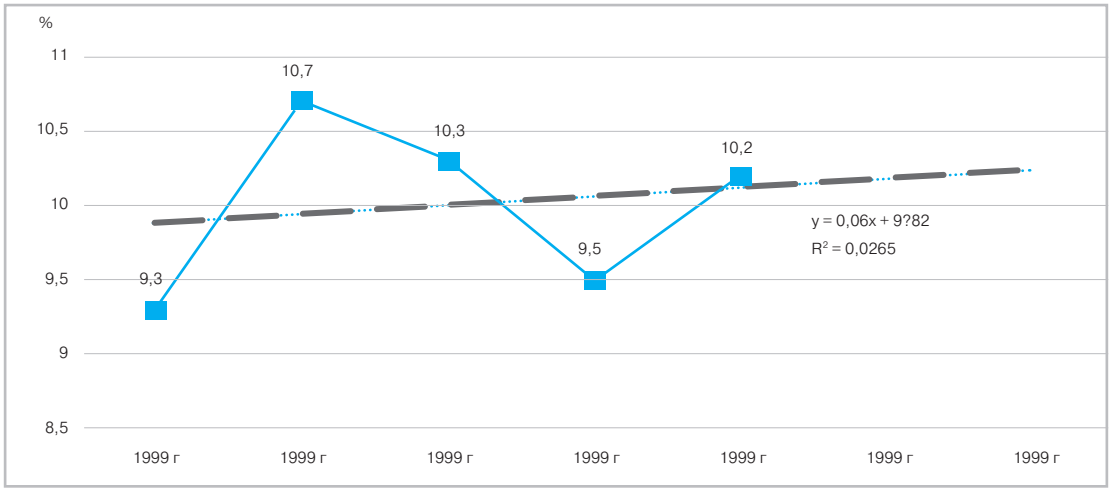

Fig. 2. **Prevalence of current asthma symptoms in eighth graders, trend line, (%) (authors' ill.)**
Рис. 2. **Распространенность текущих симптомов БА у восьмиклассников, линия тренда, (%) (рис. авторов)**

more often than in 1999 ($p < 0.001$). Another alarming signal was the increase in the rate of "dry cough unrelated to cold", compared to 1999, it increased 1.8 times by 2019-2020 ($p < 0.001$) Such cough can be one of the signs of developing asthma, and it is important to differentiate it in time. In our opinion, the increase in these symptoms is due to schoolchildren smoking.

Nowadays, adolescents more often use more modern means of nicotine delivery. Studies conducted in the Udmurt Republic show a 1.3-fold increase in the number of adolescent smokers over the last 10 years. Such indicators can be explained by the wide choice and availability of modern nicotine delivery devices and smoking mixtures, which, in turn, lead to the formation of hyperreactivity of the respiratory tract mucosa and become triggers for the development of symptoms such as asthma [20].

According to the 2019-2020 survey, 3.5% of schoolchildren surveyed confirmed their diagnosis of BA, 1.5 times higher than in 1999. This positive trend in improving the quality of asthma diagnosis is the result of targeted work on training of primary care physicians. More than 90% of pediatricians in the republic have attended seminars, aimed at improving theoretical knowledge in the field of modern therapeutic and diagnostic approaches to BA. But, as the observation showed, the difference between the actual symptoms of the disease and the established diagnosis remained fundamental. These data confirm the official statistics of morbidity, based on cases of applications mainly with moderate and severe manifestations of BA [21].

Long-term scientific experience allowed us to identify a trend in the prevalence of BA symptoms among adolescents of the republic until 2029, which had a progredient orientation.

CONCLUSION

Dynamic follow-up conducted in the Udmurt Republic using standardized ISAAC methodology over a 20-year period revealed negative and positive trends in the prevalence of BA. Data were obtained on the increasing prevalence of actual asthma symptoms, the persistent difference between diagnosed and detected cases of the disease, despite the improvement of BA diagnostics in the child and adolescent population. Symptoms corresponding to mild disease predominated in each follow-up period, but in the second decade of the study there was a trend towards an increased prevalence of symptoms with more frequent recurrences. There was a decrease in the detection of severe manifestations of the disease and in the frequency of recurrence of nocturnal and diurnal symptoms. There was a significant increase in the number of adolescents responding with breathing difficulties to physical activity and respondents with frequent episodes of non-infectious cough. The results were based on questionnaire data. It is possible that some participants may have underestimated and others

may have overestimated the frequency and severity of their symptoms, which could have affected the results. However, examination of long-term data from 1999 to 2019-2020 allowed us to recognize a general negative trend in adolescents in the republic. The comprehensive preventive measures carried out at the level of republican health care did not allow the prevalence trend to have a significant progressive growth. Thus, long-term follow-up allowed us to obtain data that are an important contribution to the understanding of BA trends in the Udmurt Republic. The identified epidemiological trends indicate the relevance of further monitoring of BA statistics in adolescents and improvement of medical prevention programs.

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FINANCING SOURCE

The authors declare the lack of sponsorship during the research and publication of the article.

ИСТОЧНИК ФИНАНСИРОВАНИЯ

Авторы заявляют об отсутствии спонсорской поддержки при проведении исследования и публикации статьи.

THE AUTHORS' CONTRIBUTION TO THE WORK

Larisa P. Matveeva — conducting research, developing the design of the publication, working with the text of the manuscript.

Margarita K. Ermakova — review of publications on the topic of the article, working with data, editing the text of the article.

Natalia R. Kapustina — conducting research, working with data.

ВКЛАД АВТОРОВ В РАБОТУ

Матвеева Л. П. — проведение исследования, разработка дизайна публикации, работа с текстом рукописи.

Ермакова М. К. — обзор публикаций по теме статьи, работа с данными, редактирование текста статьи.

Капустина Н. Р. — проведение исследования, работа с данными.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the local ethics committee of Izhevsk State Medical Academy of the Ministry of Health of Russia.

ЭТИЧЕСКОЕ ОДОБРЕНИЕ И СОГЛАСИЕ НА УЧАСТИЕ

Данное исследование одобрено локальным этическим комитетом ФГБОУ ВО ИГМА Минздрава России.