

## NUTRITION IN THE NORTH

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## EPIDEMIOLOGY OF NUTRITION AND HEALTH OF CHILDREN AND ADOLESCENTS OF REPUBLIC OF SAKHA (YAKUTIA) BASED ON RESULTS OF MONITORING STUDIES

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## ABSTRACT

A Center of Nutrition of a Scientific Research Institute of Health of the M.K. Ammosov North-Eastern Federal University has carried out monitoring epidemiological studies since 2001 on actual nutrition and eating habits among children and adolescents aged 10-18. The study uses a food questionnaire developed by a Federal State Budgetary Institution of Science «Federal Research Center of Nutrition, Biotechnology and Food Safety» (FSBIS «FRC of Nutrition, Biotechnology and Food Safety») and Federal State Budgetary Institution «National Medical Research Center for Preventive Medicine» (FSBI «National Medical Research Center for Preventive Medicine») of the Ministry of Health of Russia, adapted in accordance with peculiarities of culture and traditions of the nutrition of peoples of the North. The food questionnaire includes a section on the study of the eating habits and awareness of respondents about the healthy nutrition. Using a method of frequency analysis of consumption of certain products and daily nutrition reproduction from memory, main parameters of consumption of the particular food products including the Yakut national foods and dishes were studied. Daily rations of 5046 children and adolescents were studied by the method of daily nutrition reproduction and were evaluated in accordance with norms of nutrition (methodological recommendations MR 2.3.1.2432-08 «Norms of Physiological Needs for Energy and Food Substances for Various Groups of Population of Russian Federation»). On average, only 62.2% of examined subjects corresponded to an energy value of the rations, almost everyone had a deficiency of micronutrients (vitamins and minerals).

**Keywords:** children and adolescents, regional features, actual nutrition, eating habits, state of health.

## Introduction

The health of the children and adolescents in any society and in various socio-economic and political situations is the most urgent problem and a matter of priority, as it determines the future state of a nation gene pool, providing scientific and technical development of a country, and it is a sensitive indicator of a change of the demographic situation of the state [1]. A European strategy "Health of children and adolescents" (World Health Organization (WHO), 2005), a Concept of development of health service of Russian Federation till 2020 and a Decade of childhood for 2018-2027, declared by an Executive Order of the President of the Russian Federation [13], consider obligations to protect the health of the younger generation as investments in a major resource of social development. The organization of the rational nutrition of the children and adolescents is one of key factors of maintenance of their health, harmonious development and effectiveness of education [10, 11, 12]. The nutrition, which is adequate in qualitative and quantitative senses, contributes to preservation of the physical and mental health of the younger generation [5]. On the contrary, the physiologically inadequate nutrition during childhood and adolescence can lead to serious disorders of organism vital activity, emergence of diseases of a digestive system, endocrine and musculoskeletal systems [7, 9]. In various regions of the Russian Federation, the nutrition of the children and adolescents has its own character-

istics. According to data of Konovalova O. V. (2012), the basic disorders of a diet of adolescents in the Far North are: non-compliance with a nutrition regime, a failure to comply with the drinking regime, non-observance of optimal proportions between main ingredients of food, an excess of refined foods, simple carbohydrates and animal fats, the deficiency of vegetable oils, unsaturated fatty acids, fiber, B vitamins, the vitamins C, A and E, sulfur containing amino acids, fermented milk products, food antioxidants, the disorders of an amount and proportion of dietary mineral elements (iron, calcium, phosphorus, iodine, chromium, selenium, copper, zinc, etc.) [3, 4, 6, 7].

To ensure an optimal course of metabolic processes, to strengthen immunity, it is required a regular balanced intake of several dozen types of macro- and micronutrients. A variety of the nutrition is necessary in connection with the fact that no product contains a full spectrum of nutrients necessary for the normal vital activity of the child organism [2, 8]. In this regard, the study of the actual nutrition and its impact on the children's health is the most urgent problem of the present time.

**An aim** of this paper is a dynamic assessment of the actual nutrition and eating habits among the children and adolescents of the Republic of Sakha (Yakutia) in connection with their health status.

**Materials and methods of research**

The first epidemiological study on the actual nutrition of children in two cities

(Yakutsk and Neryungri) and 6 districts (Aldan, Verkhoyansk, Vilyuisk, Gorny, Megino-Kangalas and Suntar) of the Republic was conducted in 2001 within the context of implementation of a Plan of Activities of the Concept of State Policy on the Healthy Nutrition of the Population of the Republic of Sakha (Yakutia) for the Period till 2005 (2001). A sample was 1324 children aged 10 to 18 years. The subsequent studies were conducted every 5-6 years, in the same areas with the samples of 1569 and 2153 children, respectively. The questionnaires of the FSBIS "FRC of Nutrition, Biotechnology and Food Safety" and FSBI "National Medical Research Center for Preventive Medicine" of the Ministry of Health of Russia were used in the study. These questionnaires were adapted to the maximum extent by staff of the Center of Nutrition of the Scientific Research Institute of Health of the M.K. Ammosov North-Eastern Federal University in accordance with the traditions and culture of the nutrition of the population of the North and Arctic. The frequency of consumption of 12 Yakut national foods and dishes was separately studied. A calculation of a food set and chemical composition of foods and dishes was carried out at the FSBIS "FRC of Nutrition, Biotechnology and Food Safety". Within the context of the present epidemiological studies, the complex assessment of the actual nutrition and health of adolescents aged 15-18 was conducted in 2012-2013. 130 medical cards of schoolchildren were analyzed, the physical parameters (the

parameters of anthropometry and body composition) were studied using a Japanese apparatus "Tanita". The anthropometric parameters (length, body weight) were studied in accordance with methodological guidelines "Standards of Individual Assessment of Physical Development of Schoolchildren of Republic of Sakha (Yakutia)" (2001). Statistical processing of the factual material was carried out using a package Statistica 7.0.

### Results and discussion of them

The analysis of the state of the actual nutrition discovered some features of the nutrition among the urban and rural children and adolescents.

Thus, in the daily ration, the rural schoolchildren had the meat products 1.5-2 times higher than the recommended norms. Of the varieties of meat, children preferred beef (40-50%), colt meat (38.4-52%), pork was rarely consumed (10-14%). Fish was only present in the daily diet of 22.07%, 19.5%, 12.9% of the children in different years of the study, respectively. As of the milk, in all sex-age groups, frequent use of the milk with a low fat content (0.5-2.5%) was noted. In the different years of the studies they consumed 76.0%, 79.9% and 60.3% of the recommended standards, respectively. Sour milk products (kefir, yogurt, cottage cheese) were consumed on average by half of the children and adolescents surveyed, with preference given to the products of local producers.

In the different years of the study, a majority of the surveyed people (92%, 72.8% and 86%) daily consumed wheat bread, and the rye one only 1.8%, 2.5% and 7.5%, respectively. It should be noted that from year to year the consumption of the rye bread increased, and the wheat bread consumption decreased. A significant drawback in the diet of the urban and rural children and adolescents is absence of vegetables in 84%, 76% and 71% and fresh fruits in 86%, 64% and 82%, respectively. Here it should be noted that the imported fruits and vegetables are mainly sold in the Republic of Sakha (Yakutia).

Such products as pasta, cereals, potatoes, fresh fruits and vegetables were consumed several times a week by 42.7% - 53.6% of the urban and rural children and adolescents surveyed, the dried fruits and nuts rarely or never, chips 43.8% - 62.4%. At the same time, there was discovered the increased consumption of sugar and sweets among the urban children on average by 196% and the rural ones by 154%.

When analyzing the qualitative composition and energy value of the daily rations of the urban and rural surveyed

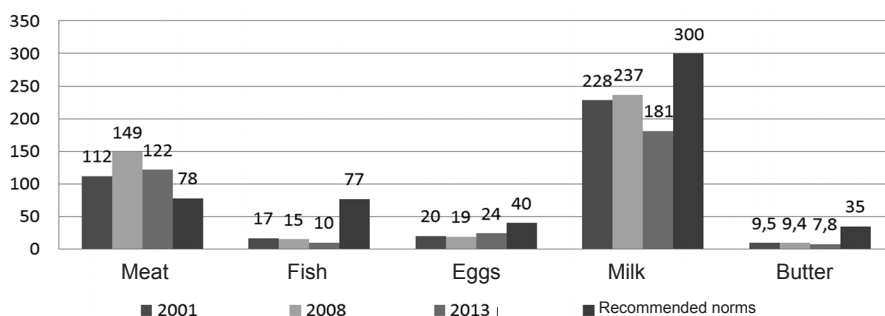


Fig.1. Average daily intake of products containing animal protein.

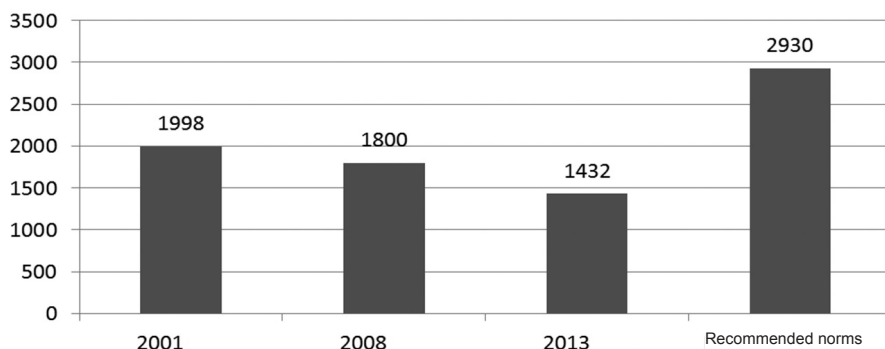


Fig.2. Average daily energy value of diets of children and adolescents of RS (Y).

subjects, the insufficient intake of almost all macronutrients (the proteins, fats and carbohydrates) from the food was discovered. On average, the intake of protein from the ration in the different years of the study amounted to 76%, 58% and 46%, fat 75%, 54% and 52%, carbohydrates 74%, 61.6% and 60.4%, respectively. It is determined that the average volume of fiber intake is much lower than the recommended values. The energy value of the ration of the surveyed subjects corresponded to 71.3%, 64.3% and 51.1% of the recommended food standards.

An energy contribution of the macronutrients is as follows: carbohydrates 52%, 55% and 54%, proteins 15%, 14% and 14%, fats 31%, 31% and 32%. Thus, the inadequate protein contribution to the energy value of the rations in 2008 and 2013 was discovered, the contribution of carbohydrates and fats was slightly higher for the surveyed subjects in the different years of the research (Table 1).

Within the framework of the studies, provision of the rations with the vitamins and minerals (B1, B2, PP, A, C, iron, calcium, magnesium, phosphorus, potassium and sodium) was investigated. The average daily intake of the vitamins among the children and adolescents was as follows: B1 57.1%, 55.7% and 52.8%, B2 43.7%, 56.2% and 56.2%,

PP (niacin) 54.7%, 57.9% and 65.8%, respectively. We also found the insufficient intake of vitamin A (66.0%, 66.0% and 64.3%).

The average daily intake of vitamin C in the dynamics by years corresponds to 48.9%, 83.6% and 48.9% of the recommended values. However, in 2008 due to C vitaminization of third courses, the intake of vitamin C was 2 times higher than in 2001 and 2013. It should be noted that during the study in the rations of children and adolescents in 2008, tea with ascorbic acid was included in accordance with Sanitary Regulations and Standards (SanRaS) requirements for the C- vitaminization of the third courses (Table 2).

A similar situation was noted with respect to the average daily consumption of macro- and microelements for the years of research.

Thus, the average daily consumption of the minerals in the years under study was: iron 80.0%, 86.6% and 64.7%,

Table 1  
Energy contribution of proteins, fats and carbohydrates, %

Macro-nutrients	Recommended values	2001 (n=1324)	2008 (n=1569)	2013 (n=2153)
Proteins	not less than 15	15	14	14
Fats	not more than 30	31	31	32
Carbohydrates	less than 50	52	55	54

Table 2

## Average daily intake of essential vitamins, mg/d

Vitamins, mg	Norms of physiological needs for children and adolescents*	2001 (n=1324)	2008 (n=1569)	2013 (n=2153)
A, $\mu\text{g}$ retinol equivalent	900	594	594	579
B1	1,4	0,8	0,8	0,7
B2	1,6	0,7	0,9	0,9
PP	19,0	10,4	11,0	12,5
C	73,0	35,7	61,0	35,7

\* Norms of physiological needs in energy and nutrients for children and adolescents of the Russian Federation, Methodical recommendations MR 2.3.1.2432—08 (Table 5.4).

calcium 34.7%, 41.5% and 29.7%, magnesium 59.4%, 57.8% and 49.4%, phosphorus 72.7%, 72.3% and 60.2%, potassium 106.0%, 104.7% and 82.4%, respectively, of the recommended norm. As for the sodium consumption, its average daily intake of the surveyed subjects was almost 2.0-2.5 times (244.7, 240.0 and 209.3%) the recommended intake norms (Table 3). The excess sodium intake can be associated with the excess daily average intake of table salt.

During the study, we investigated the eating habits and awareness of healthy nutrition issues. The eating habits were studied with regard to the consumption of the fat, milk and salt. The overwhelming majority of the urban and rural respondents (70-75.5%) noted that in their families the food was cooked using the vegetable oil. 60-66.1% of the respondents use butter for sandwiches, 6.7-10% margarine, 20-27.2% do not use the sandwich butter or margarine.

The study of availability of dairy products (presence in a retail network) with the different fat contents showed that on average up to 70% of the urban children and up to 30% of the rural ones of the total number of the surveyed subjects answered that there was always a choice of milk with the different fat contents in stores. In the different years of the research on the average, half of the respondents answered that there was always the choice of dairy products on shelves of the stores. From 30% to 40% answered that such products were sometimes available, up to 10% answered that such products on the shelves of shops could be rare.

The study of awareness of principles of healthy eating has shown that the children and adolescents have an insufficient level of knowledge in this area. So, with regard to the group of foods that should form a basis of the healthy diet, opinions of the respondents differed from the current recommendations of the World Health Organization (WHO) on the

healthy nutrition. In particular, on average up to 65% of the respondents knew about a benefit of iodized salt, and only up to 46.1% of children rarely consumed it. More than half of the respondents (up to 65.0%) during the years of the studies misused the salt: they added more salt to the food at the table, considering it not salty enough. 50% of the children preferred to consume the milk with the fat content of 3.2%, up to 35.0% of the children chose skim milk and 15% of the children categorically denied the consumption of this product type.

In all cases it was shown that the actual consumption was much lower than the awareness of the children and adolescents of the healthy nutrition (Fig. 3, Fig. 4).

Using the frequency method, the frequency of the consumption of 49 food products was studied including the consumption of the national foods and dishes. It was discovered that about 10% of the schoolchildren had very rarely consumed the national dishes of the peoples of the North (Table 4).

Within the framework of the epidemiological studies during 2012-2013, the comprehensive assessment of the actual nutrition and health of the schoolchildren aged 15-18 was conducted. The medical cards of 130 schoolchildren were analyzed. It was revealed that 53.3% of the children had the eye diseases (myopia, astigmatism, accommodation spasm, retinal angiopathy), 40% had euthyroid goiter, 26.7% had chronic centers of infection (tonsillitis, rhinitis, rhinosinusitis), 16.7% a postural disorder, 13.3% flat feet and 6.7% scoliosis and musculoskeletal system diseases (66.7%), including fractures of bones and spine (30%). These disorders were statistically associated with the poor nutrition, in particular, the eye diseases were associated with the inadequate consumption of the fruits and vegetables, berries, fish and the deficiency of the ration of vitamin B<sub>1</sub> ( $p < 0.05$ ).

Table 3

## Average daily intake of basic minerals, mg/d

Minerals, mg	Norms of physiological needs for children and adolescents*	2001 (n=1324)	2008 (n=1569)	2013 (n=2153)
Fe	15	12	13	9,7
Ca	1200	416	498,5	354,8
Mg	350	208	202,5	172,9
P	1200	872	868	721,9
K	2000	2120,0	2093,5	1647,6
Na	1200	2936,4	2880,5	2511,2

When studying the anthropometric and body composition parameters, actual height of boys and weight of girls did not meet the standard norms (Table 5).

30% of the examined children had the low level of a body mass index. These children were characterized by the low energy value of the ration  $1691.01 \pm 183.4$  ( $p < 0.04$ ), the low protein contribution to the energy value of the ration  $13.4 \pm 0.9$ , the deficiency of calcium  $543.8 \pm 149.5$ , iron  $11.0 \pm 1.9$  ( $p < 0.04$ ), B1  $0.6 \pm 0.04$  ( $p < 0.007$ ), B2  $0.9 \pm 0.2$  ( $p < 0.002$ ), vitamin A  $0.5 \pm 0.2$  ( $p < 0.003$ ), phosphorus  $869.1 \pm 83.2$  ( $p < 0.01$ ), fat  $66.6 \pm 7.8$  ( $p < 0.02$ ) and protein  $53.7 \pm 3.7$  ( $p < 0.05$ ). These children did not eat enough eggs  $35.7 \pm 16.9$  ( $p < 0.002$ ), fruits and berries  $125.5 \pm 83.7$  ( $p < 0.001$ ). They had the low content of calcium in urine  $1.3 \pm 0.2$  ( $p < 0.02$ ), a low percentage of the body fat  $10.5 \pm 1.7$  ( $p < 0.001$ ) and the percentage of water in the body  $65.5 \pm 1.3$  ( $p < 0.002$ ).

### Conclusion

The nutrition of the children and adolescents of the Republic of Sakha (Yakutia) has its regional features, which are characterized by the low energy value of the rations, the presence of the deficiency of basic food components, imbalance of the nutrient composition, as well as insufficient formation of the national traditions and culture of food of northerners among the children. This unsatisfactory nutrition was statistically associated with the prob-

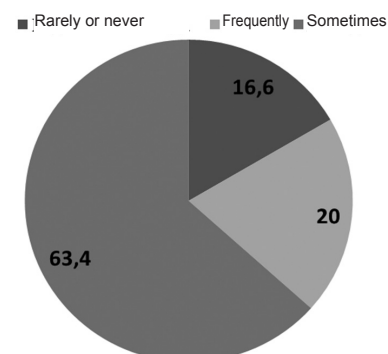


Fig. 3. Frequency of consumption of vitamins and minerals (%).



Frequency of consumption of national dishes

Table 4

National products and dishes	Daily			Several times a week			1-2 times a week			Rarely or never		
	2001	2008	2013	2001	2008	2013	2001	2008	2013	2001	2008	2013
Elk meat	0	0	0	0	0	0	0	6,7	0	100,0	93,3	100,0
Venison	0	3,3	0	0	0	6,6	12,0	10,0	20,0	78,0	86,7	73,4
Salamat	0	0	0	0	3,3	3,3	6,6	6,7	6,6	93,4	90	90,1
Kuorchekh	0	0	0	13,3	13,3	24,6	10,0	13,4	12,7	76,7	73,3	62,7
Hare meat	0	0	0	0	0	3,3	6,6	13,3	0	93,4	86,7	96,7
Suorat	0	0	0	6,6	3,3	6,6	6,6	10	12,6	86,8	86,7	80,8
Byyrapakh	0	0	0	0	0	0	0	3,3	0	100,0	96,7	100,0
Kumys	0	0	0	0	0	0	0	6,7	0	100,0	93,3	100,0
Blood sausage	0	0	0	0	0	3,3	0	10	0	100,0	90	96,7
Offal	0	0	0	0	0	0	0	10	0	100,0	90	100,0
Pancakes	0	0	0	6,6	3,3	12,6	28,5	46,7	32,5	64,9	50	54,9
Waffles	0	0	0	0	0	3,3	0	6,7	3,2	100,0	93,3	93,5

Table 5

Anthropometric parameters and body composition of schoolchildren surveyed

Parameters	Whole sample M ± m	Recommended norms	Boys M ± m	Recommended norms	Girls M ± m	Recommended norms
Height	166,6 ± 1,4	151-170	174,1 ± 2,2	154-170	162,8 ± 1,1	151-163
Weight	55,5 ± 1,4	37,5-67,5	53,6 ± 1,5	37,5-67,5	40,6 ± 13,5	42,9-59,1
BMI	19,9 ± 0,4	18,5-24,9	19,6 ± 0,7	18,5-24,9	20,2 ± 0,5	18,5-24,9
% of body fat	18,3 ± 1,5	13-25	9,5 ± 1,9	13-17	22,6 ± 1,3	18-25
% of water in body	59,8 ± 1,1	65-77	66,2 ± 1,4	65-77	56,6 ± 0,9	65-77

lems of the health state of children and development of the diseases ( $p < 0.05$ ).

The results of the monitoring epidemiological studies conducted in the Republic of Sakha (Yakutia) are the fundamental scientific, methodological and analytical basis for improving the system of the nutrition of the children and adolescents studying in the educational organizations. This basis is an instrument for the development of the scientifically based recommendations, projects, legislative acts and normative legal documents in the area of optimization of the nutrition of the children and adolescents. This is participation of the Republic in a federal program for modernization of the school nutrition, introduction of the National Program "School Milk", the development of the unified automated food monitoring system in the preschool and school educational organizations with the unified regional food rations.

The results of these studies were the basis for preparation of the Executive Order of the President of the Republic of Sakha (Yakutia) of December 25, 2009, No. 1735 "On Compensatory Payments for Food for Students from Low-Income Families of State General Education Institutions of the Republic of Sakha (Yakutia)" and the Executive Order of the Head of the Republic of Sakha (Yakutia) of May 8, 2015 No. 479 "On Additional Compensatory Payments for Food for Students from Low-Income Large Families of State General Education Organizations of the

Republic of Sakha (Yakutia)", the compensation payments are provided for the students of the state and municipal general education organizations. These Executive Orders allowed improving the structure and social support of various categories of the students of the general education institutions in terms of the organization of the healthy nutrition. To improve the organization of the nutrition of the children and adolescents in the organized groups, it is justified to conduct the monitoring epidemiological studies of the actual nutrition and food habits. The fourth studies are conducted in the dynamics in 2018.

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## SCIENTIFIC REVIEWS AND LECTURES

N.A. Solovyova, N.I. Pavlova, Kh.A. Kurtanov, M.A. Varlamova

# CYTOKINOVY MECHANISMS OF FORMATION OF BRONCHIAL ASTHMA AND OBESITY

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### ABSTRACT

Considering high prevalence of BA incidence and the progressing growth of number of persons with an excess weight of different degree of expressiveness, today the combination BA and obesity is a current problem of practical health care around the world.

The article examines the results of scientific research on the analysis of clinical and laboratory indicators of bronchial asthma (BA) in obese patients. The analysis of literary data concerning pathophysiological mechanisms of influence of excess amount of fatty tissue on character of a course of bronchial asthma is carried out. It has been established that significant volumes of adipose tissue are a source of pro-inflammatory cytokines, aggravating the course of asthma.

Researches have shown that fatty tissue is metabolically highly active and participates not only in deposition of fats and their mobilization, but also in regulation of a number of exchange processes in scales of the whole organism. Researches of biochemical processes in adipocytes (cells of fatty tissue) have shown that their activity isn't limited to influence on metabolic processes. In researches it is revealed that the high level of an expression of a number of regulatory factors (cytokine) which are taking part in formation and maintenance of inflammatory processes in an organism is characteristic of cells of fatty tissue. This fact allows considering obesity as a disease, one of components of which is the condition of the chronic inflammation covering the whole organism in general. In researches it has been shown that in the presence of obesity such signs as are specific to inflammatory process: inclusion of the intracellular alarm ways which are responsible for inflammatory activation of cells; an expression of the superficial membrane structures and receptors participating in intercellular interactions when forming inflammation; development of the cytokine stimulating further development and maintenance of the inflammatory answer; formation of the markers of a sharp phase characterizing prevalence and clinical value of inflammatory process.

Thus, the understanding of the general mechanisms which are the cornerstone of formation of obesity and BA will promote development of new methods of diagnostics and treatment.

**Keywords:** bronchial asthma, obesity, cytokine, systemic inflammation.

Despite achievements of modern medicine, introduction of new medical technologies in daily work of the practicing doctor there are still a lot of questions demanding studying. A current and complex problem is the choice of tactics of treatment of patients with a syntropy of diseases when diseases are interconnected, have joint or close etiological or / and pathogenetic

factors. Relevant and poorly studied are interfering syntropies, at which the disease developed against the background of previous one, makes heavier its course. A striking example of such syntropy is the bronchial asthma (BA) and obesity.

Both pathologies have gained now character of global epidemics in which various age populations in different

geographical zones are involved. About 10% of resources of public health care, according to some information, are spent for treatment of patients with BA and the states associated with it [7]. By rough estimates, its prevalence in the different countries is from 3 to 15% of the population today, and for the last three decades the number of patients with the diagnosis BA has increased in