IDENTIFICATION OF DISTRICTS AT RISK OF NUTRIENT-RELATED DISEASES BASED ON THE LOCAL DIET

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The growing incidence of nutrient-related diseases is a global challenge. The aim of this work was to study consumption of staple food products and to estimate the incidence of nutrient-related diseases in Voronezh region. Food consumption was analyzed from the reports of the local branch of the Federal State Statistics collected over two 5-year periods (1995–1999 and 2012–2016). The incidence of nutrient-related diseases was estimated based on the reports providing information about patients' visits to healthcare facilities. The districts of Voronezh region were assigned to 5 ranks. Over the studied periods, the population of Voronezh region considerably changed its diet: consumption of fish and seafood, fresh fruits, meat, vegetables, gourds and melons, eggs, vegetable oil, milk and dairy products per person increased significantly. At the same time, consumption of sugar, breads and potatoes still exceeds the recommended intake 1.42-2.04-fold, which means that the main component of the diet is carbohydrates. We observed a significant 4.5-fold increase in obesity incidence, a 1.8-2.0-fold increase in the incidence of anemia and endocrine disorders and a 1.2 increase in the incidence of gastrointestinal diseases. In terms of prevention measures, the priority should be given to areas at a high risk of nutrient-related diseases.

Keywords: balanced nutrition, health risk of nutrition-related morbidity

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ОПРЕДЕЛЕНИЕ ТЕРРИТОРИЙ РИСКА ПО УРОВНЮ АЛИМЕНТАРНО-ЗАВИСИМЫХ ЗАБОЛЕВАНИЙ С УЧЕТОМ РЕГИОНАЛЬНЫХ ОСОБЕННОСТЕЙ СТРУКТУРЫ ПИТАНИЯ НАСЕЛЕНИЯ

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Проблема роста уровня алиментарно-зависимых заболеваний в настоящее время имеет глобальные масштабы. Целью исследования были изучение уровня потребления основных продуктов питания и оценка показателей алиментарно-зависимых заболеваний населения Воронежской области. Баланс потребления продуктов питания изучали по данным территориального управления Росстата по Воронежской области за два пятилетних периода (1995–1999 гг. и 2012–2016 гг.). Анализ алиментарно-зависимой заболеваемости выполняли по данным обращаемости населения за медицинской помощью с последующим ранжированием показателей на отдельных территориях на пять уровней. За два пятилетних периода произошли существенные изменения в характере питания: увеличилось потребление в расчете на одного жителя рыбопродуктов, свежих фруктов, мяса и мясных продуктов, овощей и бахчевых, яиц, растительного масла, молока и молочных продуктов. Вместе с тем наблюдается избыточное потребление сахара, хлебных продуктов, картофеля — от 1,42 до 2,04 раз, что свидетельствует о преобладании в рационе углеводной составляющей. По результатам оценки, отмечается достоверное увеличение показателей заболеваемости ожирением до 4,5 раз, анемией, болезнями эндокринной системы (в 1,8–2 раза) и болезнями органов пищеварения (в 1,2 раза). Приоритеты в профилактике алиментарно-зависимой заболеваемости должны быть отданы территориям риска.

Ключевые слова: сбалансированность питания, алиментарно-зависимое заболевание, структура питания

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The growing incidence of nutrient-related diseases is a global challenge. The majority of developed countries, including Russia, are addressing it at the statewide level [1]. Understanding the causes of nutrient-related diseases and assessing their incidence are important tasks that public health monitoring and the risk-based approach to sanitary-epidemiological surveillance are expected to solve [2]. The results of data analysis and public health risk assessment are indicative of the growing incidence of nutrient-related diseases in some Russian regions, such as Samara

region [3], the Republic of Tatarstan [4], and the North of Russia [5].

The risk of developing a nutrient-related disease is especially high in certain cohorts of the population and certain regions, as shown by focused research. For example, questionnaires filled in by university students and their food records reveal that a combination of a poor diet, hereditary predisposition and an unhealthy lifestyle leads to anemia, obesity and type 2 diabetes mellitus [6]. Another research work demonstrates that industrial workers of the Arctic region are at increased risk of developing health problems because of their imbalanced diet [7]. A similar problem exists in the former USSR states. A study that included over 3,000 people residing in the towns and villages of Central and East Kazakhstan has revealed insufficient energy content in their daily meals (12–19%), low intake of vitamins C, B1, B2, and niacin (47–73% of the recommended daily dose) and deficit of retinol and tocopherol (50%) [8].

Nutrient-related morbidity varies across different Russian regions, necessitating research into regional nutritional patterns [9, 10]. Regional studies will help to elaborate measures aimed at providing the population with a balanced diet, ensuring adequate food quality control and preventing nutrient-related diseases [11].

The aim of this work was to study consumption of staple food products and assess the incidence of nutrient-related diseases in Voronezh region.

METHODS

The study was conducted in 32 districts of Voronezh region populated by 2.3 million people. Reports on the consumption of different food products collected over two 5-year periods (1995–1999 and 2012–2016) were provided by the local branch of the Federal State Statistics and reflected quantitative and qualitative changes in the consumption of 10 staple food categories: breads; potatoes; vegetables, melons and gourds; fresh fruits; sugar; meat; seafood and fish; milk and dairy products; eggs; vegetable oil. The data were compared with the values specified in the Recommended rational norms of food consumption that meet modern nutritional requirements (Order 614 of the Ministry of Health of the Russian Federation dated August 19, 2016).

The incidence of nutrient-related diseases was estimated from the data supplied by the Federal State Statistics Service (report form 12 providing information about the incidence of diseases registered in patients residing in healthcare service areas) collected from 1995 through 1999 and from 2012 through 2016. The data were analyzed in Statistica 6.0 and Microsoft Office (Excel).

To rank the average long-term incidence of nutrient-related diseases, we applied an algorithm determining the upper and lower values for this parameter based on its average value in the studied region (M) and mean square deviation (σ); the obtained data were distributed into 5 sets. Values falling into the first set were ranked as low (M – σ and lower); in the second set, below average (from M – σ to M – 0.5σ); in the third set, average (from M – 0.5σ to M + 0.5σ); in the fourth set, above average (from M + 0.5σ to M + σ); and in the fifth set, high (M + σ and above). Regions with high long-term incidence (rank 5) were considered to be at risk.

RESULTS

The analysis of data on the consumption of staple food products in Voronezh region in 1995–1999 and 2012–2016 revealed considerable changes in the diet of its population (Table 1). Consumption of fish and seafood per one person (kg/year) increased 3.14-fold; fresh fruits, 2.0-fold; meat and dairy products, 1.93-fold; vegetables, melons and gourds, 1.63-fold; eggs, 1.44-fold; vegetable oil, 1.36-fold; milk and dairy products, 1.13-fold. At the same time, consumption of potatoes and breads slightly decreased, while sugar consumption remained stable (49 kg per 1 person a year).

The population of Voronezh region consume 2.04 times more sugar than is recommended and 1.42 times more bread. At the same time, their diet lacks high biological value foods, such as milk and dairy products (sour cream, butter, cottage cheese, cheese, kefir and yoghurt), constituting only 83% of the recommended amount (i.e., consumption of these products is 1.21 times lower than it should be). Being an important source of vitamins and minerals, vegetables included in the population diet, such as cabbages, carrots, beetroot, onions, tomatoes, cucumbers, bell peppers, courgettes, green salads, etc., constitute only 92% of the advised intake (their consumption is 1.8 times lower than the recommended amount); fresh fruits, such as apples, pears, grapes, and citrus fruits, make only 75% of the advised intake (their consumption is 1.33 times lower than the recommended amount). This leads us to conclude that the main component of the diet in Voronezh region is carbohydrates.

Table 1. Consumption of staple foods in Voronezh region in 1995–1999 and 2012–2016 (per one person, kg/year)

Products	Recommended intake	Year					Average values (1995–1999)	Year					Average values (2012–2016)
		1995	1996	1997	1998	1999		2012	2013	2014	2015	2016	
Breads	96	137	137	138	142	142	139	136	136	137	137	135	136
Potatoes	90	122	115	137	141	141	131	126	127	127	127	127	127
Vegetables and gourds	140	79	76	77	81	83	79	127	129	130	130	130	129
Fresh fruits	100	39	40	38	43	22	36	74	76	75	74	74	75
Sugar	24	46	49	50	50	50	49	48	47	49	50	52	49
Meat	73	53	46	45	44	43	46	83	91	89	90	92	89
Fish	22	7	8	7	6	6	7	22	22	23	23	22	22
Milk and dairy products	325	255	227	238	238	237	239	267	269	270	270	271	269
Eggs	260	246	242	233	222	223	233	329	334	338	338	339	336
Vegetable oil	12	11	11	10	11	11	11	15	15	15	15	16	15

Imbalanced diet and negative environmental factors increase the risk of nutrient-related diseases. When comparing their long-term incidence in the two studied 5-year periods, we established that incidence per 1,000 population had increased 1.2-4.5-fold for almost every class of nutrient-related diseases except for peptic ulcers. The most significant 4.5-fold increase was observed for obesity (Table 2).

Using the data that describe the average long-term incidence of nutrient-related diseases in Voronezh region, we built a 5-level scale to rank its districts accordingly (Table 3).

Long-term statistics collected over 2012–2016 demonstrated that the incidence rate of diseases affecting blood and hematopoietic organs was 17.1 ± 1.22 cases per 1,000 population; anemia was diagnosed in 3.7 ± 0.26 individuals per 1,000 population. On the whole, this pathology tended to increase in incidence (R^2 = 0.829). The same situation was observed in some relatively "healthy" districts belonging to rank 1 (0.6–2.2 cases per 1,000 population): Nizhnedevitsky district had 1.6 cases per 1,000 population (the incidence growth rate was 111.0%); Verkhnekhavsky district had 1.4 cases per 1,000 population (the growth rate was 241.6%); in Khokholsky district 1.4 cases per 1,000 population were registered (the growth rate was 295.7%); in Ternovsky district, 0.6 cases per 1,000 population (the growth rate was 83.0%). Among the districts at risk of anemia (rank 5, 4.7–6.8 cases per 1,000 population) were Bogucharsky, Verkhnemamonsky and Kalacheevsky, exhibiting a slower growth rate (minus 33.3%, 11.9% and 30.8%, respectively) and the highest incidence rates of 4.7, 6.3 and 6.8 cases per 1,000 population, respectively.

Our analysis revealed that the incidence rate of endocrine diseases in Voronezh region had been gradually increasing since 2012 reaching its maximum in 2015 (73.3 cases per 1,000 population); their average long-term incidence was 69.3 ± 5.93 cases per 1,000 population. Five districts were ranked as high-risk areas (77.9–110.3 cases per 1,000 population), including Bobrovsky (110.3 cases per 1,000 population), Ramonsky (89.2 cases per 1,000 population), Pavlovsky, (81.4 cases per 1,000 population), Podgorensky (81.2 cases per 1,000 population), and Olkhovsky (80.1 cases per 1,000 population).

Obesity rates remained stable in only 8 districts of 32: Bobrovsky, Borisoglebsky, Buturlinovsky, Vorobiovsky, Kalacheevsky, Novousmansky, Paninsky, and Talovsky. Among the districts ranked as high-risk (13.7–26.5 cases per 1,000 population) were Kashirsky with 26.5 cases per 1,000 population (the growth rate of 637.5%), Verkhnekhavsky with 20.3 cases per 1,000 population (the growth rate of 245.0%), Ternovsky with 17.5 cases per 1,000 population (the growth rate of 394.1%), Ramonsky with 17.2 cases per 1,000 population (the growth rate of 133.4%), Bobrovsky with 17.1 cases per 1,000 population (the growth rate of 118.4%), and Khokholsky with 16.9 cases per 1,000 population (the growth rate of 710.5%).

At present, the average long-term incidence of gastrointestinal diseases in Voronezh region is 97.4 ± 4.91 cases per 1,000 population showing a strong tendency to increase (R^2 = 0.927). Among the districts assigned to rank 5 on our scale (129.8–212.9 cases per 1,000 population) are Repievsky with 212.9 cases per 1,000 population, Povorinsky with 182.9 cases per 1,000 population and Talovsky with 172.1 cases per 1,000 population. The lowest incidence (rank 1, 46.1–54.7 cases per 1,000 population) was observed in Verkhnekhavinsky (46.1 cases per 1,000 population), Olkhovsky (52.9 cases per 1,000 population) and Ertilsky (53.5 cases per 1,000 population).

Comparison of the two studied 5-year periods revealed that the incidence rate of peptic ulcers tended to decrease from 15.5 ± 0.03 to 12.9 ± 0.13 cases per 1,000 population (which is by 17%). Nonetheless, 4 regions were still assigned to rank 5 (the highest incidence) based on the average long-term disease incidence (2012–2016): Kalacheevsky with 28.2 cases per 1,000 population, Talovsky with 21.8 cases per 1,000 population, Kantemirovsky with 21.7 cases per 1,000 population, and Ternovsky with 17.8 cases per 1,000 population. But on the whole, in spite of high long-term growth rates, the incidence is decreasing.

Districts with the lowest incidence rates assigned to rank 1 included Verkhnekhavsky, Nizhnedevitsky and Repievsky (6.7–8.5 cases per 1,000 population) and showed an alarming trend: they exhibited the highest growth rate of peptic ulcer

Table 2. Average long-term incidence of nutrient-related diseases in Voronezh region per 1,000 person, M ± m

Classes/nosological categories	Average long-term incidence		Increase (+) or decrease (–) (-fold)
	1995–1999	2012–2016	
Diseases of blood/hematopoietic organs (in total)	9.8 ± 0.91	16.1 ± 1.22	+ 1.6
Anemia	2.0 ± 0.03	3.7 ± 0.26	+ 1.8
Endocrine disorders (in total)	33.3 ± 0.36	69.3 ± 5.93	+ 2.0
Obesity	2.5 ± 0.04	11.3 ± 2.58	+ 4.5
Diseases of the gastrointestinal system (in total)	78.6 ± 0.22	97.4 ± 4.91	+ 1.2
Peptic ulcers	15.5 ± 0.03	12.9 ± 0.13	– 0.8
Gastritis and duodenitis	15.1 ± 0.06	21.9 ± 1.08	+ 1.5

Table 3. District of Voronezh region ranked based on the incidence of nutrient-related diseases (upper and lower incidence values per 1,000 person)

Nosological categories	Rank 5 (high)	Rank 4 (above average)	Rank 3 (average)	Rank 2 (below average)	Rank 1 (low)
Diseases of blood/hematopoietic organs (in total)	22.3–25.7	20.3– 22.2	14.2–20.3	8.1–14.1	4.6–14.0
Anemia	4.7–6.8	3.9–4.6	2.4–3.8	1.6–2.3	0.6–2.2
Endocrine disorders (in total)	77.9–110.3	68.9–77.8	51.1–68.8	42.1–51.0	26.4–42.0
Obesity	13.7–26.5	10.9–13.6	5.3–10.8	2.5–5.2	0.5– 2.4
Diseases of the gastrointestinal system (in total)	129.8–212.9	110.9–129.7	73.5–110.8	54.8–73.4	46.1–54.7
Peptic ulcers	17.8–28.2	15.5–17.7	10.9–15.4	8.5–10.8	6.7–8.4
Gastritis and duodenitis	29.4–47.8	24.8–29.3	15.6–24.7	11.1–15.5	4.1–11.0

incidence in 2012–2016 (63.93%, 68.04% and 139.04%, respectively).

The average incidence of gastritis and duodenitis in Voronezh region is 21.9 ± 1.1 cases per 1,000 population; in 2012–2016 its growth rate was 16.6% (R^2 = 0.879). A few regions were assigned to rank 5 (29.4–47.8 cases per 1,000 population), including Talovsky with 47.8 cases per 1,000 population (the growth rate of 4.7%), Kamensky with 39.7 cases per 1,000 population (the growth rate of 6.8%), Repievsky with 32.6 cases per 1,000 population (the growth rate of 33.8%), Vorobievsky with 30.31 cases per 1,000 population (the growth rate of 100.1%), and Nizhnedevitsky with 29.5 cases per 1,000 population (the growth rate of 12.9%). The lowest incidence (rank 1) was observed in Verkhnekhavsky, Kashirsky, Liskinsky, and Paninsky districts (4.1–11.0 cases per 1,000 population), but the growth rate in these districts was the highest (60.02–203.21%).

DISCUSSION

The selective analysis of data on the consumption of staple food products in Voronezh region collected in 1995–1999 and 2012–2016 demonstrates considerable changes in the local diet: increasing intake (per 1 person) of fish and seafood, fresh fruits, meat, vegetables, melons and gourds, eggs, vegetable oil, milk and dairy products. However, consumption of sugar, breads and potatoes is well above the norm (1.42-2.04-fold), meaning that the diet is still dominated by carbohydrates.

A similar study was carried out in the northern regions of Russia demonstrating that their population follows an imbalanced diet poor in meat, fish, seafood, milk and dairy products, unsaturated fat and rich in saturated fat and breads [5]. The populations of the North of Russia and Voronezh region have been sharing the same trend for many years consuming too much breads [12].

Over the two 5-year periods studied in this work the population of Voronezh region has been showing a 4.5-fold increase in obesity incidence, a 1.8-3-fold increase in the incidence of anemia and endocrine disorders and a 1.2-fold increase in the incidence of gastrointestinal diseases in the backdrop of imbalanced diet. These troubling trends have been highlighted in the works of some authors who studied nutrition and nutrient-related diseases and are typical for students who do not follow a balanced diet and do not have their meals regularly [13].

The study of the factors affecting the adaptation reserve of teenagers residing in the High North and the central part of Russia revealed changes in their immune status and blood chemistry caused by imbalanced diet; adaptive stress response was more pronounced in the teenagers of Russia's High North [14].

The growing incidence of nutrient-related diseases prompts the development of prevention measures and innovative approaches to food quality monitoring in the Russian Federation [15].

The incidence ranking for the districts in Voronezh region and identification of areas at risk are just the first step towards finding a solution to a problem of providing the population with safe quality food. We believe that priority in the prevention of nutrient-related diseases should be given to areas at risk. The diet offered to organized groups should include (if appropriate) products with a strong positive effect on health, as well as those boosting natural immunity [16]. Certain legal and technical aspects of specialized food production should also be improved [17]. So far, a few successful projects have been implemented in Voronezh region aimed at preventing iodine and fluorine deficiencies [12], reducing the level of food contamination based on the investigation of the associations between food quality and free radical oxidation [18]. At the same time, the problem of proper nutrition is complex and necessitates further elucidation of many of its aspects.

CONCLUSIONS

This study shows that the diet of the Voronezh region population is characterized by excess consumption of carbohydrates (breads and potatoes) and the lack of foods with high biological value (milk and dairy products, fresh fruits and vegetables). The incidence of nutrient-related diseases, such as endocrine disorders, obesity, and gastrointestinal diseases, is growing in the backdrop of imbalanced nutrition.

Our findings allowed us to identify the areas at risk of nutrient-related diseases and can be used to optimize the composition and quality of population diets.

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