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NUTRITION AS A RISK FACTOR AFFECTING PUBLIC HEALTH IN IRKUTSK REGION

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On the basis of a social and hygienic monitoring study and Irkutskstat data, food products consumption has been studied in Irkutsk region; the results of a supervisory investigation of the service for chemical and microbiological food product safety have been taken into account, and the levels of individual carcinogenic risk and non-cancer hazard at the intake of chemical substances with the food products have been studied as well; we have also analyzed alimental-dependent incidence of disease and incidence with the consideration of effects from the critical organs and systems.

Key words: risk assessment, chemical contaminants of food products, food product consumption, public morbidity.

One of the main factors defining public health is nutrition. An RF Government Decree has approved the Basics of 2020 Public Nutrition State Policy that serves as a basis for the Service's activities as well as its participation in the events aimed at the realization of the Doctrine of Product Safety in the Russian Federation [6]. Despite a wide use of the health risk assessment methodology by Rospotrebnadzor, the studies of public health risks associated with peroral intake of chemical substances with the food products including multi-environmental risks are very few. [Ananiev V.Yu. et al, 2010; Buzinov R.V., Unguryanu T.N., 2010; Rezanova N.V. et al., 2010; Shishkina L.I. et al, 2010; Belousova E.A. et al, 2012; Vetrova O.V. et al, 2012; Lomovtsev A.E. et al, 2012; Kislitsina L.V. et al, 2013; I.P. Saldyan et al, 2013].

The purpose of this research is to study nutrition as a risk factor for public health in Irkutsk region. In order to solve this problem, we looked at the following objectives: to study the dynamics of incidence in children and

adult population; to define balanced nutrition in terms of consumption of the main products and assessment of economic affordability of a minimal food basket, and the levels of food products contamination.

К основным направлениям социально-гигиенического мониторинга относится оценка приоритетности загрязняющих веществ, поступающих в организм посредством различных факторов окружающей среды, и оценка риска здоровью, поэтому одной из главных задач данного исследования являлась оценка общетоксических и канцерогенных эффектов при пероральной экспозиции химических веществ, загрязняющих продукты питания.

Materials and methods. The research used the data for Irkutsk region for 2004-2012:

- forms № 12 «Information about the number of cases of diseases registered in the patients residing in the areas served by the medical organization»;
- forms № 18 «Information about the sani-

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tary condition of the Republic, krai, region, city with federal status, autonomous region, and autonomous district »;

· Irkutskstat economic and statistical bulletin of the food products consumption [3].

Additionally, in order to study nutrition as a social factor, we ranged the cost of a minimal food basket in Irkutsk region amongst 83 RF subjects as of December 2012.

In order to evaluate the level of non-cancer hazard, we used MU 2.3.7.2519-09 "Determination of exposure and evaluation of the public health risks associated with chemical contaminants in food products", and the 2012 data from the regional social and hygienic monitoring database. The levels of carcinogenic and non-cancer risks were determined with the account for the level of exposure of the adult population and children and the values of the factors of carcinogenic potential.

In the course of the research, we used the following methods: statistical, comparative, balancing (to study the social and economic background of nutrition in the region), and ranking.

Results of the research. In 2004-2012, the incidence of the diseases associated with the dietary factor increased. The cases of obesity in children went up from 686.1 to 1133.3 per 100 thsd. population of this age group; the incidence diseases associated with elevated blood pressure went up from 62.8 to 84.4‰, diabetes - from 50.2 to 78.8‰, in adult population: diseases of the blood circulatory system - from 21162.8 to 26609.8‰, including coronary artery disease - from 4592.2 to 5274.0‰; diseases characterized by elevated artery pressure - from 8177.0 to 10979.8‰; gastritis and duodenitis – from 2420.1 to 2877.4‰; diabetes – from 1704.4 to 3037.6‰; obesity – from 662.4 to 1258.‰; anemia – from 526.1 to 741.1‰; thyrotoxicosis – from 142.2 to 181.4‰; osteoporosis – from 125.3 to 292.1 cases per 100 thsd.

Control of chemical contamination of food products is important to ensure safe food.

In 2004-2012, we studied 158.9 thsd samples of food ingredients and food products in Irkutsk region using sanitary-chemical indicators, and 247.2 thsd samples using microbiological indicators; 3.2 and 16.0 thsd samples respectively (2.0 and 6.5%) did not meet the hygienic standards. In 2012, 9428 samples of food ingredients and food products were studied in Irkutsk region with the use of sanitary-chemical indicators, and 20842 samples were studied with the use of microbiological indicators; of them 237 and 1178 samples respectively did not meet the hygienic standards (HS) [1].

The results of the laboratory studies of the 7 food product groups in Irkutsk region for 2012 are presented in Table 1 below.

The calculated levels of the individual carcinogenic risk from contaminants in food products constituted: for cadmium - $1.6E-05$, for lead - $3.9E-5$, for arsenic - $3.0E-4$.

The results of the calculations of the hazard coefficients of non-cancer effects under chronic exposure to the chemical substances in food products for the population of Irkutsk region in 2012 are presented in Table 2.

When calculating the hazard indexes, with the account for the critical organs and systems, we determined a high possibility of hazardous impact on the cardiovascular, endocrine, and circulatory systems in adults and children as well as disorders of the central nervous and immune systems, and skin disorders in children (Table 3).

In 2011, the consumption of the 8 out of 10 main food products under study increased by 7.0-26.9 % (in kg per capita per year) as compared to 2004 [3]: meat and meat products - from 52 to 66; sugar – from 27 to 34; fish and fish products – from 11.3 to 13.8; eggs and egg products – from 171 to 208 eggs; vegetable oil – from 10.6 to 12.7; milk and dairy products – from 185 to 198. In the period under study, the consumption of potato decreased from 148 to 127 kg, the consumption of bread products went down slightly - from 114 to 113 kg.

Table 1

The content of chemical substances in food products in 2012.

Name of the product	Public consumption, kg/day		Содержание химических веществ, мг/кг				
	adults	children	cadmium	arsenic	mercury	lead	nitrates
Meat and meat products	0,181	0,100	0,0031 ±0,0004	0,0165 ±0,0014	0,0009 ±0,0002	0,0500 ±0,0040	–
Eggs	0,034	0,002	0,0016 ±0,0002	0,0103 ±0,0014	0,0001 ±0,00002	0,0209 ±0,0015	–
Milk and dairy products	0,542	0,300	0,0010 ±0,0002	0,0048 ±0,0008	0,0003 ±0,00004	0,0154 ±0,0014	–
Bread and bread products	0,310	0,100	0,0065 ±0,0003	0,0106 ±0,0012	0,0005 ±0,0001	0,0573 ±0,003	–
Fish and fish products	0,038	0,025	0,0065 ±0,0011	0,1239 ±0,0285	0,0098 ±0,0030	0,0576 ±0,0061	–
Potatoes	0,348	0,100	0,0015 ±0,0001	0,0045 ±0,0008	0,0004 ±0,0001	0,0317 ±0,0022	119,4000 ±4,200
Vegetables and fruit-and-vegetable products	0,225	0,350	0,0017 ±0,0002	0,0048 ±0,0008	0,0004 ±0,0001	0,0268 ±0,0021	260,5000 ±12,800

Table 2

Hazard coefficients of non-cancer effects under chronic peroral chemical exposure in Irkutsk region, 2012.

Chemical substance	Adults		Children	
	exposure mg/kg body mass/day	HQ	exposure mg/kg body mass/day	HQ
Cadmium	7,4E-05	0,15	3,5E-04	0,69
Arsenic	3,2E-04	1,07	1,5E-03	1,07
Mercury	1,6E-05	0,05	7,6E-05	0,05
Lead	9,5E-04	0,27	4,4E-03	1,26
Nitrates	1,4E+00	0,89	6,7E+00	4,17

Table 3

Hazard indexes of non-cancer effects under chronic peroral exposure to chemical substances in the population of Irkutsk region with the account for the critical organs, 2012.

Organs and systems	Adults	Children
Kidney	0,20	0,74
Endocrine system	1,54	3,07
Skin	1,07	1,07
Central nervous system	1,39	2,38
Nervous system	1,34	2,33
Cardiovascular system	1,96	5,24
Immune system	1,12	1,12
Gastro-intestinal tract	1,07	1,07
Reproductive system	0,32	1,32
Blood circulatory system	1,16	5,43
Total HI	2,43	7,24

In December 2012, the cost of the minimal food basket totaled 2943 RUB in Irkutsk region as compared to the Russian Federation average of 2609 RUB [7].

Although in Irkutsk region the relative weight of the samples of food ingredients and food products that do not meet the hygienic standards in terms of sanitary and chemical indi-

cators increased from 1.3% in 2004 to 2.5% in 2012, this indicator was lower as compared to Russia's average (Figure 1). In the period under study, the relative weight of the food product samples that do not meet the hygienic require-

ments in terms of microbiological indicators decreased from 7.2% in 2004 to 5.6% in 2012 though it is still lower as compared to Russia's average.

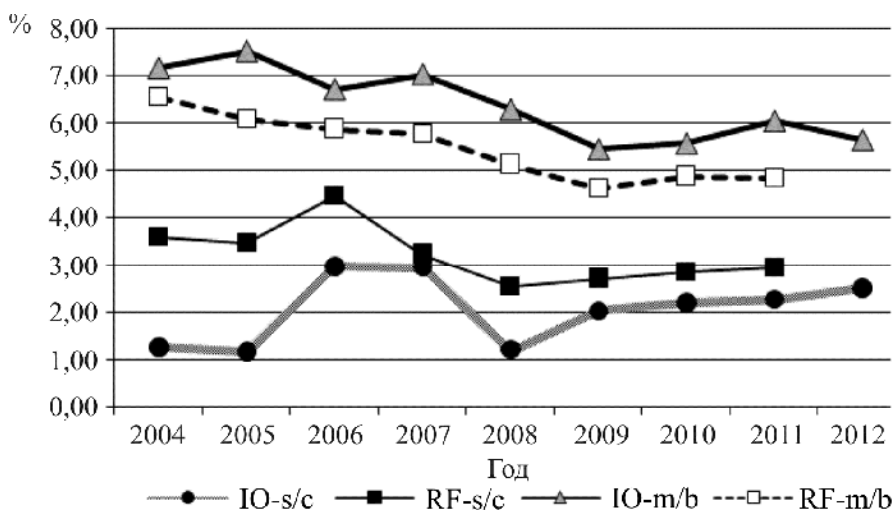


Figure.1. The change in the relative weight of the food product samples that do not meet they hygienic standards in terms of sanitary and chemical (s/c) and microbiological (m/b) indicators in Irkutsk region and the Russian Federation, 2004-2012.

Though the levels of individual carcinogenic risk under peroral exposure to cadmium and lead obtained in the course of the research were within the upper limit of acceptable risk, the levels of the risk under exposure to arsenic in products was not acceptable.

The calculated hazard coefficients of non-cancer effects of the chemical substances in food products exceeded one in adults for nitrates, and in children - for arsenic and nitrates. It was determined that the main contributor to the development of negative effects in children in Irkutsk region are arsenic, lead and nitrates in fish, meat, and vegetables.

The analysis of the morbidity in Irkutsk region with the account for possible effects in the critical organs and systems confirms a negative impact of the chemical contaminants in food products. The level of the primary disease incidence in children in Irkutsk region exceeded Russia's average in 2011 by 71% in terms of endocrine system disorders (mean for 2004-2011 - by 48%) and by 11% in terms of

digestion system disorders (11%) - see Table 4.

The levels of the primary disease incidence in adults in the region were higher as compared to the RF average in 2011 in terms of the endocrine system disorders - by 58% (mean for 2004-2011 - by 63%), nervous system disorders - by 32% (25%), circulatory system disorders - 20% (15%), and digestive system disorders - by 38% (20%).

The primary incidence of the blood and blood-forming organ disorders as well as skin and hypoderm disorders both in adults and children in Irkutsk region did not differ significantly from Russia's average in the period under study which might result from the influence of other factors.

Nutrition as a social factor in Irkutsk region cannot be considered satisfactory since the cost of the minimal food basket in Irkutsk region in 2012 ranked #59 in the list of 83 RF subjects (in ascending order) [7].

Table 4

The level of primary incidence in Irkutsk region as compared to Russia's average in 2004-2011*

Class of disease	Population group	2011	2004-2011
Blood diseases	Children	0,97	0,93
	Adults	0,89	0,89
	Population at large	1,03	1,00
Endocrine system diseases	Children	1,71	1,48
	Adults	1,58	1,63
	Population at large	1,69	1,69
Nervous system diseases	Children	0,82	0,81
	Adults	1,32	1,25
	Population at large	1,14	1,12
Circulatory system diseases	Children	0,58	0,54
	Adults	1,20	1,15
	Population at large	1,13	1,08
Digestive tract diseases	Children	1,11	1,11
	Adults	1,38	1,20
	Population at large	1,31	1,21
Skin and hypoderm diseases	Children	0,81	0,91
	Adults	0,94	0,92
	Population at large	0,93	0,95

* the RF level equals 1.

The analysis of the consumption of the main food products in Irkutsk region (based on the balancing method) showed a number of set trends regarding the change in the composition, qualitative and quantitative content of public nutrition. In 2011 as compared to 2004, the average per capita consumption of such valuable biological foods as meat and meat products, fish and fish products, milk and dairy products, eggs and vegetable oil, increased. At the same time, consumption of some products that play a significant role in the imbalance of essential components was steadily decreasing: potatoes – by 14.2%, bread products – by 0.9%, but their consumption was still exceeding the recommended level by 27.0% and 7.6% respectively.

In 2011, consumption of the following products also exceeded the recommended level: vegetable oil – by 5.8%, and sugar – by 21.4%. The consumption of all the other products in the region was below the recommended level [4]: fruits and berries – by 58.9%, milk and dairy products – by 38.1%, vegetables – by 31.7%; fish and fish products – by 23.3%, eggs – by 20.0%, meat and meat products – by 5.7%.

Thus consumption of the 6 main products was below the recommended level in Irkutsk region in 2011, and of the 4 products (vegetable oil, sugar, potatoes and bread products) – above the recommended level. Consequently, despite an improve in the composition of consumed products in Irkutsk region, the quality of public nutrition did not meet the standards of healthy nutrition, first of all, due to the malnutrition of milk and dairy products, fish and fish products, eggs, fruits and vegetables, meat and meat products, as well as simple carbohydrates [6].

It is worth noting that even though consumption of vegetables and fruits in the past 10 years went up by 1.5-2 times, it is still very low: in 2011, an average resident of the region had 326g/day of vegetables and fruits in their diet. In terms of per capita consumption of vegetables and fruits, Irkutsk region is in the 69th place out of 71 ranking positions amongst 80 RF subjects (in the ascending order). At the same time, we should note that an increase in the consumption of vegetables and fruits given today's quality will result in even higher health risks because of the nitrates and arsenic.

Imbalanced nutrition leads to increased cases of obesity, type II diabetes, blood diseases, cardiovascular diseases and other dietary diseases in the population [2, 5, 8]. In 2012 as compared to 2004, the incidence of obesity in children in Irkutsk region went up by 65.2%, of diabetes – by 56.8%, of elevated blood pressure – by 34.4%; in adults – the incidence of circulatory diseases went up by 25.7%, CAD – by 14.8%, gastritis and duodenitis – by 18.9%, elevated blood pressure – by 34.3%, thyrotoxicosis – by 27.6%, anemia – by 40.9%, diabetes – by 78.2%, obesity – by 89.9%, osteoporosis – by 2.3 times.

Conclusions:

1. The diet of the population of Irkutsk region is lacking milk and dairy products, fish and fish products, eggs, fruits and vegetables, meat and meat products, but has an excess of potatoes, bread products, and sugar.

2. The relative weight of the samples of food ingredients and food products that do not meet the hygienic standards; it is higher than Russia's average by sanitary and chemical indicators, and lower by microbiological indicators.

3. The results of the calculated toxic hazard associated with the contaminants received with food show that unfavorable factors are hazardous for, primarily, children; the main products containing nitrates, arsenic, and lead are fish, vegetables, and meat.

4. In the past 9 years, the incident of obesity and diabetes grew by 1.6-1.8 times; mean regional indicators exceeded Russia's average by 1.1-1.6 times for the endocrine and digestive system diseases in children and adults as well as for the nervous and circulatory system diseases in adults.

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