

**CURRENT TENDENCIES IN THE NUTRITION OF WOMEN AND PREGNANT
WOMEN OF INDUSTRIAL REGION OF UKRAINE AND THEIR INFLUENCE ON
MICROELEMENTS SUPPLY**

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SUMMARY

Background. During recent decades there has been observed a violation in the structure of nutrition of the population with a significant decrease in the consumption of biologically valuable products, resulting in the development of the so-called "latent hunger", particularly in sensitive groups of population – women of reproductive age and pregnant women.

Aim. To study nutritional peculiarities and the level of biotic and abiotic trace elements intake into the body of the female population, residents of the industrial region.

Materials and methods. Physiological and hygienic nutritional assessment was carried out in 185 women and pregnant women, residents of industrial and non-industrial cities of Dnipropetrovsk region of Ukraine. Actual nutrition was studied using the 24-hour food reproduction method recommended by the WHO. Calculation of the content of trace elements in the diet was carried out using well-known techniques, followed by the assessment of their compliance by the level of permissible daily load for toxic trace elements – lead and cadmium and daily requirements – for essential elements, zinc and copper.

Results. Studies performed have found significant violations of the requirements of rational nutrition in relation to its regime and the average daily food package, which is excessive in consumption of bread and bakery products, sugar and confectionery products by 9,9%-67,6% and is characterized by a shortage of other groups of foodstuff with various degree of evidence. On the background of deformation of nutrition there is observed an

increased income of xenobiotics – lead and cadmium into the female body, which is by 3,8-7,8 times higher than the level of so-called "optimal one". At the same time the level of income of essential micronutrients – zinc and copper was by 9,5-45,7% lower than the RDI.

Conclusions. Nutrition of fertile age and pregnant women, residents of industrial regions of Ukraine, does not meet the requirements of rational nutrition due to violations in diet, in quantitative and qualitative nutritional budget, excessive intake of xenobiotics and deficiency of essential micronutrients.

Key words: nutrition, microelements, women, pregnant women, industrial region.

Background. Changes in the human's nutrition formula in the XXI century on the background of globalization of anthropogenic pollution of the environment cause deterioration in the quality of life and health of the population, especially of its sensitive groups – women of reproductive age and pregnant women [1, 2].

During recent decades in Ukraine there has been observed a stable violation of the nutritional structure of the population due to deterioration of hygienic control and socio-economic disadvantages [3]. Scientific data [4, 5] testify to a sharp decline in the consumption of biologically valuable products, in simultaneously stable high level of consumption of bread and grain products, animal fat. This situation causes the development of the so-called "latent hunger" due to a shortage in vitamins, macronutrients and trace elements in the diet [6]. It should be noted that the problem of microelement deficiency (ME) is extremely important today in all countries of the world and, according to the WHO definition, being the main crisis in the nutrition of the Earth's population in the XXI century [7].

And if in deficiency of essential MEs in the diet hypomicroelementoses develop, then in various forms of contact of organisms with toxic MEs, syndrome of intoxication – toxicopathy develops [8]. Trace elemental deficit is never isolated and is always characterized

by imbalance of trace elements and manifests itself as a violation of various types of exchange [9, 10].

Thus, on the background of influence of anthropogenically determined denaturation of the environment, deformation of nutrition of the population of industrially developed regions forms the problem of adequacy of nutritional maintenance of the human organism in modern conditions [3, 4, 6]. As it is known, nutrition is the main source of minor substances necessary for the human body, the proportion of which is 65,3-95,7% of the total intake [10], in relation to this the attention of the specialists of clinical and preventive medicine to the alimentary factor, as a health-forming agent is quite understandable; this determined the aim of our study.

Aim: to study peculiarities of nutrition and the level of biotic and abiotic trace elements intake in the body of the female population of the industrial region.

Materials and methods. The physiological and hygienic assessment of nutrition of fertile age and pregnant women was carried out within the framework of clinical-hygienic assessment of reproductive health of the population of 185 women of the industrial city of Dnipro and the control one, conditionally "pure" city of Novomoskovsk, Dnipropetrovsk region, who visited consulting room in the Center for Family Planning and Human Reproduction of the SE «Dnipropetrovsk Regional Perinatal Center of the DRC», and also were registered at Maternity Hospitals in the cities Dnipro and Novomoskovsk in 2014-2015.

Practically healthy women of active reproductive age and pregnant women in the 2nd trimester of pregnancy were enrolled as study subjects. Herewith, age of the surveyed (20-50 years), the term of living in this city (not less than 5 years), the identity of social-cultural and economic conditions of life, absence of acute and chronic diseases, bad habits or occupational hazards, duration of marriage more than 2 years, born children were the criteria for selecting the population.

The actual nutrition was studied using the 24-hour diet reproduction, recommended by the WHO [11], indicating in the questionnaire the respondents the diet, the amount of food consumed, the set of dishes and individual food products consumed per day. For a more accurate analysis of the population's nutrition, the data were collected within 7 days with subsequent averaging of the results.

As experts [3] point out, today the consumption of basic foodstuffs has approached the indicators of the minimum consumer basket, which are significantly lower than the existing «Norms of Physiological Needs», which have not been updated for 18 years [12]. Therefore, hygienic assessment of the daily food package of residents of the region was carried out in accordance with scientifically grounded requirements [3, 13, 14].

The calculation of the daily intake of trace elements was carried out using well-known techniques [10], followed by an assessment of their compliance with FAO/WHO experts recommendations by the level of permissible daily load (PDL) and the results of research in the zones of ecological and biogeochemical optimum for toxic MEs – lead, cadmium [9, 10] and recommended daily intake (RDI) - for essential MEs – zinc, copper [12, 15].

Food components were calculated using tables of chemical composition and value of foodstuffs, taking into account culinary losses in the process of heat treatment [19]. The calculation of MEs content in the daily diet was based on the data of their content in the main food groups of the Dnipropetrovsk region, based on the analysis of 28,410 own studies on food raw materials and locally produced foodstuffs. This approach, as shown by the results, increases the objectivity of the subsequent calculation of the level of daily nutritional intake of nutrients into the organism of residents of the industrial region.

Statistical processing of the results was performed using statistical software license statistical packages of Statistica v.6.1 (StatsoftInc., USA, license number AJAR909E415822FA), Microsoft Excel.

Results. As a result of the research performed, the following nutritional regimen was established for women and pregnant women of industrial region: 51,7% of women and 63,2% of pregnant women have meals 3-4 times a day, 40,2% of women and 15,2% of pregnant women have meals twice a day, 8,1% of women and 21,6% of pregnant women have meals in various regimen (from one to several times a day). Herewith, only 30,3% of respondents have meal at the same time a day. Most women consume food irregularly, in general with dinner being the largest amount of food: women – 45,9%, pregnant women – 40,3%. Only 39,4% of the female population consumes the biggest amount of food for lunch.

For cooking at home, 13,3-50,0% of respondents prefer locally produced and domestic products bought in grocery stores, 25,0-66,7% – foodstuff from the market.

The results of the study of the average daily food package are presented in **Table 1**, which implies that each woman of fertile age and pregnant woman consumes 329,3-329,8 g of bakery products per day, 280,9-312,1 g of milk and dairy products, 62,3-91,5 g of meat and meat products, 18,7-23,6 g of fish and fish products, 427,7-512,9 g of vegetables, fruits and berries, 74,2 -83,8 g sugar and confectionery products, 27,7-34,4 g of fatty products, 20 g of eggs.

The deformation of the actual nutrition of the female population forms negative tendencies in the intake of the biotic and abiotic MEs into the body (**Table 2**).

It follows from the table, that with the daily nutrition residents of the Dnipropetrovsk region intake lead on average in the amount of $0,164 \pm 0,004$ and $0,137 \pm 0,005$ mg/day for women of industrial and control cities, respectively. Pregnant women intake lead in the amount of $0,156 \pm 0,004$ and $0,121 \pm 0,006$ mg/day on average, respectively. The content of cadmium in female ration of both industrial and control cities is $0,022 \pm 0,0005$ and $0,019 \pm 0,0007$ mg/day on average, in ration of pregnant women – $0,022 \pm 0,0007$ and $0,018 \pm 0,0006$ mg/day, respectively.

Daily, with nutrition budget women of fertile age intake zinc in the amount of $9,20\pm 0,28$ and $10,06\pm 0,44$ mg, pregnant women – $8,35\pm 0,31$ and $11,12\pm 0,42$ mg, in industrial and control cities respectively. The content of copper in the diet of women in industrial and control cities is $1,56\pm 0,07$ and $1,81\pm 0,13$ mg/day, pregnant women – $1,63\pm 0,04$ and $1,88\pm 0,09$ mg/day, respectively.

Discussion. Studies have found significant violations of the requirements to rational nutrition by female population of fertile age and pregnant women of industrial region, in particular its regime. In turn, inconsistency between the dietary regimen and principles of rational nutrition can become a risk factor of disorders of the normal functioning of the digestive tract, reducing the effectiveness of digestion and uptake of useful substances, reducing the resistance, which, together with the deficit of nutrients in the diet, increases tension of adaptive and detoxification processes.

Our investigations have found that the average daily food package of women and pregnant women of industrial regions is excessive in consuming of two groups of food products – bread and bakery products, as well as in sugar and confectionery. At the same time, if for pregnant women the reliable difference between the actual values and recommended ones is not detected, then the excess of consumption of bakery products by women of fertile age makes up 9,9% ($p < 0,05$), this coincides with the all-Ukrainian data [3]. At the same time, in both groups there is noted an increased consumption of sugar and confectionery – by 48,3-67,6% when compared with the recommended level ($p < 0,05$). These findings correspond with the research results of other authors, according to which the energy value of diet is provided mainly by carbohydrates at the expense of bread and bakery products, potatoes and sugar [4].

In all other dietary groups there is noted deficit as compared with the recommended food package. It should be noted that during pregnancy physiological needs of female

organism in biologically active nutrients significantly increase, as evidenced by the increase in the recommended norms of consumption of the main foodstuff groups and therefore their deficit is more perceived in preserving general dietary habits.

Estimation of consumption of animal products, important to the organism, testifies that the deficit of milk and dairy products in the diet of women of reproductive age of Dnipropetrovsk region reaches 32,3%, being the most pronounced for cheese and sour cream – 56,0% ($p < 0,001$). Pregnant women, residents of industrial regions, consume only 53,4% of milk and dairy products from the values recommended ($p < 0,001$). At the same time, in contrast to women of reproductive age, in this group the greatest deficit is characteristic for sour-milk drinks consumption – 56,6% ($p < 0,001$).

Other proteins of animal origin are not less important in the nutrition of the female population, the intake of the latter in the body is provided mainly at the expense of meat, fish and eggs. The consumption of meat and meat products for adult women is 61,0% ($p < 0,001$), fish – 47,2% ($p < 0,01$) from the norm recommended. The deficit of these food groups in the daily diet of pregnant women in the Dnipropetrovsk region is even more pronounced and constitutes 63,4% for meat and meat products ($p < 0,01$), 68,8% – for fish and fishery products ($p < 0,001$). The deficit of egg consumption in both groups is 50,0% ($p < 0,05 - < 0,01$). The obtained results coincide with the data of other authors [3, 4, 6] regarding the fact that the Ukrainians consume less than a half of the scientifically based ration of meat and meat products, fish which is an evidence of latent hunger.

Such a situation can be explained by national traditions of nutrition, economic opportunities, personal peculiarities of the attitude to consumption of certain foods.

Low level of consumption of vegetables, fruits and berries – sources of vitamins, trace elements and food fibers less than 31,6% ($p < 0,01$) for women and 55,0% ($p < 0,001$) – for pregnant women causes alarm. Taking into account excessive consumption of potatoes by the

female population – by 40,6% ($p < 0,01$), the deficit of other vegetables and fruits in this group is even more pronounced being 52,3% and 43,7% respectively ($p < 0,001$).

The consumption of fats by women of reproductive age in general is almost consistent with the recommended needs and makes up 98,3%. At the same time, the diet of pregnant women is limited by 38,7% ($p < 0,05$) regarding the consumption of vegetable oil, as a source of biologically active substances: polyunsaturated fatty acids, fat-soluble vitamins, phospholipids and sterols.

In addition to the above, such a situation shows the total lack of awareness of the basic principles of healthy nutrition and, according to various authors [1, 6], is a factor that causes increase in morbidity and decrease in the life expectancy of the population, an increase in the frequency of complications of pregnancy, childbirth and the postpartum period.

We have found that women of the industrial region consume predominantly locally produced and domestic products, the chemical composition of which certainly depends on peculiarities territorial cultivation of plants and animal feeding, and thus determines the level of availability with biotic and abiotic elements.

It has been established that with a daily diet women of fertile age intake lead in the amount not exceeding the level of PDL – 0,26 mg/day, according to the recommendations of FAO/WHO experts [10]. It should be noted that if in the city of comparison, the level of daily intake of lead in no case exceeds PDL, then in an industrial city about 5% of women intake lead in the amount that exceeds safe level, according to recommendations of FAO/WHO experts. Although with a daily diet pregnant women intake lead in concentrations that do not exceed the level of PDL, however it is by 6,1-7,8 times ($p < 0,01$) higher than the optimum level of its intake [9]. It should be noted that pregnant women of the control city intake by 13% reliably less amount of metal than fertile women ($p < 0,05$) in the absence of differences in observation groups of the industrial city.

The content of cadmium in rations of women of both industrial and control cities complies with FAO/WHO recommendations, although by 3,8-4,4 times ($p<0,01$) exceeds the level of intake of this toxicant for background areas. The level of cadmium intake into the body of pregnant women does not differ significantly from the results of studies on daily rations of fertile women, as resulted from the studies, with 1,2 times ($p<0,001$) higher level of metal intake into the body of pregnant women of industrial city.

This situation testifies to increased level of intake of abiotic metals in the body of women and pregnant women of industrial region, which coincides with the results of other studies [16] and being a risk factor for their health, since, according to WHO, abiotic metals are the leading environmental pollutants [1, 2, 8] – known polytropic toxins that can affect various systems of the body – hematopoietic, nervous, digestive, endocrine, cardiovascular, sexual. The basis of formation of pathochemical mechanisms of their toxic effects are: competitive displacement of biotic metals such as zinc and copper from exchange; inhibition of a number of enzymes due to the blockage of sulfhydryl groups to which they has a high affinity; disturbance of cell membrane function by stimulating free radical reactions in them.

As a result of the influence of xenobiotics on the body, the energy of the cell is disturbed, hypoxia is manifested [17], that causes the formation of a "disadaptation syndrome" in the body, in which the main regulatory burden load falls on the metal-enzyme system, the active component of which is zinc and copper [18].

In the space of 24-hours with food rations zinc enters into the body of women of fertile age in the amount that is 1,2-1,3 times ($p<0,01$ - $p<0,001$) lower in relation to the RDI [12, 15] and makes up 76,7-83,8% of RDI ($p<0,01$) by average values for women and 69,6-92,7% – for pregnant women. Pregnant women of industrial city with diet ration consume zinc in an amount that is 10% higher as compared to women of fertile age ($p<0,05$).

The level of intake of copper into the body of women in industrial and control cities with foodstuffs is by 9,5-22,0% deficient ($p < 0,01$) even when compared with the lower limit of daily needs [12, 15]. Pregnant women of control city intake copper with food rations in the amount that is by 15% higher ($p < 0,05$) as compared with that of pregnant women of industrial city, although it is deficient in relation to the lower limit of biological demand by 6,0-18,5% ($p < 0,05$). If we take into account the increased need in copper for pregnant women, then the deficiency of this element in this case will reach 37,3-45,7% ($p < 0,01$).

These findings corresponds with the results of the research of diets, conducted among female [19, 20] and pregnant women [18]. It was revealed that female diets are poor in zinc and are 60-80% of RDI. It is known, that zinc plays an important role in many biological functions [7, 8]. Although severe zinc deficiency is relatively rare in human population, mild to moderate one appears to be quite prevalent. This microelement is especially important for pregnant women. During pregnancy, zinc and other micronutrient deficiencies are common due to increased nutrient requirements of the mother and the developing fetus. These deficiencies can negatively impact pregnancy, insufficient fetus growth and body weight, high ratio of premature birth [19]. Zinc intake data suggest that the risk of deficiencies is high – 82% of the pregnant women worldwide have inadequate zinc intake [18].

Conclusions.

1. Nutrition of fertile and pregnant women of industrial region does not meet the requirements of rational nutrition with violation of diet, quantitative and qualitative diet content, with excessive consuming of bread and bakery products, sugar and confectionery – by 9,9%-67,6 % and is characterized by a shortage of other foodstuff groups.

2. On the background of nutritional deformation, there is observed the increased intake of xenobiotics – lead and cadmium into the female body, which exceeds the level of "optimum" by 3,8-7,8 times with a simultaneous shortage of zinc and copper in the diet – by

9,5-45,7%. Such a situation potentiates the risk to the health of the female population of the industrial region, creates conditions for increased load on the barrier-detoxification system of the organism, contributing to the development of the syndrome of ecological disadaptation and further development of ecologically-related diseases, complications of pregnancy, childbirth and the postpartum period.

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