

## ENGLISH VERSION: HYGIENIC ASSESSMENT OF THE ACTUAL CONSUMPTION OF MICRONUTRIENTS BY INTERNATIONAL STUDENTS FROM INDIA\*

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*The healthy nutrition of students' youth is an important factor providing conditions for high efficiency and quality of life. The study of ethnic features of actual nutrition of international students is relevant for the formation of science-based ways to prevent and correct nutritional deficiencies and nutritional-related pathologies, improve the adaptation processes and working capacity of this social group. The aim of this study is the hygienic assessment of the actual intake of micronutrients by this group of students. The object of the study was 119 international students from India, healthy or almost healthy according to the results of medical examination, 70 (59%) young men and 49 (41%) young women who live in Ukraine for 3 to 4 years, average age of the individuals was  $20.8 \pm 1.1$  years, they were attributed according to physical activity to group I of the working population. The subject of the study was the weekly diet, obtained by food frequency questionnaire. Calculation of the vitamin and mineral value of diets and analysis of the data was made during the study period. The study of the micronutrient component of the students' diet revealed inadequate intake for a number of components: vitamin deficiency of B<sub>2</sub> 23%, B<sub>6</sub> 9%, PP 15%, B<sub>12</sub> 11%, excess intake of vitamin A 27%, insufficient intake of phosphorus 27%, zinc 16%, iodine 7%, selenium 9% in the diet of the male group; deficient content of vitamin B<sub>2</sub> 9%, PP 11%, B<sub>12</sub> 12%, folic acid 18%, excess consumption of vitamin A 13%, deficiency of phosphorus 21%, iron 11%, zinc 9%, iodine 7% and selenium 8% in the diet of the female group. Ratio of calcium and phosphorus was 1.4:1 for young men, 1.2:1 for women. The diet of this ethnic group needs a complex correction by these indicators of diet diversity using local, seasonal food, educational work among international students in order to increase awareness of healthy eating and the composition of local products, development of diets adapted to the culinary, cultural and ethno-religious traditions this layer student, because selective, monotonous nutrition, increased requirements for micronutrients due to changes in climatic and time zones, ethno-religious restrictions in nutrition create conditions for the formation of nutrition-related diseases in this social group.*

**Key words:** nutrition, vitamins, micronutrients, ethnic differences, prevention.

Nutrition-related disorders caused by insufficient, excessive or imbalanced nutrition are found in multiple forms in different national and social groups [1,2]. Students constitute a special segment of population. They belong to the same age category and have similar conditions of life and professional activity. A healthy diet of students' youth is an important factor that provides the prerequisites for high working capacity and quality of life [3,6,12]. A special group consists of individuals who came to study to Ukraine from other countries. During the years of independence, Ukrainian education has entered the world educational space. Every year, the number of foreigners who receive education in Ukraine increases. In particular, according to the Ukrainian State Center of International Education, in 2013/2014 academic year the number of studying citizens from other countries in the universities of Ukraine was about 70.000 students from 145 countries. This group of young people is under multifactorial sources of the environment in the country where they study. Other types of food, other meals, change of eating patterns and cooking are factors that affect health and adaptation to new climatic, social and chronobiological conditions. It should be noted that a significant part of foreign students has the traditions of their religious or ethnic group in the diet [2,6,7,8,12]. A study of the USSR times showed that 8-32% of foreign students from the countries of the Middle and Near East used exclusively vegetarian food, 55% of students had food predominantly vegetable, 80% daily consumed vegetables and fruits, particularly citrus fruits, 90 % used the services of public catering before the arrival for study [12]. However, in modern Ukraine the issue of ethnic features of foreign students' nutrition is not fully understood and discussed. Selective feeding in conditions of changing the region of residence and the choice of meals are a prerequisite for

the formation of alimentary disorders and alimentary-related pathology [1,2,4]. It exacerbates the problem of rationalizing the supply of the contingent, which arrives to the territory of Ukraine from different geographical areas to study. Studying the ethnic characteristics of the actual nutrition of foreign students in the new conditions of life has a multi-purpose direction and preventive value. It is relevant for the formation of scientifically substantiated ways of preventing and correcting the nutritional deficiencies, improving the adaptation processes, the working capacity of this social group.

Previous works show the characteristics of the consumption of macronutrients (proteins, fats and carbohydrates) by students from India and the body mass index as a somatometric indicator of the nutritional status of this group [18,19]. The aim of this study is the hygienic assessment of the actual intake of micronutrients (vitamins and minerals) by this group of students. The object of the study was 119 international students from India, healthy or almost healthy according to the results of medical examination, 70 (59%) young men and 49 (41%) young women who live in Ukraine for 3 to 4 years. During the interview 22 people (19%) noted that they observe Muslim traditions in nutrition (they consume halal food), 80 people (67%) reported that they confess Hinduism and adhere to lactovegetarianism (milk and vegetable diet), 17 people (14%) noted that they consume vegetable, dairy products, eggs and chicken, but do not eat meat at all. The average age of the individuals was  $20.8 \pm 1.1$  years. All respondents were attributed according to physical activity to group I of the working population. The subject of the study was the weekly diet, obtained by food frequency questionnaire. The calculation of the average daily vitamin and mineral value of diet for this period and analysis of the data were made. Data on the

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chemical composition of food were obtained from both Ukrainian sources [1,2,13] and from international databases FAO, USDA, EuroFIR [20,21,22]. The loss of nutrients in the process of cooking in the analysis was taken into account [2]. Comparison of the data with the "Norms of the Physiological Needs of the Population of Ukraine in Essential Food Substances and Energy" (order of the Ministry of Health of Ukraine No. 272 of 18.11.1999) was carried out [1]. The study of the micronutrient compo-

nents of the diet of students revealed inadequate consumption for a number of components. Attention is drawn to the deficiency of vitamins B<sub>2</sub>, B<sub>6</sub>, PP, B<sub>12</sub> and excessive intake of vitamin A in the male group. The analysis of the questionnaire of the women's group revealed the deficient content of vitamins B<sub>1</sub>, B<sub>2</sub>, sub-adequate level of vitamin B<sub>6</sub> and a significant deficiency of folic acid and vitamin B<sub>12</sub> in the diet of female students from India (See Table 1)

Table 1  
Average daily intake of vitamins by international students from India (M ± m)

Vitamin	Male		Female	
	Actual daily consumption	Daily requirement	Actual daily consumption	Daily requirement
E, mg	19±1,13	15	17±1,57	15
A, mcg	987±38.22	1000	980±45.38	1000
B <sub>1</sub> , mg	1.56±0.17	1.6	1.26±0.13	1.3
B <sub>2</sub> , mg	1.54±0.09	2.0	1.46±0.06	1.6
B <sub>6</sub> , mg	1.82±0.07	2.0	1.71±0.04	1.8
PP, mg	18.64±1.12	22	14.25±0.92	16
Folic acid, mcg	241±10.2	250	164±9.8	200
B <sub>12</sub> , mcg	2.67±0.21	3	2.64±0.19	3
C, mg	79.68±4.81	80	68.64±4.40	70

Figure 1 shows the relative deviation of the vitamin content in the daily diet of students in this ethnic group. Vitamin A surplus is 27% and 13%, vitamin B<sub>2</sub> deficiency is 23% and 9%, vitamin PP deficiency is 15% and 11%, vitamin B<sub>12</sub> deficiency is 11% and 12% in male and fe-

male diets respectively exceed the tolerance level of ± 5%. At the same time, 9% of the lack of vitamin B<sub>6</sub> in the daily diet of young men and 18% of the lack of folic acid in the daily diet of girls was noted.

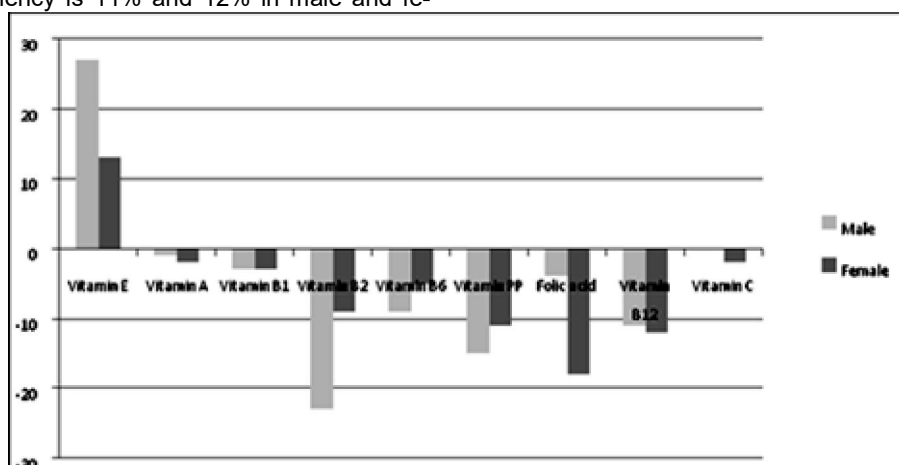


Fig.1 Relative deviation of the average daily intake of vitamins by international students from India, % of daily requirement.

The actual consumption of macro- and microelements also has certain characteristics. Noteworthy is the deficiency of phosphorus, zinc, iodine and selenium intake in

the men's group. The analysis of the diet of a female group found a deficient content of phosphorus, iron, zinc, iodine and selenium (See tab.2)

Table 2  
Average daily intake of minerals by international students from India (M ± m)

Minerals	Male		Female	
	Actual daily consumption	Daily requirement	Actual daily consumption	Daily requirement
Ca, mg	1206±62.7	1200	1114±56.8	1100
P, mg	879±75.1	1200	944±69.8	1200
Mg, mg	407±9.2	400	365±7.1	350
Fe, mg	14.2±1.1	15	15.1±1.1	17
F, mg	0.74±0.02	0.75	0.73±0.03	0.75
Zn, mg	12.6±0.2	15	10.9±0.6	12
I, mg	0.14±0.02	0.15	0.14±0.03	0.15
Se, mcg	63.7±2.7	70	42.4±1.9	50

The imbalance of these minerals' content exceeds the permissible level of variation  $\pm 5\%$  both in men's and in women's diets (see Fig.). There is the inadequate intake of phosphorus 27%, 16% zinc, iodine, selenium 7% and 9% in men's group diet, 21% lack of phosphorus, iron,

11%, 9% zinc, iodine, selenium 7% and 8% in the women's group diet. Ratio of calcium and phosphorus was 1.4: 1 for young men, 1.2: 1 for girls at the recommended 1: 1.

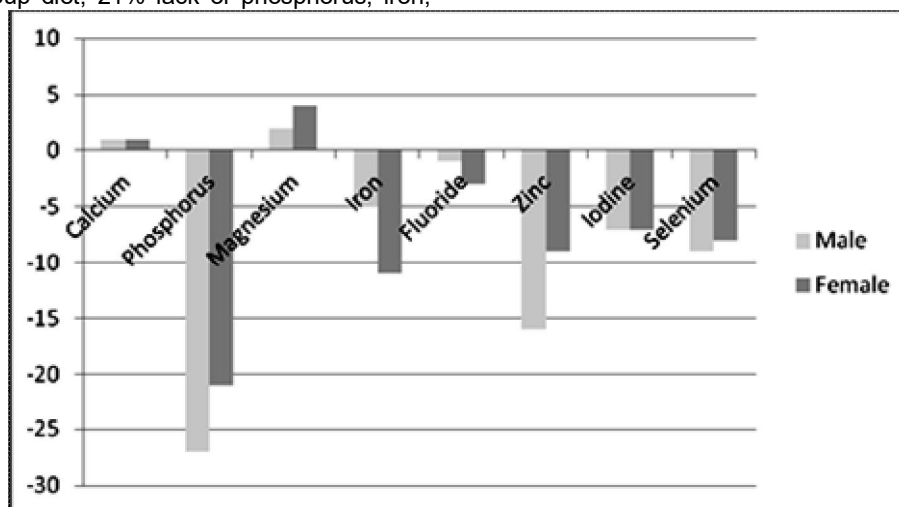


Fig.2 Relative deviation of the average daily intake of minerals by international students from India, % of daily requirement.

Many micronutrients deficiencies are associated primarily with low (according to MHU recommendations) energy value of the diet, the ratio between the impaired macronutrients (proteins, fats and carbohydrates), selective diet with insufficient consumption of complex carbohydrates and animal nutrients in male and female groups that was detected in earlier studies [18]. Also, 20% (24/119) of students, 11% (8/70) of boys and 31% (15/49) of girls, have a body mass index within the 1st stage of malnutrition [19]. As for the content of micronutrients, as Figure 1 shows, the students of both sexes are provided with vitamins A, B<sub>1</sub> and C within physiological needs. The content of folic acid in the male diet meets the recommended standards and subnormal value of vitamin B<sub>6</sub> is marked in women diet. However, vitamin deficiencies were quite alarming in terms of certain vitamins. The combined lack of folic acid, vitamins B<sub>6</sub> and B<sub>12</sub> in the respondents' diet is a risk factor for atrophy of lymphoid tissue, significantly reducing the number of T-helper cells, reducing the production of cytokines, particularly important link of antitumor immunity - interleukin-2. Also, polydeficiency of vitamin B<sub>12</sub> and folic acid (female group) participating in the synthesis of nucleoprotein, maturation and nuclear division of cells, synthesis of amino acids, nucleic acids, purines and pyrimidines strongly impact on tissue that is intensively divided: erythroid, in which there are the earliest disorders that are manifested in anemia. Vitamin PP is part of pyridine nucleotides and co-dehydrogenase enzymes that protect the hemoglobin and membranes of red blood cells from oxidation. Its deficiency is also a risk factor of dysmetabolism of hematopoietic tissue [2,4,11]. Excessive men's consumption of vitamin A, which is fat-soluble and is capable of cumulation, provided probability of increasing occurrence of hypervitaminosis A, which inhibits processes of proteosynthesis, osteo- and chondrogenesis [2,4].

Consumption of certain minerals such as calcium, magnesium and fluoride, is consistent with recommendations of the Ministry of Health of Ukraine in both groups.

Consumption of iron in the men's group has a subadequate level. Regarding dyselementosis, the greatest attention is attracted to the significant lack of phosphorus in both groups. Phosphorus compounds form complex compounds of biologically active proteins, fatty acids, which include nucleoproteins of cell nuclei, phospholipids (lecithin) etc. Phosphorus is part of adenosine triphosphate and creatine phosphate which are energy storages. Also, phosphorus is part of the bone. Prolonged lack of phosphorus is a risk factor for violation of these processes [2,4]. Prolonged lack of phosphorus is a risk factor for violation of these processes [2,4]. Zinc deficiency in the diet of both sexes increases the probability of leucopenia [4.11] and disorders of the endocrine glands [2,4]. Lack of selenium, which protects the erythrocyte membranes from free radical damage is another factor in the adverse effect on blood formation for men and for women's groups [11]. Lack of iodine is not endemic to the Odessa area. It is the result of selective nutrition inherent to foreign students who are reluctant to consume local foods of the new host country, which for them is Ukraine [6]. Iron deficiency, which is the true blood-forming element, is certainly important in the women's group, given the monthly menstrual blood loss. In addition, 57% of body iron is part of hemoglobin, the part of the trace element peroxidase, cytochrome, cytochrome oxidase, because it gives the lack of oxidation processes [2,4,11]. These data characterize nutrition of respondents as unbalanced and inadequate of vitamins (polyhypovitaminosis). Deficiency of vitamins in the diet inevitably leads to metabolic disorders, creating metabolic basis for alimentary-dependent diseases. Lack of vitamin B<sub>1</sub>, B<sub>2</sub>, PP, B<sub>6</sub> can be compensated in part by replacing rice, which is the cereal of choice for this ethnic group, to yeast bread and oatmeal. It also will help to improve the content of complex carbohydrates in the diet. Deficiency of vitamin B<sub>12</sub> is optimally adjusted in this age with introduction to the diet of liver and dishes from it [4.13]. But students of this ethnic groups at first, have cultural and religious restrictions on its use, and secondly,

the liver has the highest content of vitamin A, obtaining of which is excessive. Therefore, reasonable correction of B<sub>12</sub> vitamin deficiencies due to increasing consumption of beef in the diet of students who follow the Islamic traditions in food, chicken products in the diet of students traditionally do not eat meat but consume poultry, replacement of soft cheese and milk on a solid cheese with decreasing consumption of brown and red carrots in the diet of people that follow the traditions of lactovegetarians. A necessary condition for the realization of specific functions of vitamins in metabolic processes is the normal course of their own metabolism: absorption in the intestine, transport to tissue, conversion to the active form. The absorption and transport of vitamins often carried by transport proteins are complete proteins [2,11]. Preferential respondents use the vegetable food. It creates conditions for malabsorption of vitamins [4]. Insufficient intake of valuable animal protein inhibits the synthesis of body proteins, including transport proteins. First, it should be increased with the intake of animal protein according to the regulatory quota. Excess dietary fiber content accelerates peristalsis, which prevents effective absorption of vitamins [2,4]. The diet of foreign students from India needs a complex correction for the content of insoluble fiber, animal protein and vitamins. In the consumption of minerals, this group of students has visible signs of dyselementosis. Nutrition of respondents in terms of the content of micro and macroelements is unbalanced and inferior. Deficiency of mineral elements is manifested through a significant period of time, making it difficult to diagnose and therefore it is reasonable to pay due attention to prevention of this type of nutritional disorders [2]. Correction of dyselementosis is advisable through the introduction of fish and seafood of vegetable (algae) and animal (mussels, shrimp, brine) origin in a diet, depending on the ethnic and religious restrictions and personal preference. A further concern is combined polydeficiency of micronutrients (vitamins and minerals), which affect the blood. For normal hematopoietic tissue metabolism the administering of a set of micronutrients to the bone marrow is needed. Their deficiency inhibits all parts of hematopoiesis [11]. Therefore, the diet of this ethnic group needs a comprehensive correction of these indicators through diet diversification from local seasonal food.

Thus, the actual nutrition of this group of students from India is unbalanced in terms of vitamins, micro- and macroelements, which creates a metabolic basis for pathological conditions or diseases. For statistical evidence and further examination of revealed laws is necessary to increase the total volume of the sampling. Additional tests of students to study biochemical indicators of nutritional status are expedient, namely the content of vitamins, minerals, total protein, hemoglobin and lipid abnormalities in blood plasma. Selective, monotonous meals, improper cooking, increase micronutrient needs due to changes in climate and time zone, the lack of a sustainable diet, ethnic and religious restrictions in the diet create conditions for the formation of alimentary-dependent diseases in a given social group. General recommendations for correcting the diet are compliance with the regime of nutrition, diet diversification and rationalization by local seasonal products, bringing micro- and macronutrient composition and total caloric meals at the limit of recommended values, decrease consumption of fast food; educational work among foreign students to raise awareness of nutrition issues, in terms of the local food and sustainable ways of cooking, developing diets

that are adapted to the culinary, cultural and ethno-religious traditions of this segment of students to prevent alimentary-dependent pathologies among foreign students whose country of origin is India.

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