Comparative characteristics of selenium content in students from different regions of the world

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Abstract. The study was performed to determine Selenium level in a first year foreign students' biosubstrates who came for an education to Peoples' Friendship University of Russia - RUDN University. The number of students who participated in the study was in total 583 and contained of students from North and Tropical Africa, Latin America, the Near and Middle East, East and South-East Asian, Central Asia and Russia (Moscow). The analysis of selenium concentration in hair, blood serum and urine was made with Inductively coupled plasma mass spectrometry (ICP-MS). The conducted study demonstrated that the highest hair selenium level was in the Tropical Africa and Latin America students' samples. The highest selenium concentration in the blood serum and urine characterized Latin America students' samples. In the result of the study the selenium deficiency was not demonstrated in any participated students' group.

1 Introduction

For the past two decades, our knowledge and understanding of the Selenium biological role and its importance in the human diet were significantly progressing. Modern knowledge of the Selenium is a necessity for the health risk assessments, associated with Selenium deficiency through the population. Selenium (Se) is an important micronutrient which has its own fundamental impact on the human biology [1,2]. Se is a key component for the several main metabolic pathways, including thyroid hormone metabolism, antioxidant system and immune functions [3-8]. Se also plays an important role in maintaining human homeostasis [9,10]. Although Selenium is an essential micronutrient for the human health, the «window» for it's beneficial actions isn't that wide between toxicity and indispensability [5,10]. Se could be helpful as well as harmful, depends on its concentration and chemical compounds [11]. Micronutrient is required for effective protection from the adverse effects of heavy metals and xenobiotics [12], while being the antagonist of Hg and As, as well as protector from Cd, Pb and Tl [5,13,14]. Selenium multiple biological activity depends on the dietary intake level. Selenium deficiency increases risk of HIV disease progress and transmission. Moreover, inadequate Selenium level can cause changes in gut microbiome, that may be more susceptible to cancer, thyroid hormone dysfunctions, inflammatory gut diseases and cardiovascular disorders [12].

General amount of Selenium in human body greatly varies depending on population, diet and geographical region, while dietary intake depends on soil compounds [15,16]. Dietary

Selenium deficiency affects around 1 billion people in the world, and for the moment insufficient Selenium intake occurs in many countries [17].

Growing number of selenium deficient regions in the world leads to many pathological disorders. Lately the problem of Selenium shortage is occurring more often in African countries south of the Sahara Desert as a public health problem [18]. Studies show that the risk of dietary Selenium deficiency in 7 countries of South Africa is >60% and 22% across the Africa. Selenium status in the Near and Middle East countries widely varies, due to the higher Selenium presence in one region as the opposite from another. Such difference is noticeable even in the provinces of one country. These contrasts may be related to inequality of Selenium concentrations in the soil where the food is grown [4,10]. At the same time the data on Selenium deficiency in the countries of South Africa and the Near East is poor and insufficient. At the same time the data on Selenium deficiency in the countries of the South Africa and the Near East is poor and insufficient [19].

The importance of information about Selenium content in students biosubstrates from different regions of the world that comes to study in Moscow region is obvious to developing practical recommendations for enhancing foreign students adaptive potentia

2 Materials and methods

Our study included 583 first-year students, both male and female, from different climatic and geographical regions of the world who came to study in Patrice Lumumba Peoples' Friendship University of Russia, including students from countries of the North America (-56), Tropical Africa (n-77), Latin America (n-57), Near and Middle East (n-109), Central Asia (n-100), East and South-East Asia (n-99). The control group consisted of Moscow based students (n-85). The average age of examined students was 18-25 years old. The biosubstrates were collected on the first medical examination right after arrival to the university.

The determination of Selenium status in blood serum, hair and urine was made with inductively coupled plasma mass spectrometry (ICP-MS) at NexION 300D (Perkin Elmer Inc., Shelton, CT, USA). The hair samples in the amount of 0,5 g each were collected by cutting it close to the scalp from the back of the head with stainless steel scissors, previously treated with ethyl alcohol. For the purpose of the research were used proximal parts of the hair 1-2 cm long, indicating the state of macro- and micronutrients metabolism over the last 1–2 months.

Urine samples were collected in the morning time with the sterile urine container (100 ml) (Greiner Bio-One, Austria). Students were instructed to collect urine before their first meal on the empty stomach. The urine samples for analysis were medium size. The samples were stored in the refrigerator compartment at -40°C, and transferred frozen in thermal containers to the laboratory.

Blood samples were collected in the morning time on an empty stomach by venipuncture from ulnar vein using 7,5 ml S-Monovette vacuum tubes (Sarstedt, Nümbrecht, Germany). The blood samples collecting were performed by a certified nurse in a clinical setting. After obtaining whole blood, samples were centrifuged at 1800 rpm/min for 10 min to obtain serum isolation. Serum samples were collected in a 1 mL Eppendorf tubes (Eppendorf, Hamburg, Germany). The blood serum samples were stored in a low-temperature refrigerator at -40°C. The blood serum samples were transported while maintaining the same temperature regime.

The statistical analysis on an obtained data was provided with Microsoft Excel software package (Microsoft Office 2020, Microsoft Corporation, USA) and Statistica 10.0 for Windows (Statsoft, Tulsa, USA). For achieving indicators that doesn't characterized with Gaussian distribution in a context of descriptive statistics were used medians and suitable inter quartile range (IQR). The results of a statistical analysis were considered statistically respective at $p < 0,05$.

3 Results

The result of our study demonstrated that Selenium level in the Tropical Africa students' hair samples was respectively higher than Moscow (on 19%) and North Africa (on 15%) students' hair samples (table 1). Also the Selenium level in the Latin America students' hair samples was respectively higher than Moscow (on 16%) and North Africa (on 13%) students' hair samples.

Table 1. Selenium content in biosubstrates of students from different regions of the world

Region	Biosubstrate		
	Hair µg/g	**Serum** µg/ml	**Urine** µg/ml
Russia (Moscow)	0.446[3.4] (0.343-0.494)	0.093[4] (0.082-0.102)	0.039[4] (0.025-0.056)
North Africa	0.459[3.4.] (0.368-0.573)	0.091[4] (0.080-0.106	0.046 (0.032-0.056
Tropical Africa	0.529[1.2] (0.474-0.811)	0.089[4] (0.085-0.101	0.036[4] (0.025-0.046
Latin America	0.517[1.2] (0.404-0.682)	0.117[1.2.3.5.6] (0.111-0.126)	0.055[1.3.5.6] (0.036-0.080
Near and Middle East	0.489 (0.304-0.666	0.092[4] 0.078-0.103	0.038[4] (0.031-0.047
Central Asia	0.476 (0.340-0.553)	0.089[4] (0.083-0.099)	0.034[4] (0.025-0.046
Eastern and Southeast Asia	0.494 (0.315-0.873)	0.098 (0.087-0.105)	0.043 (0.032-0.054

Data are presented as median and corresponding boundaries of the interquartile (Q1-Q3) interval. [1,2,3,4,5,6,7]- reliability of differences from the groups: [1]Moscow, [2]North Africa, [3]Tropical Africa, [4]Latin America, [5]Near and Middle East, [6]Central Asia, [7]East and Southeast Asia, with $p<0.05$.

Collected results of the research showed that students from Latin American countries characterized with the highest Se blood serum level, the results respectively shows higher Se status compared to results of the students from Moscow (on 36%), South (on 29%) and Tropical (on 31%) Africa, Near (on 27%) and Middle (on 31%) East. The results are generally coordinate with the known data on Se blood serum level of Latin Americans [3, 20,21,22].

Elevated blood serum Selenium level of Latin American students is most likely a result of the traditional diet typical for the regions students from. Multiple research demonstrates that measured Selenium level in blood plasma or serum varies depending on the region or country [4]. Studies that took place in Brazilian Amazon showed that Selenium status of the local coastal communities fluctuates from normal to extremely high and varies from 142 to 2447 µg/L in blood serum [20,23,24,25]. Selenium blood serum level of this region correlates respectively with higher dietary fish and Brazil nut consumption [21,22,23]. Studies that took place in Argentina showed that Selenium blood serum level range between 47 and 105 µg/L [24, 26]. Selenium blood serum concentration is expedient to consider as the most reliable biomarker of Selenium status not only for individuals, but on the population level [27,28,29].

Selenium urine concentration is also associated with the region of residence. Collected urine excretion level belongs to the Latin America group of students (0,055 µg/L) and is respectively higher compared to the students from different regions of the world, such as Moscow (on 41%), Tropical Africa (on 53%), Near and Middle East (on 45%), Central Asia (on 62%), East and South-East Asia (on 28%). This fact could be explained that the higher Selenium blood serum concentration is, the more goes its excretion with urine, since it is the

only way to excrete Selenium from the body [27,28]. It should be mentioned that there is a lack of data on Selenium urine concentration through population, especially in countries of Latin America, Africa and Asia [30].

4 Conclusion

Overall, the result of the study shows wide variability of Selenium level in the students body through different geographical regions of the world. Also, as the results of the study, the Selenium deficiency has not been demonstrated in the examined students body.

However, the result of the study set to show that students from Latin America countries characterized with the highest Selenium levels in blood serum and urine, while the highest Selenium hair level demonstrated by students from African countries among all studied groups. The differences in the Selenium hair concentration may be due to the nature of the local traditional diet of the regions where students were based before arriving to study in the Russian Federation.

The results of the studies may apply for development of the preventive measures complex for correction of foreign students' elemental status and enhancing adaptive potential, who came to study in Moscow megapolis from different regions of the world.

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