

## **Selenium in Healthy Individuals in Mato Grosso do Sul State, Brazil**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors LZZ and PM headed the project. Authors THF, FZC, AFDS and VADN conducted the analysis and interpretation and drafted the manuscript. Authors LZZ and PM was involved in the early work and assisted with the interpretation of the results. Authors THF, FZC and AFDS were in charge of data management. All authors were involved in the critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The aim of the present research was to assess plasma selenium concentrations in healthy individuals, in the State of Mato Grosso do Sul, Brazil, as part of the mapping of the Brazilian states. Selenium levels were measured in 342 healthy individuals, using Inductively Coupled Plasma Spectrometry (ICP-OES). The average plasma selenium concentration in this study was  $65 \pm 20$   $\mu\text{g/L}$  (mean  $\pm$  SD; range 21– 144  $\mu\text{g/L}$ ), the lowest in comparison to other Brazilian states. The predictor variables, such as gender, ethnicity, blood type or body mass index do not correlate with plasma selenium concentration.

*Keywords: Selenium; plasma concentration; trace elements; micronutrient.*

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## 1. INTRODUCTION

There is a great body of evidence to show health-promoting properties of selenium (Se) [1]. In fact, its deficiency is considered to be an important factor in the development of various diseases. So, optimization of Se status is of great help in disease prevention and treatment. Data are also actively accumulated to indicate that selenium levels have a significant association with thyroid cancer [2]. Furthermore, an optimal Se status is shown to be beneficial in cardiovascular diseases and neurodegenerative disorders [3,4]. Selenium plasma concentrations can vary widely, depending on its content in soils, dietary intake, bioavailability and other factors [5,6]. An intake of at least 40µg/day was suggested as the minimum Se amount required for humans [7]. It must be borne in mind that high selenium exposure can induce toxic effects [8]. So, before recommending any supplementation (either direct or by food enrichment) it is of utmost importance to establish the ground levels of Se in local population. The purpose of the present work is to determine blood plasma concentrations of this element in healthy individuals in Mato Grosso do Sul, Brazil.

## 2. METHODS

This descriptive-analytical research was conducted at the Federal University of Mato Grosso do Sul, Brazil, during the period of April through December 2014. The study protocol and informed consent were approved by the Ethics Committee of this University (protocol N°2256 CAAE 0334.0.0.049.000-11). The informed consent was given by the participants before enrollment. The study enrolled a total of 342 healthy blood donors of both genders, aged 18-63 years old, occupationally non-exposed to selenium. Such an approach has recently been successfully used by Australian researchers [9]. The individuals who were receiving vitamins and mineral supplementation, or any thyroid medication were not included in the study. Only one sample of each blood donor was included in the study. The ethnic groups included white Brazilians, mixed race (pardo Brazilians), black and asian Brazilians. Information regarding blood types was also collected according to ABO system. Body mass index (BMI) was employed for the purpose of nutritional status assessment. The samples were collected after blood donation at the University Blood Center and immediately transferred into vacuum tubes free of trace elements, for later analytical determinations. Plasma selenium concentrations were measured

by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). All materials, plastic or glass, were previously immersed for 24 h in a solution of Extran 5% (Merck), rinsed and immersed for at least 24 h in 10% nitric acid (Merck) solution for decontamination from any metal residue. Then, they were washed with ultrapure water (Milli-Q, Millipore, Bedford, USA) and dried at 40°C. Appropriate amounts of selenium stock solution (100mg/L, SpecSol™), were diluted with ultrapure water, yielding concentrations of 25 µg/L, 50 µg/L, 100 µg/L, 150 µg/L and 200 µg/L, which were used for the construction of calibration curve. The correlation coefficient of the resulting calibration curves were 0.998. The accuracy was assured by analysis of certified reference materials (Seronorm™ Trace Elements Serum). Kolmogorov–Smirnov test was performed in order to evaluate variables distribution. The statistical analysis was carried out using mean±SD, Student's-test, qui-square test, Z-test with Bonferroni correction, ANOVA and Tukey pos-test, and Pearson's linear correlation. Data were analyzed by using either SPSS, version 17.0 or SigmaStat, version 3.5 softwares. The *P* value adopted was .05.

## 3. RESULTS

The average plasma Se concentration in this study was 65±20 µg/L (mean±SD; range 21–144 µg/L). The evaluation according to gender and age showed no statistical differences (*P* = 0.60; *P* = 0.89). The distribution of the participants according to ethnic origin showed 79.8% (n= 273) white Brazilians, 11.7% (n= 40) mixed race, 7.9% (n = 27) black Brazilians, and 0.6% (n = 2) asian Brazilians. The plasma selenium concentrations according to this characteristic were 66±21 µg/L, 67±21 µg/L, 65±15 µg/L, and 63±11 µg/L, respectively. No significant differences were observed among the ethnic groups and plasma Se concentrations (*P* = 0.91). As for blood types, selenium concentrations were 65±20 µg/L for type O, 65±19 µg/L for type A, 69±15 µg/L for type B, and 60±21 µg/L for type AB. No statistically significant differences were found between these values (*P* = 0.66).

The average of BMI was 26.9±4.3, being 26.6±3.9 for male and 27.6±4.9 for female (*P* = 0.05). As for nutritional status of the participants, 36.6% (n= 125) had healthy weight, 41.2% (n = 141) were overweight, and 22.2% (n = 76) were obese. No correlations were found between genders and BMI (*P* = 0.18), as well as between plasma Se and BMI (*P* = 0.87). These data are shown in Table 1.

#### 4. DISCUSSION

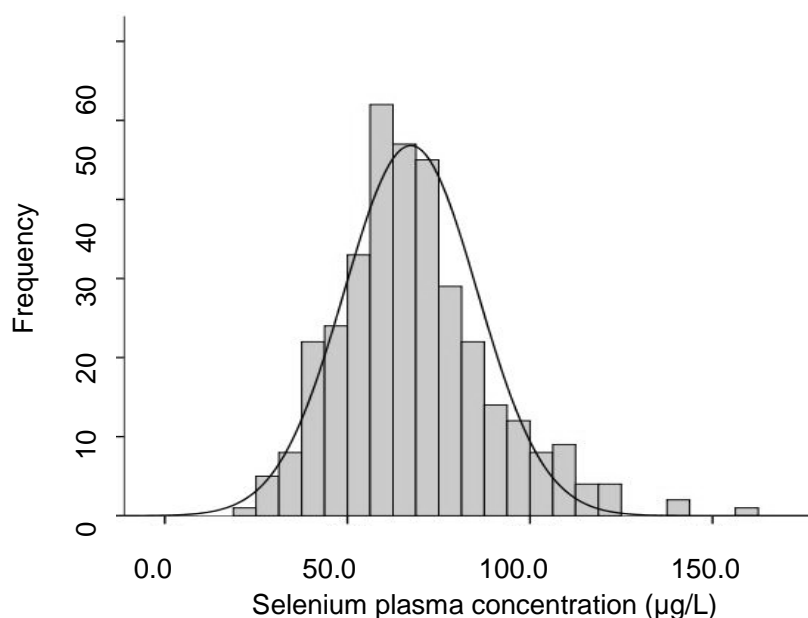
Universal normal ranges of plasma or serum selenium levels have not been set because of the dramatic variability in blood selenium levels according to geographical factors [10]. As for Brazil, blood selenium concentrations measured so far [11,12] are given in Table 1, along with our results. The latter were shown to follow the Gaussian distribution, as seen in Fig.1.

As can be seen, the level of selenium as measured in Mato Grosso do Sul is the lowest in

comparison to other Brazilian states. Mato Grosso do Sul is located in Midwest region of Brazil, with an area of 357,146 km<sup>2</sup>, and an estimated population of 2,619,657 inhabitants. This part of the country, as the neighboring state of São Paulo, presents a selenium soil deficient [13,14] that can affect the food chain. Furthermore, nutritional factors are involved, since the main products consumed in Mato Grosso do Sul are basically the same as in the neighboring states of São Paulo, Mato Grosso, and Goiás, regions where there is evidence of selenium deficiency [6,14,15].

**Table 1. Plasma selenium concentration (mean±SD) in respect to age, gender, ethnicity, blood type and BMI**

Variable		Selenium (µg/L)	P value
Age (years)	33.4±11	65±20	-
Gender	M	65.8	0.61
	F	63.9	
Ethnicity	White Brazilians	66±21	0.91
	Mixed race	67±21	
	Black Brazilians	65±15	
	Asian Brazilians	63±11	
Blood type	O	65±20	0.67
	A	65±19	
	B	69±15	
	AB	60±21	
BMI	18.5-24.9	65±17	0.87
	25-29.9	65±20	
	> 30	65±14	



**Fig. 1. Blood donors number versus plasma selenium concentration**

**Table 2. Plasma selenium concentration ( $\mu\text{g/L}$ ) for healthy subjects in Brazil**

State	Number of participants	Se concentration ( $\mu\text{g/L}$ )	Mean values
São Paulo [12]	371	72-154	89.3*
Minas Gerais [12]	169	68-158	
Goiás [12]	281	70-120	
Rio Grande do Sul [12]	79	89-134	
Pará [12]	225	132-245	
Rio de Janeiro [11]	30	56.5-94.5	73.18
Mato Grosso do Sul (our data)	342	21-144	65

\*Mean values including the participants from São Paulo, Minas Gerais, Goiás, and Rio Grande do Sul

Another possibility is that the metabolic interference with copper can be put forward. Previous published papers showed that plasma copper concentration in Mato Grosso do Sul exceeds the average data from other localities [16-18]. Presently, we have no rational explanation for high plasma copper concentration in Mato Grosso do Sul.

However, these data may be helpful for mapping selenium levels in Brazilians and world population.

## 5. CONCLUSIONS

This study represents an important data for future studies on biomonitoring trace elements deficiency in Brazilian people. As already mentioned, our study demonstrated that the predictor variables chosen, such as gender, BMI, ethnic group or blood types do not appear to influence plasma selenium concentration. So, these data point to the conclusion that ethnicity [19] does not contribute to the plasma selenium levels.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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