Serum selenium concentration in Mashhad prisoners, Iran

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ABSTRACT

الأهداف: تحديد مستويات تركيز السيلينيوم في الدم بين السجناء في السجن المركزي في مدينة مشهد شمال شرقي ايران.

الطريقة: أُجريت هذه الدراسة المقطعية على العينة العشوائية المكونة من 435 سجيناً (387 من الرجال الذين تتراوح أعمارهم ما بين 10±34.5 عاماً، و48 من النساء اللاتي يبلغن 11±36.4 عاماً) الذين تم جمعهم من السجن المركزي في مدينة مشهد، إيران وذلك خلال الفترة من مايو إلى يونيو 2008م. لقد قمنا باستخدام أسلوب أخذ العينات متعددة المراحل والذي يتناسب مع الجنس، والفئات العمرية، ونوع الجريمة. ثم قمنا بتقييم مستوى المصل من السيلينيوم باستخدام مقياس الطيفي الامتصاصي الذري.

النتائج: لقد كان متوسط تركيز السيلينيوم في الدم 20±121 ماموغرام/لتر. ولقد كانت نسبة انتشار نقص السيلينيوم لدى مجموع عينة الدراسة 9.7% حيث كان نقص السيلينيوم أكثر انتشاراً لدى النساء منه لدى الرجال (25.5% مقابل 7.7%) (p=0.00). وكان للتوزيع العمري من نقص السيلينيوم نمطاً مختلفاً بين الرجال والنساء حيث كانت المستويات الأقل من متوسط مستويات السيلينيوم بين الرجال منتشرة لدى الفئة العمرية 50 عاماً أو أكثر، في حين لم تتغير مستويات السيلينيوم بين الإناث باختلاف العمر. كما لم يكن لمؤشر كتلة الجسم وتغير الوزن أي علاقة بمستويات السيلينيوم.

خاتمة: تشير نتائج هذه الدراسة إلى أن مستويات السيلينيوم بين السجناء في السجن المركزي تبعث على القلق. كما أن المرأة قد تكون أكثر عرضة لنقص السيلينيوم خاصة في سن الشيخوخة. ولهذه الدراسة الأثر على المسئولين في السجون وراسمي السياسات الصحية.

Objectives: To determine the serum selenium concentration among prisoners in the central jail of Mashhad, Northeast of Iran.

Methods: In a cross-section study, a sample of 435 prisoners (387 men [34.5±10 years] and 48 women [36.4±11 years]) recruited during May 2008 to June 2008 from Mashhad Central Prison, Mashhad, Iran, using multistage sampling method, proportionate to gender, age groups and kind of crime. Serum level of selenium was assessed using atomic absorption spectrophotometer.

Results: The mean of serum selenium concentration was 121±20 µg/l. Prevalence of selenium deficiency was 9.7% in selected sample. The selenium deficiency was more prevalent in women than men (25.5% versus 7.8%, p=0.00). Age distribution of serum selenium level had a different pattern among men and women. While in men serum selenium level on average was least in those aged 50 and over, in women, serum selenium did not change with age. Body mass index (BMI) and weight change had no relations.

Conclusion: Results of this study suggest that selenium status of the prisoners in Mashhad central prison is of concern. Women may be at higher risk for selenium deficiency. These results have implications for officials in charge with prisoners and health policy makers.

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The limited food ration of prison makes the prisoners more susceptible to micronutrient deficiencies. Currently, information of micronutrient deficiencies among inmate prisoners are limited worldwide due to various reasons including security reasons, delicate bioethical norms regarding prisoners as experimental

subjects, limited study resources, not wishing to create demands for reform or other issues. Micronutrients are essential elements needed only in small quantities, while affecting human performance greatly.[1,2] Selenium is one of such micronutrients, which are important for human health and are said to be effective in chronic diseases such as diabetes and coronary diseases and their complications.[2] Globally, more than one third of the world's population suffer from selenium deficiency.[3] There are many studies on micronutrient deficiencies among Iranian population as, the prevalence of Iron Deficiency (ID) has been reported to be 35.6% in northern Iranian population.[4] Zinc deficiency is a common nutritional burden especially among Iranian population.[1,3,5,6] Parizadeh et al reported that zinc deficiency in great Khorasan province, North East of Iran was 22.1%.[6] There are rare studies about selenium deficiency in Iranian population. Selenium is essential to the activity of many enzymes such as glutation-peroxidase. This enzyme has an important role in protecting of immune system and increasing duration of red blood cells' life.[7,8] Anticarcinogenic effects of selenium also have been noted in many researches.[9,10] The major dietary sources of selenium are cereals, seafoods, red meat, chicken, and eggs. The content of selenium in food depends on the selenium content of the soil where plants are grown or animals are raised.[11] The special diets of prisoners provide limited sources for micronutrients due to their retention into prison and their consumption from its diet. The aim of this study was determining selenium levels and the deficiency prevalence among prisoners in central jail of Mashhad. The results of the study may have implementation for policy makers to improve inmate health.

Methods. A total of 435 inmates including 387 men and 48 women were recruited among 8718 prisoners at Mashhad central prison, using a multistage sampling method proportionate to gender, age groups, and kind of crimes. The study was undertaken in Mashhad Central Prison, during May 2008 to June 2008. Mashhad is the second major city of Iran, with a big prison for covering northeast of Iran. The Ethics Committee of Mashhad University and prison authorities approved the project. Informed consent was obtained from all participants. The research was in accordance with principles of Helsinki Declaration.

Inclusion criteria were living in prison for more than 2 months days and nights, having no any medical special condition (being apparently healthy), for which should obey a specialized diet, or interfere with his/her health and be happy to participate in the study. Exclusion criteria were any chronic or acute medical condition, drug abuse, and any special diet for any reason. All prisoners were fed within the prison using food ration of prison and some free-shops in the jail (foods from outside the jail are prohibited by law).

Fasting blood samples was taken in early morning from the antecubital vein. Serum levels of selenium and zinc were assessed using Flame atomic absorption spectrophotometry (PerkinElmer model 3030, USA, 1980). The reference ranges for selenium were considered 90-143µg/L.[12] Using an interviewer-administrated questionnaire demographic data were collected. Food intake from all sources in the jail was recorded, and anthropometric measurements were made at the time of interview, using the standard methods. Drug history and supplement use were also asked from prisoners.

Statistical analysis. All data were analyzed using the Statistical Package for Social Sciences for Windows, version 11.5. (SPSS Inc., Chicago, IL, USA). The values were presented as means ± standard deviation (SD). Parametric tests were used to determine differences between data sets that were normally distributed. Analysis was performed using t-test, Chi-square test, and Fisher's exact test. A p value equal or less than 0.05 was considered statistically significant.

Results. The population characteristics are presented in **Table 1**. Type of crime, the composition of the population in different wards was shown in **Table 1**. Also, women were more obese than men. In general, the mean of selenium concentration was 121 ± 20 µg/l and overall prevalence of selenium deficiency was 9.7% (**Table 2**). **Table 2** summarizes the serum concentration of selenium. We observed that selenium was higher in male compared with females (122±21 versus 111±20.6 µg/l, p=0.001) and selenium deficiency was more prevalent in women than men (25.5% versus 7.8%, p=0.00). Also, age distribution of selenium status was different between 2 genders (**Table 3**). In total, 24 cases have used supplements, when excluding them, and using ANOVA test lowest serum selenium levels among men were seen in those with the age of 50 and over (115.3± 13.7µg/l) and the highest was seen in those of the age of 41-50 years (129.96 ± 20.1µg/l) (p=0.020). Differences in selenium deficiency by age groups in

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women were almost the same among age groups in men (p=0.46). Zinc status has also investigated in prisoners, and the results showed that serum levels of zinc did not vary with age in women (p=0.195), but it was nearly significant in men (p=0.050). Tukey test result of serum selenium among age groups of males has shown in **Table 4**. With respect to crime types (as they were kept in different wards and had different background) the differences on selenium state did not reach to a significant level (p=0.08). Participants were asked about their weight change during prison stay, 48% of them lost their weight but ANOVA test revealed no difference in selenium and zinc status between them and others with no change in weight and those who got weight (p=0.48 and p=0.64). There was no relation between BMI and serum level of selenium and zinc. Education level has no relation with selenium and zinc status (p=0.88 and p=0.93).

Discussion. Prison is a closed environment; therefore, food intake of prisoners is dependent to the limited food ration of prison. Thus, it is necessary for health care providers to pay attention to the nutritional status of inmates. The results of this study showed that selenium deficiency is one of concerns of nutritional status among prisoners. Women in prison are at greater risk for micronutrient malnutrition. In the present study, the mean serum selenium concentration was 121 µg/l. The selenium deficiency was seen in 9.7% of the total participants with more prevalence in women. There are limited data on the selenium status of free-living population of Mashhad. Ghayour-Mobarhan et al, has reported an average serum selenium level of 86.9 µg/l in a sample of free-living subjects in Mashhad.[13] Pizent et al from Croatia reported that the serum selenium level among men prisoners was 53 (30-100) µg/l in the prisoner's group and 65 (45-109) µg/l in the reference subjects.[14] Significantly, lower selenium levels were found in the prisoners compared to the reference subjects. The selenium status varies greatly across the world. In some regions of USA and some parts of China, average selenium concentration is reported to be high (>200 µg/l), and in some other parts such as Serbia it is reported to be very low (<50 µmol/l).

Table 1 - Population characteristics of a sample of Mashhad Central jail, Mashhad, Iran.

Population characteristics	Men (n=387)	Women (n=48)	*P*-value
Type of crime			
Accused (%)	35 (9.0)	11 (22.9)	0.005
Sentenced (%)			
Addiction	193 (50.0)	35 (72.9)	0.002
Financial	99 (25.6)	1 (2.0)	0.000
Criminal	26 (6.7)	1 (2.0)	0.228
Others	34 (8.8)	0 (0)	0.022
Demographic characteristics (Mean± SD)			
Age (year)	34 ± 9	36 ± 11.0	0.391
Weight (kg)	72.6 ± 11.0	71.0 ± 10.9	0.379
Height (m)	1.73 ± 0.06	1.58 ± 0.06	0.000
Body mass index (kg/m^2)	24.2 ± 3.6	28.23 ± 4.5	0.000

Table 2 - Selenium status* among inmate prisoners in Mashhad Central jail, Mashhad, Iran.

Gender	Total number	Mean±SD (µg/l)	Low selenium status n (%)
Men	385	122±21	30 (7.8)
Women	47	111±21	12 (25.5)

*Cut-off point for serum level of selenium is defined as 90 µg/l.

Table 3 - Age distribution of serum selenium among 2 genders*

Age group	Selenium µg/l *p*=0.02		Zinc µg/l *p*=0.05	
	Mean	95% confidence interval	Mean	95% confidence interval
Male				
<30	117.9	113.7-122.0	83.17	80.4-95.9
30-40	123.6	119.04-128.8	85.01	81.9-88.1
41-50	129.9	121.8-138.1	89.28	85.6- 92.9
>50	115.3	106.1-124.6	87.46	71.1 -86.2
Female				
<30	118.2	105.1-131.4	79.17	74.9-83.4
30-40	114.1	103.3-125	84.3	77.4-91.2
41-50	111.4	82.3-140.5	86.6	77.7-95.4
>50	107.0	41.14-172.8	84.5	52.2-116.8

*ANOVA - one way test is used for analysis.

Table 4 - Tukey test result of serum selenium among male age groups.

Tukey test	30 - 40 years	41 - 50 years	>50 years
Selenium			
<30	*p*=0.254	*p*=0.027	*p*=0.975
30-40		*p*=0.453	*p*=0.518
41-50			*p*=0.135
Zinc			
<30	*p*=0.791	*p*=0.119	*p*=0.617
30-40		*p*=0.402	*p*=0.329
41-50			*p*=0.061

Similarly, reported prevalence of selenium deficiency in various part of Iran is also different; in a study by Nouarie et al in 4 cities, from different parts of Iran, selenium deficiency was 71% in Ardebil and 0% in Khoramabad, Kerman and Sari in Iran.[15] Also, Rafraf et al[12] investigated the serum level of selenium in women of childbearing age and postmenopausal women living in Tabriz, Iran. It was shown that 57.5% had serum selenium concentrations under 80μg/l.[12] However, according to this study, micronutrient deficiency in prison may be of concern although it may not be more prevalent from free-living people.

Study limitations. Prisoners may benefit from supplementation if it is impossible to increase their micronutrients from diets. However, for the current study it was difficult to determine whether nutrition supply in prison was inappropriate or socioeconomic and other affecting factors have been in action before and during living in jail. Lack of comparison with free-living people or their relatives or families for a fair judgment of the effect on prison nutrition ration on micronutrient status of inmate people. However, there is some information as mentioned before. This study just covered one prison in Iran, and its results may not represent all prisons in Iran. However, Vakil Abad Jail is the biggest jail in east of Iran with a capacity of more than 10,000 person, in which various types of prisoners have been kept. Almost in all cases we had no information on nutritional status before coming to jail in prisoners.

In conclusion, results of this study suggest that both in general population and prisoner population, Selenium deficiency is an issue of concern. Although the Selenium status in prisoners may not be as bad as the general population but prisoners are on limited rations of the jails. Women may be at higher risk for selenium deficiency. These results have implications for officials in charge with prisoners and health policy makers.

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References

1. NX Ninh NK, ND Vinh, HH Khoi HH. Successful micronutrient programs: micronutrient deficiency control strategies in Vietnam. Hanoi: National Institute of Nutrition 2003. p. 1-24.
2. Hasan NA. Effects of trace elements on albumin and lipoprotein glycation in diabetic retinopathy. ***Saudi Med J*** 2009; 30: 1263-1271.
3. Food and Agriculture Organization of the United Nations. The State of Food Insecurity in the World 2004. Rome (IT): Food and Agriculture Organization of the United Nations; 2004.
4. Gholamreza V. Anemia in north of Iran (south-east of Caspian Sea). ***Pak J Biol Sci*** 2007; 10: 1703-177.
5. Mahmoodi MR, Kimiagar SM. Prevalence of zinc deficiency in junior high school students of Tehran City. ***Biol Trace Elem Res*** 2001; 81: 93-103.
6. Parizadeh SMR, Kazemi-Bajestani SMR, Shapouri-Moghaddam A, Ghayour-Mobarhan M, Esmaeili H, Majidi MR, et al. Serum zinc and copper concentrations and socioeconomic status in a large Persian cohort. ***Asian Biomedicine*** 2011; 5; 329-335.
7. Rayman MP. The importance of selenium to human health. ***Lancet*** 2000; 356: 233-241.
8. Murray DAB, Botham KM, Kennelly PJ, Rodwell VW, Weil PA. Harper's illustrated biochemistry. 28th ed. New York (NY): McGraw-Hill Medical; 2009.
9. Combs GF, Jr. Current evidence and research needs to support a health claim for selenium and cancer prevention. ***J Nutr*** 2005; 135: 343-347.
10. Whanger PD. Selenium and its relationship to cancer: an update. ***Br J Nutr*** 2004; 91: 11-28.
11. Hashemipour M, Siavash M, Amini M, Aminorroaya A, Rezvanian H, Kachuei A, et al. Goiter persistence after iodine replenishment, the potential role of selenium deficiency in goitrous schoolchildren of Semirom, Iran. ***Exp Clin Endocrinol Diabetes*** 2008; 116: 75-79.
12. Rafraf M, Mahdavi R, Rashidi MR. Serum selenium levels in healthy women in Tabriz, Iran. ***Food Nutr Bull*** 2008; 29: 83-86.
13. Ghayour-Mobarhan M, Taylor A, Lanham-New S, Lamb DJ, Azimi Nejad M, Kazemi-Bajestani SMR, et al. Serum Selenium and Glutathione Peroxidase in Patients with Obesity and Metabolic Syndrome. ***Pakistan Journal of Nutrition*** 2008; 7: 112-117.
14. Pizent A, Jurasovic J, Pavlovic M, Telisman S. Serum copper, zinc and selenium levels with regard to psychological stress in men. ***J Trace Elem Med Biol*** 1999; 13: 34-39.
15. Nouarie M, Pourshams A, Kamangar F, Sotoudeh M, Derakhshan MH, Akbari MR, et al. Ecologic study of serum selenium and upper gastrointestinal cancers in Iran. ***World J Gastroenterol*** 2004; 10: 2544-2546.