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Assessment of Plasma Selenium Level based on Dietary Intake among Geriatric Patients

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Abstract

Low plasma selenium level is related to the increasing risk of death in geriatric patients, particularly those with multiple comorbidities. The sufficient level of selenium intake as an antioxidant is necessary. This study aimed to investigate the plasma selenium level based on dietary intake in geriatric clinic population at Dr. Hasan Sadikin General Hospital Bandung. This study was a descriptive study using cross-sectional method. Fourteen geriatric patients were selected by consecutive sampling technique. Semiquantitative food frequency questionnaire (SQ-FFQ) was used as a tool to assess dietary intake. Plasma selenium level was measured as selenium binding protein 1 (SELENBP1) using enzyme-linked immunosorbent assay kit. Overall, mean of plasma selenium level of the subjects was 2,68 µg/L and mean of selenium intake was 62,85 µg/day. Selenium level of the subjects with sufficient selenium intake (85,7%) was 2,62 µg/L and selenium level of the subjects with deficient selenium intake (14,3%) was 3,05 µg/L.Plasma selenium level of the subjects with sufficient selenium intake was lower if compared with the subjects with deficient selenium intakes.

Keywords: antioxidant, dietary intake, geriatric, plasma selenium level.

Introduction

Life expectancy of Indonesian has increased to 69,65 years in 2011 with the percentage of the elderly population reached to 7,58%.[1] The increase in the number of elderly population is a challenge in Indonesia because it causes an increasing prevalence of degenerative diseases. The aging process in the elderly causes the impairment of physical, psychological, and psychosocial aspects. Moreover, the elderly are particularly vulnerable to malnutrition.[2]

A cohort study carried out by InCHIANTI (Invecchiare in Chianti/Aging in the Chianti area, Italy), EVA (Etude du Vieillissement Arteriel), and WHAS (Women's Health and Aging Studies) found that low plasma selenium levels are associated with increasing risk of death in the elderly.[3] It

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suggests that selenium is needed by human body in order to prevent oxidative stress that plays an important role in the pathogenesis of various degenerative diseases that are more common in the elderly.[4] Selenium is an essential micronutrient, indicating it cannot be produced in the body. It must be obtained through daily food consumption.[5]

Elderly with multiple comorbidities need higher amount of selenium as an antioxidant. Therefore, it is necessary to provide data regarding the association between dietary intake and selenium status in the elderly so that the better health care management can be conducted. In Indonesia there are still no data regarding to selenium status based on dietary intake in geriatric patients. This study aimed to investigate the plasma selenium level representation based on dietary intake in geriatric clinic population at Dr. Hasan Sadikin General Hospital Bandung.

Methods

This research was a quantitative descriptive study using cross-sectional design. The subjects were elderly patients at the geriatric clinic Dr. Hasan Sadikin General Hospital Bandung during October 2016. The subjects were selected based on consecutive sampling. The exclusion criteria in this study included the subjects who took antibiotic in the last month, active smoker in the past year, and was undergoing dietary protein restriction. Subjects willing to participate in this study had signed informed consent.

This study was approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Padjadjaran No: 585/UN6.C1.3.2/KEPK/PN/2016. Personal data and dietary intake of the subject were identified through interviews conducted using semiquantitative food frequency questionnaire (SQ-FFQ) which has been validated in the elderly population in geriatric clinic at Dr. Hasan Sadikin General Hospital Bandung. Interviews were conducted using food models and household size tools. Subjects' dietary intake were further

Table 1. Characteristic of subjects

Characteristics	n=14 (%)	Mean ± SEM
Age (years old)		
60-69	7 (50)	66.29 ± 1,02
70-79	3 (21.4)	74.33 ± 2,03
≥ 80	4 (28.6)	83.25 ± 1,65
Gender		
Male	8 (57.1)	
Female	6 (42.9)	
Education level		
Elementary School	1 (7.1)	
Junior High School	2 (14.3)	
Senior High School	5 (35.7)	
Diploma	2 (14.3)	
Bachelor	4 (28.6)	
Selenium Intake		
Sufficient	12 (85.7)	
Deficient	2 (14.3)	

SEM = Standard Error of Mean

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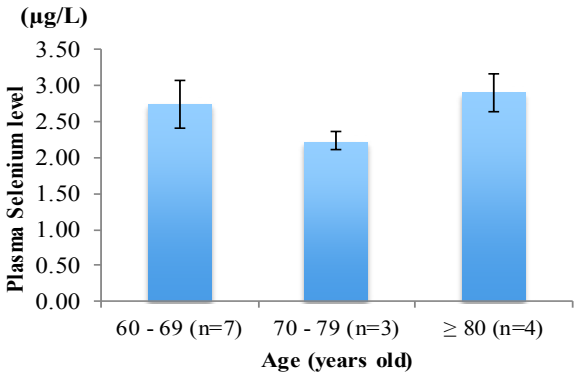

Figure 1. Plasma selenium level based on age

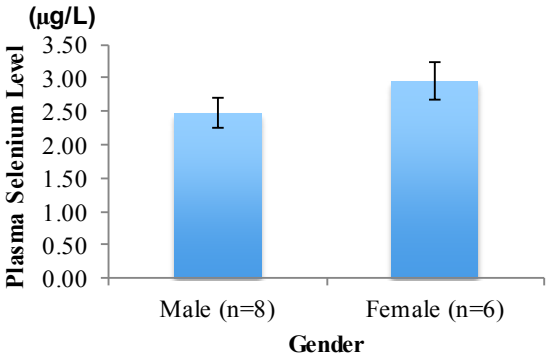

Figure 2. Plasma selenium level based on gender

categorized by Gibson, *i.e.,* sufficient if selenium intake ≥ 77% of recommended dietary allowance (RDA) (30µg/day) and deficient if <77% of RDA.[6] The quantity and the frequency of subjects' consumption to foods list on questionnaire was calculated to determine subjects' selenium intake per day using a data processing program by referring to the food composition table derived from United States nutrient database for standard reference (USNDSR).

After the interview, the blood sample from *fossa cubital vein* were obtained. Blood sampling was conducted by professionals in the laboratory of pathology clinics Dr. Hasan Sadikin General Hospital Bandung. Blood that has been taken was inserted into a tube which has been given a 10% EDTA, then centrifuged at 3000 rpm for 15 minutes to obtain blood plasma. Blood plasma was inserted into the tube, labeled and stored at -80°C. Blood plasma was investigated for selenium binding protein 1 (SELENBP1) using enzyme-linked immunosorbent assay (ELISA) to determine the level of selenium in plasma with the unit of µg/L. The subjects dietary intake and plasma selenium level were further analyzed using statistical data processing program and presented as mean and standard error of mean (SEM). Normality test using Shapiro-Wilk test was performed to confirm that the data were normally distributed.

Results and Discussion

A total of fourteen subjects participated in this study. The subjects characteristics in this study were presented in the Table 1. The majority of subjects were 60-69 years old and

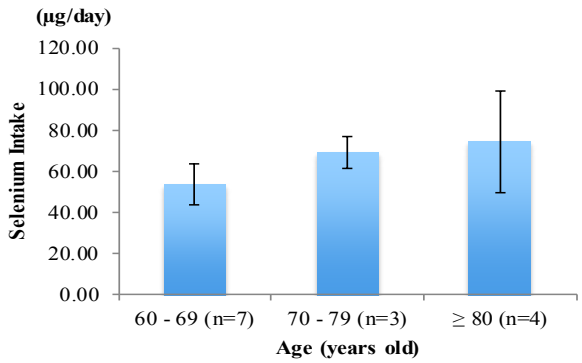

Figure 3. Selenium intake based on age

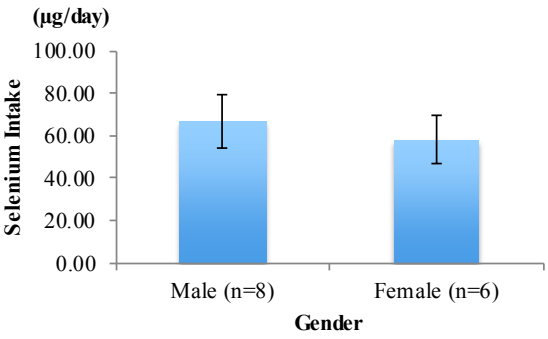

Figure 4. Selenium intake based on gender

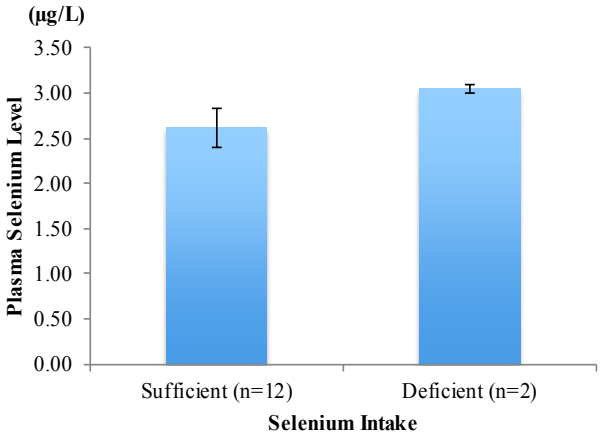

Figure 5. Plasma selenium level based on selenium intake

male. Most subjects were senior high school graduates. Nearly all subjects had sufficient dietary intake of selenium.

Subjects had a mean of plasma selenium concentration of 2.68 µg/L and selenium intake of 62,85 µg/day. Subjects' plasma selenium levels and dietary intake based on age and gender are presented on the Figure 1. The mean of plasma selenium level was 2.74 µg/L in group with the age between 60-69 years old, 2.23 µg/L in the group of 70-79 years old, and 2.90 µg/L in the group of ≥ 80 years old. The result can be seen on the Figure 1. The mean of plasma selenium level in the male subjects was 2.48 µg/L, while it was 2.95 µg/L for the females group. The result can be seen on the Figure 2.

The mean selenium intake was 53.54 µg/day in the age group 60-69 years old, 69.19 µg/day in the age group 70-79 years old, and 74.38 µg/day in the age group ≥ 80 years old. The result can be seen on the Figure 3.
Plasma selenium levels of the subjects were categorized by adequacy of selenium intake which can be seen in Figure 5. Subject with sufficient selenium intake had lower plasma

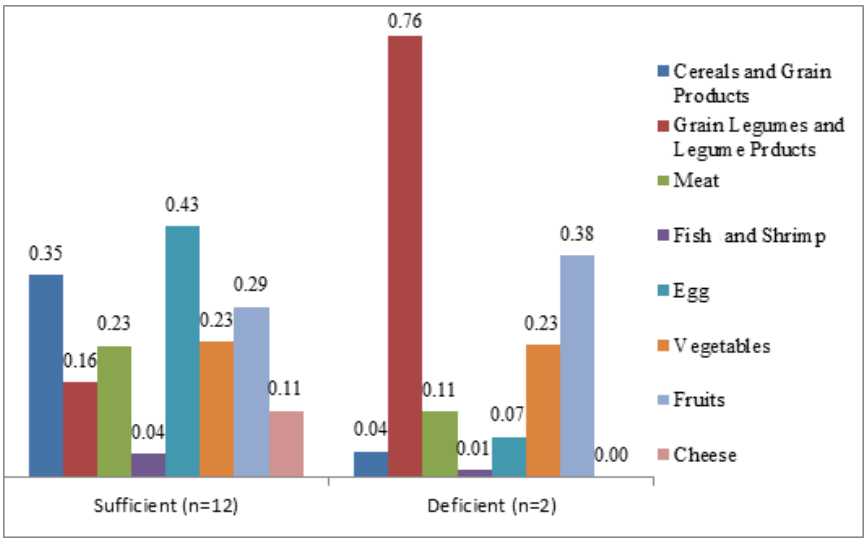

Figure 6. The frequency of consumption toward food source of selenium

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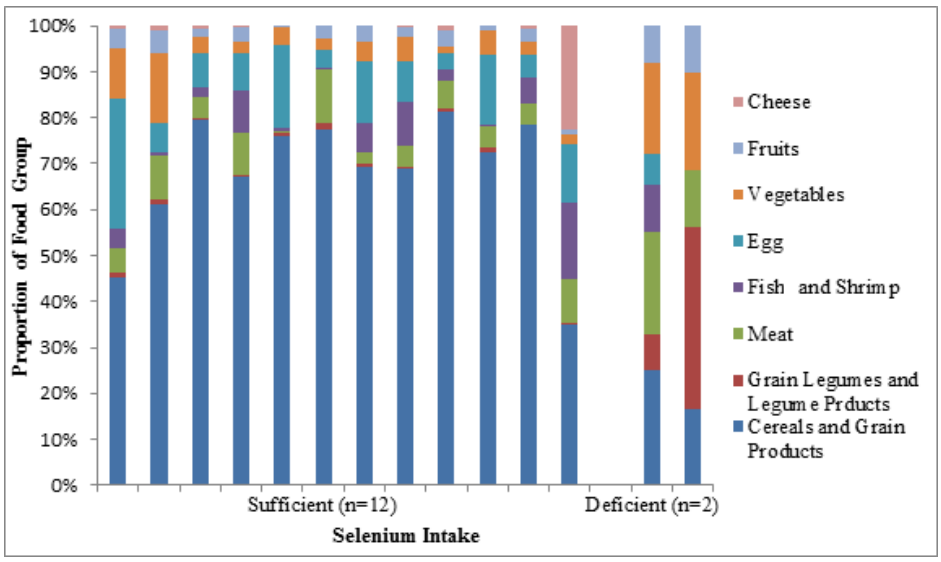

Figure 7. Proportion of selenium food source

selenium level compared to subjects who had deficient selenium intake. The frequency of subjects' consumption toward food source of selenium either on a daily, weekly, monthly, or yearly were converted to the frequency of consumption per day, the data were grouped by adequacy of selenium intake (Figure 6).

The mean frequency of consumption in subjects with sufficient selenium intake to the food group such as cereals and grain products, meat, fishs and shrimp, egg, and cheese were more often than in subjects with deficient selenium intake. The mean frequency of consumption in subjects with deficient selenium intake to the food group such as grain legumes and legume products and fruits were more often than in subjects with sufficient selenium intake. The proportion of various group of food to the total amount of selenium intake on the subject was presented in Figure 7.

Food group such as cereals and grain products, fishs and shrimp, egg, and cheese in subjects with sufficient selenium intake had a greater proportion as a source of selenium than in subjects with deficient selenium intake. Food group such as grain legumes and legume products, vegetables, and fruits had a greater proportion as a source of selenium in subjects with deficient selenium intake compared to subjects with sufficient selenium intake.

The characteristics of subject in this research showed that the majority of subjects were in the age range of 60-69 years old and the majority of subjects are male. Based on elderly citizen statistics of Indonesia in 2014, the percentage of elderlies in the age range of 60-69 years old in West Java which is 4.71% larger than the other age group and the morbidity of male and female were 25,10 % and 25,05 %, respectively.[7] Those percentage directly affects the total amount of male patients in geriatric clinic which is higher than the female patients.

The mean of plasma selenium level observed in the subjects was 2.68 ng/ml. It was

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lower compared to other research in elderly population. Previous study showed that the mean of plasma selenium level in subjects aged ≤ 65 years old was 74,02 µg/L. Different finding shown in EVA study, indicating that the mean of plasma selenium level for the elderly with the mean age of 54 years old was 100.2 µg/L.[3,8]

The lower plasma selenium level in this study could be caused by several factors. The possibility of source of selenium in the Indonesian food was lower compared to other countries. A research conducted by Rita *et al.* showed that rice in Bandung, ndonesia as the staple food showed average selenium level of 0.035 µg/g, it was lower compared to other region such as Croatia, Pakistan, New Zealand, Thailand, England, and US.[9]

Lauretani *et al.* stated that selenium has an important role in proinflammatory condition by its function on glutation peroxidase enzyme to break down hidrogen peroxidase and lipid peroxodase so the stress oxidative can be reduced.[3] The assessment of selenium level in this study has been done by measuring SELENBP1 level. Based on Yang *et al.,* selenium has three forms of protein categories, which are protein containing selenomethionine, protein containing selenocysteine, and peptide which bounded selenium such SELENBP1.[10] The assessment of selenium level in this study was done only by measuring SELENBP1 instead of measuring the total plasma of selenium level.

The plasma selenium level in subjects with the age group of 70-79 years old was lower than the other age of groups (Figure 1). Subjects in the older age group are more vulnerable to complex health problems, such as impairement in heart and renal functions. More pathologic condition occured in the elderly can cause the retention of selenium in various tissues, which are more likely to generate oxidative stress and inflammation in the body, thus the level of selenium in the blood become low.[11]

Plasma selenium level in females was higher than males (Figure 2.) It was similar to the study conducted by Kim *et al.*, which showed that female subjects had selenium level of 120.81 ± 27.37 µg/L while male subjects had selenium level of 103.29 ± 31.05 µg/L. The awareness of healthy life by consuming nutritious foods in females is higher than males.[12] However this research result showed that selenium intake in females were lower compared to males (Figure 4.). This finding is comparable with previous studies showing tha the difference of selenium level based on gender was not significant.[11,12]

The mean of selenium intake on the subject was 62.85 µg/day. This number exceeds the RDA that is equal to 30 µg/day. The results of this study are similar to the study by Gonzalez *et al* showing that selenium intake in the elderly in Spain exceeded the RDA (99.4 µg/day). It was related to the similar food containing higher nutrition such as cereals, fish, meat, and dairy product (Figure 7.) Based on Combs, those food groups are the main source of selenium.[13,14]

Selenium intake was increased by the increase of age groups (Figure 3.), but selenium intake in the age group over 80 years old had a range of 13.89 to 132.31 µg/day thus the increase was not significant. Montgomery *et al* stated that planning of nutrition or dietary intake in the elderly are affected by the treatment process, economic and social factors and health problems.[15]

Plasma selenium level was lower in subjects with sufficient selenium intake than in subjects with deficient selenium intake (Figure 5).

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Selenium level in plasma are influenced by different process of metabolism depending upon the various form of selenium in the diet. Level of selenium in plasma illustrates the total selenium, which is the selenium in the form of selenocysteine (selenoprotein) and selenomethionine which binds to plasma protein such as albumin. Selenomethionine can directly bind to plasma proteins because they do not undergo the process of first metabolism as selenocysteine and may result in increased concentrations of selenium in the plasma. Therefore, the consumption of selenomethionine contributes to variations in plasma selenium levels in human.[13,16,17]

Selenomethionine source is supplements and food groups derived from plants.18 In subjects with deficient selenium intake is known that the frequency and proportion of the consumption of grain legume and legume products, fruits and vegetables as a source of selenium is higher than in subjects with sufficient selenium intake (Figure 6,7). The higher selenium intake in subject with lower selenium level can be caused by assessment of selenium intake that obtained from food composition tables refer to the USDA Nutrient Database due to the lack of food composition tables for selenium in Indonesia. Assessment of dietary intake using appropriate food composition tables based on region is very important because the levels of selenium in foods varies in each region.[19]

This study had some limitations. There were the possibility of recall bias because the subjects were asked to recall the frequency and quantity of food that has been consumed. Besides, the calculation of selenium intake was not obtained from food composition table for selenium in Indonesia, thus the generalizability for Indonesian elderly population is limited.

The finding of this study is expected to become a basis data for further research in Indonesia related to selenium status and dietary intake in a larger scale, thus the representation of plasma selenium level can be more consistent.

Conclusions

Plasma selenium level of the subjects with sufficient selenium intake was lower if compared to the subjects with deficient selenium intakes.

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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