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Gender differences in nutritional intake and status in healthy free-living elderly

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ABSTRACT

Malnourishment in the older population is reported to be a consequence of inadequate food intake, underlying diseases, with females being at higher risk and economically more vulnerable. The objective of this study were **t**o determine the patterns of gender differences in nutritional intake and status among free-living elderly in the Jakarta urban area. A cross sectional design was performed on free-living elderly people aged 60 years and older in South Jakarta. A total of 298 free-living elderly were interviewed on demography and social economic status, and assessed on anthropometric measures, two-day nonconsecutive dietary recall and biochemical indices using fasting blood samples. This study showed that most significant gender differences were in daily energy and nutrient intakes. Males had more energy intake 1246.6 kcal compared to female 1043.1 kcal and consumed more carbohydrate 168.1 g, protein 39.7 g, total vitamin A 12229.7 μg, vitamin C 22.3 mg, iron 6.87 mg, and zinc 4.9 mg food sources. Older males had better status indices for anemia than did older females (p=0.009). Older persons who co-resided with family had better dietary nutrient intakes than those living in nuclear families, except for protein, total vitamin A and zinc food sources. There are gender differences in energy, dietary nutrient intake, nutritional status and health status in free-living elderly. Both genders were deficient in all macronutrients and selected micronutrients, especially iron and zinc.

Keywords : Gender, nutritional intake, healthy elderly

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INTRODUCTION

The rapid increase in the number of the elderly population due to longevity has been dramatic throughout the world. The percentage of the elderly population over 60 years old will be doubled in 2025, and around 80% of the elderly will be in developing countries.[1,2] Indonesia is one of the nations with a large population of aging people, thus maintaining a healthy physical and mental status in the elderly population and will be one of the crucial aspects

of public health challenges. The elderly have a decreased resistance against disease, and generally have inadequate nutrition and inadequate financial and social support. Most of them face risks of disease and unhealthy environment. The incidence of infections and chronic disease, such as atherosclerosis and diabetes mellitus, have been shown to rise with increasing age. Older persons also have the risk of low nutrient intake, both for macronutrients or micronutrients. A proportion of the elderly have deficiencies of several micronutrients, such as vitamin E, vitamin C, folic acid, iron and zinc, which have an important role in maintaining the immune function.[2,3] Most studies on health and nutritional status among older persons have been conducted in developed countries and very few in developing countries. In Indonesia there are limited data on the elderly population as one of the high risk targets that have been reported. Several studies among the urban elderly in Jakarta have reported deficiencies of iron, thiamine and folic acid intake[4] and a high prevalence of low body mass index.[5-7] Intake of high quality nutrients will ensure that the body has sufficient nutrients to maintain its function of preventing deficiency and delaying the onset of chronic diseases. Poor nutritional status in older people is multifaceted and includes the physiological, psychological and social changes associated with aging that affect food intake, body weight and are exacerbated by the occurrence of illness.

Gender-associated differences in nutritional status and health complaints among older persons have been noted in several studies.[8-12] Thus gender should be considered to be a determinant factor. Recently, there has been a shift in the concept of healthy and successful aging, from a focus on number of years to the level of quality of life. This shift has introduced to lead the healthy lifestyle, especially food intake and habitual physical activity as dominant determinants of quality of life (QOL) and well-being.[13]

A balanced diet and variety in nutritional intake will ensure that the body has adequate nutrients. Because nutrition is a modifiable risk factor, attempts should be made to devise preventive nutritional strategies aimed at improving the quality of life and consequently reducing the utilization of unnecessary health care resources. The purpose of the present study was to determine the patterns of gender differences in nutrient intake and status among healthy free-living elderly.

METHODS

Study design

The study was conducted as a cross-sectional study at one public health center area in South Jakarta, and the data were collected from July to September 2007.

Subjects

The subjects were aged 60 years and over and living at Mampang Prapatan district South Jakarta. The study area was chosen because of previous and current studies on the high numbers of inactive members of *Posyandu lansia* (integrated health care for the elderly) in district health centers of South Jakarta. The total population of Mampang Prapatan district was approximately 103,136 persons with an estimated 15,9% (16,415) of residents aged 60 years and above. Most of elderly had a moderate to low social economic background.

Study participants were recruited by announcements made in the district health center and in sub-district public health centers that were under the jurisdiction of the district health center, through cadres in the community where the study was conducted. To identify eligible elderly subjects, we performed a survey in eight hamlets to collect a list of names of the

elderly who were eligible according to the following inclusion criteria: participants had to be 60 years or older (verified by their national identification card (*KTP*) or other papers), healthy and free-living, able to verbally communicate and willing to participate.

The subjects were a part of the "Daily multi micronutrients supplementation in upper respiratory infection" (SUPEL) study. A total of 298 elderly subjects was enrolled on this study. During home visits we provided the subjects with detailed information on the study, and if they agreed to participate in the study, they were invited to join and sign a written informed consent form. A face-to-face interview for each participant was conducted by the cadres as trained interviewers. Each cadre was responsible for one hamlet area (around 35 elderly subjects) to obtain data on the field study and assist in filling out the questionnaire.

Data collection and measurement

Demographic and social economic characteristics, health status, and dietary intake were collected from each participant, using a pre-tested questionnaire. The demographic indicators included age and gender of the participant. Social economic status (SES) of the participant was indicated by years of schooling, history of past occupation and information on financial support.

Health status

The self-reported history of health status was divided into two categories: (i) degenerative diseases and (ii) acute infection. For the category of degenerative diseases, the respondents were asked if they had been suffering from hypertension, diabetes mellitus or rheumatism or a combination of these diseases. For acute infections, the participants were asked if they had suffered from upper respiratory tract infection, diarrhea or fever or a combination of the two, in the last month as reference period.

Dietary assessment

Dietary intake data were collected by a trained nutritionist through a home visit to each elderly participant in the initial two weeks of the study. The dietary intake was assessed using a prospective 2-day non-consecutive and semi-quantitative food frequency questionnaire.[14] Each participant was asked to recall all the foods and drinks consumed the day before (for 24-h recall) and a frequency checklist of foods was used to estimate the regular daily intake of foods, with the last month as reference period (for SQ-FFQ). Both assessments included dietary intake of food sources of macronutrients and micronutrients by describing the foods and portion sizes in as much detail as possible. Three-dimensional food models were used as an aid in recognizing several foods and portion sizes, on the assumption of the presence of memory impairment in older persons. Portion sizes were correlated to standard portions using the reference standard of Indonesian foods. Dietary adequacy was calculated based on Indonesian Recommended Daily Allowance (RDA), and the Indonesian food composition tables were used to convert foods into nutrients. Nutrient analysis was performed by the Nutrisurvey for Windows program according to Erhardt et al. (2005).[15]

Anthropometric assessment

Anthropometric assessment methods were used to measure weight, height (derived knee-height by standard equation) and waist-hip ratio. At the time of measurement, the elderly wore minimal clothing. A portable scale was used to measure weight to the nearest 0.1 kg (platform model electronic weighing scale SECA 770 Alpha, Hamburg, Germany). Stature was measured to the nearest 0.1 cm with a caliper for knee-height (Ross caliper, USA) and

calculated with Chumlea's equation. The subjects were seated with the knee bent at 90^0 and the foot at 90^0 relative to the leg.[16]

Body mass index (BMI) was calculated as the weight (kg) divided by the square of the height (m^2). For Asian populations, BMI is classified into the following categories: underweight (<18.5 kg/m2), normal (18.5 – 22.9 kg/m2), overweight (23.0 – 27.5 kg/m2), and obese (≥27.6 kg/m2).[17]

Biochemical assessment

From each participant, 8 mL of fasting venous blood was drawn from the antecubital vein between 8 to 10 AM for assessment of hemoglobin (Hb), serum zinc and total serum protein concentrations. The blood sample was divided into two vacutainer tubes (Becton Dickinson), one tube receiving 3 ml of venous blood with added EDTA anticoagulant for determination of hemoglobin level, and the other tube 5 ml of blood without EDTA for zinc and total protein determination. The hemoglobin concentration by the cyanmethemoglobin method was used in screening for anemia.

For serum zinc and protein determination, serum was separated out from the 5 ml of venous blood by centrifugation at 3500 rpm for 10 minutes. Subsequently the serum was divided into 2 tubes, (i) for serum zinc, 1 mL of serum was taken with a special pipette and tube to avoid contamination (all tubes used had to be free of trace elements) and stored at or below -20^0C; and (ii) for total serum protein, 500 ìml of serum was used.

For determination of serum zinc concentration, the serum sample was centrifuged at the maximum speed of 15,000 rpm for 15 minutes and analyzed by atomic absorption spectrofotometry (AAS) according to the manufacturer's instructions (Perkin Elmer). The AAS instrument used was GBC 933 AA, with 1000 mg Timisol Zinc Standard reagent (Merck 1.09953). The resulting absorbance was read using a Zn lamp with ë = 213.9 nm.

Total serum protein measurement was conducted on the 500 ìmL serum sample using a TRX 7010 automatic analyzer. Normal threshold values used in this study were as follows: hemoglobin ≥12 g/L for the female elderly and ≥13 g/L for the male elderly;[18] for both genders: zinc status >10.7 µmol/L;[13,19] total protein range 6.4-8.3 g/dL and albumin range 3.4-4.8 g/dL (Prodia Clinical Pathological Laboratory cut-off values).

Ethical considerations

Before the study, the selected elderly subjects and their family were informed by the cadres about the purpose and protocol of the study. Assurance was given to the subjects that their participation was voluntary, and that they could at any time withdraw from the study without any sanction. If they agreed to participate in the study, they were invited to join and return the written informed consent form (legalized by signature for literate subjects or by thumb-print for illiterate subjects). The protocol and informed consent form had been approved by the Ethical Committee of the Medical Faculty, Trisakti University.

Statistical Analysis

Descriptive statistics were calculated and expressed as mean and standard deviation (for a normal distribution), median and range (for other kinds of distribution), and proportions. Significant differences in general characteristics, anthropometric, dietary and biochemical measures between females and males were analyzed using independent t, chi square and Mann-Whitney tests, depending on the normality of the distribution. A p value of less than 0.05 ($p < 0.05$) was considered to be statistically significant. Data analysis was performed using SPSS for Windows version 15.

Table 1. Baseline Characteristic of the 60 to 85 year old female and male free-living elderly

Variables	Female (n=189)	Male (n=109)	p-value
Mean age (SD) *	64.8 (4.65)	65.1 (4.53)	0.351
Range	60 - 83	60 - 85	
Educational background (%) **			
None	69 (36.5)	11 (10.1)	0.000
6 yr education	87 (46.0)	55 (50.5)	
≥ 9 yr education	33 (17.5)	43 (39.4)	
History of occupation (%) **			
Entrepreneur	10 (5.3)	22 (20.2)	0.000
Laborer	3 (1.6)	25 (22.9)	
Government employee	4 (2.1)	16 (14.7)	
Merchant	26 (13.8)	12 (11.0)	
Unemployed	146 (77.2)	34 (31.2)	
Financial support (%) **			
Regular	132 (69.8)	68 (62.4)	0.187
Non-regular	57 (30.2)	41 (37.6)	
Health-fund sources (%) **			
Insurance	17 (9.0)	17 (15.6)	0.084
Non-insurance	172 (91.0)	92 (84.4)	

Note: * Mann Whitney test; **Chi-square test

RESULTS

A total of 109 male and 189 female elderly subjects were enrolled in the study. Selected characteristics of the free-living elderly are presented in Table 1 according to gender.

The subjects in the study area were mostly females (approximately 63%). Mean age between genders was slightly different, with a maximum age of 83 years for females and 85 years for males, and males tending to be older than females. The proportion of literate persons and the history of occupation as young adults were significantly different ($p<0.05$) between female and male elderly. Almost 36% of female subjects were illiterate and 77% were unemployed as young adults, and carried out only household work as their daily activity. There were no differences between genders for sources of financial support, the majority obtaining financial support from their children for their monthly expenditures on food, health services and household needs. Mean body mass index (BMI) values were identical in both genders, and the majority of subjects was categorized as having a normal BMI (Table 2).

Table 2. Anthropometric variables of the 60 to 85 year old female and male free-living elderly

Variables	Female (n= 189) Mean (SD)	Male (n =109) Mean (SD)	p-value
Weight (kg) *	49.1 (10.5)	56.8 (9.8)	0.000
Height (cm) *	151.1 (4.2)	161.3 (4.4)	0.000
BMI (kg/m^2) *	21.6 (4.3)	21.9 (3.6)	0.529
Waist circumference (cm) *	78.1 (11.7)	81.2 (10.7)	0.022

Note: *Independent-t test

Table 3. Pattern of living of the 60 to 85 year old female and male free-living elderly

Variables	Female n (%)	Male n (%)	p-value
Size of house (m^2) *			
≤ 80 m^2	111 (58.7)	71 (65.1)	0.275
> 80 m^2	78 (41.3)	38 (34.9)	
Status of house *			
Own house	150 (79.4)	90 (82.6)	0.501
Does not own house	39 (20.6)	19 (17.4)	
Co-residence *			
Nuclear family	16 (8.5)	17 (15.6)	0.059
Extended family	173 (91.5)	92 (84.4)	

Note: * Chi-square test

Overall, the proportion of underweight (BMI <18.5 kg/$m^{2)}$ among female and male subjects was 27% and 20%, respectively. The proportions of overweight (BMI 23.0–27.5 kg/m^2) were different between females (22%) and males (28%). Overweight was more prevalent in males than in females, but obesity occurred more in females (13%) than in males (8%). Moreover, there were significant differences in weight, height and waist-hip ratio among females and males ($p<0.05$). Males were significantly heavier, taller and had a higher waist-hip ratio than females older. Both genders have a high risk of cardiovascular disease due to hip-waist circumference ratio.

The pattern of living of the subjects is shown in Table 3. no differences were found between genders on size of house, living arrangement and co-residence. The majority of older persons lived in a house of less than ≤ 80 square-meters and preferred to co-reside with their extended family (siblings or relatives). Of those who lived in a nuclear family, 4% lived alone; males tended to live in a nuclear family in comparison to females.

The health status of the elderly is shown in Table 4. The majority of self-reported health problems among the participants were not significantly different between females and males. Most of them had disorders that were diagnosed as degenerative diseases, namely hypertension, diabetes mellitus and rheumatism. However, a higher proportion of the females reported suffering from degenerative diseases than did the males, i.e. 46.5% and 41.3% respectively.

Table 4 . Health status of the 60 to 85 year old female and male free-living elderly

Variables	Female (n=189)	Male (n=109)	p-value
Degenerative diseases (%) *			
Hypertension	40 (21.2)	15 (13.8)	0.113
Diabetes mellitus	12 (6.3)	7 (6.4)	0.980
Rheumatism	36 (19.0)	23 (21.1)	0.668
Morbidity in past of 1 month (%) *			
Upper Respiratory Infection	62 (32.8)	36 (33.0)	0.968
Diarrhea	30 (15.9)	5 (4.6)	0.004
Fever	41 (21.7)	23 (21.1)	0.905

Note : *Chi–square test

Table 5. Daily energy and nutrient intake by the 60 to 85 year old female and male free-living elderly

Variables	Female (n=189)	Male (n=109)	p-value
Energy (kcal)	1043.16 (345.88)*	1246.65 (437.71)*	0.000
%< RDA	65	61	
Carbohydrate (g)	142.62	168.09	0.000
%< RDA	59.4	55	
Protein (g)	33.98	39.72	0.000
%< RDA	68	66	
Vitamin A (µg RE)	1122.95	1229.70	0.626
%< RDA	0	0	
Vitamin E activity (mg)	0.00	0.00	0.428
% < RDA	100	100	
Vitamin C (mg)	14.40	22.30	0.048
% < RDA	19	25	
Fe (mg)	5.81	6.87	0.134
% < RDA	48	53	
Zn (mg)	3.89	4.93	0.001
%<RDA	41	37	

Note : * mean (SD)

No gender difference was found in complaints of upper respiratory infection, diarrhea, and fever in the past month. The prevalence of diarrhea appeared mostly to be experienced significantly by female elders ($p<0.05$). In general, the differences in proportion of morbidity of acute illness between females and males were quite high.

Table 5 lists the energy intake among the subjects. Almost 93% of older persons of both genders were found to have a lower energy intake compared to the Indonesian RDA (*Angka Kecukupan Gizi)*. Females had a lower reported intake of energy and nutrients than males. The energy intake of the females was 65% of RDA and that of the males was 61%, which affected their carbohydrate and protein intake. Females had significantly lower dietary intakes of energy ($p=0.000$), carbohydrate ($p=0.000$), protein ($p=0.000$), vitamin C ($p=0.048$) and zinc ($p=0.001$), in comparison to males. Both genders tended to have an inadequate micronutrient intake, except for vitamin A.

Table 6. Biochemical laboratory measurements of the 60 to 85 year old female and male free-living elderly

Variables	Female (n=188)	Male (n=108)	p-value
Zinc (µmol/l)	11.05 ± 2.1	12.36 ± 5.3	
Zinc deficiency (%)	59 (31.2)	23 (21.1)	0.06
Hemoglobin (g/dl)	12.67 ± 1.4	14.17 ± 1.5	
Anemia status (%)	52 (27.5)	46 (42.2)	0.009
Protein status (g/dl) (%)			
<6.4 (low)	55 (29.3)	24 (22.2)	0.043
6.4 - 8.30 (normal)	94 (50.0)	70 (64.8)	
>8.30 (high)	39 (20.7)	14 (13.0)	
Albumin status (g/dl) (%)			
<3.4 (low)	43 (22.9)	14 (13.0)	0.037
3.4 - 4.8 (normal)	142 (75.5)	84 (77.8)	
>4.8 (high)	3 (1.6)	10 (9.3)	

Table 7. Body mass index by age group and gender

Variables	60-70 years (n=242)	> 70 years (n=56)	P value
BMI			
Underweight	57 (23.6)	15 (26.8)	
Normal	96 (39.7)	24 (42.9)	0.826
Overweight	60 (24.8)	12 (21.4)	
Obese	29 (12.0)	5 (8.9)	

The majority of biochemical indices for serum zinc, hemoglobin level and total serum protein were categorized as normal. However, zinc deficiency is more prevalent among females than among males (31% vs. 21%), while anemia was more prevalent among males (42% vs. 27.5%). Low protein and albumin status was more prevalent among females than males ($p < 0.043$ and < 0.037 respectively). Thus there were gender differences in micronutrient deficiency and protein status (Table 6).

There were no significant differences between nutritional status in each age group. However, 23.6% of the younger elderly (< 70 yr) and 26.8% of the more advanced age group (>70 yr) were in the BMI category of less than 18.5 kg/m^2 (underweight). Overweight and obese were more prevalent among the younger subjects (Table 7).

There was no significant difference in nutrient intake between age groups, except for food sources of vitamin E ($p<0.05$); both age groups have lower dietary intakes. However, the younger subjects had higher intakes of energy, carbohydrate, total vitamin A, vitamin C and food sources of zinc than the older ones (Table 8).

Table 8. Nutrient intake by age group and co-residence

Variables*	60-70 years (n=242)	> 70 years (n=56)	P value
Energy (kkal)	1069.95 (843.15; 1342.90)	1022.30 (792.07; 1257.92)	0.356
Carbohydrate	153.71 (123.52; 194.91)	141.50 (122.04; 181.56)	0.257
Protein	35.20 (26.20; 48.40)	35.58 (27.89; 44.94)	0.817
Total vitamin A (µg RE)	1155.0 (804.31; 1863.28)	1364.75 (757.46; 1840.30)	0.784
Total vitamin E activity (mg)	0.00 (0.00; 0.09)	0.00 (0.00; 0.09)	0.020
Vitamin C	17.21 (6.45; 65.33)	15.55 (5.64; 57.88)	0.797
Fe (mg)	6.28 (3.71; 10.59)	6.68 (4.06; 14.35)	0.310
Zn (mg)	4.23 (3.06; 5.65)	4.14 (3.25; 5.36)	0.975
Variables*	**Nuclear family/alone (n=33)**	**Extended family (n=265)**	**P value**
Energy (kkal)	1098.26 (919.47; 1298.38)	1056.11 (827.93; 1322.37)	0.743
Carbohydrate	154.58 (135.65; 193.26)	149.88 (121.3; 190.58)	0.462
Protein	33.75 (26.83; 45.10)	35.46 (26.37; 48.14)	0.782
Total vitamin A (µg RE)	1087.97 (792.08; 1865.35)	1214.90 (804.08; 1851.00)	0.813
Total vitamin E activity (mg)	0.00 (0.00; 0.09)	0.00 (0.00; 0.09)	0.946
Vitamin C	25.05 (6.40; 43.35)	16.90 (6.25; 65.60)	0.702
Fe (mg)	6.89 (3.50; 10.71)	6.22 (3.81; 11.44)	0.807
Zn (mg)	3.96 (2.95; 5.47)	4.18 (3.12; 5.61)	0.623

Note :* Mann Whitney test, median (25th percentile; 75th percentile)

No significant difference was found in nutrient intakes between the two categories of co-residence. Older persons who lived in a nuclear family tended to have lower nutrient intakes of protein, total vitamin A and food sources of zinc, compared with those who lived in an extended family.

DISCUSSION

This study presents information on gender differences in patterns of nutrition, health condition and living condition among healthy free-living elderly residents in an urban area of Jakarta. Sixty-three percent of the population are females as the majority of the older population, and presumably females will continue to be the majority. Information regarding years of schooling and history of past occupations indicates that most of the elderly females are illiterate (37%), with less opportunity or participation in economically remunerative work in the past. This is the same phenomenon that has been predicted in the UN report (2002)[19] and the report on "Older population in Indonesia" by UNFPA (2006),[1] in that elderly women constitute the majority of the older population in most countries. This fact could be interpreted to mean that the elderly females are dependent and vulnerable to financial and economic security. Most of the older persons receive regular financial support from their pension and from their children to pay for their monthly expenditure.

The findings of this study on the pattern of living are that most of the elderly parents live in their own household in co-residence with their family. As in most Asian cultures, the norm is that the older persons co-reside with their family members and are cared for by them. Co-residence is the main component of family support and the best as proxy indicator. Depending on the situation, most older persons were co-residing with daughters, younger siblings or other close relatives.[20,21] However, the percentage of older persons living without children, whether alone or with their spouse, is very small. In terms of gender differences, co-residence with children had similar patterns in females and in males.

From their self-reported health status, older females were at higher risk of illness for both degenerative diseases and acute infections, as compared to older males. Older persons are known to be more vulnerable to a higher incidence of morbidity; however, the higher incidence of chronic diseases or acute infections will alter the need for health services to manage the diseases of old age. Although this will have an impact on nutritional status of the elderly, in this study there were no differences between younger and older subjects in suffering from illness, but the younger elderly were more vulnerable than the older ones.

Regarding anthropometric measures, the present study demonstrates that although most members of the elderly population are of normal weight, 29% of them has under-nutrition. This prevalence shows that under-nutrition is quite high among older persons, and this is identical to the results of other studies that had been conducted among the older population worldwide.[12,13,22] No difference was found in the proportions of BMI categories between younger and older subjects. In this study it appears that the elderly population has a predisposition for overweight and obesity. Obesity and high waist circumference values in the older person constitute risk factors predisposing to degenerative disease, such as heart disease and diabetes.

The present study demonstrates an inadequacy of dietary intake for energy and selected nutrients, resulting in a high prevalence of risk of malnutrition based on gender. The recommended daily energy intake is

approximately 2050 kcal for older males and 1600 kcal for older females (based on the Indonesian RDA). The lower than recommended levels of energy and selected nutrient intakes proves that there is a tendency for low consumption in this study. The older person has a risk of inadequate micronutrient intake, except for vitamin E. The main factors known to lead to decreased nutritional intake are chronic diseases, declines in absorption and metabolism in the gastrointestinal tract, depression and low income,[2,23] which subsequently could lead to decreased resistance to infection in the elderly.

Most of the mean values of nutrient intake were below the Indonesian RDA for the older person. This low energy intake did not adversely affect the protein intake. The data on regular daily consumption in this study (not shown) indicate that the majority of the protein intake is obtained mainly from a plant based diet, such as soybean products (tempeh and tofu). Similar findings in Kusumaratna et al. (2005)[24] showed that tempeh and tofu were the major sources of protein intake for daily consumption (68%) in most of elderly persons. Our results regarding the low dietary intake of macronutrients and selected micronutrients in both genders are confirmed by the biochemical indices of lower serum protein and albumin levels, and higher anemia and zinc deficiency status. In both genders, the prevalence of anemia was significantly higher in subjects with lower biochemical indices. Anemia was found in 42% of males and 28% of females. Hemoglobin levels were below the cut-off point recommended by WHO in 5.4% and 4.4% of aged males and females, respectively.[11] Anemia is due mostly to low intake of food sources of iron and/or low bioavailability of dietary iron, based on the patterns of regular consumption of staple food. The decrease in hemoglobin levels that occurs with aging is generally not due to the commonly recognized causes of anemia, such as iron deficiency or chronic disease, but probably to a decrease in the production of blood cells that might related to the process of aging.[25,26] Similar predisposing factors due to zinc deficiency have been found in this study.

From the proportion of daily nutrient intakes (Table 4) it is apparent that elderly males tend to have lower dietary intakes of vitamin C and food sources of iron as compared to females. In both genders the low intake of animal products, known to be the best food sources for iron and zinc, might have resulted in low dietary intake analysis and biochemical indices. This finding is supported by previous studies, namely the European ZENITH study[27], the study on free-living elderly in Japan[28] and the study on free-living elderly in South-Jakarta.[7] Among the micronutrients, zinc is known to be essential in the elderly, for its impact on immune functions. In the present study, among the older population we have observed gender differences in zinc status, total protein and albumin concentrations, with a higher number of deficiencies in females.

CONCLUSIONS

Among healthy free-living elderly there was a high prevalence of undernourished and lower dietary intakes of macronutrients and micronutrients. Responsiveness to the risks associated with these deficiencies among healthy free-living elderly should be increased for a healthy aging of the elderly.

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