**Original Article**

# Food intake and eating patterns of Indonesian elderly before the 1998 economic crisis

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The Nutrient and Metabolic Study of Indonesian Elderly (NUMSIE) was conducted in part to identify differences in eating patterns and in food and energy intakes between elderly people residing in urban metropolitan Jakarta (JAK) and in urban non-metropolitan Semarang (SEM) in order to investigate the prevalence of food and energy deficiencies. Data on food intake were collected from 212 JAK elderly and 238 SEM elderly aged 60 years and over using a quantitative food frequency questionnaire (FFQ). Although most of the elderly lived with their families or extended families, a large proportion of the subjects were eating alone, especially in the SEM sample. Jakartan elderly had significantly higher intakes of most food groups, except for added sugar and cow's milk. Total food intake of JAK subjects was also significantly higher ($P < 0.0001$) than that of SEM subjects. The ratio of plant to animal food was lower among SEM elderly due principally to their higher intake of milk. Thirty percent of both JAK and SEM elderly consumed less than the recommended amounts of cereals, followed by vegetables and fruits (10%, 47% JAK; 22%, 75% SEM, respectively). Finally, it was found that the range of daily energy intakes was higher in JAK (1251–2079 kcal) than in SEM (939–1579 kcal). This suggests that SEM elderly were more likely to be energy deficient than were JAK elderly. While the results of this study indicate that food and energy intakes may be inadequate in Indonesian elderly, especially in non-metropolitan areas, more analyses are required to ascertain the true prevalence of malnutrition in this age group using anthropometric and blood measurements.

**Key words: food intake, eating pattern, elderly, food inadequacy, energy deficiency, Australian Core Food Groups, Jakarta, Semarang, Indonesia.**

## Introduction

It is expected that Indonesia will experience a doubling of the proportion of people aged 60 years and over from 13 million (6% of total population) in 1996 to 38 million (13% of total population) in 2025.[1] Life expectancy at birth has increased rapidly in the last three decades, from 45.7 years in 1971 to 63.5 years in 1995.[2] Data from Soekirman *et al.* show a shift in mortality patterns; in 1986 infectious diseases were the leading cause of death but this changed to cardiovascular diseases in 1992.[3] This demographic transition will have consequences for the provision and development of health services for the Indonesian population.

For several decades, nutrition programs in Indonesia have been mainly focused on the four major nutrition problems, namely protein-energy malnutrition, vitamin A deficiency, nutritional anaemia[4] and iodine deficiency disorders.[3,5] Intervention programs have been developed and applied to children[6,7] and pregnant and lactating women,[8–10] but research on the food habits and nutritional problems of older Indonesians is limited.

Studies conducted before the economic crisis in Indonesia reported that macronutrient[11,12] and micronutrient deficiencies,[13,14] were common among Indonesian elderly, especially in rural communities (e.g. 90% of rural and and 33% of urbanized elderly in West Sumatra consumed less than 1500 kcal per day).[12] Therefore, the potential nutrition problems among elderly people could equal those of children. However, these elderly studies are limited by the small number of subjects, the dietary methodology utilized (24 h

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recall), reporting on nutrients rather than food, and the focus on one particular ethnic group in one particular location.

More studies are needed to confirm the extent of food and energy deficiencies among Indonesian elderly and whether differences exist between urban non-metropolitan areas, where lifestyles are more traditional, compared with urban metropolitan areas, where lifestyles are more modern. This will have important implications in the development of intervention programs. Also, mortality follow-up studies of elderly Indonesians studied before the crisis will provide some information on the impact of the crisis on longevity.

This paper reports the prevalence of food and energy deficiencies of elderly Indonesians aged 60 years and over from Phase I (cross-sectional) of a study conducted before the 1998 economic crisis in urban metropolitan Jakarta ($n$ = 220) and in urban non-metropolitan Semarang ($n$ = 241). Jakarta was chosen because its population represents a diverse range of ethnic groups. Semarang was chosen because although it consists mainly of one ethnic group, Javanese, this community follows a more traditional lifestyle. A 5-year mortality follow-up study (Phase II prospective cohort study) will be conducted in 2002 to investigate dietary predictors of survival and the impact of the 1998 economic crisis on Indonesian elderly.

## Subjects and methods

### *Study population*

Jakarta is the capital and the biggest city of Indonesia with a total population of approximately 10 million.[15,16] Its communities have assumed a 'modern' lifestyle and they reflect the diverse ethnicity of the Indonesian archipelago. In contrast, Semarang (500 km east of Jakarta) is more ethnically homogenous (98% Javanese) and communities tend to follow a more traditional village lifestyle. In this paper, the term JAK is used to define those living in urban metropolitan Jakarta and SEM for those living in urban non-metropolitan Semarang.

The Nutrition and Metabolic Study of Indonesian Elderly (NUMSIE), a cross-sectional and prospective mortality follow-up study, was established in 1996–97 by the South-east Asian Ministers of Education Organization (SEAMEO) Tropical Medicine (TROPMED) Regional Center for Community Nutrition, University of Indonesia in Jakarta, Indonesia in collaboration with the Department of Nutrition, Faculty of Medicine and the Faculty of Public Health, University of Indonesia, Jakarta, and the Health Research Institute of Diponegoro University in Semarang, Central Java, Indonesia. The study protocol was approved by both Human Ethics Committees of the Faculty of Medicine, University of Indonesia, Jakarta and Diponegoro University, Semarang. Informed consent was obtained from each subject after explaining the nature of the study procedures.

The eligible population included men and women aged 55 years and over from 10 public health centres in both Jakarta and Semarang. Subjects were randomly selected; elderly from each Public Health Centre were listed and numbered consecutively in ascending order and random sampling was performed until a sample size of approximately 30 was achieved. The selected subjects were invited by the midwives of each centre for an interview, anthropometric measurements and blood collection. Those with severe disabilities or apparent psycho-geriatric diseases, such as dementia, were excluded. In total, 304 subjects (90 men and 214 women) living in Jakarta and 292 people (76 men and 216 women) living in Semarang participated in the study. They were all community dwelling and came from different socioeconomic backgrounds.

In the present report we used data from the Phase I cross-sectional study. Since life expectancy at birth in Indonesia in the 1990s has been 60 for men and 64 for women, only those aged 60 years and over were included in the analysis. Thus, a total of 220 JAK subjects (36% men and 64% women) and 241 SEM subjects (27% men and 73% women) were analysed. Data on food intake were available on 212 JAK subjects and 238 SEM elderly.

### *Data collection*

Data were obtained by questionnaires, physical examination and blood sample. An interviewer-administered questionnaire was collected on the examination day, which provided information about demography, economic and health status, physical activity, activities of daily living (ADL), cognitive function, well-being, social activities and networks and food habits. Data collection was carried out in 1996 on JAK subjects (1 year before economic crisis), while in SEM the study was conducted 1 year later (the beginning of the economic crisis).

Food intake over the period of 12 months prior to the interview was assessed with a quantitative food-frequency questionnaire (FFQ). The questionnaire included 195 food items and general questions about food habits. Indonesian food models developed by the Nutrition Research and Development Centre in Bogor and standard household measurements (such as a glass or a cup of tea) as well as other traditional cooking utensils and natural units (e.g. a banana) were used to demonstrate portion size.

Each subject was asked to recall the frequency of consumption of the 195 food items in terms of the number of times they had eaten the food per day, per week or per month. Food items were then grouped into 13 food groups: (i) meat (e.g. chicken, beef, lamb, organ meat); (ii) eggs (e.g. hen eggs, duck eggs, quail eggs); (iii) fish (e.g. salmon, sardines, prawns); (iv) dairy products (e.g. milk, cheese, yoghurt; (v) legumes and nuts (e.g. mungbean, peanut, kidneybean); (vi) coconut milk; (vii) tempeh and tofu; (viii) rice and other cereals (e.g. bread, noodles, corn); (ix) vegetables (e.g. green leafy vegetables, root vegetables, fruit vegetables); (x) fruits (e.g. banana, papaya, oranges, watermelon); (xi) sugar and sugar products (e.g. soft drinks, cheese cakes); (xii) oils and spreads (e.g. margarine, butter, coconut oil, palm oil); and (xiii) beverages (e.g. tea, coffee).

All data were entered into a computer using the Microsoft EXCEL program (Microsoft Corporation, Washington, USA). A computer application using the SAS package (SAS Institute, Carry, NC, USA) was developed to calculate the frequency and amounts of food consumed in grams per day.[17]

The Australian Core Food Groups were used as a surrogate standard to define food deficiency.[18] The Core Food Groups recommend minimum amounts of foods to be consumed from five food groups in order to obtain at least 70% of the recommended dietary intakes for micronutrients, and > 50% of energy intake from carbohydrate and < 30% from

fat. The daily food intake of Indonesian elderly was converted into standard servings and then compared with the Core Food Groups. For instance, 30 g of bread is equivalent to 90 g of cooked rice (recommended amount of bread per day is 210 g). Differences in food intakes between the JAK and SEM samples, were analysed using the Wilcoxon Rank Test.

## Results

Table 1 shows the distribution of the study population according to their age group and Table 2 shows other demographic characteristics. Sixty-eight percent of the total sample were in the 60–70 years age group and only 3% were aged 80 years and over. In Jakarta, the population was more heterogeneous in terms of ethnicity but in Semarang, 98% of the subjects were Javanese.

**Table 1.** Distribution of subjects by age group

| Age group | Men *n* (%) | Women *n* (%) | Total *n* (%) |
|---|---|---|---|
| JAK | *n* = 79 | *n* = 142 | *n* = 221 |
| 60–69 | 49 (63) | 109 (77) | 158 (71) |
| 70–79 | 28 (35) | 30 (21) | 58 (26) |
| ≥ 80 | 2 (3) | 3 (3) | 5 (3) |
| SEM | *n* = 64 | *n* = 177 | *n* = 241 |
| 60–69 | 36 (56) | 121 (68) | 157 (65) |
| 70–79 | 26 (41) | 51 (29) | 77 (32) |
| ≥ 80 | 2 (3) | 5 (3) | 7 (3) |
| Total | *n* = 143 | *n* = 319 | *n* = 462 |
| 60–69 | 85 (59) | 230 (72) | 315 (68) |
| 70–79 | 54 (38) | 81 (25) | 135 (29) |
| ≥ 80 | 4 (3) | 8 (3) | 12 (3) |

JAK, urban metropolitan Jakarta; SEM, urban non-metropolitan Semarang.

**Table 2.** Demographic characteristics of the study population (%)

| | JAK | SEM |
|---|---|---|
| Ethnicity*** | | |
| Javanese | 52 | 98 |
| Sundanese | 15 | 0.5 |
| Betawis | 20 | — |
| Minangkabaus | 8 | 0.5 |
| Others | 5 | 1 |
| Marital status *** | | |
| Single | 1 | — |
| Married | 61 | 48 |
| Divorced | 1 | 2 |
| Widowed | 37 | 50 |
| Education**** | | |
| No formal education | 21 | 53 |
| Primary | 23 | 31 |
| Secondary | 38 | 15 |
| Tertiary | 18 | 1 |
| People living in the house **** | | |
| Alone | 5 | 12 |
| 2–5 | 48 | 57 |
| 6–9 | 38 | 27 |
| ≥ 10 | 9 | 4 |
| Area where most time spent during childhood **** | | |
| Rural | 76 | 47 |
| Urban | 20 | 53 |
| Rural + urban | 4 | |

JAK, urban metropolitan Jakarta; SEM, urban non-metropolitan Semarang.
Significant differences between JAK and SEM: **** $P < 0.0001$;
*** $P < 0.001$ (Wilcoxon rank sum test).

### *Eating patterns*

Although one third of the JAK subjects and half of the SEM subjects were widowed, the percentage living alone was low. However, a large proportion of the subjects ate alone during breakfast, lunch and dinner (Table 3). A total of 50% prepared and cooked their own meals whereas the remainder had meals prepared by family members, relatives or other helpers. Alcohol was rarely consumed, and only 15% of the sample grew their own fruits and vegetables.

The staple food and main energy source was rice, which was eaten three times per day in both the JAK and SEM communities. Plant protein, mainly from tempeh, tofu and other legumes (e.g. mung beans, peanuts, kidney beans), was the major source of protein in the diets of elderly Indonesians at both locations. Approximately 70% of total protein intake were derived from plant foods. Animal protein was derived from eggs, chicken, fish and meat. Vegetables were mostly cooked and were rarely eaten raw. One third of vegetables were stir-fried, and others were boiled or cooked with coconut milk. The most popular fresh fruits were banana, papaya, orange and watermelon.

### *Food intakes*

Total food intakes of the JAK subjects were 44% higher than the SEM subjects ($P = 0.0001$). The mean plant-to-animal food ratio of the SEM sample was 12 compared with 15 for

**Table 3.** Eating patterns of the study population (%)

| | JAK | SEM |
|---|---|---|
| Eat breakfast | 80 | 78 |
| Alone | 47** | 62 |
| With families or friends | 53 | 38 |
| Eat lunch | 95 | 93 |
| Alone | 55**** | 70 |
| With families or friends | 45 | 30 |
| Eat dinner (evening meal) | 95 | 95 |
| Alone | 42**** | 63 |
| With families or friends | 58 | 37 |
| Eat out ** | | |
| Never | 72 | 86 |
| Rarely | 10 | 2 |
| Once or twice/month | 11 | 6 |
| Once or more/week | 7 | 6 |
| Food preparation and cooking | | |
| Herself/himself ** | 48 | 52 |
| Spouse | 20 | 19 |
| Family members | 4 | 18 |
| Organization | 15 | 1 |
| Housemaid/helper | 13 | 10 |
| Do not drink alcohol | 98 | 97 |
| Fruits and vegetables from own-garden | 14 | 15 |

JAK, urban metropolitan Jakarta; SEM, urban non-metropolitan Semarang.
Significant differences between JAK and SEM: **** $P < 0.0001$;
** $P < 0.01$ (Wilcoxon rank sum test).

the JAK sample; this difference was mainly accounted for by the higher intake of cow's milk in the former. The mean daily intakes of most food groups of JAK subjects were higher compared with their SEM counterparts, except for eggs, fish, milk and added sugar (Table 4). Even though tempeh and tofu are recognized as traditional Javanese foods, the daily intake of these foods was higher among the JAK subjects than among the SEM subjects. In particular, the intakes of vegetables, fruits, rice and other cereals (e.g. noodles, bread), oils (e.g. coconut oil), coconut milk, meat, legumes and tea were significantly higher in the JAK sample. A comparison of food intakes between the two communities can be seen in Table 4.

### *Food and energy deficiencies*

When the data were analysed according to Australian Core Food Groups (which indicate the minimum amounts of foods recommended for a healthy diet),[18] approximately 30% of the JAK and SEM elderly were not consuming the recommended daily amount of cereals. A greater percentage of SEM elderly were not achieving the recommended intake for vegetables (22%) and fruits (75%) compared with JAK elderly (10% and 47%, respectively (Table 5)). In addition, it was found that the range of energy intakes of JAK elderly (1251–2079 kcal) was higher than that of SEM elderly (939–1579 kcal) (Figs 1, 2). Furthermore, 12.2% of JAK elderly and 28.2% of SEM elderly had energy intakes below 1000 kcal. This suggests that SEM elderly were more likely than JAK elderly to be energy deficient.

## Discussion

Our results indicate that food intakes differ between urban metropolitan and urban non-metropolitan populations. Elderly living in an urban metropolitan setting have a higher total food intake than those living in urban non-metropolitan areas. This is probably due to differences in food availability and lifestyle. It seems that the urban metropolitan population has a more diverse food pattern than the urban non-metropolitan population. Irrespective of ethnicity or economic status, people living in urban communities share certain commonalities with respect to food consumption. These include dependency on income for food (due to limited amount of own food production), a high degree of exposure to new food, a large variety of foods available for consumption, and a higher rate of consumption of street food or restaurant food.[19]

Thompson *et al.* reported that nutrient deficiency in the elderly is more evident in rural areas.[20] Another study conducted in Ireland also found that suboptimal nutritional status was present to a greater degree in subjects living in a geographically isolated rural area, but inadequate nutrition was detected in the city-dwelling elderly.[21] Both groups, but particularly the rural elderly, were discovered to have deficient intakes of many nutrients when compared against 80% of Irish RDA. It is also notable from the International Union of Nutritional Sciences Food Habits in Later Life study, which included approximately 2000 elderly from six countries, that rural elderly compared with their urban counterparts have a lower energy and total food intake.[22] For example, rural Chinese from Tianjin had lower total food and

**Table 4.** Differences in food intakes between Jakarta and Semarang elderly

| Food group | JAK ($n$ = 212) | | | SEM ($n$ = 238) | | |
|---|---|---|---|---|---|---|
| | Mean ± SD g/day | Median g/day | Range (25th–75th percentile) | Mean ± SD g/day | Median g/day | Range (25th–75th percentile) |
| Total food | 961 ± 332**** | | | 669 ± 260 | | |
| Animal food | 96 ± 70 | 23 | 12–40 | 114 ± 114 | 13 | 4–31 |
| Meat *** | 29 ± 23*** | 14 | 7–29 | 20 ± 19 | 15 | 7–28 |
| Eggs | 21 ± 19 | 17 | 9–30 | 21 ± 17 | 14 | 5–35 |
| Fish | 23 ± 21 | 0 | 0–2 | 22 ± 22 | 0 | 0–0 |
| Dairy products | 23 ± 44 | 8.5 | 0–30 | 52 ± 98 | 0.5 | 0–42 |
| Plant food | 887 ± 305**** | | | 567 ± 200 | | |
| Legumes and nuts | 38 ± 45* | 25 | 10–48 | 32 ± 43 | 17 | 5–38 |
| Tempeh and tofu | 180 ± 172* | 125 | 62–250 | 119 ± 63 | 107 | 72–151 |
| Vegetables | 180 ± 102**** | 162 | 103–246 | 108 ± 72 | 90 | 60–140 |
| Fruits | 140 ± 92**** | 114 | 75–193 | 76 ± 69 | 62 | 28–106 |
| Rice and cereals | 326 ± 120**** | 316 | 254–362 | 219 ± 84 | 200 | 162–256 |
| Coconut milk | 22 ± 21* | 17 | 7–31 | 12 ± 25 | 12 | 5–25 |
| Plant:animal ratio | 15 ± 25 | | | 17 ± 27 | | |
| Others | | | | | | |
| Sugar products | 14 ± 39 | 0 | 0–15 | 18 ± 10**** | 11 | 3–21 |
| Total oils and spreads | 25 ± 14**** | 23 | 17–30 | 9 ± 10 | 15 | 10–24 |
| Coconut oil | 17 ± 15**** | 17 | 0–25 | 9 ± 13 | 10 | 0–15 |
| Palm oil | 0.4 ± 15**** | 0 | 0–0 | 0.1 ± 2 | 0 | 0–15 |
| Poly unsaturated oil | 7 ± 12 | 0 | 0–11 | 20 ± 23**** | 0 | 0–0 |
| Tea | 337 ± 340** | 250 | 32–500 | 227 ± 195 | 200 | 35–300 |

JAK, urban metropolitan Jakarta; SEM, urban non-metropolitan Semarang.
Total food = plant food + animal food; animal food, meat + eggs + fish + milk + dairy products; plant food = legumes and nuts + tempeh and tofu + vegetables + fruits + rice and cereals + coconut milk; sugar products = sugar + soft drinks.
Significant differences between JAK and SEM: **** $P < 0.0001$; *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$ (Wilcoxon rank sum test).

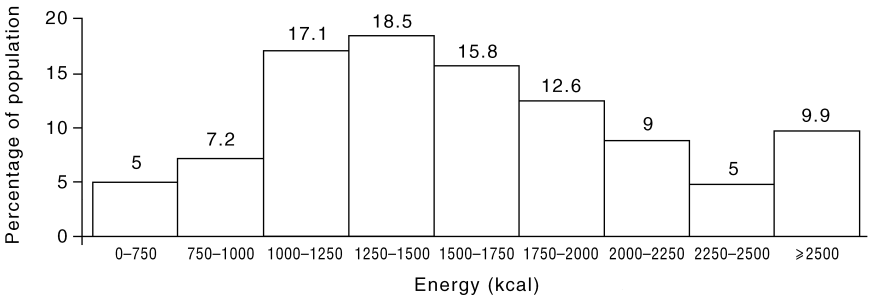


**Figure 1.** Distribution of energy intake of Jakartan elderly.

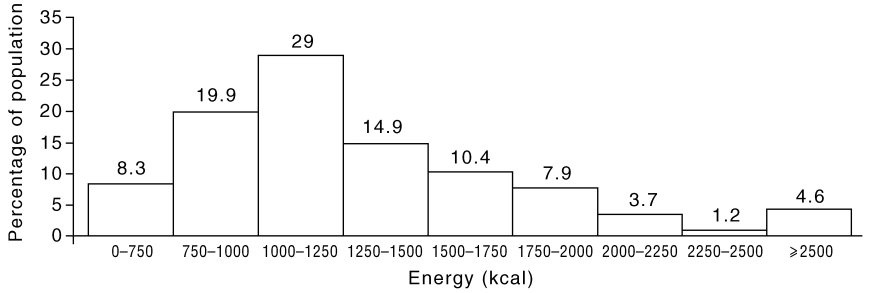


**Figure 2.** Distribution of energy intake of Semarang elderly.

**Table 5.** Percentage distribution of food deficiency for Indonesian elderly and Greek elderly according to Australian Core Food Groups*

| | Cereal | Vegetables | Fruit | Milk | Meat |
|---|---|---|---|---|---|
| Urban metropolitan Indonesians JAK† | | | | | |
| Men | 29 | 10 | 47 | 48 | 6 |
| Women | 40 | 17 | 56 | 40 | 10 |
| Urban non-metropolitan Indonesians SEM‡ | | | | | |
| Men | 28 | 22 | 75 | 31 | 6 |
| Women | 29 | 19 | 76 | 45 | 3 |
| Urban Greeks§ | | | | | |
| Men | 50 | 11 | 71 | 51 | 0 |
| Women | 73 | 27 | 85 | 54 | 0 |
| Semi-rural Greeks§ | | | | | |
| Men | 41 | 38 | 75 | 100 | 3 |
| Women | 71 | 52 | 87 | 100 | 16 |

*Australian Core Food Groups – Cereals: 210 g bread/day; other cereal products were converted to bread equivalents (i.e. 30 g bread = 90 g cooked rice/pasta or 20 g breakfast cereal). Vegetables (include legumes): 300–375 g/day; 75 g or ½ cup cooked vegetables is equivalent to ½ cup cooked dried beans, peas, or one cup salad vegetables or one potato. Fruits: 300 g/day; 150 g fruits is equivalent to one medium fruit (banana, orange, apple) or ½ cup juice, or one cup diced pieces or canned fruit. Milk: 450 mL/day; 250 mL (one cup) fresh milk is equivalent to ½ cup evaporated milk, 40 g cheese, 200 g yoghurt. Meat: 60–100 g/day; 65–100 g cooked meat, chicken, egg is equivalent to ½ cup cooked dried or canned beans, two small eggs, ⅓ cup peanuts. †JAK, urban metropolitan Jakarta; ‡SEM, urban non-metropolitan Semarang; §Taken from reference 35.

nutrient intakes than urbanized Chinese from Tianjin[23] and elderly Greeks in rural Greece had lower intakes of most food groups compared with Greek migrants living in urban Melbourne.[24]

Ethnicity plays an important role in food habits due to tradition. Javanese people, particularly those from Central Java (i.e. Semarang and Yogyakarta), tend to have a smaller portion of food, especially staple foods, fruit and vegetables, compared with other ethnic groups in the country. Fruit and vegetable consumption of people in Central Java is relatively low.[25] This may explain, in part, the low energy intakes reported in the current study in Semarang (1319 ± 555 kcal) and in another study of elderly people in West Sumatra (1130 ± 420 kcal).[12] In contrast, the mean energy intakes of Jakarta elderly reported in this study (1735 ± 649 kcal) and in a study conducted in urban West Sumatra (1700 ± 460 kcal) were significantly greater. Even so, both urban metropolitan and urban non-metropolitan residents have energy intakes lower than the recommended energy intakes of Indonesians aged 60 years and over (men 2200 kcal/day; women 1850 kcal/day).[26,27]

Another factor affecting the differences in food intakes between JAK and SEM elderly is time frame. The information from subjects in JAK was gathered before the economic crisis, whereas in SEM it was gathered at the beginning of the crisis, which probably had an impact on food consumption, especially among the vulnerable group. In addition, because eating alone was more prevalent among the SEM elderly, this may have also affected the total amount of food eaten since eating with others has been associated with greater food intake.[28] In addition, traditional Indonesian cuisine uses coconut milk and oils (along with herbs and spices) to enhance the flavour of many foods, especially vegetables, tofu and tempeh, and this facilitates their consumption. Since the intakes of coconut milk and oils were higher among JAK than SEM elderly, this could partly explain the higher intake of vegetables, tempeh, tofu, and total food in the former.

Food patterns which are proportionately higher in plant foods (approximately 70% of total food intake) compared with animal foods (30% of total food intake) appear to confer longevity.[29–33] Such food patterns tend to have plant-to-animal food ratios of between 2.5 and 3.0. More data is needed to investigate the effect of food patterns on health and longevity where ratios are much higher than 3.0 (i.e. where minimal animal foods are consumed). For example, the mean plant-to-animal food ratio of the Indonesian elderly was much higher (ratio among JAK = 15 and among SEM = 12) than mean ratios found in long-living elderly populations in Greece (Crete) in the 1960s (ratio = 3) and in Greek-born Australians in the 1990s (ratio = 2.7).[34] Indonesians might

benefit by including more animal foods to lower the ratio of plant to animal foods.

According to the Australian Core Food Groups, inadequate food was consumed by both JAK and SEM elderly from the following food groups: vegetables, fruit, cereals and dairy products. An adequate amount of food was consumed from the meat group due to the high intake of meat alternatives, such as tempeh and tofu. The prevalence of food deficiency among Indonesian elderly, however, is lower than that of Greeks aged 70–79 years except for the meat group (Table 5).[35] It is important to note the following limitations associated with estimating food deficiency: (i) the Australian Core Food Groups were developed for Caucasian populations and therefore the recommended amounts may be too high for Asian populations; (ii) the potential for underestimating food and energy intakes due to under-reporting associated with FFQ.[24]

Although food deficiencies were prevalent among the study populations, the intakes of some protective foods[36] such as eggs, organ meat, fish, fruits, vegetables and legumes, especially traditional soy products like tempeh and tofu, is encouraging. Other protective foods commonly used, but not reported in this paper, include herbs and spices (e.g. chilli, pepper, garlic, onion, ginger, turmeric) and *Jamu* (a traditional herbal drink, popular among Javanese people). The protective nutritional value of these foods derives especially from their content of phytochemicals,[37] which are multifunctional compounds[38] usually having a health benefit (e.g. antioxidant, antimutagenic, anti-angiogenic, immunomodulatory, and oestrogenic).

This study illustrates the need for dietary evaluation of and intervention for the elderly, with emphasis on non-metropolitan populations. Although rural food production and traditional knowledge remain important, older people seem to be nutritionally advantaged by living in the cities. While the results of this study suggest that food and energy deficiencies are a problem among Indonesian elderly, especially in non-metropolitan areas, more analyses are required to ascertain the true prevalence of undernutrition in this age group using anthropometric and blood measurements.

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