Original Article

Nutrient adequacy and food group consumption of Filipino novices and religious sisters over a nine month period

Jessica A Grieger PhD[1], Jere D Haas PhD[2], Laura E Murray-Kolb PhD[3], Penny Kris-Etherton PhD, RD[1], John L Beard PhD[1]

[1]*Department of Nutritional Sciences, Pennsylvania State University, University Park, PA, USA*
[2]*Division of Nutritional Sciences, Cornell University, Ithaca NY, USA*
[3]*Center for Human Nutrition, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA*

Rice is commonly consumed in the Philippines; however the contribution of other foods to the diet is not well defined. Our aim was to determine the nutrient intake and food group intake of Philippine nuns and compare their intakes to the current estimated average requirements (EAR), and food-based recommendations, respectively, and assess any differences in nutrient adequacy and energy intakes between body mass index (BMI) categories. Body weight was assessed at baseline and at nine months; three-day weighed food intakes were recorded once every fortnight (n=187). At baseline, the mean (SD) age and BMI of the women was: 25.0 (4.6) years and 21.8 (17.3) kg/m², respectively. Over the nine months, women with an underweight (n=46; <18.5 kg/m²) and acceptable BMI (n=132; 18.5-25 kg/m²) lost 5.0 kg (p=0.005) and 1.5 kg (p=0.047), respectively, whereas overweight women maintained their weight. Irrespective of BMI, 98% of women consumed less than the adequate intake for calcium, and no one met the folate EAR. The intake of all food groups (e.g., rice, vegetables, fruit, meat, dairy) was lower than food-based recommendations. It is evident that the nutrient density of the Philippine diet is poor. In order to meet nutrient requirements, it is recommended that all women increase intake of fruits, vegetables, fish, meat and dairy products, to reduce risk of micronutrient deficiencies. For the overweight women, these nutrient dense foods also are recommended, however it is important that they be substituted for energy dense foods to promote weight loss and prevent weight gain.

Key Words: diet, micronutrients, food groups, female, Philippines

INTRODUCTION

Philippine culture and cuisine have a strong Spanish, Chinese and American influence. Rice is the main food eaten three times a day; with fish and seafood supplying the principal source of protein. Although these foods are components of a healthful diet, many Filipinos have low intakes of micronutrients.[1, 2]

Between 1973 and 1982, the Philippine National Nutrition Survey showed a steady increase in energy intake from 1750 kcal to more than 2500 kcal.[3] However, between the 1987 and 1993 National Nutrition Surveys, there was a decline in the intakes of energy (1761 – 1692 kcal (7363 – 7073 kJ), iron (10.7 – 10.1 mg), calcium (420 - 390 mg), thiamine (16.3 - 16.1 mg) and niacin (16.3 – 16.1 mg).[4] In addition, per capita total food consumption, and consumption of major food groups including cereal and cereal products, starchy roots and tubers, fruits, and vegetables, also decreased.[4] These data indicate that low intakes of micronutrients have persisted over a six year period despite the currently available fortified foods such as iron fortified rice, iodized salt, vitamin A fortified margarine, wheat flour, sugar and cooking oil, and several fortified processed foods. Low intakes of these nutrients are commonly associated with micronutrient deficiencies such as anemia, osteoporosis and hypothyroidism, which are prevalent in this population.[4,5]

The previous dietary intakes from the National Nutritional Surveys in the Philippines are outdated. Therefore, we sought to update dietary data in a group of Filipinos. Our aim was to determine the nutrient intake and food group intake of Philippine nuns and compare their intakes to the current estimated average requirements (EAR), and food-based recommendations, respectively, and assess any differences in nutrient adequacy and energy intakes between body mass index (BMI) categories.

We analysed baseline data from a previous prospective, randomized, controlled trial following nine months of

Corresponding Author: Prof. John Beard, Department of Nutritional Sciences, 110 Chandlee Laboratory, University Park, PA, 16802
Tel: +1 814 863 2917; Fax: 1-814-863-6103
Email: jlb62@psu.edu.
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iron-fortified rice consumption in Philippine women, livin convents in greater Manila where all foods were provided.[6] This group was studied because of the ability to assess intake using the weighed food method in subjects who freely selected and ate foods served to them in a highly controlled setting. In addition, their dietary patterns were representative of dietary practices in the Philippines.[7] Our study was conducted to provide updated nutrient adequacy and food intake data to determine whether further studies are needed to justify intervention efforts targeted to improve the nutritional status of the Philippine population.

MATERIALS AND METHODS

Subjects

The study was a nine month (March to November) prospective study of women who were, and were training to become, religious sisters of the Roman Catholic Church, located in convents near Manila, the Philippines. Recruitment and screening for eligible subjects at the convents can be found in the report by Haas et al.[6] For the current analysis, complete anthropometric and dietary data were collected from 187 women. The procedures were reviewed and approved by the Institutional Review Boards for use of human subjects in research at The Pennsylvania State University, Cornell University, and the University of the Philippines and were in accordance with the Helsinki Declaration of 1975 as revised in 1983.

Anthropometry

Body weight and height were measured by digital scales and stadiometers at the beginning and end of the nine month trial. Body mass index was calculated using weight (kg) / height (m)². BMI was categorized according to the World Health Organisation: <18.5 kg/m² = underweight; 18.5-25 kg/m² = acceptable; 25.1-30.0 kg/m² = overweight; > 30.0 kg/m² = obese.[8]

Convent meals and dietary intakes

Cooks prepared all meals based on menus designed by the sisters. An individual was free to consume as much, or as little, as she wanted but portions were weighed. Thus the variety of food items were limited by the "menu" for that particular meal but the quantity was not limited.

Ten trained graduate students who lived in the convents with the subjects collected data on dietary intake using the weighed food method. Weighed intakes were collected from each subject on three random days (including one weekend day) every two weeks throughout the nine month trial; however the current analysis is based on baseline data prior to the nine month iron-fortified rice intervention. Conversion of weighed food items to nutrients was made using Philippine and ASEAN food composition tables[9] and food groups were primarily determined by their prior placement within food groupings in the food composition tables of the Philippines.[9] In some cases when the food items were not in the composition table but were a part of the Thailand or Indonesian composition tables, the field staff assigned foods to a food group.

Estimated energy requirements (EER) were calculated by: basal metabolic rate (BMR) = body weight (lb) x 10; physical activity (PA) = BMR by 30% (inactive); dietary thermogenesis (DT) = BMR + PA x 10%; EER = PA + BMR + DT. Protein requirements were calculated as 0.6 g/kg. Energy and nutrient intakes were compared to the current USA Dietary Reference Intakes.[10] Energy density was calculated as: energy intake (kcal)/ weight of food (g); meal density was calculated as: energy intake at specific meal (kcal)/ weight of food at meal (g); nutrient density (quantity of nutrient per calorie)/1000 kcal was calculated as: (specific nutrient intake/ energy intake (kcal)) * 1000. Food groups were categorised by primary foods in the Asian diet as well as mixed dishes across primary food groups. There are no Filipino food-based recommendations; therefore Thai food-based recommendations were used because their food intake patterns are similar.[11]

Statistical analyses

Statistical analyses were performed using SPSS for Windows (SPSS Inc., Chicago, Illinois, Release 15.0.1). Descriptive data are represented as mean (SD), or between groups as mean ± SEM. Students' t tests were used to identify differences in continuous variables between groups. Chi-square tests were used to compare categorical data. The Pearson correlation was used to assess associations between continues variables. The α-level for significance was set at $p < 0.05$.

RESULTS

Data were collected from 187 nuns who had a mean (SD) age, body weight and BMI of 25.0 (4.6) years, 108 (16.3) lb (48.9 kg) and 21.8 (17.3) kg/m², respectively. Twenty five percent (n=46) of the women were in the underweight BMI category (<18.5 kg/m²); 71% (n=133) were in the acceptable BMI category (18.5-25 kg/m²); and 4% (n=8) were considered overweight (25.1-30.0 kg/m²) or obese (>30.0 kg/m²). At the end of the nine month period, women in the original underweight BMI category had lost 5.0 kg (43.6 ± 0.9 kg vs. 37.6 ± 1.6 kg, p=0.005), women in the acceptable BMI category had lost 1.5 kg (49.7 ± 0.5 kg vs. 48.2 ± 0.8 kg, p=0.047), but women in the overweight/obese category maintained their weight (67.8 ± 3.3 kg vs. 66.3 ± 3.8 kg, p=0.306).

Energy and nutrient intakes

Mean (SD) daily energy and nutrient intakes are reported in Table 1. Mean carbohydrate intake accounted for 68% of total energy intake, which was higher than fat intake (20%, $p < 0.001$); and carbohydrate and fat intake was higher than protein intake (12% of total energy intake, both $p < 0.001$). Ninety nine percent (n=185) of the women met the carbohydrate EAR of 100 g, however 98-99% of women did not meet the adequate intake (AI) for fiber (25 g) and calcium (1000 mg). None of the women met the folate EAR of 320 µg per day. In the whole group, there was no difference in total daily energy or nutrient intakes or density, or in the number of women meeting nutrient recommendations between the BMI categories (Figure 1).

Nutritional supplements

Over the day, 48 women (26%) consumed at least one chocolate flavored, fortified supplement beverage. These

Table 1. Mean (SD) daily energy and nutrient intakes

	Mean (SD)	Range	EAR
Energy (kcal)	1954 (676)	456 - 4434	1543†
Protein (g)	54 (20)	12 - 111	29‡
Fat (g)	45 (19)	8 - 106	-
Carbohydrate (g)	334 (121)	69 - 773	100
Crude Fiber (g)	11 (5)	2 - 30	25 (AI)
Calcium (mg)	488 (195)	88 - 1157	1000 (AI)
Iron (mg)	8 (4)	1 - 23	8.1
Vitamin A (µg)	545 (521)	26 - 3062	500
Thiamine (mg)	0.8 (0.3)	0.1- 2.2	0.9
Riboflavin (mg)	0.9 (0.4)	0.1 - 2.4	0.9
Niacin (mg)	15 (6)	3 - 38	11
Folate (µg)	115 (41)	6 - 238	320
Zinc (mg)	8 (2)	0.7 - 13	6.8

EAR: Estimated average requirement

†Mean for this group based on the estimated energy requirement calculation with an inactive lifestyle; ‡ Mean for this group based on 0.6 g/kg/day

women had a higher energy (2146 ± 112 kcal vs. 1887 ± 53 kcal), fat (51 ± 3 g vs. 42 ± 2 g), carbohydrate (364 ± 10 g vs. 324 ± 19 g), iron (10 ± 0.7 mg vs. 7 ± 0.3 mg), vitamin A (780 ± 97 µg vs. 464 ± 37 µg), riboflavin (1.1 ± 0.1 µg vs. 0.8 ± 0.0 µg), thiamine (0.9 ± 0.1 mg vs. 0.7 ± 0.0 mg) and niacin (17 ± 0.9 mg vs. 14 ± 0.5 mg) intake (all $p \leq 0.048$). At breakfast, 52% (n=24) of the women in the underweight group consumed chocolate flavored energy drinks compared to none of the women in the overweight/obese BMI category ($p < 0.001$). There was no difference in energy or macronutrient intake between the underweight and overweight/obese groups, however women in the underweight group and who consumed an energy drink had a higher thiamine (0.30 ± 0.0 mg vs. 0.1 ± 0.0 mg, $p=0.046$) and iron (3.5 ± 0.5 mg vs. 1.3 ± 0.3 mg, $p=0.041$) intake. Collectively for the whole study group, there was no difference in body weight, or in the number of women meeting the EAR, between those who did and did not consume an energy fortified beverage.

Energy and nutrient contributions at meals

Lunch contributed 30% of the total daily energy intake, compared to supper (28%, $p < 0.001$) and breakfast (25%, $p < 0.001$) which provided the least energy intake ($p = 0.001$ vs. supper). Women in the underweight BMI category had the lowest energy intake at lunch (518 ± 33 kcal) compared to those who had a normal (597 ± 20 kcal, $p = 0.043$) or overweight/obese BMI (786 ± 81 kcal, $p = 0.003$). At lunch, there was a trend for a lower energy density among the women in the underweight BMI category (0.44 ± 0.02 kcal/gram) compared with women in the overweight/ obese BMI category (0.56 ± 0.06 kcal/gram, $p=0.052$). Women in the underweight BMI category also had a lower calcium (54.4 ± 4.0 mg/kcal), niacin (2.6 ± 0.2 mg/kcal), and iron (0.9 ± 0.1 mg/kcal) density during the lunch meal compared with women in the overweight/obese BMI category (calcium: 78.6 ± 9.7 mg/kcal, $p=0.022$; niacin: 4.3 ± 0.6 mg/kcal, $p=0.006$; iron: 1.4 ± 0.2 mg/kcal, $p=0.005$). Energy intake at supper also was lowest in women in the underweight category compared to those in the normal category (475 ± 30 kcal vs. 553 ± 18 kcal, $p = 0.025$); and there was a trend be-

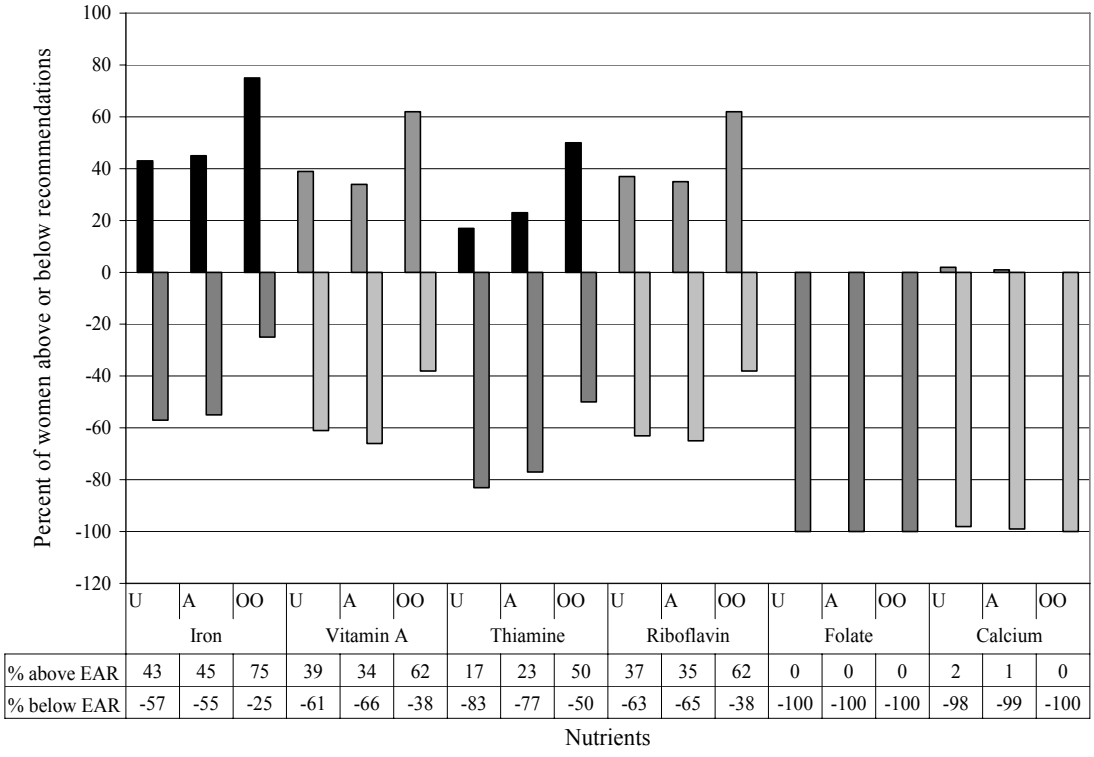

Figure 1. Percent of women in each BMI group, above or below energy and nutrient recommendations
U: Underweight BMI; A: Acceptable BMI; OO: Overweight/obese BMI

Table 2. Philippine food guidelines, Thai portion size equivalents, and actual food groups consumed

Food group	Philippine Food guide pyramid	Portion measures for Thai	USDA Food Guide	Actual intake	Percent difference vs. Thai portion sizes	*p* value
Rice-starchy food (Rice, cereals, starchy vegetables)†	Eat most	240 – 480 g	3 cups/wk	186 g	-22 – 61%	<0.001
Vegetables‡	Eat more	160 g	5 servings (90 – 150 g)	101 g	-37%	<0.001
Fruit	Eat more	3 pieces (~150 g each)	4 servings	119 g	-74%	<0.001
Meat (meat, poultry, fish)	Eat moderately	90g	5.5 servings (60 – 90 g)	44 g	-51%	<0.001
Milk	Eat moderately	2 glasses (~ 16 fl oz/448 g)	3 cups (16 fl oz – 24 fl oz)	19 g	-96%	<0.001
Fats, oils and sugars	Eat just enough	-	§	-	-	-

30 g = 1 oz

† Thai recommendation based on lowest to highest portion sizes (i.e. 1 slice bread = 8 rice serving spoons (one rice serving spoon = 60 g of cooked rice/starch product; 50 g noodle; 30 g bread slice). Food based recommendation is based on the lowest (e.g. 8 rice serving spoons of 30 g bread slice) and highest (e.g. 8 rice serving spoons of cooked rice/starch product) rice serving spoon size/food. US recommendations based on 1 ounce serving of grains (i.e., ½ C (30 g) cooked rice, pasta or cereal; 1 oz dry pasta or rice; 1 slice bread; 1 small muffin (1 oz); 1 C ready-to-eat cereal flakes)

‡ Thai recommendation based on 4 rice serving spoons (1 rice serving spoon = 40 g of cooked vegetable product). US recommendations based on 1 serving as: ½ C cooked vegetable product).

Thai recommendation based on 6 rice serving spoons (1 rice serving spoon = 15g of cooked meat product). US recommendations based on 1 serving as: 28 g cooked lean meat (equiv. to 1 egg; ½ C cooked dry beans; 2TB peanut butter)

§ USDA recommend 27 g oil and 267 calories, based on a 2000 calorie diet

tween women in the underweight vs. overweight/obese category (619 ± 73, p =0.068).

Women in the underweight BMI category consumed the lowest volume of food over the whole day (1184 ± 34 g) compared with women in the acceptable (1325 ± 25 g, p <0.001) and overweight/obese category (1449 ± 81 g, p=0.003).

Food based recommendations and food group contribution

All food groups consumed by the Philippine women were lower than portion sizes of the Thai recommendations (Table 2). In relation to energy intake, the Rice food group contributed most to total daily energy intake (24%, p <0.001 vs. all other food groups), followed by Cereals (16%, p <0.001), Meat (10%, p <0.001) and then Fruit (7%, p <0.001) (Figure 2). The "other" food group categories consisted of: Condiments; Alcoholic beverages; Non alcoholic beverages; Combination foods/mixed meals; and Miscellaneous (e.g. non-dairy creamer) which all contributed to ≤ 4% each.

Most calcium came from the Milk group (94 ± 2 mg, p <0.001 vs. all other groups), followed by the Fish group (75 ± 2 mg, p <0.001 vs. all other groups). Most folate came from the Vegetable and products group (26 ± 0 µg, p <0.001 vs. all other groups) and then equal intakes from

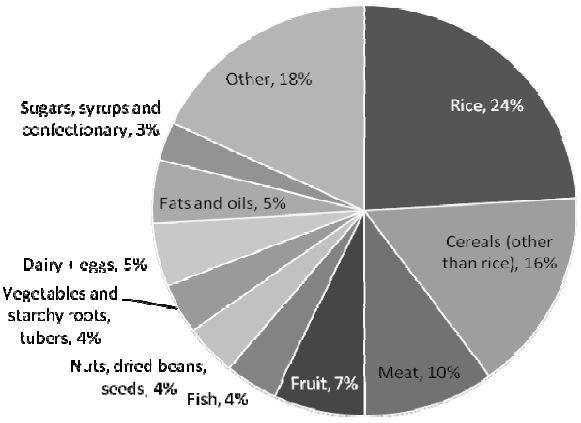

Figure 2. Percent energy from food groups

the Fruits (21 ± 0 μg, p <0.001 vs. all other groups) and Nuts, dried beans and seeds, group (20 ± 0 μg, p <0.001 vs. all other groups). Most vitamin B_{12} came from Fish (2.4 ± 0.0 μg, $p \leq 0.046$) and Meat (1.5 ± 0.0 μg, $p \leq 0.046$) as did zinc from the same food groups, respectively (3.9 ± 0.1 mg, and 3.2 ± 0.1 mg, p <0.001 vs. all other food groups).

DISCUSSION

Our aim was to determine the nutrient intake and food group intake of Philippine nuns and compare their intakes to the current estimated average requirements (EAR), and food-based recommendations, respectively, and assess any differences in nutrient adequacy and energy intakes between body mass index (BMI) categories. Irrespective of BMI, we found that at least 1/3 of the women did not meet the EAR for vitamin A and riboflavin, 98% consumed less than the adequate intake for calcium, and no one met the EAR for folate. Our results are consistent with previous studies in developing countries that identified low intakes of calcium, vitamin B_{12} and iron in Philippine[12] and Malaysian[13] women; and low intakes of calcium and vitamin A in Japanese, Fiji and Vietnamese women.[14] These nutrients all play different, yet pivotal roles in the body including bone health, nervous system function, and red blood cell production. It is evident that many women in developing countries have low nutrient intakes, and if continued in the longer term, these women are at great risk for developing micronutrient deficiencies. It is recommended that all women consume nutrient dense foods such as fruits, vegetables, whole grain foods, dairy, fish and meat in order to increase nutrient intake and reduce risk for micronutrient deficiencies.

The low micronutrient intakes in our women reflect their inadequate consumption of important food groups such as fruits, vegetables, dairy, meat and fish. In comparison to Thai recommendations, we found that rice and starch products also were low by at least 22%, which is equivalent to 1 C of cooked rice. As suggested above, in order to consume a diet that is nutritionally adequate, it is recommended that all women incorporate other food groups into their dietary pattern, such as fruits, vegetables, dairy, meat and fish. To achieve a diet that meets food group recommendations, this would be equivalent to an additional two pieces of fruit, 1/2 serving of meat, 1/2 serving of vegetables, and two glasses (16 floz) of milk per day. This appears to be possible, particularly if the meat and vegetables were provided at the evening meal, and one piece of fruit and one glass of milk are consumed at the morning and afternoon mid-meal.

The inclusion of extra food items into the diets of these women also will assist in the prevention of weight loss which we found among the underweight and normal weight women. Although some of the women consumed an energy fortified beverage which resulted in a higher energy and nutrient intake, these women had a lower BMI compared with those who did not consume an energy-fortified beverage. For some women, inclusion of additional foods and an energy fortified beverage may be necessary to prevent weight loss and achieve and maintain a healthy body weight. We found that although the overweight/obese women maintained their weight, their diets were nevertheless low in nutrients. Thus, it is recommended that the overweight/obese women substitute nutrient dense foods for energy dense, low nutrient dense foods to prevent weight gain and encourage weight loss to achieve a healthy body weight.

The strength to our study is the 3-day weighed food intakes that were measured by trained staff in our large sample of women. Limitations of our study were that we used the same “inactive” physical activity level to calculate energy requirements. Therefore we may have underestimated physical activity level, and hence energy needs for some women. We also compared Philippine food intake with food-based recommendations for Thailand, thus Philippine food-based recommendations are needed.

In conclusion, nutrient intakes of all women were below recommendations and this was evident in their less than recommended consumption of all food groups. It is recommended that all women incorporate nutrient dense foods in their diets, such as fruits, vegetables, fish, dairy and meat to prevent micronutrient deficiencies. The underweight women should increase the portion sizes of these nutrient dense foods to increase body weight, and achieve a healthy BMI. For the overweight/obese women, it is important that they substitute nutrient dense foods for energy dense foods to prevent weight gain and achieve weight loss. In addition, all women could consume more of the currently available fortified foods and perhaps strategies could be put in place to fortify other nutrients in foods (e.g., calcium and folate in milk or ready-to-eat breakfast cereals). These food-based strategies will increase the nutrient density of the diet, thereby improve nutrient adequacy, and shift the Philippine food cuisine toward a healthy dietary pattern that includes all food groups. This will help reduce risk of micronutrient deficiencies and related nutrient-deficiency diseases.

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AUTHOR DISCLOSURES

No conflict of interest exists for any author.

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[1]*Department of Nutritional Sciences, Pennsylvania State University, University Park, PA, USA*
[2]*Division of Nutritional Sciences, Cornell University, Ithaca NY, USA*
[3] *Center for Human Nutrition, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA*

探討菲律賓見習修女和修女在九個月期間之營養素適當性和食物群組的攝取

在菲律賓米食是常被攝取的食物，然而其他食物的飲食貢獻並沒有得到很好的界定。本研究目的在探討菲律賓修女的營養素和食物群組攝取量，且將其攝取量分別與目前的平均需要估計量(EAR)、食物指南建議量相互比較。並且評估在不同身體質量指數(BMI)組別之間，營養素適當性和熱量攝取的任何差異。在基準日及 9 個月後測量體重；每兩星期紀錄一次為期 3 天的食物攝取量(n=187)。在基準日，這些婦女的年齡和 BMI 平均值(標準差)分別為：25.0 (4.6)歲和 21.8 (17.3) kg/m²。在九個月中，體重過輕(n=46；<18.5 kg/m²)和 BMI 正常(n=132；18.5-25 kg/m²)的婦女分別減少 5.0 公斤(p=.005)和 1.5 公斤(p=.047)，反之體重過重的婦女仍維持其體重。不論 BMI 值為何，98%的婦女攝取的鈣量少於適當攝取量，而且葉酸攝取量也無人達到平均需要估計量(EAR)。所有食物群組(如米、蔬菜、水果、肉類、奶製品)的攝取低於食物指南的建議量。很明顯，菲律賓膳食的營養密度是貧乏的。為了滿足營養需求，建議所有的婦女增加攝取水果、蔬菜、魚類、肉類和奶製品，以減低微量營養素缺乏的風險。對於過重的女性，也建議攝取這些營養素稠密食物，但重要的是，以此取代高熱量的食物，以促進體重減輕和預防體重增加。

關鍵字：飲食、微量營養素、食物群組、女性、菲律賓