Dietary assessment of refugees living in camps: A case study of Mae La Camp, Thailand

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Abstract

This study presents data on consumption patterns, methods of food procurement, and adequacy of dietary intake among Burmese refugee camp households living along Thailand's border with Burma. Households established for one or more years and with children under 15 years of age were sampled. A questionnaire was used to determine economic, food-consumption, and dietary intake patterns; foods consumed were weighed and measured using a 24-hour recall for the household unit; and nutritional status was determined by a Microtoise tape and digital standing scales. In total, 182 households containing 1,159 people were surveyed. The average household energy and protein intakes were 96.6% and 111.4%, respectively, of the recommended daily allowance (RDA) for healthy Thais. Twelve percent of protein was derived from animal sources. Carbohydrate, protein, and fat accounted for 84%, 9%, and 7% of total energy, respectively. The intake of vitamins A, B_1, B_2, and C and of calcium ranged from 24.2% to 53.1% of the RDA. Iron intake was 85.3% of the RDA, derived mainly from rice, fermented fish, mung beans, green leafy vegetables, and eggs. Ration foods supplied 60.5% to 98.18% of all nutrients consumed in the households, with the exception of vitamins A and C. Among children under five years of age, 33.7% were underweight, 36.4% were stunted, and 8.7% were wasted. Although the refugees were able to procure some nonration foods by foraging, planting trees and vegetables, raising animals, and purchasing and exchanging ration foods for other items, the quantity and quality were not sufficient to compensate for the nutrients that were low or lacking in the ration. The overwhelming majority of dietary nutrients were provided by ration foods, and although the ration and the overall diet may be adequate for short-term subsistence, they do not suffice for long-term survival and optimal growth, especially for younger children.

Key words: Burma, household consumption, nutrition status, refugees, Thailand

Background

Refugees from Burma (Myanmar), totaling nearly 140,000 people living in 10 camps along the Thailand-Burma border, receive basic food and relief assistance from the Burmese Border Consortium (BBC), as well as a variety of health and education services provided by various nongovernmental organizations. The Thai Government does not provide any type of food support for the refugee population.

Rice is the staple food for the refugees and traditionally constitutes the mainstay of the diet, which includes fermented fish and a variety of vegetables, both grown and foraged, as well as meat and fish, hunted and raised. The food basket provided by the BBC is sufficient in both quality and quantity for subsistence in short-term situations, and it has been assumed that refugees living in camps for an extended period should be able to supplement the food basket to create a balanced diet for long-term sustenance. The BBC's basic food basket includes rice, split yellow hulled mung beans, fermented fish, soybean oil, dried chilies, and iodized salt, averaging 2,200 kcal per person per day (children under five years of age receive one-half the amount of rice, beans, and oil).

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Paper presented at the Fifth International Conference on Dietary Assessment Methods, Chiangrai, Thailand, January 26–29, 2003.

This study determined how the BBC ration foods are utilized and the ability of households to supplement their food basket, and it evaluated the nutritional status of the refugees. This study is meant to provide information to assist the BBC and other organizations involved in providing food and relief to refugees living in camps in identifying the appropriate amount and types of foods that need to be supplied in long-term refugee situations in general.

Study site

Mae La Camp, located in Mae Sot District, Tak Province, on the northern border between Thailand and Burma, has been in existence since 1995 and is home to close to 40,000 refugees. The majority of residents are members of ethnic groups from border states in Burma, mainly Skaw Karen, with some Pwo Karen, Burmese, and Mon scattered throughout. The shelters in Mae La camp are made mostly of bamboo provided by the BBC (walls and floors) and thatched roofs, with only some structural supports made of wood. Space and water are very limited within the confines of the camp.

The camp is divided into three zones and is administered by an elected camp committee. The camp is located along a main thoroughfare, and some camp residents find day labor in neighboring farms, although the movement of refugees in and out of the camp is increasingly restricted by Thai border officials. Nonetheless, the camp has a lively economy. Zone C has a large market, with over 100 small shops that sell food and goods daily. Zones A and B have a few small shops selling some dry and some fresh foods. Camp residents are free to travel between zones to access markets, health services, churches, etc.

Methods

Zone A in Mae La Camp was randomly selected as the study site from the three zones (A, B, and C). The systematic, random sampling of households in the study area included only households living in zone A for one or more years and with children under 15 years of age. The sample size was calculated as 1,079 persons [1], as determined by the Taro Yamane formula $n = N / (1+Ne^2)$, where $N = 37{,}070$ (total population of Mae La Camp, Burmese Border Consortium, December 2000) and $e = 0.03\%$. The average number of persons per household was six, and the calculated sample size was 180 households. An extra 10% of the households were included in the final sample; 16 households were excluded from data collection and analysis because they were not available (not at home or moved) during data collection. Data were collected during 10 days in March 2001, during the dry season, when fewer vegetables are available for foraging and water for gardens is more scarce. The refugees receive a uniform food basket throughout the year, regardless of the season.

A questionnaire was developed and implemented to collect data on household demographics, economy, and resources; sources and consumption patterns of nonration foods; and dietary intake of the household unit. The questionnaire was pretested in a small sample of households and revised for clarity and content. Data were collected during visits to the sample households by using trained interpreters to interview household members. The head of the household was interviewed on economics and food procurement. Because the refugees eat from shared plates, a 24-hour recall at the household level of food consumed during the previous day was also conducted with the household cook, including meals eaten outside of the home. The amounts of each dry ingredient consumed by the entire household, both rice and other foodstuffs, were estimated by the household member who had cooked the previous day, using real food models. Foods were weighed on a 1-g digital food balance. The amounts of food left over at the end of the previous day were estimated and weighed by using either the actual food or the food models. All household members were asked to estimate the amounts of cooked rice consumed per person per meal, and these were weighed in households that had left-over cooked rice. The age and sex of household members who had consumed the food were also recorded.

The household members were also invited to a central location for anthropometric measurements. The nutritional status of the children and adults in the sample households was evaluated by measuring their weight and height with a 100-g beam balance scale and a Microtoise tape (a metal height-measuring tape reading to the nearest 0.1 cm) to determine the level of protein–energy malnutrition. Children under age 13 were examined for clinical signs of micronutrient deficiencies, including Bitot's spots, angular stomatitis, pallor, and goiter.

Descriptive statistics were used to analyze household demographic and economic data using SPSS 9.0. The INMUCAL New Database I (NDI), the software program used by the Institute of Nutrition at Mahidol University, Thailand, for nutrient analysis, was used to analyze the nutrient content of foods consumed from 24-hour recall [2] (trace minerals and amino acid contents of foods are not available in the database). Dietary reference intakes are currently being developed for the region, and were unavailable for use in analysis; recommended daily allowances (RDAs) were used as the reference. The RDA for each household was calculated as the sum of the individual members' RDAs, and these data were compared with the RDAs for healthy Thais (1989) [3]. The RDA for each household was calculated as follows: the RDA for each household member who

consumed food during the 24-hour recall period was recorded; the sum of the household members' RDA was calculated and recorded as the household RDA; and the household intake was compared with the household RDA to determine the percentage of the RDA of each nutrient that was consumed by the household.

Descriptive statistics were used to analyze average household nutrient intakes. The combined intakes of all sample households were used to calculate the proportion of nutrients from ration and nonration foods. Descriptive statistics were also used to analyze the nutritional status of children and adults. Weight for age (W/A), height for age (H/A), and weight for height (W/H) were compared with those of the World Health Organization/National Center for Health Statistics (WHO/NCHS) 1995 reference population (< –2 SD W/A, H/A, and W/H; < 80% median W/H; < 70% median W/H) [4, 5]. The adult body-mass index was calculated and compared with recognized cutoff points [6].

Results

Household demographic and economic characteristics

Data were collected from 182 of the 200 households selected for the zone A sample, with a total population of 1,159 people. Of these, 48.9% were male, 51.1% were female, and 54.1% were between the ages of 14 and 60 years (table 1). The average household size was 6.4 persons. Among the 182 households sampled, 76.9% had sought refuge in Thailand more than five years previously, and 84.1% had resided in Mae La Camp for more than two years. Eighty-six percent of the families sampled belonged to the Skaw Karen tribe. Sixty-six percent were Christian and 29.7% were Buddhist. The main occupation reported prior to coming to Thailand was agriculture (55.5%), followed by general labor (28.6%).

Food consumption

Nutrient content of overall diet

Data on food consumption were collected from 1,086 household members. The 24-hour recall interviews from 182 households revealed that the average energy intake was 96.6 ± 20.8% of the daily RDA for healthy Thais. The households consumed an average of 111.4 ± 31.1% of the RDA for total protein, but only 12% of the protein was obtained from animal sources. The intakes of vitamins A, B_1, B_2, and C were 36.0%, 37.8%, 24.2%, and 51.7% of the RDA, respectively (table 2). Carbohydrate, protein, and fat accounted for 84%, 9%, and 7% of the total calories, respectively.

Contribution of ration foods to nutrient intake

Ration foods (rice, beans, fermented fish, oil, and dried chili) constituted the main sources of food and provided more than 86% of all nutrients consumed in the households, except for vitamin A (38.8%), vitamin C (2.1%), vitamin B_2 (60.5%), and animal protein (65.4%) (table 3). Vitamins A and C were supplied mainly by nonration foods (61.2% and 97.9%, respectively) and largely from vegetables such as green gourd, pumpkin, cassava leaves, mustard leaves, morning glory, and tomato. From the ration foods, most of the energy in the diet came from rice (87.1% of total calories). Rice was also the main source of protein (71.5%), vitamin B_1 (64.8%), niacin (88.7%), iron (51.9%), and phosphorus (57.1%). Fermented fish

TABLE 1. Age and sex distribution in 182 households surveyed in Zone A, Mae La Camp[a]

	Male		Female		Total	
Age (yr)	%	*n*	%	*n*	%[a]	*n*
< 1	1.1	13	1.3	15	2.4	28
1–5.9	8.5	99	9.0	104	17.5	203
6–13.9	11.0	127	12.3	143	23.3	270
14–60	26.7	310	27.4	317[b]	54.1	627
>60	1.6	18	1.1	13	2.7	31
Total	48.9	567	51.1	592	100	1,159

a. All percentages are based on the total sample of 1,159.
b. Of the reproductive-age women interviewed, 24 were pregnant and 26 lactating.

TABLE 2. Nutrients consumed per household per day as a percentage of RDA (N = 182)

	Nutrient intake/day/household (% RDA)			
Nutrient	Mean	SD	Range	Median
Energy (kcal)[a]	96.6	20.8	43.6–192.8	95.56
Protein (g)[b]	111.4	31.1	48.3–203.0	106.36
Vitamin A (RE)[c]	36.0	33.0	0.0–199.0	26.31
Vitamin B_1 (mg)	37.8	11.4	16.9–118.8	35.53
Vitamin B_2 (mg)	24.2	17.4	5.7–100.9	18.70
Vitamin C (mg)	51.7	67.0	0.3–422.3	23.21
Niacin (mg)	63.8	14.4	29.4–119.1	60.91
Iron (mg)	85.3	27.4	30.8–184.9	82.24
Calcium (mg)	53.1	30.3	4.6–160.6	47.61
Phosphorus (mg)	78.2	22.3	31.3–148.9	73.41

a. Proportion of energy supplied by carbohydrate, protein, and fat, 84:9:7; goal, 55–65:10–15:25-30.
b. Proportion of animal protein to plant protein, 1:7.3 (12:88); goal, 1:1–2.
c. Two units are currently used for quantifying vitamin A activity in foods, as a result of recent research findings. Both refer to 1 µg of all-*trans*-retinol (vitamin A). The retinol equivalent (RE) is defined as equivalent to 6 µg of dietary all-*trans*-β-carotene. The more recently recommended retinol activity equivalent (RAE) is defined as equivalent to 12 µg of dietary all-*trans*-β-carotene, and this unit is used in the INMUCAL database [2].

TABLE 3. Percentage of nutrients obtained from ration and nonration foods, all households combined ($N = 182$)

Nutrient	Ration foods						Nonration foods
	Rice	Beans	Fermented fish	Soybean oil	Dried chilies	Total ration food	
Energy	87.1	2.9	2.8	2.8	1.3	97.0	3.0
Carbohydrate	93.7	2.4	1.1	0	0.8	98.1	1.9
Fat	25.9	1.3	14.8	43.2	5.5	90.6	9.4
Total protein	71.5	9.8	8.1	0	2.1	91.4	8.6
Plant protein	81.6	11.2	0	0	2.4	95.1	4.9
Animal protein	0	0	65.4	0	0	65.4	34.6
Vitamin A	0	0	0	0	38.8	38.8	61.2
Vitamin B_1	64.8	14.0	0	0	8.4	87.2	12.8
Vitamin B_2	29.0	31.5	0	0	0	60.5	39.5
Vitamin C	0	0	0	0	2.1	2.1	97.9
Niacin	88.7	2.7	0	0	0	91.4	8.6
Iron	51.9	7.1	23.6	0	3.6	86.1	13.9
Calcium	7.9	0	82.4	0	1.0	91.3	8.7
Phosphorus	57.1	0	32.2	0	4.5	93.8	6.2

was the main source of calcium in the diet (82.4%), provided the fish were consumed whole and the bones eaten. The major sources of iron among ration foods were rice (51.9%), fermented fish (23.6%), and mung beans (7.1%), and among nonration foods, green leafy vegetables and eggs (13.9%).

Weight of rice consumed per person per meal

Most refugees (80%) ate a rice-based meal twice a day, except for children under six years old, who ate three meals per day. The amount of cooked rice consumed per person per meal was 190, 300, and 429 g for children aged 1–3, 4–6, and 7–9 years, respectively. Males aged 10–12, 13–15, 16–19, and 20 or more years consumed 506, 593, 745, and 857 g of rice per meal, respectively; females in the same age groups consumed 469, 643, 621, and 744 g, respectively (table 4).

Nonration foods

Nonration foods from eight identified food groups available in the camps were purchased on average one or two times per food group per month, at a cost of 5 to 6 baht per time (except for meat and fresh fish) (US$1 = approximately 40 baht). The households spent a median of about 55 baht per month on food. The median annual household income was 500 baht. The majority of households (77.5%) bought vegetables a median of four times per month, at 3 baht per month (at a cost of about 5–10 baht/kg). Most families (74.7%) obtained fresh fish at a median of twice a month at 10 baht each month (at a cost of 20–30 baht/kg). Eggs were purchased by 47.7% of households, meat by 39.0%, canned fish by 31.3%, and steamed fish by 19.8%. Most families (69.2%) bought snacks for their children (table 5).

On average, each household possessed between one-half and one square meter of land for planting. During the rainy and dry seasons (approximately from June through February), 69.8% of the households reported planting vegetables and fruits for consumption (table 6). These included one or more of the following: cassava, *Acacia concinna,* gourds, pumpkin, green peas, basil, ginger, lemongrass, banana, and/or papaya. On average, the households were able to plant one or two types of trees or other plants on their small plots of

TABLE 4. Quantity of cooked rice consumed according to age group

Age (yr), sex	No. of persons[a]	Rice/person/meal	
		Mean ± SD (g)	Mean no. of serving spoons or tuppees[b]
1–3, M and F	43	190 ± 106	3
4–6, M and F	39	300 ± 101	5
7–9, M and F	39	429 ± 179	7
10–12, M	8	506 ± 100	8
10–12, F	17	469 ± 190	8
13–15, M	12	593 ± 140	10
13–15, F	10	643 ± 155	11
16–19, M	7	745 ± 228	12
16–19, F	7	621 ± 231	10
20–60, M[c]	47	857 ± 250	14
20–60, F	54	744 ± 245	12

a. A total of 62 households were surveyed.
b. 1 tuppee = approximately 60 g of cooked rice.
Note: Thai Food Guide model (Nutrition Flag) recommends 8–12 tuppees/day.

TABLE 5. Household expenditures on different types of food ($N = 182$)

Food	Households purchasing food in past month		Frequency of purchase (times/mo)[a]		Amount spent (baht/month)[a]	
	%	n	Median	Range	Median	Range
Meat	39.0	71	1	1–4	30	5–50
Fresh fish	74.7	136	2	1–20	10	2–40
Steamed fish	19.8	36	2	1–12	5	5–20
Salted fish	9.3	17	1	1–12	5	5–20
Canned fish	31.3	57	1	1–8	6	5–30
Eggs	47.7	85	2	1–8	5	2–53
Vegetables	77.5	141	4	1–30	3	1–20
Seasonal fruit	19.8	36	2	1–7	5	1–50
Sugar	51.1	93	—	—	—	—
Snacks	69.2	126	—	—	—	—
Beverages	23.1	42	—	—	—	—
Noodles, rice noodles, ready-cooked food, other	13.7	25	—	—	—	—

a. Frequency and amount spent are given for households purchasing that type of food; data were not collected for sugar, snacks, beverages, and noodles etc. US$1 = approximately 40 baht.

TABLE 6. Households that had a garden, raised animals, or foraged for food within the previous year ($N = 182$)

Activity	%	*n*
Gardening	69.8	127
Raising animals	55.5	101
Foraging	74.2	135

land. Almost three-quarters of the households (74.2%) foraged for foods in the surrounding area, gathering bamboo shoots, mushrooms, potatoes, and wild fruits. About half of the households (55.5%) reported raising ducks, chickens, and/or pigs for consumption and sale (table 6). The households raised an average of five or six ducks and/or chickens for consumption, whereas pigs were raised in smaller numbers (approximately one pig for each household that raised them) and were more often sold than consumed.

Nutritional status

The nutritional status measurements of 178 refugee children aged 0 to 4.9 years revealed that 33.7% were underweight (W/A < –2 SD), 36.4% were stunted (H/A < –2 SD), and 8.7% were wasted (W/H < –2 SD) (table 7). In comparison, the prevalence of malnutrition among Thai children under five years of age, reported in 1996 and based on the NCHS standard and –2 SD cutoff, was 18.6% underweight, 16.0% stunted, and 5.9% wasted [7]. Based on WHO-endorsed criteria for identifying the severity of malnutrition among children in refugee populations, children were classified as malnourished if their weight-for-height scores fell below 70% to 80% of the NCHS reference population. The prevalences of severe and moderate wasting were 0.6% and 4.1%, respectively (table 8). Among older children, 41.2% of those aged 5 to 9.9 years, 31.5% of those aged 10 to 13.9 years, and 19.7% of those aged 14 to 17.9 years were underweight (W/A < –2 SD); 61.6% of those aged 5 to 9.9 years, 51.6% of those aged 10 to 13.9 years, and 51.5% of those aged 14 to 17.9 years were stunted (H/A < –2 SD); and 1.8% of those aged 5 to 9.9 years and none of those aged 10 to 13.9 years were wasted (W/H < –2 SD) (table 7).

The nutritional status of 345 adults from the sample households was assessed using the standard body-mass index (BMI) formula and cutoffs. It was found that the majority of adults (62.6%) measured were of normal nutritional status (BMI 20–24.9), 18.8% were thin (BMI 18.5–19.9), 7.2% were very thin (BMI < 18.5), 9.6% were overweight (BMI 25–30), and 1.7% were obese (BMI > 30). All of the obese adults were female (table 9). Examinations for clinical signs of micronutrient deficiencies were conducted on 422 children. Vitamin A supplements are routinely provided to children under 6 years of age and lactating women. Among children up to 13 years of age, none had Bitot's spots, 5.0% had active angular stomatitis wounds, 7.6% had scars from previously active wounds, 9.2% had pale eyelids, 3.6% had pale fingernails, and 0.2% had edema. Among children 7–13 years of age who were examined for goiter, 2% had grade 1 goiter (table 10).

Discussion

Although the study results indicate that the households received sufficient quantities of energy, as compared with the RDA, the proportion of energy from carbohydrates was very high, with a proportionately small amount of energy from protein and fat. The protein intake appears more than adequate, but most of the

TABLE 7. Children aged 0–18 years malnourished according to the criteria weight-for-age (W/A), height-for-age (H/A), and weight-for-height (W/H) as compared with NCHS reference standard –2 SD (1983, mean ± SD)

Criterion and age	Children below cutoff for W/A, H/A, and W/H (< –2 SD)					
	Boys		Girls		Total	
	%	*n/N*	%	*n/N*	%	*n/N*
W/A						
0–4.9 yr	33.3	30/90	34.1	30/88	33.7	60/178
5–9.9 yr	42.5	31/73	40.2	37/92	41.2	68/165
10–13.9 yr	32.0	16/50	31.0	13/42	31.5	29/92
14–17.9 yr	31.0	9/29	10.8	4/37	19.7	13/66
H/A						
0–4.9 yr	33.0	29/88	40.0	34/85	36.4	63/173
5–9.9 yr	62.2	46/74	61.1	55/90	61.6	101/164
10–13.9 yr	49.0	24/49	54.8	23/42	51.6	47/91
14–17.9 yr	51.7	15/29	51.3	19/37	51.5	34/66
W/H[a]						
0–4.9 yr	10.3	9/87	7.1	6/85	8.7	15/172
5–9.9 yr	2.7	2/73	1.1	1/90	1.8	3/163
10–13.9 yr	0	0/18	—	—	0	0/18
14–17.9 yr	—	—	—	—	—	—

a. No overweight children were found using weight-for-height standard deviation from mean (W/H > 2 SD); NCHS reference was used for children up to 10.9 years only.

TABLE 8. Children aged 0 to 5 years within weight-for-height (W/H) cutoffs as compared with WHO/NCHS reference standard % median (percentage of children who fall below 70% and 80% of the median weight of children from the WHO/NCHS reference population of the same length or height)

Age (yr)	No. of children	Children within NCHS W/H cutoffs					
		Severe wasting (< 70% of median)		Moderate wasting (70%–80% of median)		Normal (> 80% of median)	
		%	*n*	%	*n*	%	*n*
< 1	24	0	0	4.2	1	95.8	23
1–1.9	47	0	0	4.2	2	95.7	45
2–4.9	101	1.0	1	4.0	4	95.0	96
Total	172	0.6	1	4.1	7	95.3	164

TABLE 9. Adult nutrition status (age 18–60 years; $N = 345$) as measured by body-mass index (BMI)[a]

Sex	% (*n*)					
	Very thin; BMI < 18.5	Thin; BMI 18.5–19.9	Normal; BMI 20–24.9	Overweight; BMI 25–30	Obese; BMI > 30	Total
Male	5.0 (7)	26.2 (37)	63.1 (89)	5.7 (8)	0	100 (141)
Female	8.8 (18)	13.7 (28)	62.2 (127)	12.3 (25)	2.9 (6)	100 (204)
Total	7.2 (25)	18.8 (65)	62.6 (216)	9.6 (33)	1.7 (6)	100 (345)

a. BMI = weight (kg)/height^2 (cm).

TABLE 10. Children with clinical signs and symptoms of nutrient deficiencies[a]

	Signs and symptoms present		No data	
Signs and symptoms	%	*n*	%	*n*
Bitot's spots	0	0	.	—
Angular stomatitis			.	
Active wound	5.0	21		—
Dry lesion	7.6	32		—
Pale eyelids	9.2	39	.	—
Pale fingernails	3.6	15	.	—
Edema	0.2	1	11.1	47
Goiter grade 1	2.0	4	12.2	24

a. Data for goiter are from 197 children aged 7 to 13 years who were examined for goiter sign. All children found to have goiter grade 1 were 7 to 12 years old and were from three households that migrated to Thailand in 1991, 1992, and 1993 and later moved to Mae La Camp in 1997, 1998, and 2000, respectively. Data for all other signs and symptoms are based on 422 children aged 0 to 13 years.

protein came from plant sources, mainly from rice. Although ration foods overwhelmingly accounted for the sources of nutrients in the diet, the intakes of vitamins A, B_1 (thiamine), B_2 (riboflavin), B_3 (niacin), and C and the mineral calcium were lower than recommended (< 70% of RDA). Nonration food provided most of the vitamins A and C and heme iron, mainly because these nutrients are found in foods that were not provided in the ration.

Both children and adults consumed large quantities of rice, as compared with the recommended intakes from the Thai Food Guide [8]. When rice intake is extrapolated from more than two meals to only two meals per day, children aged four to six years would consume an average of 600 g/day, as compared with the recommended 480 g/day, and adults would consume 1,242 to 1,714 g/day, as compared with the recommended 480 to 720 g/day. The large quantities of rice consumed make it less likely that both children and adults would be able to consume adequate nutrients for optimal growth and health.

Despite the very limited space, the refugees in Mae La Camp were able to plant several types of vegetables, such as green peas and gourds, in pots or small beds. However, the limited amount of garden produce was not sufficient to fully supplement the ration, and the households had to purchase additional vegetables and other foods from shops once a week, on average. Animal food in the diet came mostly from the markets. The type of animal food eaten most often was fresh fish, but it was purchased infrequently.

Over half of the households raised chickens and/or ducks. Several animals were raised at one time; they were usually kept to produce eggs for household consumption, or the hatchlings were sold or used for religious rites. Most households were able to forage for other foods, such as bamboo shoots, mushrooms, and potatoes, and hunt birds and rodents for household consumption.

Although it was adequate in energy, as reflected in the relatively low rates of wasting, the refugee diet was disproportionately high in carbohydrates and lacked sufficient quality protein, vitamins, and minerals, as indicated by the ongoing need to provide vitamin A supplements and clinical evidence of micronutrient deficiencies. This contributed to the high prevalences of underweight and stunting among the refugee children under five years of age, which were much higher than those among Thai children under five in general. The pattern of stunting in refugee children under 18 years of age reflects the long-term insufficiency of essential nutrients necessary for optimal skeletal development and growth. The rate of stunting among children aged two to five years was two to three times higher than that among children in younger age groups (one to two years and under one year). This might be explained by the excellent rates of breastfeeding in the postpartum period; during the first year of life, the infants have a steady supply of essential nutrients, such as calcium, phosphorus, zinc, iron, essential amino acids, and essential fatty acids, from breastmilk. However, during the weaning period and into the second year of life, they receive less breastmilk and lack adequate complementary foods.

Although the rates of wasting were generally low (the WHO criteria classify wasting less than 5% as acceptable [4]), and were lower in older children (aged two to five years) than in younger children (aged one to two years) (5% vs. 19.2% W/H < –2 Z scores), this does not indicate a reversal of stunting. Instead, these children may be able to eat larger amounts of energy foods, such as rice and oil, thereby increasing their body weight relative to their height.

Conclusions

All of the households surveyed had lived in the camp for at least one year, and thus should have developed coping mechanisms with which to adequately supplement their diets. Although the refugees were able to procure some nonration foods by foraging, planting trees and vegetables, raising animals, or exchanging ration foods for other items, the quantity and quality were not sufficient to compensate for the nutrients that were low or lacking in the ration. Foods were also purchased from the markets in the camp, but the households had very weak purchasing power, as evidenced by their low monthly food expenditures.

Although energy and total protein met or exceeded the RDA, the diet was too high in carbohydrates and lacked sufficient quality protein (animal or comple-

mentary plant protein). The intakes of vitamins A, B_1, B_2, and C, as well as of calcium, were low, and vitamins A and C had to be obtained predominantly from nonration foods. The diet contained few sources of calcium, especially for younger children who may not be able to chew fish bones or for those families who do not consume the bones.

The overwhelming majority of dietary nutrients were provided by ration foods, and although the ration diet and the overall diet may be adequate for short-term subsistence, they do not suffice for long-term survival and optimal growth, especially for younger children. In response, the Burmese Border Consortium is considering implementing a series of options to address the high proportion of carbohydrate and low proportion of animal protein and fat in the diet, as well as to improve the micronutrient balance in the diet. The options include implementing a comprehensive plan to support gardens and animal husbandry; fortifying or providing fortified foods in the food basket; and initiating nutrition education via existing community health workers and teachers. Similar programs being undertaken among other refugee populations should also consider these options, after having undertaken similar studies on their nutritional status, methods of procuring food, and dietary intake patterns.

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Brief Communication

Magnitude of zinc deficiency among nulliparous nonpregnant women in a rural community of Haryana State, India

Priyali Pathak, Umesh Kapil, Suresh Kumar Kapoor, Sada Nand Dwivedi, and Rajvir Singh

Abstract

Zinc deficiency during pregnancy affects the outcome of pregnancy. A high prevalence of zinc deficiency (55.5%) has been reported among pregnant women. It is not known whether pregnancy leads to zinc deficiency due to the increased fetal needs or whether the women are zinc deficient when they become pregnant. No data are available on the zinc status of nulliparous nonpregnant women from India. To assess the magnitude of zinc deficiency among nulliparous nonpregnant women in a rural community of Haryana State, India. A community-based cross-sectional survey was conducted in six villages of a rural area in a district of Haryana State, India. All nulliparous nonpregnant women aged 18 years or over who were willing to participate in the study were enrolled. Each woman was questioned about her age, socioeconomic status, and dietary pattern with the use of a pretested semistructured questionnaire. Blood from the antecubital vein was drawn to assess the serum zinc levels using an atomic absorption spectrophotometer. Serum zinc levels less than 70.0 µg/dl were considered to indicate zinc deficiency. The dietary intakes of zinc, protein, and calories were assessed by the 24-hour dietary recall method. Two hundred eighty-eight nulliparous nonpregnant women were enrolled. Forty-one percent had zinc deficiency, and 75.7%, 1.4%, and 7.3% of the women consumed less than 50% of the recommended intake of zinc, protein, and calories, respectively. Women who consumed less than 50% of the recommended intake of calories (1,875 kcal) were at a 4.9 times higher risk of zinc deficiency than women who consumed more than 50% of the recommended intake. A high prevalence of zinc deficiency was found among the nulliparous nonpregnant women in the area studied.

Key words: Calorie intake, nonpregnant women, nulliparous women, zinc deficiency

Introduction

Zinc plays an essential role during periods of rapid growth and development. It is an important micronutrient during pregnancy. A recent study from India reported a 55.5% prevalence of zinc deficiency among pregnant women [1]. No data are available on the zinc status of nulliparous nonpregnant women from India, and hence the present study was conducted to assess the magnitude of zinc deficiency among this group in a rural community of Haryana State, India.

Methods

A community-based cross-sectional survey was conducted in six villages of a rural community of a district in Haryana State, India, from November 2000 to October 2001. All nulliparous nonpregnant women at least 18 years of age were enrolled in the study by visits to their homes. No woman declined to participate in the study. The inclusion criteria were that the women had to be married and living with their husbands and free from any known chronic illness that would affect their dietary intake. The nonpregnancy status of the subjects was confirmed by inquiring about the last menstrual period. The Ethical Committee of the All India Institute of Medical Sciences, New Delhi, approved the

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study. The objectives of the study were explained to the women, and informed consent was obtained. All women participated in the study. Each woman was asked about her age, socioeconomic status (Udai Pareek Classification) [2], and dietary pattern with the use of a pretested, semistructured questionnaire.

The magnitude of zinc deficiency was assessed by measuring serum zinc levels. Blood from the antecubital vein was drawn and collected in previously labeled polypropylene tubes. The tubes were transported in ice packs to the central laboratory. The blood samples were centrifuged at 3,500 rpm at 4°C for 30 minutes, which separated the serum. The serum was collected in Eppendorf vials and stored at –80°C until analysis. The zinc level was determined by the standard atomic absorption spectrophotometric method [3]. Estimations were undertaken in batches of 50 serum samples each. Standard reference serum with a known level of zinc (Sero AS, Norway) was estimated for serum zinc level with each batch of estimation for internal quality control. All estimations were undertaken in triplicate. The mean of the three values was reported as the serum zinc level for that particular sample. For the batch of estimation, where the serum zinc level for the control was over- or underestimated, the batch of estimation was repeated. Serum samples with zinc levels less than 70 μg/dl were considered to indicate zinc deficiency [4]. Serum zinc measurement, although a good indicator of zinc status, does not itself conclusively diagnose zinc deficiency. However, serum zinc level is still considered to be a useful practical indicator to assess zinc status [5, 6].

The dietary intake of 78% of the women was assessed by using the 24-hour dietary recall method [7]. The intakes of zinc and calories were calculated by using the Nutritive Value of Indian Foods published by the Indian Council of Medical Research [8].

The data were subjected to statistical tests of the mean and standard deviation by using SPSS version 7.5. Univariate logistic regression analysis was performed, and crude relative risks and 95% confidence intervals were calculated.

Results

Two hundred eighty-eight nulliparous nonpregnant women were enrolled in the study. The mean age of the study subjects was 20.3 ± 2.3 years. The majority of the women (78.1%) were of lower-middle-class and middle-class socioeconomic status. Blood was collected from 258 women. The remaining 30 refused to have blood collected; their characteristics were similar to those of the women who consented to provide blood samples.

The mean serum zinc level of the women was 74.2 ± 23.1 μg/dl. Forty-one percent of the women had zinc deficiency (table 1). The data on dietary patterns revealed that 76% of the women were vegetarians. The daily mean dietary intakes of zinc, protein, and calories were 6.0 ± 2.3 mg, 48.6 ± 27.5 g, and 1,564.7 ± 410 kcal, respectively (table 2). It was found that 75.7%, 1.4%, and 7.3% of the women consumed less than 50% of the recommended daily intakes of zinc, protein, and calories, respectively. Univariate logistic regression analysis revealed that women consuming less than 50% of the recommended daily intake of calories (1,875 kcal) were at a 4.9 times higher risk of zinc deficiency than those consuming more than 50% of the recommended daily intake (95% confidence interval, 1.5–16.1).

Discussion

The present study revealed a high prevalence (41.5%) of zinc deficiency among nulliparous nonpregnant women. No previous study has documented the magnitude of zinc deficiency among nulliparous nonpregnant women in India. In the present study, the mean serum zinc level was 74.2 ± 23.1 μg/dl. Comparable mean serum zinc levels among nonpregnant women were reported by Rathi et al. (69.0 ± 3.22 μg/dl) [9] and Yasodhara et al. (78.1 ± 21.85) [10]. The dietary pattern of the nulliparous nonpregnant women in our study may have been similar to that of subjects in ear-

TABLE 1. Distribution of study subjects according to zinc level

Zinc level (μg/dl)	Study subjects		Mean ± SD zinc level (μg/dl)
	n	%	
< 70.0	107	41.5	56.1 ± 12.5
≥ 70.0	151	58.5	87.0 ± 20.1

TABLE 2. Distribution of study subjects according to their consumption of nutrients as a percentage of the recommended dietary allowance (RDA)

Nutrient	RDA	Mean ± SD dietary intake	No. (%) of subjects having dietary intake		
			> 75 % RDA	50%–75 % RDA	< 50 % RDA
Zinc	15 mg	6.0 ± 2.3 mg	9 (3.7)	46 (20.6)	170 (75.7)
Protein	50 g	48.6 ± 27.5 g	214 (95.2)	8 (3.4)	3 (1.4)
Calories	1, 875 kcal	1,564.7 ± 410 kcal	152 (67.4)	57 (25.2)	16 (7.3)

lier Indian studies [9, 10], as the serum zinc levels were similar. Bahl et al. (82.2 μg/dl) [11], Prema et al. (110 μg/dl) [12], Goel and Misra (120.5 ± 7.7 μg/dl) [13], Kapoor et al. (121 ± 4.0 μg/dl) [14], and Ghosh et al. (127.32 ± 17.65 μg/dl) [15] reported higher serum zinc levels among nonpregnant women than those in our study. This may be possibly due to higher intake of zinc by the nonpregnant women in these Indian studies.

Zinc deficiency is common in areas where the population subsists on diets low in dietary zinc and/or with low bioavailability of zinc. The bioavailability of zinc in the diet is influenced by the food source as well as the other components of the diet that inhibit or promote the absorption of zinc. The primary inhibitor of zinc absorption is phytic acid, which is present in significant amounts in staple foods such as cereals, maize, and rice. The main source of energy (90%) of the women in the present study was cereals (wheat). Consumption of such cereal-based diets, which are high in phytic acid, leading to low bioavailability of zinc, is a possible reason for the high prevalence of zinc deficiency.

Although a high prevalence of zinc deficiency has been documented among women of developing countries, the functional significance of such deficiency is not yet understood. Zinc-supplementation trials conducted among pregnant women in developing and developed countries have reported mixed results. The majority of the trials have reported an increase in birthweight and a reduction in very preterm (≤ 32 weeks) and very-low-birthweight (< 1,500 g) babies [16–19]. A few studies have documented no positive impact of zinc supplementation on birthweight and on the prevalence of large-for-gestational-age infants, small-for-gestational-age infants, premature rupture of membranes, and preterm labor [20–22]. However, most zinc-supplementation studies have documented a positive impact. A recently conducted technical consultation [23] on the public health importance of maternal zinc deficiency recommends future research among populations that are at high risk for adverse pregnancy outcomes. Dietary zinc and other dietary constituents affecting zinc absorption should also be studied. Zinc-intervention trials should begin not only during gestation but also before conception [23]. The findings of our study support these recommendations.

Acknowledgments

We duly acknowledge the financial support of Vide Project No. 5/9/5/2000-RHN, provided by the Director General, Indian Council of Medical Research, New Delhi, for the present study. The infrastructure facilities provided by the Director, All India Institute of Medical Sciences, are also acknowledged.

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Letters to the Editor

In response to Vuong and King, "A method of preserving and testing the acceptability of gac fruit oil, a good source of β-carotene and essential fatty acids"

Editor's note: When the following letter was sent to the authors, they thanked Dr. Solomons for detecting the error and asked that an erratum be published (see below). However, Dr. Solomons' letter goes beyond correcting the error and provides valuable insight into the carotene-to-retinol conversion issue. —NSS

To the Editor:

Vitamin A deficiency is a worldwide nutritional scourge, and the situation seems to be deteriorating in some parts of the world, such as sub-Saharan Africa [1]. The role of provitamin A carotenes in the control of hypovitaminosis A has been a particular interest at CeSSIAM [2], and a landmark event in gaining a valid perspective on the issue was the publication of the relevant section of the dietary reference intakes [3], which defined the retinol activity equivalent (RAE) in January 2001. Prior to that date, the value of provitamin A carotenes in food matrices had been overvalued by the application of the conventional 1:6 and 1:12 bioconversion factors, producing falsely high estimates of population vitamin A security and illusory aspirations to improve vitamin A status by promoting green and orange vegetables [2]. However, the potential for the carotenes in edible oils to contribute dietary vitamin A activity had been severely undervalued by the same factors, since the dietary reference intake RAE proposes a three-times-greater bioefficacy for emulsified provitamin A carotenes in an oil base [3].

The *Food and Nutrition Bulletin* has been in the forefront in providing information on the dietary context of oil-based provitamin A sources [4, 5], and an additional example was the recent publication by Vuong and King [6] on the chemical and nutritional context of the gac fruit (*Momordica cochinchinensis* Spreng). As stated in their text on p 228: "The total carotenoid concentration of gac fruit oil is 5,770 ppm, consisting mainly of two carotenes, β-carotene and lycopene" [6]. We were troubled, however, when trying to get a handle on the dietary vitamin A value of the oil of this fruit compared to that of the palm fruit (genus *Elaeis*) [6], encountering a host of internal and external inconsistencies. For the sake of clarity in the international discussion and toward an informed use of appropriate dietary approaches to hypovitaminosis A, we raise some of these inconsistencies.

The confusion derives in part from internal inconsistencies in the concurrent expression of nutrient concentration both per milliliter of oil and per 100 ml of edible portion of oil. Table 2 from Vuong and King [6] provides values for "β-carotene and isomers" in units of *micrograms per milliliter* (ppm) as 2,710 μg/ml for freshly prepared gac oil and 1,622 μg/ml for the same oil after three months of storage. However, in their table 5 (a comparative table of nutritional quality of gac fruit oil and of other fat and oil sources), in which the expression is *per 100 g of edible oil*, there is a disconnect: the vitamin A activity in *retinol equivalents* for gac oil is presented as 40 RE for data from the same article [6].

The external inconsistency is a similarly invalid conversion factor calculation for the red palm oil (RPO), reported by Nagendran et al. [7] as 8 RE in Vuong and King's composite table 5 [6]. We have created a table in this letter, comparing the values of Vuong and King [6] and those of Nagendran et al. [7], along with information on the molecular-distilled RPO product, Carotino, published by Scrimshaw [8]; all are expressed for 100 g (approximately 100 ml) of edible oil (table 1). Indeed, with a uniform denominator, fresh gac oil would still have about five times the vitamin A activity of crude RPO, but the RE value, itself, is over 100 times what Vuong and King [6] presented in their table 5. Retinol equivalents, however, use a 1:6 conversion efficiency

TABLE 1. Comparison of provitamin A concentrations and their conversion to RE and RAE for 100 g of edible product for three carotene-rich oils of interest

Provitamin A content (per 100 g)	Edible oil medium	Retinol equivalents (per 100 g)[a]	Retinol activity equivalents (per 100 g)[b]	Ref.
271,000 μg β-carotene[c]	Gac fruit oil[d]	45,167	135,500	6
162,200 μg β-carotene[c]	Gac fruit oil[e]	27,033	81,100	6
37,688 μg β-carotene	Red palm oil (crude)	6,281	18,844	7
23,622 μg α-carotene	Red palm oil (crude)	1,970	5,910	7
β- + α-carotenes combined	Red palm oil (crude)	8,250	24,750	7
28,000 μg β-carotene	Red palm oil (processed)	4,667	14,000	8
17,500 μg α-carotene	Red palm oil (processed)	1,458	4,375	8
β- + α-carotenes combined	Red palm oil (processed)	6,125	18,375	8

a. Assumes that 6 μg of all-*trans* β-carotene and 12 μg of other provitamin A carotene are equivalent to 1 μg of preformed vitamin A.
b. Assumes 2 μg of all-*trans* β-carotene in oil (and by implication 4 μg of other oil-based provitamin A carotenoids) are equivalent to 1 μg of preformed vitamin A.
c. Bioconversion value applied as if all β-carotene was the all-*trans* isomer.
d. Converted from μg/ml to μg/100 g from authors' table 2 [6]. Assay at time of elaboration of the oil.
e. Converted from μg/ml to μg/100 g from authors' table 2 [6]. Assay after three months of storage.

assumption. With the newer, US/Canada DRI conversion of 1:2 [3], with its retinol *activity* equivalent convention, the effective, maximal dietary vitamin A activity is still three times higher (see final column of our table).

Provitamin A–containing oils, by virtue of their intrinsic safety and cultural application as food in a dietary context, have much to contribute in the public health campaign to eradicate hypovitaminosis A. Therefore, we felt it important to set the record straight and rectify the RE expression in the Vuong and King article [6], while pointing out how the potential vitamin A activities of carotene-rich oils from fatty fruits are raised even further in the context of the latest insights into provitamin A bioconversion [3].

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Authors' response

To the Editor:

We are indebted to Drs. Solomons, Orozco, and Ventura for the corrections, and for the calculations.

The units in the headings for two columns of table 5 in our paper were incorrect: For both carotenes and vitamin A, the column heading should have specified mg instead of μg. We are resubmitting the following Table 5 as an erratum.

L. T. Vuong
J. C. King

TABLE 5. Nutritional quality of gac fruit oil and of other fat and oil sources (per 100 g of edible portion)[a]

Oil	Carotenes (mg)	Vitamin E (mg)	Vitamin A[b] (RE × 10^3)	Saturated FA (g)	MUFA (g)	PUFA (g)	Cholesterol (mg)	Energy (kcal)	Phytosterol (mg)
Coconut	—	0.3	0	87	6	2	0	862	86
Corn	—	21.1	0	13	25	62	0	884	968
Gac[c]	577	33.0	45	31	45	24	0	NA	NA
Lard	—	0.12	—	41	47	12	12	902	0
Olive	—	12.4	—	14	77	9	0	884	221
Peanut	—	12.9	—	18	49	33	0	884	207
Red palm[d]	50	21.7	8	48	37	10	0	NA	NA
Soy bean	—	11.2	—	15	24	61	0	884	250

RE, retinol equivalents; FA, fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids, NA, not available.

a. USDA Nutrient Database for Standard Reference, Release 13, Nov. 1999, USDA, Nutrient Data Laboratory, Agricultural Research Service.

b. Based on β-carotene-to-retinol conversion ratio of 6 to 1.

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In response to Natera et al., "Estimation of daily micronutrient intake of Filipinos"

To the Editor:

I am writing in regard to an article in the *Food and Nutrition Bulletin* Supplement (Vol. 23, No. 3, September 2002, pp. 222–227). The study is "Estimation of daily micronutrient intake of Filipinos" by Natera et al. I would like to raise some points regarding the clarity, accuracy, and coherence of the paper.

The study compared two sets of data on nutrient content of one-day diets of Filipinos, a comparison that suffers from two serious limitations. The nutrient intake reported in the first study in 1992 came from only one region (National Capital Region) using only eight samples [1]. On the other hand, the intake data in the second study in 2000 came from several regions of the country, numbering 9 or 13, depending on which section of the paper is read [2]. A second limitation is the large variations in food items for the diet samples used during the two-year duration of the second study.

The noncomparability of the two studies precludes any conclusions about nutrient intakes having increased or decreased from one period to the next. The limitations of the study and the extent to which they undermine the potential use of the collected data should have merited some attention from the authors, given their claim as to the study's usefulness in terms of addressing the malnutrition problem of the country, redefining nutrition strategies, and serving as a basis for assessing dietary requirements.

In two instances, the text and the corresponding table do not agree. One example is fruit intake (83 g in the text but 77 g in table 1). Another example is milk and milk products (56 g in the text but 44 g in table 1).

According to the authors, the 0.38 μg of iodine in their 2000 study was significantly less than the iodine content of approximately 65 μg in the Filipino diet, and they explained that "the decreased values maybe [sic] due to a loss of iodine in the cooking process." It should be noted that the 0.38 μg of iodine is the amount per gram of dry diet sample, whereas the 65 μg is the *estimated iodine content of the average Filipino diet* (reference 3, p. 181).

There is some confusion about nutrient recommendation and nutrient intake. For example, the authors said that "The average phosphorus intake of Filipinos, estimated to be 976 mg per day,…while the calcium

intake is approximately 450 mg per day," but based on table 3 these figures refer to the 1989 RDA, and the 2000 mean intakes were 564 mg for phosphorus and 251 mg for calcium. A similar error was made in reference to the RDA and the intakes of sodium and potassium.

It is not clear how the authors arrived at some statements in the Results and Discussion section of the paper. For example, "This study reports a mean intake of 8.35 mg of iron while in 1992 it was 5.8 mg, which coincides with the problem of iron-deficiency anemia present in 37.2% of the Filipinos in 1993." Or, "it is safe to present the data as typical intake values" after pointing out the large regional variations in intake due to the seasonality of foods. Or, declaring that "Hence establishing the safe range of nutrient intake for the Filipino may be simple, while establishing a nutrient requirement to prevent detectable signs of impaired function may be complicated" from a prior statement about regional variations in habitual food consumption. A one-day diet is hardly the basis for claiming habitual intake. Moreover, the regional variations in intake were not presented.

Finally, the conclusion that intakes of calcium and sodium in 2000 were generally larger than those reported in 1992 is not supported by the findings of the study.

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Authors' response

To the Editor:

We would like to respond to Dr. Florencio's letter to the editor regarding the article "Estimation of daily micronutrient intake of Filipinos," which was published in the *Food and Nutrition Bulletin* Supplement (Vol. 23, No. 3, September 2002, pp. 222–227).

We would like to express our appreciation for the comments given to the said article. The differences in the figures are errors from the manuscript. With reference to the manner in which the data and other related information are presented, please be advised that the authors have the rightful disposition to interpret and to evaluate the data and other information presented. Considering the regional variables encountered in the sampling of diet plus the limitations of the study, it was emphasized (Conclusions and Recommendations) that additional baseline information is needed.

Finally, regarding the usefulness of the data in terms of addressing malnutrition problems in the country and redefining nutrition studies, it is common knowledge that hard-core evidence or information, no matter how small, is necessary to be able to legislate and promulgate measures to address the existing nutrition problem.

Once again thank you for your comments.

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Reply to commentary on "Malnutrition and dietary protein"

We are grateful to Dr. Joe Wray [1] for his strongly positive reaction to our findings about the importance of protein availability to growth [2] and for his contribution to the discussion by reference to several more studies concerning food intake, infection, and growth in young children. It is particularly noteworthy that the studies in India, Colombia, and Mexico [3–5] all show not only that supplementing the diets of children makes

them grow faster, but that supplementation can offset the negative effect of infection on growth and even, in the case of Mexico, reduce the amount of illness. We concur entirely with Wray's observation that since it is not feasible to protect children entirely from potentially fatal illnesses, improvements in their diet offer a reliable way to assure that they nonetheless grow normally and are more likely to survive the weaning period. Supplementation may be the single most effective way to prevent childhood deaths in poor populations. (The study in India dealt only with the effect of supplementation on children exposed to measles, and measles infection can be entirely prevented by immunization. The Colombian and Mexican studies, in contrast, dealt respectively with diarrheal disease and with infections of all kinds, which are harder to prevent.)

We note that all three programs employed a supplement with fixed proportions of protein and energy, so none of them throws any light on the question we investigated, which is whether additional protein contributes more to growth than additional energy does. The programs may have differed from one another in the protein/energy ratio, but comparisons among them would be unlikely to reveal whether a higher share of protein would do more to promote growth. There were too many differences among the populations studied and the circumstances under which children were supplemented. Only a program that gave some children higher protein supplements than others, while providing the same number of calories to all, would provide a clear answer to that question.

It is also worth noting that supervised supplementation—assuring that each child actually eats the additional food rather than giving it to the child or parent to take home and share—offers a way to overcome in part the discrimination against girls in the distribution of food and especially of protein, to which Wray and we draw attention. How effective this will be presumably depends on the size of the supplement relative to the children's regular diet, because if the supplement is small, its contribution can be negated by redistribution of food at home. The effectiveness of supplementation may also depend on the educational impact of the program, particularly if parents change their views of the relative nutritional rights or requirements of boys and girls.

Finally, we thank Wray for emphasizing "the difference between a clinical and a socioeconomic-statistical approach" [1] to the connection between protein and growth. Our caution in recognizing that other factors in the diet besides protein availability may be crucial for growth arose from the socioeconomic-statistical nature of our data and methods. It remains true that human beings are largely made of protein and cannot make protein for their growth and functioning from non-protein sources, so scarcity of protein can hardly fail to affect growth and adult height, whatever other limitations may exist.

Dean T. Jamison
Joanne Leslie
Philip Musgrove

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Do crowded classrooms crowd out learning? Evidence from the Food for Education Program in Bangladesh

International Food Policy Research Institute (IFPRI) Discussion Paper 149 (May 2003)

Akhter U. Ahmed and Mary Arends-Kuenning

Key words: Bangladesh, food-for-education, school enrollment, targeting

In Bangladesh, pervasive poverty has kept generations of families from sending their children to school, and without education, their children's future will be a distressing echo of their own. Many children from poor families in Bangladesh do not attend school either because their families cannot afford books and other school materials, or because the children contribute to their family's livelihood and cannot be spared. In some areas, there is also a lack of schools. Among those who enter primary school, only about 40 percent of them complete it. The great success of the Food for Education (FFE) program of the Government of Bangladesh has led to larger classes, but do these crowded classrooms crowd out learning?

How does the FFE program work?

The Government of Bangladesh launched the FFE program in 1993. The FFE program provided a free monthly ration of food grains to poor families in rural areas if their children enrolled in primary school, and maintained an 85 percent attendance rate. The family could consume the grain, or sell it and use the cash to meet other expenses. Before the program was terminated in June 2002, the FFE program covered about 27 percent of all primary schools and enrolled about one-third of all primary school students. FFE beneficiary students accounted for about 13 percent of all students in primary schools in Bangladesh. The cost of the program (including the value of food grains) was approximately US$37 per beneficiary student per year. A two-step targeting mechanism was used, selecting poor areas, then poor households within those areas.

Data from school and household surveys conducted in Bangladesh by the International Food Policy Research Institute (IFPRI) in September-October 2000 were used to evaluate the FFE program. The surveys included primary schools with and without the FFE program, and a cross section of households including program beneficiaries and nonbeneficiaries. The sample included 600 households in 60 villages in 30 unions in 10 thanas, and 110 schools in the same 30 unions from which the household sample was drawn. In addition, a standard academic achievement test, designed to assess the quality of education received by students, was given to students in both FFE and non-FFE schools.

The impact of the FFE program

IFPRI analysis showed that the FFE program led to increased enrolment and class attendance rates, particularly among girls. However, classrooms of FFE schools became more crowded: on average, classrooms in FFE schools had 22 percent more students (67 students) than classrooms in non-FFE schools (55 students). Within FFE schools, the average test score is lower for FFE beneficiaries than nonbeneficiary students, which brings down the aggregate score in FFE schools. In non-FFE schools, average test scores of all students are comparable to nonbeneficiaries in FFE schools. Boys consistently outperformed girls in the achievement test in all subjects in all types of schools, regardless of FFE beneficiary status.

Does classroom crowding (resource dilution) or the lower ability of FFE children (peer effect) affect test scores of non-FFE students in FFE schools? IFPRI's multivariate analysis does not support the resource dilution hypothesis. Class size has no effect on student achievement.

Results of the peer effect analysis, however, show that the learning performance of non-FFE students in FFE schools is negatively affected when an average of 44 percent of the students in class are FFE beneficiaries. This is probably due to the teachers having to go more slowly to accommodate poorly performing FFE students. These students come from poorer families. Evidence from household surveys show that children from poor families are less likely to have educated

parents who could help them in their studies at home, to afford study materials, and to find enough time to do the homework, as many of them must contribute to their family's livelihood. Moreover, from birth, these children are often deprived of the basic nutritional building blocks that they need in order to learn.

Nevertheless, there are benefits to non-FFE beneficiaries from being in an FFE school because FFE schools must meet certain minimum educational quality standards to maintain FFE eligibility. For example, in FFE schools, at least 10 percent of Grade 5 students must qualify for the national annual scholarship examination. No such performance standards are required for non-FFE primary schools. These benefits to non-FFE beneficiaries outweigh the negative peer effects up to the point when FFE beneficiaries reached 69 percent of the students in the classroom. After 69 percent, the benefits derived from minimum performance standards vanish.

The overall effect at the community level is measured by the Minimum Learning Achievement, the percentage of children in a community who attain a minimum achievement score, weighted by the enrolment rate in that community. The minimum learning achievement in FFE communities is higher than in non-FFE communities (despite the latter tending to be richer) due to the increased enrolment from the FFE program. Particularly, major benefits accrued to the children from poor families who would not have attended school without the FFE program.

Results and conclusions

As a food-based social safety net, the FFE program in Bangladesh served a wider purpose than simply providing the poor with immediate sustenance through take-home food rations, important as that is. It has empowered children from poor families with education, thereby paving their pathway out of poverty.

The FFE enrollment increase was greater for girls than boys, yet boys consistently outperformed girls on the achievement tests. Having drawn them into school, improving the quality of girls' education will ultimately strengthen the beneficial effects of women's education on various family-level outcomes, such as children's schooling, child health and nutrition, and women's fertility.

The concern that learning performance of non-FFE students in FFE schools may be adversely affected by increased class size generated by the FFE program appears to be unfounded. But, unchecked, the negative peer effect could hinder student achievement. In the FFE program, this was offset by the required minimum educational quality standards. Setting clear standards for performance is important, even at the primary level. Minimum performance standards should be incorporated in the design of the recently implemented Primary Education Stipend program (a cash-for-education program that has replaced the government's FFE program), as well as in the ongoing pilot testing of the school-feeding program launched by the Government of Bangladesh with support from the World Food Programme.

The impact of PROGRESA on food consumption

International Food Policy Research Institute (IFPRI) Discussion Paper 150 (May 2003)

John Hoddinott and Emmanuel Skoufias

Key words: Caloric availability, food consumption, PROGRESA, Mexico

Together with 16 other Millennium Development Goals, the global community has committed itself to halving by 2015 the proportion of the world's population that lives in poverty and suffers from hunger. While the goals of reducing poverty and hunger may seem intertwined, a review of the existing literature suggests this may not be the case. This paper contributes to this debate, using an analysis based on the impact of Mexico's Programa de Educación, Salud y Alimentación (PROGRESA).

Background

Since 1997, PROGRESA has provided cash transfers linked to children's enrollment and regular school attendance and to health clinic attendance. The program also includes in-kind health benefits; nutritional supplements for children up to age five, and pregnant and lactating women; and instructional meetings on health and nutrition issues. In 2000, PROGRESA reached about 40 percent of all rural families and about 11 percent of all Mexican families.

This paper explores whether PROGRESA improves the diet of poor rural Mexicans—a major objective of the program. As such, this evaluation provides insights into whether interventions designed to alleviate poverty also succeed in reducing hunger.

Data and methodology

When PROGRESA began in 1997, it was not administratively feasible to provide benefits to all households simultaneously. Therefore, communities were randomly selected for participation (treatment localities), and the rest were introduced into the program at later phases (control localities). We exploited this random allocation to explore whether PROGRESA improved the diet of poor rural Mexicans and to gain insights into whether interventions designed to alleviate poverty also succeed in reducing hunger.

We used a longitudinal sample of approximately 24,000 households from 506 communities located in the first states receiving PROGRESA benefits. Of the 506 communities, 320 were designated as treatment and 186 as control communities. In control localities, the incorporation of beneficiary households into PROGRESA was postponed until the year 2000.

We first compared potential beneficiaries in treatment areas to those in control areas. This provided an estimate of the impact of PROGRESA inclusive of errors in the operational aspects of the program. Next we examined whether PROGRESA has an impact conditional on households receiving monetary benefits.

To explore whether PROGRESA led to an increase in the physical consumption of food, we constructed a measure of caloric availability at the household level expressed in calories per person per day. The November 1998 survey round revealed several noteworthy features. The first is the monotony of the diets of poor households, with calories from grains accounting for about 75 percent of caloric availability. Second, there was a statistically significant difference in the unconditional means across these poor households (though the magnitude of the difference was small). However, as we moved from November 1998 to June 1999, and then to November 1999, the magnitude of these differences increased. By November 1999, households receiving PROGRESA benefits had, at the mean, 7.8 percent more calories available per person per day than did comparable households in control localities. Particularly striking were the increases in calories consumed from vegetables and fruits and meat and animal products.

A parametric analysis revealed that the conditional impact of PROGRESA on poor households was generally smaller than the unconditional impacts and that there was little evidence of much of a statistically significant impact on caloric availability as of November 1998. This was not surprising, given that an

examination of administrative records indicated that PROGRESA had undertaken only limited operations at the time of this survey. By contrast, in June 1999, households receiving PROGRESA benefits in treatment localities obtained 4.3 percent more calories than did comparable households in control localities. And in November 1999, the effect is even higher: households receiving benefits obtained 7.1 percent more calories than did comparable households in control localities, with much of these gains coming about through increased acquisition of calories from vegetable and animal products—a finding consistent with the view of respondents that PROGRESA was enabling them to "eat better."

We examined whether these changes in caloric acquisition were driven by increased incomes or by another feature of PROGRESA, the platicas. As part of the program, beneficiaries attend a series of lectures (platicas) where information on health and nutrition is provided by a doctor or nurse. Although participation in PROGRESA raises the amount of calories acquired from grains and other foods, this would appear to be entirely due to PROGRESA's income effect. However, even after controlling for this effect, participation in PROGRESA appears to have an impact on the acquisition of calories from fruits, vegetables, and animal products. It is possible that this reflects the influence of the platicas beneficiaries attend, where they are encouraged to eat a more diverse diet, including more fruits, vegetables, milk, and other animal products. There is some evidence that information conveyed during these meetings spills over and positively affects the behavior of nonbeneficiaries in treatment localities. We also observed this effect in households with preschool children, which is significant for Mexico, where poor quality diets inhibit the physical growth of children less than 30 months.

Lastly, we examined whether provision of the papilla nutrition supplement—another component of PROGRESA—crowded out the acquisition of calories, but found no evidence that this was the case.

Conclusions

In examining the impact of PROGRESA on household food consumption, we had to be conscious of the survey design with which we worked, the manner in which PROGRESA operated, and the need to specify the functional form relationship between caloric acquisition and incomes. Controlling for differences in household and municipality characteristics, as well as differences in prices among municipalities, we found that there is no evidence of a statistically significant impact of the program on caloric availability as of November 1998, not surprising, since PROGRESA had begun only limited operations at the time of this survey.

However, there is evidence of a significant impact in June and November 1999. By November 1999, households receiving PROGRESA benefits in treatment localities obtained 7.1 percent more calories than did comparable households in control localities. The impact is greatest on the acquisition of calories from vegetable and animal products. Some of this impact is an income effect; some may also reflect attendance at platicas.

More generally, these results suggest that efforts to reduce poverty in the developing world will also reduce hunger.

Books received

An atlas of obesity and weight control. The Encyclopedia of Visual Medicine Series. George A. Bray. CRC Press, Boca Raton, Fla., USA, 2003 (ISBN 1-84214-049-3) 136 pages, hardcover. US$89.95.

The world is experiencing an increasingly serious epidemic of obesity that represents environmental changes to which humans are not genetically adapted. The author, one of the world's leading authorities on obesity and its causes, has updated the epidemiological data in many tables and figures and reviewed in detail genetic and environmental mechanisms. The hundred pages of figures and illustrations clearly and comprehensively focus on the clinical approach to the problem when prevention fails. These are based on the author's years of successful teaching and research. What is still needed is a companion atlas giving similar coverage to the prevention of obesity.

Community-based health care: Lessons from Bangladesh to Boston. Edited by Jon Rohde and John Wyon. Management Sciences Health, with the Harvard School of Public Health, Boston, Mass., USA, 2002 (ISBN 0-913723-83-5) 366 pages, paperback. US$40.00.

This volume is devoted to the history of early field studies demonstrating the importance of preventive as well as curative medicine in community-based health care. It is of interest to the nutrition community not only because nutrition interventions are an integral part of preventive medicine at the community level, but also because it provides concise summaries of several classic field studies of the effects of nutrition and health interventions at the community level. These are the Bangladesh Rural Advancement Committee-International Center for Diarrheal Disease Research, Bangladesh (BRAC-ICDDR,B) study in Bangladesh, the Narangwal study in India, the Hospital Albert Schweitzer (HAS) study in Haiti, and the Save the Children Study in Vietnam. For those interested more broadly in the community-based approach to nutrition and health care, this is a rare series of first-hand accounts of the development of community-based medicine that led to the WHO Alma Ata declaration and shaped contemporary approaches to primary health care.

Diet, nutrition and the prevention of chronic diseases. WHO Technical Report Series 916. Geneva, 2003 (ISBN 92-4-120916) 149 pages, paperback. US$20.70.

This report of a joint WHO/FAO Expert Consultation reviews the evidence on the effects of diet and nutrition on chronic diseases and makes recommendations for public health policies and strategies that encompass societal, behavioral, and ecological dimensions. Although the primary aim of the Consultation was to set targets related to diet and nutrition, the importance of physical activity was also emphasized.

The Consultation considered diet in the context of the macroeconomic implications of public health recommendations on agricultural and the global supply and demand for fresh and processed food. In setting out ways to decrease the burden of chronic diseases such as obesity, type 2 diabetes, cardiovascular disease, and osteoporosis, the report proposed that nutrition be placed at the forefront of public health policies and programs.

This report shows how, at the population level, a good diet and exercise throughout life are necessary to reduce the threat of a global epidemic of chronic disease. The report will be useful to medical and public health professionals everywhere. (Adapted from WHO promotional materials.)

The double burden of malnutrition in Asia. Causes, consequences and solutions. Stuart Gillespie and Lawrence J. Haddad. Sage Publications, New Delhi, India, 2003 (ISBN 0-7619-9757-1) 236 pages, hardcover. US$54.95.

By far the largest number of malnourished children

are in Asia, and this burden is persisting at the same time that another is emerging: overweight with its linkages to chronic degenerative diseases in later life. What makes this even more alarming is the growing evidence that children malnourished in utero and in infancy undergo metabolic changes that make them more vulnerable to such disease if they are no longer nutritionally deprived as adults.

This book looks at the prevalence of under- and overnutrition as well as chronic disease in the countries of Asia. As economists, the authors look at both the human and the economic costs of this double burden and go on to identify options for remedial action in the different countries. The need for a life-cycle approach to the problem has been increasingly recognized by the international agencies and is adopted by the authors in identifying the risks in Asian countries at each stage of the life cycle and what is practical to do about them.

Although the book is small, its approach is remarkably comprehensive. Extensive tables present a profile of malnutrition in Asia according to source, direct and indirect actions to reduce malnutrition, and prevention of malnutrition by addressing underlying causes. Another table goes even further by listing a series of actions for reducing malnutrition through "developing an enabling environment and indicating how each can be achieved." For those concerned with developing or implementing programs and policies to deal with malnutrition not only in Asia but in other developing regions, this volume provides a useful guide and checklist.

Gender, physical activity, and aging. Edited by Roy J. Shephard. CRC Press, Boca Raton, Fla., USA, 2001 (ISBN 0-8493-1027-X) 304 pages, hardcover. US$84.95.

One of the most important health findings in recent decades is the extent to which loss of strength and mobility with aging can be slowed and even reversed with strength training. This is in addition to previous knowledge of the strong relationship of lack of aerobic exercise with obesity and chronic degenerative diseases such as diabetes, hypertension, and ischemic heart disease.

Regardless of longevity, men have several more years of quality life than women. Yet until recently, most aging research was focused on men. This book explores the factors responsible for gender differences in morbidity and mortality with aging, including the extent to which these are determined by social and economic factors rather than biological differences. It notes that gender comparisons between men and women are confounded by discrepancies in body size and composition. The contribution of diminished physical activity in both men and women to the overall loss of functional capacity and fitness and the difference between the sexes is explored.

In successive chapters a distinguished panel of authors systematically explores the impact of gender and habitual physical activity on specific physiological, biological, biochemical, and pathological features of the aging process important to physical performance, independence, and quality of life for the elderly. Although this volume will appeal particularly to professionals working in geriatrics, it will also be of interest to all concerned with the nature and impact of human aging as well as how it is influenced by environmental factors.

HIV and infant feeding: A report of a WABA-UNICEF Colloquium; September, 2002, Arusha, Tanzania. Main writer and editor, Ted Greiner. World Alliance for Breastfeeding Action (WABA) , Penang, Malaysia, 2003 (ISBN 983-99192-8-8) 90 pages, paperback.

There is no longer a need to extol the benefits of breastfeeding or the extent to which failure to breastfeed is associated with high infant mortality in developing countries. Just as a consensus was being achieved on the importance of promoting breastfeeding under all circumstances, the rapidly spreading epidemic of HIV/AIDS introduced a tragic complication. As evidence mounted that under some circumstances HIV/AIDS could be transmitted to the infant by breastmilk, this posed a major crisis for the breastfeeding movement. It has been established that breastfeeding by untreated HIV-positive mothers passes the virus to the infant in about one-third of cases, and an average of 15% of babies breastfed for two years develop HIV/AIDS. Yet many of these infants would die anyway if they did not receive breastmilk.

Facing this dilemma, UNICEF, with the World Alliance for Breastfeeding Action (WABA), convened a colloquium on HIV and Infant Feeding in Arusha, Tanzania, in September 2002. This paperback is the report of the meeting. The meeting summary provides much useful information, but the closest that it comes to resolving the issue is the statement "HIV and infant feeding risk assessment should include an assessment of the mother's health and nutritional status, availability of nutritional support, family context and prevailing social and environmental conditions." It fails to indicate how to use these data to decide what feeding regimen to recommend.

There can be no criticism of the summary's emphasis on priority research, on strengthening health systems, on improving monitoring and evaluation, and on a wider sharing of existing tools, guidelines, and manuals. But nutrition and health workers need more specific recommendations as to what decisions to make in the field. Some kind of decision tree, even if provisional, is lacking.

Human demography and disease. Susan Scott and Christopher J. Duncan. Cambridge University Press, Cambridge, UK, 1998 (ISBN 0-52162052-X) 370 pages, hardcover. US$85.00.

Most chapters in this book deal with the demographic effects of specific infectious diseases in recent centuries, but the opening chapter has a substantive section on the relationships between malnutrition and famine and susceptibility to infectious diseases and death. The chapter on infectious diseases in England and Wales in the nineteenth century emphasizes this relationship. Other chapters refer to the relationship of malnutrition to infant mortality, child mortality, population dynamics and population growth, pregnancy, and susceptibility to disease. Chapters exploring the population impact of cycles in grain prices and the price of wool in seventeenth-century England also have obvious nutritional implications. However, this book is more for economic historians and demographers than for nutritionists.

Molecular basis of human nutrition. Lifelines Series. Tom Sanders and Peter Emery. Taylor & Francis Group, London, 2003. (ISBN 0-748-40753-7) 176 pages, softcover, US$25.95; (ISBN 0-415-29917-9) 165 pages, hardcover, US$80.00.

This is a good elementary text for undergraduates studying nutrition as part of training in biology or life sciences. For students majoring in nutrition it does not replace textbooks with more comprehensive coverage of the molecular and metabolic basis for malnutrition.

Poverty and health: DAC guidelines and reference series. World Health Organization and Organization for Economic Cooperation and Development, Geneva, 2003 (ISBN 92-4-156236-6) 92 pages, paperback. US$27.00. Order number 1150538

This Reference Document on Poverty and Health, jointly published by the Organization for Economic Cooperation and Development (OECD), extends the analysis and recommendations of the OECD/WHO Committee on Development Assistance (DAC) *Guidelines on Poverty Reduction* [1] by setting out the essential components of a public health approach that benefits the poor. It provides a framework for action within the health system—and beyond it, through policies in other sectors and through global initiative.

The nutrition and health of the poor has become a critical development issue. The publication emphasizes that in addition to the intrinsic value of improved health for individuals, investment in health is an important and previously underestimated means of economic development; substantially improved health outcomes are a prerequisite if developing countries are to break the cycle of poverty. The document is aimed at a broad range of professionals working on policy and its implementation at headquarters and in the field in both international and national agencies.

Reference

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Role of zinc in stunting of infants and children in rural Ethiopia. Melaku Umeta. Ph.D. Thesis, Wageningen University, Wageningen, Netherlands, 2003 (ISBN 90-5808-814-6) paperback.

Doctoral theses are occasionally reviewed in the *Bulletin* when they are formally published and meet the *Bulletin* criteria for usefulness and originality. The diets of rural Ethiopian populations are relatively high in total iron and zinc, but because of their high content of phytates and tannins, the bioavailability of iron and zinc is low. Evidence is presented that zinc supplementation increased both linear and ponderal growth in both stunted and nonstunted children, with a greater effect on those who were stunted. Unfortunately, this effect can be reversed if zinc supplementation is discontinued.

Zinc supplementation of stunted children in rural Ethiopia also resulted in markedly lower morbidity from cough, diarrhea, fever, and vomiting. This small paperback demonstrates the importance of determining the role of zinc deficiency in the stunting that is so highly prevalent among young children in most developing countries. This study and others that are appearing regularly in the scientific literature give increasing reason to include zinc in the multiple fortification of cereal flours.

News and notes

IVACG, INACG, and IZiNCG Meetings 2004

Meetings of the International Vitamin A Consultative Group (IVACG), International Nutritional Anemia Consultative Group (INACG), and International Zinc Nutritional Consultative Group (IZiNCG) will be held in Peru in mid November 2004.

There will be joint sessions on interactions from the metabolic to the policy levels among deficiencies of the three nutrients (vitamin A, iron, and zinc) and their control.

For specific dates and details on submitting abstracts, please check the following websites:

IVACG	*ivacg.ilsi.org*
INACG	*www.izincg.ucdavis.edu*
IZiNCG	*inacg.ilsi.org*

SCN News (UN System Standing Committee on Nutrition)

SCN News (ISSN 1564-3751) is a periodic review of developments in international nutrition compiled from information available to the SCN. *SCN News* aims to help the sharing of experience in nutrition and is now published twice yearly. Recent issues have featured articles on Nutrition in the Context of Conflict and Crisis (#24), Nutrition and Health of School-age Children (#25), and Mainstreaming Nutrition for Improved Development Outcomes (#26). Publication of items in *SCN News* does not imply endorsement of views given, nor necessarily the official positions taken, by the SCN and its member agencies. The SCN gratefully acknowledges funding assistance from the Government of The Netherlands for the preparation and printing of *SCN News*.

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International Life Sciences Institute	*www.ilsi.org*
International Nutritional Anemia Consultative Group (INACG)	*inacg.ilsi.org*
International Vitamin A Consultative Group (IVACG)	*ivacg.ilsi.org*
International Union of Nutritional Sciences (IUNS)	*www.iuns.org*
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Pan American Health Organization (PAHO)	*www.paho.org*
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Author Index for Volume 24

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The editors of the *Food and Nutrition Bulletin* welcome contributions of relevance to its concerns (see the statement of editorial policy). Submission of an article does not guarantee publication; acceptance depends on the judgment of the editors and reviewers as to its relevance and quality. All potentially acceptable manuscripts are peer-reviewed. Contributors should examine recent issues of the *Bulletin* for content and style.

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—corporate author:

2. Committee on Enzymes of the Scandinavian Society for Clinical Chemistry and Clinical Physiology. Recommended method for the determination of gammaglutamyltransferase in blood. Scand J Clin Lab Invest 1976;36:119–25.

Book or other monograph reference

—personal author(s):

3. Brozek J. Malnutrition and human behavior: experimental, clinical and community studies. New York: Van Nostrand Reinhold, 1985.

—corporate author:

4. American Medical Association, Department of Drugs. AMA drug evaluations, 3rd ed. Littleton, Mass, USA: Publishing Sciences Group, 1977.

—editor, compiler, chairman as author:

5. Medioni J, Boesinger E, eds. Mécanismes éthologiques de l'évolution. Paris: Masson, 1977.

—chapter in book:

6. Barnett HG. Compatibility and compartmentalization in cultural change. In: Desai AR, ed. Essays on modernization of underdeveloped societies. Bombay: Thacker, 1971:20–35.

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