〈Material〉

Differences in dietary sources of selected nutrients between urban and rural Sri Lankans

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Dietary sources of insufficient nutrients ; protein, calcium, vitamin A and riboflavin, were compared between urban and rural Sri Lankans. In order to find out practical solutions for nutritional improvement based on regional patterns of food choice, one-day dietary records collected from 55 urban subjects and 46 rural subjects were assessed. In both groups, intakes of four nutrients were short by more than 20% of the Recommended Dietary Allowances (RDAs) ; 73% for protein, 71% for calcium, 46% for vitamin A and 50% for riboflavin. Contribution of meat protein to total protein intake was greater in the urban area (3.9% versus 0.5%) reflecting the quantity of the consumption. Calcium intake from fish by the rural subjects (14.1% of total calcium intake) was greater than the urban counterparts (7.5%). Vitamin A intake from meat and eggs was greater in the urban area (10.6% versus 4.8%) and that from fruits was greater in the rural areas (9.7% versus 14.7%). Riboflavin intake from milk and dairy products was greater in the rural areas (9.7% versus 17.7%). Thus, dietary sources were very different between the regions, but recommended usage of commonly available foods, for example, fruits, dried sardines and powdered milk for increased intakes of vitamin A, calcium, protein and riboflavin, respectively, could ease the nutrients deficiencies.

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Key Words Sri Lanka, nutrient deficiency, urban-rural comparison, food sources

Introduction

Starvation and undernutrition were once major nutritional problems in developing countries[1)~3)]. Although they are still prevailing, considerable improvements of nutrition level have been made over the last few decades owing to the development of a market economy in the third world. On the other hand, rapid economic and social changes have brought about greater disparity in income between urban and rural areas. This disparity

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results in regional differences in food availability and thus nutrient intake[4)~5)].

Many studies have been carried out collecting comparative data on nutritional conditions between urban and rural areas of developing countries[6)~8)]. Most studies, however, have focused on the intake of selected nutrients and energy, but little is known about the food sources of these nutrients. Those assessments are important but the nutritional condition cannot be improved by them only. From the public health nutritional point of view, it is considerably essential to know the food sources of insufficient nutrients in order to guide the subjects in their food choice. Furthermore, when the dietary guidance is given, regional differences in food availability have to be considered. For this reason, we need to know the dietary sources of nutrients and the patterns of food selection in urban and rural areas separately.

Sri Lanka is classified as one of low-income countries. Although civil war has continued for years in the northern part of the island, the literacy rate and the life expectancy at birth are approaching the levels of those of industrialized countries as the country has become stabilized[9)]. We deal here with an urban-rural comparison on food sources of nutrients that might be insufficient in Sri Lankan diets. We presume differences in food sources may influence the nutrient intake. With observation of dietary pattern, we would be able to give practical advice that help the residents improve their nutrient intake.

Subjects and Methods

1.Study areas

This study was conducted in Colombo, Kalutara and Nuwara Eliya Districts of the Democratic Socialist Republic of Sri Lanka. Based on population density and degree of industrialization, Colombo was classified as urban area and Kalutara and Nuwara Eliya as rural area[10)].

2.Subjects

Subjects were volunteers in good health who agreed to participate in this survey. They were enlisted by community health workers in the study areas. Ethnicity of the subjects was Shinharase which accounted for more than 70% of the population[10)]. All subjects were literate except for preschool children. Table 1 shows the number of subjects by gender and age group.

3.Nutrition survey

Before initiating the survey, the participants were brought together and instructed by dietitians how to keep diet records. The subjects were required to weigh and record all food and recipe ingredients, including liquids, that were consumed for breakfast, lunch, dinner and snacks for a single day. A ladle was provided for each participant to help measure the volume. For small children, parents were asked to keep the records for them. Entries were made on the diet record sheets provided in advance by the study staff. Instruction and examples of diet record were also written on the first page of the record sheets. When collecting the sheets, the dietitians checked them through with the help of interpreters.

Food record data were coded and entered for analysis based on calculation system for the Japanese National Nutrition Survey[11)]. This program estimates total dietary intake of energy and nutrients (i.e. protein, fat, carbohydrate, calcium, iron, vitamin A, thiamin, riboflavin, niacin, vitamin C and vitamin D). For that is not listed in the food table included in the calculation system, we substituted food that has a similar nutrient content as shown in Table 2. Only coconut, which is a major component in Sri Lankan foods, have been analyzed using data base for Sri Lankan food[12)]. Adequacy of nutrient intake is expressed as percentage of the recommended dietary allowance (RDA) recommended by World Health Organization (WHO)[13)~15)].

Table 1 The number of subjects for nutrition survey

Age (year)	Urban				Rural			
	Male	%	Female	%	Male	%	Female	%
0- 4	3	8.3	1	5.3	0	0.0	0	0.0
5-10	3	8.3	2	10.5	0	0.0	0	0.0
11-14	7	19.4	8	42.1	3	13.6	8	33.3
15-19	0	0.0	0	0.0	3	13.6	4	16.7
20-29	1	2.8	0	0.0	0	0.0	1	4.2
30-39	2	5.6	4	21.1	0	0.0	4	16.7
40-49	11	30.6	3	15.8	4	18.2	4	16.7
50-59	7	19.4	0	0.0	5	22.7	3	12.5
60-69	1	2.8	0	0.0	4	18.2	0	0.0
70-79	0	0.0	0	0.0	3	13.6	0	0.0
80-89	1	2.8	1	5.3	0	0.0	0	0.0
Total	36	100.0	19	100.0	22	100.0	24	100.0
Mean age ±SD[a]	33.3 ±20.4		24.4 ±18.6		45.8 ±21.8		27.3 ±15.4	

[a]SD, standard deviation

Table 2 Substitution of Japanese food for Sri Lankan food

Food category	Sri Lankan		Japanese
Roots and tubers	Manioc root	⟶	Sweet potato (baked)
Fats and oils	Coconut oil	⟶	vegetable oil
Nuts and seeds	Jak seeds (raw)	⟶	Chestnuts
Peas, beans and vegetables	Dhal, yellow	⟶	Peas (dry)
Leafy vegetables	Gotukola	⟶	Watercress (leaves)
	Manioc leaves	⟶	Red Malabar nightshade (leaves)
Other vegetables and fruits	Jak, tender	⟶	Silverberries
	Watakolu	⟶	Cucumber

4.Time period of observations

The surveys were conducted in August 1994 and March 1995.

5.Statistics

The average intake of nutrients for urban and rural areas was compared and tested (Welch's t-test). Data were analyzed using programs available in HALBOW software (version 4.0, 1994, Gendaisugakusya, Kyoto, Japan).

Results

1.Adequacy of nutrient intake

In Table 3, percent of dietary intake to the RDAs was indicated. Values for intake of protein, calcium, vitamin A and riboflavin were short by more than 20% of RDA both in the urban and in the rural areas. The following are urban-rural comparisons on food sources which supplied these four nutrients.

Table 3 Adequacy of nutrient intake[a]

	Urban (n=55)	Rural (n=46)
	mean±standard deviation	
Energy (%)	83±20	86±26
Protein (%)	72±19	74±28
Fat (%)	92±32	86±37
Carbohydrate (%)	81±21	88±25
Calcium (%)	62±40	80±69
Iron (%)	116±58	110±68
Vitamin A (%)	46±39	46±44
Thiamin (%)	161±47	215±61*
Riboflavin (%)	48±19	52±32
Niacin (%)	111±41	141±57*
Vitamin C (%)	191±143	324±329*
Vitamin D (%)	127±127	110±121

[a]Figures in the table are the mean±SD of adequacy for subjects in each group. Adequacy for individual was calculated as follows:
Nutrient intake / RDA for subject×100
Significantly different from urban value as assessed by Welch's t-test, * : $p<0.05$.

2.Food sources contributed to protein intake (Table 4)

Protein intake from rice was greater in the rural areas whereas the intake from wheat and other cereals was greater in the urban area. Total protein intake from these two food groups was almost the same in the urban (50.6%) and rural (52.6%) areas. Protein intake from meat and eggs was greater in the urban area and the intake from other animal foods was greater in the rural areas.

Table 4 Food sources contributed to protein intake

Food group	Urban (n=55)	Rural (n=46)
	% of total protein	
Rice	25.2	38.0
Wheat and other cereals	25.4	14.6
Coconut	5.9	5.5
Peas, beans and their products	7.5	6.6
Fish and shellfish	18.5	19.2
Meat	3.9	0.5
Eggs	2.3	1.1
Milk and dairy products	2.2	4.6
Other	9.1	9.9
Total	100.0	100.0

3.Food sources contributed to calcium intake (Table 5)

In the rural areas, calcium intake from milk and dairy products as well as fish and shellfish was almost twice as much as in the urban area. The intake from cereals was greater in the urban area.

Table 5 Food sources contributed to calcium intake

Food group	Urban (n=55)	Rural (n=46)
	% of total calcium	
Milk and dairy products	16.4	26.0
Fish and shellfish	7.5	14.1
Peas, beans and their products	4.8	4.5
Dark colored vegetables	14.7	11.4
Other vegetables	2.4	1.9
Cereals	29.0	18.6
Other	25.2	23.5
Total	100.0	100.0

4.Food sources contributed to vitamin A intake (Table 6)

Vitamin A intake from meat and eggs was greater in the urban area and that from fruits was greater in the rural areas.

Table 6 Food sources contributed to vitamin A intake

Food group	Urban (n=55)	Rural (n=46)
	% of total vitamin A	
Dark colored vegetables	63.5	66.1
Fruits	9.7	14.7
Meat	1.7	0.2
Eggs	8.9	4.6
Milk and dairy products	7.5	8.8
Fish and shellfish		
Other	8.7	5.6
Total	100.0	100.0

5.Food sources contributed to riboflavin intake (Table 7)

Riboflavin intake from fruits was greater in the rural areas and the intake from animal foods other than milk and dairy products was greater in the urban area.

Table 7 Food sources contributed to riboflavin intake

Food group	Urban (n=55)	Rural (n=46)
	% of total riboflavin	
Cereals	34.7	32.9
Peas, beans and their products	4.2	3.8
Vegetables	12.5	13.9
Fruits	4.2	10.1
Fish and shellfish	9.7	6.3
Meat	5.6	0.0
Eggs	8.3	3.8
Milk and dairy products	9.7	17.7
Other	11.1	11.5
Total	100.0	100.0

Values were rounded off to 2 decimals.

Discussion

Intake of four nutrients was insufficient in the studied population. For these nutrients, in order to improve the intake levels, recommendation on food choice should be given. To be practical and feasible, such advice has to include food which is easily available and commonly consumed by people in each group. Observed food sources of the nutrients are giving us the information about the tendency of food choice and food preference in two groups. Their patterns of food sources were different between the areas. By comparing these two patterns and considering the differences of food availability, we could draw a hint from the pattern observed in one area as to what we ought to recommend to the other.

1.Protein

Traditional meal in Sri Lanka is rice with curry. In rural area, most people seemed to keep the traditional diet and rice was the most important source of protein. On the other hand, compared to the rural counterparts, urban residents introduced more bread into their diet. This resulted in greater contribution of wheat to protein intake in the urban area.

Protein deficiency is one of four major nutritional deficiency disorders prevailing in Sri Lanka[16]. The intake of protein and particularly animal protein requires to be increased. However, meat and eggs are relatively expensive, so that rural people in particular cannot afford them because of their small cash income. We would like to encourage them to increase the consumption of powdered milk which is already widely and frequently used both in urban and in rural areas. The strongest point is that it can supply a relatively large amount of protein with small quantities and be applicable to practical use in daily cooking. For example, it would be easy to increase the intake of animal protein in the diet by dissolving the product in cow's milk for tea or in coconut milk, which is an essential ingredient for making curry. Consumption of powdered milk was observed in both areas and it seemed familiar to the people, it would not be difficult to promote the use of the product.

2.Calcium

Although the total intake of milk and dairy products was about the same for the urban (32.2±76.8g) and the rural (32.3±76.5g) areas, high-calcium foods such as powdered milk and skim dry milk were consumed in large quantities in the rural areas (data not shown). This consequently resulted in a higher calcium intake from this food group. It would be convenient to use skim dry milk, because it is cheaper and can be stored without a refrigerator in the tropical climate. If the urban residents also increase the consumption of the above high-calcium foods, which are easily available in Sri Lanka, their calcium intake would expect to be improved.

On the other hand, the total intake of fish and shellfish in the rural areas was significantly smaller than in the urban area, as shown in the study published[17], and therefore, the calcium intake from this food group should be smaller. However, the calcium contents in the fish products consumed in the two areas were different. The fish that was consumed most often in the urban area was a raw bonito, and that in the rural areas was a dried bonito. The calcium content in a dried bonito was twice that of a raw bonito. Furthermore, the consumption of a dried sardine (with a calcium content of 22 times that of cow's milk) was also greater in the rural areas. Urban subjects would be able to buy a variety of food at a store and we encourages them to choose dried fish products rather than raw fishes. Small fishes like a dried sardine which can be eaten whole, are especially recommended rather than a dried bonito. Because a dried bonito has smaller weight than a raw bonito in one portion and this results in providing calcium not so much. Fortunately, people in Sri Lanka are in the habit of eating small fishes which can provide significant amount of calcium even if gram of intake is small.

Because the consumption of wheat, which has a higher calcium content than rice, was significantly greater in the urban area[17], the calcium intake from cereals was also higher. This is one of the benefits of eating bread.

3.Vitamin A

Because rural subjects consumed significantly larger amounts of fruits[17], vitamin A intake from this food group was higher than for their urban counterparts. In both areas, fruits contributed in the second place to the vitamin intake. The vitamin intake can be increased by intentionally choosing vitamin A-rich fruits. For example, we would like to advise choosing mangos (890IU of vitamin A/100g of fruit) or watermelons (210IU/100g) rather than pineapples (0IU/100g) or bananas (15IU/100g) in which vitamin A contents are small[12]. This strategy seems reasonable because Sri Lanka is rich in fruits and people often eat them.

4.Riboflavin

The intake of meat was significantly greater in the urban area[17]. The difference in the contribution of meat to riboflavin intake was greatly affected by this difference in meat consumption. Though meat is definitely the most effective source of riboflavin, it is difficult to augment meat intake in rural area due to its price and marketing system. Because skim milk powder is also rich in riboflavin, an increased intake of riboflavin as well as calcium is expected from this source.

5.Limitations of the study

There are some limitations in the study because of the design.

First of all, one-day dietary records were not reflective of usual food intake. In addition to one day diet record, biological parameters (blood) were also investigated. However, we did not use the biological data because the blood samples were not available for some subjects. In a situation like this, we assume that three-day diet records would be more appropriate.

Secondly, because sample size was too small and the participants were restricted to the Shinharase, results of this study cannot be generalized to the entire population of Sri Lanka. The subjects from various age groups were taken into the analysis because we would not like to decrease the number of samples any more.

In spite of the limitation, the current study can be regarded as one of the few studies which have focused on the food sources of selected nutrients and therefore the results of the study provides a contribution to the fields of dietetics, especially for practical application.

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