Macronutrient Intake and Nutritional Status of Primary School-Aged Girls in Rural and Urban Areas of South Vietnam

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(Received May 15, 2002)

Summary The dietary habits and nutritional status of Vietnamese primary school girls were investigated using a cross-sectional survey. We interviewed 348 girls aged 7 to 9 yr old, randomly selected from three rural (n=193) and two urban (n=155) primary schools. The nutritional status of the children was evaluated by anthropometric and biochemical data. Dietary data were calculated based on the results of a 24-h recall interview carried out for three consecutive days. The dietary macronutrient pattern of the rural group showed a deficiency of energy, fat, animal protein, and fiber content. On the other hand, high animal protein ratio, deficiency of fiber consumption, low polyunsaturated fatty acid, and high saturated fatty acid proportions were typically found in the urban group. A high number of rural children skipped lunches, resulting in low energy consumption; however, frequently skipped breakfast in the urban group did not influence total energy consumption because of extra meals taken. The mean height of rural children was 5.8 cm less than that of their urban counterparts. In addition, 11.4% of wasted rural children needed emergency intervention with energy supplementation. Moreover, a high proportion of children with a high atherogenic index (AI) (41.5%) and low HDL cholesterol (40.9%) were found in the rural group. In contrast, a tendency toward obesity, high cholesterol, LDL cholesterol, and high AI was observed in a proportion of the urban children (5.2%, 15.5%, 12.3%, and 29.0%, respectively).

Key Words primary school girl, Vietnam, macronutrient intake, nutritional status, anthropometry

Poverty and wealth have profound effects on diet, nutrition, and health. Poverty leads to chronic undernutrition, whereas economic growth changes disease patterns toward higher rates of childhood obesity, diabetes, coronary heart disease, and so on (1). Vietnam is undergoing an economic transition, and the dichotomy in socioeconomic status has created two distinct dietary and disease patterns between urban and rural areas (2). This big gap between the poor and the affluent is reflected in the health of Vietnamese school children, with a high prevalence of stunted growth in the rural areas (3) in contrast to obesity, which has become more prevalent in urban areas (4). Poor nutrition was reported to hinder the learning ability of children (5). The development of some non-communicable diseases such as atherosclerosis in adults has its origins in childhood and adolescence (6). Therefore, improving the health of school-aged children is also emerging as a policy priority in Vietnamese nutrition transition.

A better understanding of dietary habits and nutritional status of school-aged children could lead to a more appropriate intervention program. Hitherto, information relating to the nutritional status of primary school-aged children was very limited. Especially, biochemical measurements were not often carried out, since the collection of blood samples from primary school-aged children was not common in Vietnam. For this reason, we set up a survey to investigate the dietary habits and nutritional status of primary school-aged children in rural (low-income) and urban (high-income) areas of South Vietnam based on dietary intake, anthropometric examination, and biochemical measurements.

METHODS
Subjects
A cross-sectional survey was conducted from October 1 to November 1, 1999. The Binh Chanh District was
selected from 10 rural areas and First District was randomly selected from 12 urban districts of Ho Chi Minh City. Then, three of the 51 schools in Binh Chanh District and two of the 36 schools in First District were randomly selected. From the list of 2,848 primary school girls between 7 and 9 yr of age, 351 girls were randomly selected for the survey. Binh Chanh is a rural area in which most of the people are farmers and fishermen. First District is a trading area and the majority of people are merchants. Overall, 35.8% of the children were aged 7, 35.2% aged 8, and 29% aged 9 in the rural group. In the urban group, the percentages were 36.1%, 34.2%, and 29.7%, respectively. In the rural group, one child was found to have urethra-rec-talostoma disease. In the urban group, one child had suffered from urinary tract infection and another child had a history of hepatitis. These three children were all excluded from the survey, and 193 rural and 155 urban children participated with parental consent.

Data collection

Dietary intake. Twenty-four hour dietary intake recall was conducted and repeated every day for three consecutive days by trained interviewers. A common set of household measures, photographs and/or pictures of food were used to facilitate the estimation of portion size. All of the interviewers were medical doctors working in the Ho Chi Minh Child Nutrition Center. Parents or caregivers of the children were asked to perform 24-h dietary recall interviews for three consecutive days. The parents and their children were asked to recall all the food consumed by the child during the previous day. The 24-h dietary recall data were used to calculate dietary energy and nutrient intake using Excel Eiyokun, version 08.E, developed by Dr. Yukio Yoshimura, Shikoku University, Japan. Excel Eiyokun data were obtained from the Nutritive Composition Table of Vietnamese Foods (7). The Vietnamese Recommended Dietary Allowance (Vn-RDA) (8) was used as the standard to estimate the nutrient intake status. However, the standard for simple carbohydrates (SCH) and fiber consumption has not yet been established, so we had to use the American standard for children (9,10). "Food Need for Vietnamese," established by the Vietnamese National Institute of Nutrition (11), was also used to evaluate proper food consumption in this survey.

Anthropometric, blood pressure measurements. Weight was recorded using an electronic scale (Omron, Digital Scale, HN-210, Tokyo, Japan) with the subject in minimal clothing and barefoot. Height was measured while the subject was barefoot and in standing position using a standard scale (Idea Height Scale, N.o 966, Hata Exercise Tool Company, Tokyo, Japan). Z scores of weight for age (WAZ), height for age (HAZ), and weight for height (WHZ) were calculated by the anthropometric assessment function of Epi Info 6 (Centers for Disease Control and Prevention, Atlanta, USA) (12). The left mid-arm circumference (MAC) was measured and compared with the normogram (13) to estimate the nutritional status. If the value was under the third to fifth percentile of the normogram, we concluded that the child was undernourished (13). Body fat was measured using a bioelectric impedance method on a body fat analyzer (TBF-511, Tanita Co., Ltd., Tokyo, Japan). Blood pressure was measured using a mercury sphyg-momanometer and a child-size cuff. Measurements were taken on both left and right arms after the child had been seated for about 15 min.

Biochemical measurements. Fasting blood was collected from each participant on the third day of the interview for measurement of biochemical data. Biochemical parameters were divided into two groups: [1] Serum proteins, liver and kidney functions indicated by serum albumin, serum transferrin, BUN, creatinine, and transaminase; and blood counts such as total leukocyte and lymphocyte count (14). [2] Serum lipid profile included total cholesterol (TC), HDL cholesterol, LDL cholesterol, triacylglycerol (TG) and atherogenic index (AI) (15). The biochemical values of TC>5.17 mmol/L, HDL cholesterol<0.9 mmol/L, LDL cholesterol>3.36 mmol/L, TG>2.26 mmol/L and AI>3 were the cut off values used to estimate abnormal blood lipid profile in this survey (15). Total leukocyte count and lymphocyte count were determined using a Cell Dyn 3200 (Abbott Diagnostics, Ho Chi Minh, Vietnam). Other biochemical parameters were analyzed by the Analytical Section of the Faculty of Medicine, Jichi Medical School. Briefly, the analytical methods were as follows: plasma protein using the Biuret method (Dia-tron, Tokyo, Japan), and albumin using the bromocresol green method (Eiken Kagaku Co., Tokyo, Japan). Serum iron (SI) and unsaturated iron binding capacity (UIBC) were determined by an automated method using a Techicon-H 6000 analyzer. BUN was measured using an urease glutamate dehydrogenase ammonia assay (Serotec Co., Tokyo, Japan), and creatinine by POD assay enzymatic reaction (Kainos Co., Tokyo, Japan). Transaminases were determined using an enzymatic method (Kanto Kagaku Co., Tokyo, Japan). Total cholesterol, HDL cholesterol, LDL cholesterol, and triacylglycerol were determined by enzymatic assay (Kyowa, Tokyo, Japan). Other biochemical parameters such as total iron binding capacity (TIBC), serum transferrin (TFN), and atherogenic index were calculated using the following equations: TIBC=UIBC+SI, TFN=(TIBC×0.76)+18, and AI=(TC−HDL cholesterol)/HDL cholesterol (14).

Statistical analysis

Statistical analyses were performed using SPSS for WINDOWS (Statistical Package for Social Sciences, version 6.0 1996; SPSS, Inc., Chicago, USA). Independent sample t-test and Chi-square test were conducted to evaluate differences in median and prevalence data between the rural and urban groups. Odds ratios (ORs) were calculated using a logistic regression model.

Ethical considerations

Parents of the participating children were informed of the purpose of the survey. Assurance was given that the cooperation was voluntary. The survey protocol was approved by the Research and Ethical Review Board of the
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RESULTS

Nutritional status

Anthropometric data. The mean values of height, weight, body fat, and left mid-arm circumference (LMAC) of the urban children were significantly higher than those in the rural group. The prevalence of stunted (HAZ<2), wasted (WHZ<2), and underweight (WAZ<2) children was also significantly higher in the rural group than in the urban group. The prevalence of undernourished children assessed by LMAC under the 3rd to 5th percentile of the normogram in the rural group was significantly higher than that of children in the urban group. Moreover, obesity (WHZ>+2) was observed only in the urban group. The mean values of both systolic and diastolic blood pressure of the urban children were significantly higher than those of the rural children (Table 1).

Biochemical data

General nutritional data. The mean values of nutritional data for both groups, shown in Table 2, were within the normal range (14). Serum protein, transferrin, BUN, and lymphocyte count of the urban children were significantly higher than those of the rural children.

Atherogenic data. As shown in Table 2, both groups had normal mean values for cholesterol, HDL cholesterol, LDL cholesterol, TG, and AI (15). However, some urban children had TC, LDL cholesterol, TG, and AI values higher than the upper reference value (Table 2). On the contrary, the number of rural children, who had HDL cholesterol under 0.9 mmol/L, was five times higher than that of the urban children (40.9% vs. 8.4%) (Table 2).

Dietary data

Macronutrient intake.

Diet structure: The intake of protein, fat, and carbohydrates as a percentage of total energy was 14%, 15%, and 71% for the rural group and 16%, 22%, and 62% for the urban group (Table 3).

Energy: The energy consumption of the rural group was significantly lower than that of the urban group, and only reached 70% of the Vn-RDA (5.3 MJ vs. 7.5 MJ/d) (Table 3). More than 10% of the rural children consumed under half of the Vn-RDA for energy, while this prevalence was negligible in the urban group (0.7%) (Table 3). On the other hand, the percentage of children who had energy consumption above the Vn-RDA for energy increased from 4.2% in the rural group to 47.7% in the urban group (Table 3).

Protein: More than half of the rural children had animal vegetable protein ratio (AVPR)<0.8, but more than 80% of the children with AVPR>1 were found in the urban group (Table 3). The consumption of animal protein food sources such as meat, fish, eggs, and milk-dairy products was insufficient in the rural group (Table 4). In the urban group, meat is the main animal protein source. Their meat consumption was twice the Vietnamese RDA, while fish, milk-dairy products, and egg consumption were only the half that of the Vietnamese RDA in their dietary habit. Therefore, meat is the alternative protein source for fish, milk-dairy products, and egg in this group (Table 4). About vegetable protein, adequate soybean product consumption was found in both groups (Table 4).

Fat: High SFA, MUFA, and low PUFA with different levels were the fatty acid patterns of both groups. The

| Table 1. Anthropometric and blood pressure data of rural and urban school-age girls. |
|---------------------------------|----------|---------|----------|----------|
|                                 | Rural (n=193) | Urban (n=155) | p* | Odds ratio2 (95% CI) |
|---------------------------------|--------------|--------------|----|----------------------|
| Mean±SD                         |              |              |----|                      |
| Age (yr)                        | 8.4±0.9      | 8.4±0.9      | ns |                      |
| Weight (kg)                     | 20.6±3.1     | 25.8±6.0     | 0.000 |                 |
| Height (cm)                     | 121.0±6.5    | 126.8±7.4    | 0.004 |                 |
| Weight for age Z score          | -1.4±0.8     | -0.3±1.2     | 0.000 |                 |
| Height for age Z score          | -1.2±0.8     | -0.3±0.9     | 0.000 |                 |
| Weight for height Z score       | -1.1±0.8     | -0.1±2.8     | 0.000 |                 |
| Left mid-arm circumference (cm) | 16.0±1.3     | 18.0±2.3     | 0.001 |                 |
| Body fat (%)                    | 10.6±2.9     | 15.1±5.9     | 0.000 |                 |
| Systolic blood pressure (mmHg)  | 93.2±7.0     | 100.0±7.7    | 0.000 |                 |
| Diastolic blood pressure (mmHg) | 46.9±6.0     | 54.7±6.3     | 0.001 |                 |
| % of subjects                   |              |              |----|                      |
| Weight for age Z score<−2 (Underweight) | 21.8 | 5.8 | 0.000 | 4.5 (2.1–9.6)\(|
| Height for age Z score<−2 (Stunted)    | 13.5 | 1.9 | 0.000 | 7.9 (2.3–26.6)\(|
| Weight for height Z score<−2 (Wasted) | 11.4 | 5.2 | 0.039 | 2.4 (1.1–5.5)\(|
| Weight for height Z score>2 (Obese)   | 0.0  | 5.2 | 0.001 | nc |
| Left mid-arm circumference<5th percentile | 14.4 | 2.6 | 0.045 | 3.0 (0.9–9.2) |

1 p, Significantly different levels between rural and urban groups calculated using t test (p*) or Chi-square test (p**).
2 Odds ratios and 95% confidence intervals were calculated using logistic regression model.
ns, not significant. nc, odds ratios was not calculated due to very small number of subjects. * p<0.001, b p=0.05.
mean energy derived from the fat consumption of rural children (15%) was much lower than that of the RDA for Vietnamese children (20-25%). Furthermore, 17.6% of the rural children obtained under 10% of their energy from fat (Table 3). The percentage of children who had a high-fat diet increased from 0.5% to 5.8% for rural to urban group, for high-saturated fatty acid 6.7% in rural and 24.5% in urban group (Table 3). Lard and oil were the main fat source in the rural and urban groups, respectively (Table 4).

Carbohydrates: Energy derived from simple carbohydrates (SCH) was in the normal range in both groups. However, the energy level from SCH was above 10% for 25.4% of the rural children and 43.5% of the urban children. Low fiber consumption was found in both groups. More than 99% of the children in the rural and urban groups consumed low amounts of fiber (Table 3). Higher vegetable consumption was found in the urban group than in the rural group (Table 4).

Eating habits

Irregular eating habits were found in both the rural and urban groups, with a quite contrary trend. Nearly 20% of the rural children skipped lunch (Fig. 1A), which resulted in low energy consumption (Fig. 1B). On the contrary, more than 30% of the urban children skipped breakfast (Fig. 1A); however, this phenomenon did not influence the energy consumption of these children (Fig. 1B).

DISCUSSION

Our finding is that there is a big gap in the diet and nutritional status of primary school girls living in rural and urban areas.

Nutritional status

Under-nutrition.

Stunting: Low height for age might be an indicator of growth impairment caused by malnutrition in the past (16), although it is argued that the process of stunting still develops during the primary school years (17). In this survey, 13.5% of the rural children were found to have stunted growth. Moreover, the mean height of rural girls was 5.8 cm less than that of their urban counterparts. This phenomenon is a shocking fact for the Vietnamese, because it is similar to the gap in height between Japanese children before and after World War II (18). In reality, the Japanese government devoted approximately 8 yr to remove 3 cm from this height gap (19).

Underweight and wasted: Malnutrition, in even moderate or mild form, has many significant adverse effects.
Table 3. Macronutrient intake of rural and urban school-age girls in comparison with Vietnamese-RDA.

| Energy and nutrients | Vn-RDA\(^3\) | Rural \((n=193)\) | Urban \((n=155)\) | \(p^1\) | Odds ratio\(^2\) (95% CI) |
|----------------------|--------------|-----------------|-----------------|------|-----------------|
| Energy (MJ/d)        | 7.5          | 5.3±1.0         | 7.5±1.5         | 0.000 | —               |
| Protein (g/d)        | 40.0         | 44.3±11.0       | 71.0±17.0       | 0.000 | —               |
| Protein (% of energy) | —            | 14.0±2.1        | 16.0±2.0        | 0.001 | —               |
| Animal protein (% of energy) | —     | 6.0±2.6         | 9.3±2.7         | 0.000 | —               |
| Vegetable protein (% of energy) | —    | 8.0±2.1         | 6.7±2.3         | 0.004 | —               |
| Animal vegetable protein ratio | 0.8–1.0   | 0.8±0.4         | 1.4±0.5         | 0.001 | —               |
| Fat (% of energy)    | 20.0–25.0    | 15.0±5.3        | 22.0±4.3        | 0.000 | —               |
| SFA\(^4\) (% of energy) | <10.0       | 4.5±3.5         | 7.8±3.8         | 0.000 | —               |
| MUFA\(^5\) (% of energy) | 10.0        | 6.7±7.7         | 9.1±5.0         | 0.000 | —               |
| PUFA\(^6\) (% of energy) | 2.7         | 1.8±2.1         | 2.1±1.3         | ns   | —               |
| SFA : MUFA : PUFA    | 3.0 : 4.0 : 3.0 | 3.5 : 5.1 : 1.4 | 4.1 : 4.8 : 1.1 | —    | —               |
| Carbohydrates (% of energy) | —          | 71.0±6.0        | 62.0±5.0        | 0.000 | —               |
| SC\(^7\) (% of energy) | <10.0        | 8.0±5.0         | 9.0±4.0         | 0.047 | —               |
| Fiber\(^8\) (g/kg body) | 0.5         | 0.18±0.1        | 0.20±0.1        | ns   | —               |

\(\text{Mean±SD}\)

\(\%\) of subjects

\(p^*\)

\(p^{**}\)

1\(^\text{p}\). Significantly different level between rural and urban groups calculated using \(t\) test (\(p^*\)) or Chi-square test (\(p^{**}\)).

2\(^\text{Odds ratio and 95\% confidence intervals were calculated from logistics regression model.}\)

3\(^\text{Vietnamese Recommended Dietary Allowances (8); SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; SC, simple carbohydrates, reference from “The Food Guide Pyramid” (9).}\)

4\(^\text{Reference from “Carbohydrate and Dietary Fiber” (10).}\)

\(\text{ns, Not significant. nc, odds ratios was not calculated due to very small number of subjects, a }p<0.001, b p<0.005, c p<0.05.}\)

All values were calculated based on a 24-h recall interview for three consecutive days.

Table 4. Comparison of food consumption patterns between rural and urban children.

| Food                          | Vn-RDA\(^1\) | Rural | Urban |
|-------------------------------|--------------|-------|-------|
| Meat (g/d)                   | 60.0         | 39.1±31.0 | 132.5±60.3\(^a\) |
| Fish (g/d)                   | 55.0         | 47.3±36.9 | 38.8±37.7\(^b\) |
| Eggs (g/d)                   | 30.0         | 12.6±16.2 | 22.8±18.0\(^b\) |
| Milk-dairy products (g/d)    | 220.0        | 15.7±34.9 | 130.2±151.4\(^a\) |
| Soybean products (g/d)       | 60.0         | 83.3±32.8 | 68.4±68.2\(^b\) |
| Fat source                   |
| Lard (g/d)                   | —            | 5.5±5.8  | 1.4±2.6\(^a\) |
| Oil (g/d)                    | —            | 4.3±6.6  | 18.0±9.8\(^a\) |
| Carbohydrate source          |
| Rice (g/d)                   | 250.0        | 226.4±71.3 | 252.3±50.0\(^a\) |
| Roots (g/d)                  | 110.0        | 17.5±31.9 | 12.0±16.7\(^a\) |
| Fiber source                 |
| Vegetable (g/d)              | 285.0        | 88.4±52.3 | 129.5±61.9\(^a\) |

\(\text{Values are mean±SD.}\)

1\(^\text{Food needs for Vietnamese (11).}\)

\(^a\) \(p<0.001, \text{b }p<0.05 \text{ urban group vs. rural group.}\)

\(\text{All values were calculated based on a 24-h dietary recall interview for three consecutive days.}\)
Malnutrition affects not only a child’s physical and mental development, but also emotional stability and behavioral development (5). According to NCHS/WHO, an excess of 6% of the wasted and underweight children in a population should be considered a public health problem (20). In our study, in the rural group, 11.4% and 21.8% of the children were wasted and underweight, respectively (i.e., malnutrition is an important nutrition problem in this population).

In this research, body estimation was carried out using WAZ, HAZ and WHZ parameters since exercise and other physical activity habits are known to have an influence on body estimation to some extent. However, in our survey, these activities were not carefully investigated. This problem will be solved in the future. Arm circumference—arm muscle and fat areas—is an indicator to estimate body composition. In the rural group, the proportion of wasted children was 11.4% if estimated by WHZ<-2, but 14.4% if estimated by left mid-arm circumference<5th percentile. Poor muscle tone might be a factor that masks wasting as measured by low weight for height (21) in this survey.

In comparison with China, our findings suggest that malnutrition in rural primary school girls is not very serious. Only 13.5% of Vietnamese girls living in rural areas were found to have stunted growth in contrast to 24.8% of rural Chinese rural school-aged children (22). The prevalence of underweight in the rural group of this survey was also lower than that in China (21.8% vs. 38.3%) (23).

Overweight. Only in the urban group, 5.2% of children were found to be overweight or obese. It is well known that school-age obesity has important health consequences and is a major antecedent of adult obesity (6). In many industrialized countries, prevention of obesity is a public health priority with much concern focusing on children and adolescence (24). Compared with schoolgirls in China (9.6%) (22) or Thailand (15.6%) (25), the obesity prevalence in Vietnamese girls living in urban areas is still low. However, half of the urban children with energy consumption above the Vn-RDA, a risk factor for obesity, suggest an alarm for increasing obesity rates in this population in the future. The escalating obesity among school-age children in China (23), as well as in Thailand (25), and the difficulty in controlling it in these countries are valuable lessons for the Vietnamese.

Blood lipid profile. High TC, LDL cholesterol and low HDL cholesterol are associated with increased risk of coronary heart disease (15). The TC concentration in the urban children was nearly at the upper limit of normal and close to the average TC of 8–9 yr-old Japanese children (4.4 vs. 4.6 mmol/L) (18). Keys et al. (26) found that SFA increased blood TC levels, and on the contrary, Hegsted et al. (27) reported that PUFA reduces TC. A high SFA and low PUFA proportion in the fat intake pattern of urban children showed a trend toward a risk of increasing TC among this population in the future.

Low HDL cholesterol was found in nearly half of the rural children (Table 2). When ORs was calculated, the number of children with HDL cholesterol below 0.9 mmol/L was 7.6-fold higher in the rural group than in the urban group. Consequently, rural children are 1.7 times more likely to have an AI over 3 (the upper limit value of AI) than urban children (Table 2). It seems that an increased risk of developing atherosclerosis might be more likely in rural children than in urban children. Schlierf et al. (28) reported that HDL cholesterol was positively correlated with energy and fat intake. Therefore, increased energy and fat intake is necessary for rural children to improve their low HDL cholesterol status.

Dietary status

Dietary pattern.

Diet structure: The diet structure of Vietnamese rural children is similar to that of Japanese children in the period from 1945 to 1950, when there was a food supply...
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shortage (18). The diet was characterized by low fat and high carbohydrate intake (Table 3). On the other hand, the suitable fat intake of the Vietnamese urban group was close to that of Japanese children in the period from 1945 to 1950, when the food supply had been restored (18).

Energy: A marked difference in energy consumption between rural and urban areas was found in this survey. Energy consumption of Vietnamese children living in rural areas only reached 70% of that of the urban children and 83% of the energy consumption of Japanese children in the period from 1945 to 1950 (18). In this period, the food supply was insufficient in Japan, and this event might have resulted in the shorter height (3 cm) of Japanese children (19). Therefore, energy deficiency in rural children should be included in a nutritional intervention strategy.

Protein: Animal protein, high quality protein necessary to maintain the growth of children (14), was consumed inadequately in the rural group. In contrast, the tendency for high AVPR in the dietary pattern was observed in the urban group. This typical diet was reported as leading to a dietary net acid load, which has a negative effect on the calcium balance (29).

Fat: Regarding fat consumption, our findings revealed a low-fat diet in the rural group, while the appearance of a high-fat diet has begun in the urban group. Moreover, an imbalance in fatty acid consumption was observed in both groups: lard instead of vegetable oil consumption in the dietary habit of rural children might be responsible for the high MUFA intake (Table 4); otherwise, excessive meat consumption (Table 4) might be the cause of the high proportion of SFA and MUFA intake (Table 3) in the urban group.

Carbohydrates: Nutrition transition in the developing world was described as "The world moves toward the higher fat and higher refined carbohydrate Western diet" (30). The trend of increased SCH consumption was also found in both rural and urban groups in this survey, with a rather high percentage of children consuming SCH over the recommended limit (9). A high consumption of soft drinks and confectioneries might be one reason for this phenomenon. In contrast to SCH, low vegetable consumption is a popular trend of children's diets (10). A similar trend was also found in this survey regarding fiber consumption by both groups, only reaching half of that of the American RDA.

Irregular-eating habit. Skipped lunches in the rural group as well as skipped breakfasts in the urban group might result in fasting at school, which is one condition that can hinder a child's learning ability (31). Lower energy consumption among rural children who skipped lunch suggests a shortage of food supply in this population. On the contrary, invariable energy consumption among urban children who skipped breakfast shows that these children might replace the energy derived from breakfast with an extra meal or fast food, which is rich in fat and SCH, and low in fiber.

In conclusion, the large gap in the diet structure between urban and rural school-age children resulted in differences in anthropometric and biochemical values. The height difference of 5.8 cm between urban and rural children is a problem that should be solved. In addition, the existence of underweight, stunting and wasting in rural children also requires intervention with emergency energy supplementation. The trend of becoming overweight is also a health problem for the urban children. Consequently, a suitable intervention strategy is needed for each group. A nutritional education program with different contents might be necessary for the two groups, and the introduction of school lunches may be an effective method to improve the quantity and quality of dietary intake by rural children.

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