Regional study of nutritional status of urban primary schoolchildren. 3. Kuala Lumpur, Malaysia

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Abstract

A total of 5,995 children (7.8% of all 7- to 10-year-old primary schoolchildren in Kuala Lumpur), randomly selected from 166 schools (97.6% of all schools), were measured for their weight and height. The analyses of all weight and height data, including the cutoffs used for defining stunting, underweight, and wasting and for thinness and overweight, were carried out as recommended by the World Health Organization (WHO). The prevalences of stunting (height-for-age Z score < –2 SD), underweight (weight-for-age Z score < –2 SD) and wasting (weight-for-height Z score < –2 SD) among all the children studied were 6.7%, 7.1%, and 4.5%, respectively. Undernutrition among boys was more serious than among girls according to all three indicators. Because it was not possible to analyze the weight-for-height data for most of the children above 8.5 years of age, body mass index (BMI)-for-age was used to determine the prevalences of thinness and overweight for all the children. Based on the reference data, the prevalence of overweight (at or above the 95th percentile) was 9.7% and 7.1% for boys and girls, respectively, and 8.4% overall.

Introduction

As a result of rapid socioeconomic development in Southeast Asia in the last 30 years, countries in the region are being confronted with both extremes of malnutrition, wherein undernutrition coexists with overnutrition problems. Nutritional deficiencies are slowly being reduced or eradicated in many of these countries. On the other hand, coronary heart disease, cancer, and diabetes have now become major health problems, particularly in urban areas. As countries in the region continue to develop rapidly, the nutritional situations are expected to change rapidly as well. It is thus important to continue to monitor the nutritional status of all community groups, including that of schoolchildren.

The rising prevalence of obesity among children and adolescents is of particular concern to many health authorities. However, there is currently a lack of adequate baseline data on the extent of the problem in the region. There has been no national nutrition survey in Malaysia. Nutritional studies of communities have thus far been conducted on specific population groups, most often in rural areas.

The International Life Sciences Institute (ILSI) (Branch) has therefore coordinated studies in three South Asia countries, Philippines, Indonesia, and Malaysia, to provide an understanding of the nutritional status (as determined by weight and height) and the dietary, and physical activity patterns of urban primary schoolchildren. The data were obtained to assist health authorities in the formulation, implementation, and evaluation of intervention programs among this important target group.

Similar approaches were used in the studies in Manila, Kuala Lumpur, Jakarta, and Bogor. This paper presents findings obtained for children in Kuala Lumpur, Malaysia.

Subjects and methods

A list of all primary schools in Kuala Lumpur was obtained from the Education Department. Visits were made to each school to obtain a list of all children in primary grades 2 to 4 (ages 7 to 10 years). A master list was then prepared for the classes within each school and the children within each class. Starting with a randomly selected number, every 10th child on the master list was selected for inclusion in the study for measurement of body weight and height. Basic socio-

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economic indicators were also collected from each child. From this group, 10% were randomly selected for determination of food consumption, activity patterns, and food beliefs and attitudes of the children and their parents.

Weight and height measurements were obtained by using an electronic beam balance with a height attachment. The study team carried the scale to the schools and calibrated the instrument before use. The scale measured body weight to the nearest 0.1 kg and height to the nearest 0.1 cm. Information on activity patterns, food intake, beliefs and attitudes, and socioeconomic indicators was obtained by using a set of structured questionnaires. These results will be presented in other papers in this series.

Data collection

Weight and height measurements of the children were analyzed for height-for-age, weight-for-age, and weight-for-height Z scores using the Anthro software of the Centers for Disease Control (Atlanta, Ga., USA). Malnourished children were identified as those with Z scores less than –2 SD of the median for the three indicators, which indicate the prevalence of underweight, stunting, and wasting, respectively. Children were considered overweight when their weight-for-height Z scores were greater than 2 SD of the NCHS reference. For children more than 9 years of age, the body mass index (BMI)-for-age was used to determine the prevalence of thinness and overweight of these children, using less than the 5th percentile and equal to or greater than the 85th percentile of the first National Health and Nutrition Survey (NHANES I) [1], respectively. The analyses of all weight and height data, including the cutoffs used for defining stunting, underweight, and wasting and for thinness and overweight, were based on World Health Organization (WHO) recommendations [2].

All data obtained, including socioeconomic data, weight, and height, and nutrient intake were entered into dBase software (Borland International, Scotts Valley, Calif., USA) and analyzed using the SPSS for windows version 8.0 software (SPSS, Chicago, Ill., USA). Independent sample *t*-tests were used to compare means between boys and girls. In all statistical analyses, $p < .05$ was taken as significant.

Results and discussion

Mean weight, height, and BMI

In 1996 we measured the weights and heights of 5,995 primary schoolchildren, 7 to 10 years old (representing 7.8% of all children in the age group), in 166 schools (97.6% of all schools) in Kuala Lumpur.

The mean weight, height, and BMI of the children, presented for boys and girls and for each age group, are shown in table 1. There was no significant difference in mean weight between the boys and girls for all the age groups, except for the 8-year-old children. In the latter group, the boys were significantly heavier than the girls. There was no consistent difference in height between the boys and girls within each of the four age groups. The boys appeared to be taller than the girls for the 7- and 8-year-old groups, but only the mean height for the latter age group was significantly different. For the 9- and 10-year-old groups, the converse was true: the mean height for girls was significantly greater than

TABLE 1. Weight, height, and BMI of schoolchildren according to sex and age

Sex and age (yr)[a]	*n*	Mean ± SD weight (kg)	Mean ± SD height (cm)	Mean ± SD BMI (kg/m^2)
Male				
7	341	24.3 ± 5.5	123.8 ± 5.8	15.7 ± 2.6
8	1,066	26.5 ± 6.7	126.9 ± 6.1	16.3 ± 3.1
9	958	28.8 ± 7.6	131.2 ± 6.5	16.6 ± 3.3
10	672	32.1 ± 8.7	135.9 ± 6.9	17.2 ± 3.5
Female				
7	311	23.9 ± 5.5	123.4 ± 5.9	15.6 ± 2.7
8	1,053	25.5 ± 6.0	126.4 ± 6.1	15.8 ± 2.8
9	941	29.1 ± 7.6	132.1 ± 7.3	16.5 ± 3.1
10	653	32.0 ± 8.2	136.9 ± 7.3	16.9 ± 3.2
Both sexes				
7	652	24.1 ± 5.5	123.6 ± 5.9	15.7 ± 2.6
8	2,119	26.0 ± 6.4	126.7 ± 6.1	16.1 ± 3.0
9	1899	28.9 ± 7.6	131.7 ± 6.9	16.5 ± 3.2
10	1,325	32.1 ± 8.4	136.4 ± 7.1	17.1 ± 3.3

a. *N* for boys = 3,037; *N* for girls = 2,958; total *N* = 5,995.

that for boys. The mean BMI for boys was higher than that for girls in all age groups, but only the difference for the 8-year-old group was statistically significant.

Prevalence of undernutrition

The prevalences of stunting (height-for-age Z score < –2 SD), underweight (weight-for-age Z score < –2 SD), and wasting (weight-for-height Z score < –2 SD) among the whole group of schoolchildren studied were 6.7%, 7.1%, and 4.5%, respectively (table 2). Undernutrition was more serious among boys than girls. The prevalence of stunting was higher among boys (7.9%) than girls (5.5%). The prevalence of underweight was also higher among boys (7.7%) than girls (6.4%). The difference in wasting between boys and girls was less marked: 4.7% for boys and 4.4% for girls.

The mean height-for-age Z score of the boys was significantly lower than that of the girls, whereas the mean values of weight-for-age Z score and weight-for-height Z score of the girls were significantly lower.

Differences in growth and in the prevalence of undernutrition were observed between boys and girls within each of the four age groups of children studied (table 2 and fig. 1). The height-for-age of boys was generally poorer than that of girls. The mean height-for-age Z score of boys was lower than that of girls in all age groups. The difference was only statistically significant for the 9-year-old children and when all age groups were combined. In addition, the percentage of boys found to be stunted (height-for-age Z score < –2 SD) was about 1.2 to 1.6 times higher than the girls for all age groups. The prevalence of stunting was 7.9% among all boys and 5.5% among all girls.

In terms of underweight (weight-for-age Z score < –2 SD), the growth of boys was also generally less satisfactory than that of girls. Except for the 10-year-old group, the prevalence of underweight among boys was 1.2 to 2.1 times higher than among girls in all age groups. For the oldest group of children, the prevalence of underweight among girls was 1.1 times higher than that among boys (8.0% and 7.3%, respectively). There was no clear pattern in the difference between mean

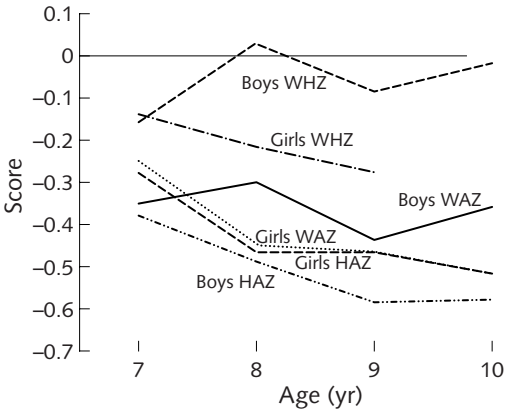

FIG. 1. Mean height-for-age (HAZ), weight-for-age (WAZ), and weight-for-height (WHZ) scores according to age and sex

TABLE 2. Height-for-age, weight-for-age, and weight-for-height of schoolchildren according to sex and age

Sex and age (yr)	Height-for-age			Weight-for-age			Weight-for-height			
	n^a	Mean ± SD Z score	< –2 SD (%)	n^a	Mean ± SD Z score	< –2 SD (%)	n^a	Mean ± SD Z score	< –2 SD (%)	> +2 SD (%)
Male										
7	341	–0.38 ± 1.08	5.0	341	–0.35 ± 1.43	7.9	341	–0.16 ± 1.42	4.4	9.1
8	1,065	–0.49 ± 1.06	7.5	1,066	–0.30 ± 1.47	7.0	1,056	0.03 ± 1.53	4.6	11.6
9	955	–0.59 ± 1.07	9.0	957	–0.44 ± 1.37	8.9	930	–0.09 ± 1.41	5.1	8.0
10	672	–0.58 ± 1.08	8.4	671	–0.36 ± 1.30	7.3	610	–0.02 ± 1.36	4.3	8.5
All ages	3,033	–0.53 ± 1.07	7.9	3,035	–0.36 ± 1.40	7.7	2,937	–0.04 ± 1.45	4.7	9.5
Female										
7	311	–0.28 ± 0.98	2.9	311	–0.25 ± 1.27	3.2	307	–0.14 ± 1.39	3.9	7.8
8	1,053	–0.47 ± 0.94	5.3	1,053	–0.45 ± 1.19	5.9	1,006	–0.22 ± 1.23	4.6	5.0
9	939	–0.47 ± 1.05	5.5	941	–0.47 ± 1.22	7.0	723	–0.28 ± 1.16	4.6	4.4
10	649	–0.52 ± 1.03	7.1	653	–0.52 ± 1.16	8.0	0	—	—	—
All ages	2,952	–0.46 ± 1.00	5.5	2,958	–0.45 ± 1.20	6.4	2,036	–0.23 ± 1.23	4.4	5.1
Both sexes										
7	652	–0.33 ± 1.03	4.0	652	–0.31 ± 1.36	5.7	648	–0.15 ± 1.40	4.2	8.5
8	2,118	–0.48 ± 1.00	6.4	2,119	–0.37 ± 1.34	6.4	2,062	–0.09 ± 1.39	4.6	8.4
9	1,894	–0.53 ± 1.06	7.3	1,898	–0.45 ± 1.29	8.0	1,653	–0.17 ± 1.31	4.9	6.4
10	1,321	–0.55 ± 1.05	7.8	1,324	–0.44 ± 1.24	7.6	—	—	—	
All ages	5,985	–0.49 ± 1.04	6.7	5,993	–0.41 ± 1.30	7.1	4,973	–0.12 ± 1.36	4.5	7.7

a. The numbers of subjects are less than the numbers analyzed for weight and height because some of the measurements exceeded the capability of the Anthro program.

weight-for-age Z score of boys and girls. The mean weight-for-age Z score of girls was significantly lower than that for 8- and 10-year-old boys and for all the age groups combined.

Weight-for-height Z score could not be analyzed for about 3% of the boys and 30% of the girls. This was because the Anthro software program, which is based on the NCHS data, has an inherent limit to the maximum height and age that it can handle. Thus, it was not possible to compare the weight-for-height Z scores of 10-year-old boys and girls.

The difference in mean weight-for-height Z score of the children followed the same pattern as that observed for weight-for-age Z score. The mean weight-for-height Z score of girls was significantly lower than that of 8- and 9-year-old boys and for all the age groups combined. Except for 8-year-old children, in which there was no difference between boys and girls, the prevalence of wasting was 1.1 times higher among boys and for all age groups combined. The overall prevalence was 4.7% for boys and 4.4% for girls.

Prevalence of overweight

The prevalence of overweight (weight-for-height Z score > 2 SD) was 7.7% (table 2). This was about 1.6 times greater than the prevalence of wasting. The prevalence of overweight among boys (9.5%) was about 1.9 times greater than that among girls (5.1%). For all age groups, this prevalence was 1.2 to 2.3 times higher in boys. As explained earlier, the weight-for-height Z scores for 10-year-old girls could not be analyzed by the Anthro program.

Prevalence of thinness and overweight according to BMI-for-age

Because it was not possible to analyze about 30% of the weight-for-height data for girls, especially the older children, BMI-for-age was used to determine the prevalences of thinness and overweight of all the children in the study. The prevalence of thinness (BMI < 5th percentile of NHANES I reference data [1]) was 13.7% for boys ($N = 3{,}037$) and 15.4% for girls ($N = 2{,}958$); the combined prevalence for both was 14.5% ($N = 5{,}995$). The prevalence of risk of overweight (≥ 85th percentile of NHANES I reference data) was 19.2% for boys and 16.5% for girls, with a combined prevalence of 17.8% (table 3).

When the prevalences based on BMI-for-age are compared with figures derived from weight-for-height Z scores based on the NCHS reference (table 3), the prevalence of thinness was found to be about three times higher, whereas the prevalence of overweight was about two to three times higher. The comparisons made are not strictly valid, because the children in both groups are not exactly the same. Further investigations were therefore carried out by analyzing the prevalences of thinness and overweight for the same group of children using the two methods.

The group of children that could be analyzed by both methods consisted of 2,937 boys and 2,036 girls under 8.5 years of age. Table 4 shows that using BMI-for-age gave a three-times-higher prevalence of thinness among boys. The prevalence of thinness based on weight-for-height Z score was therefore only about

TABLE 4. Comparison of prevalence of thinness using weight-for-height Z scores and BMI-for-age for the same group of children

Sex and age (yr)	*n*	< –2 SD (%)	< 5th percentile (%)	BMI
Male				
7	341	4.4	6.2	1.4
8	1,056	4.6	11.5	2.5
9	930	5.1	17.0	3.3
10	610	4.3	18.0	4.2
All ages	2,937	4.7	14.0	3.0
Female				
7	307	3.9	9.4	2.4
8	1,006	4.6	15.7	3.4
9	723	4.6	18.4	4.0
10	0	—	—	—
All ages	2,036	4.4	15.7	3.6

TABLE 3. Comparison of prevalence of thinness using the weight-for-height Z scores and BMI-for-age[a]

	Weight-for-height Z score			BMI-for-age		
Subjects	*n*	< –2 SD (%)	> 2 SD (%)	*n*	< 5th percentile (%)	≥ 85th percentile (%)
Boys	2,937	4.7	9.5	3,037	13.7	19.2
Girls	2,036	4.5	5.2	2,958	15.4	16.5
Both sexes	4,973	4.6	7.7	5,995	14.5	17.8

a. The children analyzed using the two methods were not exactly the same; the sample sizes were also different.

4.7%, whereas the prevalence based on BMI-for-age was 14%. It can also be noted that this difference in the prevalence of thinness obtained by the two methods increased with the age of the children. A similar difference was observed for girls. In table 5, a similar tabulation for the prevalence of overweight analyzed by the two methods shows that when the cutoff point was at or above the 85th percentile of BMI-for-age, the prevalence for both sexes was about 2 to 2.5 times higher than obtained by using the weight-for-height Z score.

When the prevalence of overweight was analyzed using a cutoff point at or above the 95th percentile of the NHANES I reference data [1], the results were much closer to those obtained using –2 SD of the weight-for-height Z score (table 5); the ratios ranged from 0.7 to 1.3. The prevalence of overweight was 8.6% for boys and 5.3% for girls. It is to be noted that these children are a subsample of the study subjects, selected only to demonstrate the difference between the two methods of analysis.

The prevalence of overweight was determined for all the children in the study based on a cutoff point at or above the 95th percentile of the reference data. The data in table 6 can be taken as an estimate of the prevalences of overweight: 9.7% for boys and 7.1% for girls. The prevalences for each of the age groups for the boys and girls are also given in the table. The prevalence was slightly lower among girls. For children of both sexes, the prevalence declined with increasing age.

Comparison with rural primary schoolchildren

The prevalence of undernutrition among subjects in this study was much lower than that found in a study of rural schoolchildren [3] of about the same age that was conducted at almost the same time as this study. The sample consisted of 1,057 boys and 1,069 girls (N = 2,126) in 69 villages and seven estates located in nine states in peninsular Malaysia. The prevalence of stunting and underweight was about four times higher among the rural children, and the prevalence of wasting was about 1.6 times higher (table 7). The same difference was observed for both boys and girls.

The prevalence of the risk of overweight among this group of urban schoolchildren (7.7%) was about four times higher than that reported for rural primary

TABLE 5. Comparison of prevalence of overweight using the weight-for-height Z scores and BMI-for-age for the same group of children

Sex and age (yr)	*n*	> 2 SD (%)	≥ 85th percentile (%)	BMI/NCHS % ≥ 85th percentile/ % > 2 SD	≥ 95th percentile %	BMI/NCHS % ≥ 95th percentile/ % > 2 SD
Male						
7	341	9.1	16.2	1.8	10.3	1.1
8	1,056	11.9	20.0	1.7	10.6	0.9
9	930	8.0	16.0	2.0	7.3	0.9
10	610	8.5	17.2	2.0	6.4	0.8
All ages	2,937	9.6	17.7	1.8	8.6	0.9
Female						
7	307	7.8	17.9	2.3	10.1	1.3
8	1,006	5.0	13.5	2.7	5.3	1.1
9	723	4.4	11.1	2.5	3.2	0.7
10	0	—	—	—	—	—
All ages	2,036	5.3	13.3	2.5	5.3	1.0

TABLE 6. Prevalence of overweight among all subjects based on cutoff point of ≥ 95th percentile of BMI-for-age

	Boys		Girls		Both sexes	
Age (yr)	*n*	Prevalence (%)	*n*	Prevalence (%)	*n*	Prevalence (%)
7	341	10.3	311	10.3	652	10.3
8	1,066	11.2	1,053	7.2	2,119	9.2
9	958	8.9	941	7.0	1,899	8.0
10	672	8.5	653	5.5	1,325	7.0
All ages	3,037	9.7	2,958	7.1	5,995	8.4

TABLE 7. Prevalence of undernutrition among urban and rural primary schoolchildren

Children	Height-for-age		Weight-for-age		Weight-for-height	
	n	< –2 SD (%)	*n*	< –2 SD (%)	*n*	< –2 SD (%)
Urban						
Boys	3,033	8.1	3,035	7.9	2,937	4.8
Girls	2,952	5.6	2,958	6.8	2,036	4.5
Both sexes	5,985	6.9	5,993	7.4	4,973	4.6
Rural[a]						
Boys	1,049	34.4	1,057	29.1	950	8.2
Girls	1,066	24.9	1,069	26.1	731	6.2
Both sexes	2,115	29.6	2,126	26.9	1,681	7.3
Rural and urban						
Boys	4,082	4.4	4,092	3.7	3,887	1.7
Girls	4,018	4.5	4,027	4.1	2,767	1.4
Both sexes	8,100	4.4	8,119	3.8	6,654	1.6

a. Data from World Health Organization [2].

schoolchildren (1.9%) [3] (table 8). The prevalence of overweight among rural boys and girls was approximately the same at 2.0%. On the other hand, the prevalence of overweight among urban boys was about twice that among urban girls.

Conclusions

The mean weights and heights of boys were greater than those of girls for the younger age groups (7 and 8 years). As the ages increased (9 and 10 years), the reverse was true and the girls were heavier and taller than the boys. The mean BMI was generally greater for boys in all age groups. Undernutrition, as determined by the prevalences of stunting, underweight, and wasting, was also more serious among the boys, particularly as measured by stunting and underweight.

The prevalence of overweight was higher than that of wasting for both boys and girls in all age groups. Boys had a slightly higher prevalence of overweight than girls; the difference was larger for the older children. Both undernutrition and overweight were more frequent among boys. The prevalence of undernutrition among the urban study subjects (less than 8%) was much less than that among rural primary schoolchildren. On the other hand, the prevalence of overweight (about 8%) was much greater than among rural children (about 2%). The factors responsible for this difference in nutrition between rural and urban children should be investigated to provide useful lessons for the prevention and control of overweight.

TABLE 8. Prevalence of overweight among urban and rural schoolchildren

Children	*n*	> 2 SD (%)
Urban		
Boys	2,937	9.5
Girls	2,036	5.2
Both sexes	4,973	7.7
Rural[a]		
Boys	1,731	2.0
Girls	1,544	1.9
Both	3,275	1.9
Urban and rural		
Boys	4,668	4.8
Girls	3,580	2.7
Both sexes	8,248	4.1

a. Data from World Health Organization [2].

The analysis of weight and height measurements in this study was complicated by the fact that the study subjects ranged from 7 to 10 years old, consisting of younger primary schoolchildren in the prepuberty age group. As is well known, the NCHS data in the Anthro program are not appropriate for analyzing children over 9 years of age. The results of investigations into the use of weight-for-height Z score and BMI-for-age for the determination of thinness and overweight have been discussed earlier.

The analyses suggested that the use of cutoff points of less than the 5th percentile and equal to or greater than the 85th percentile for determining the prevalences of thinness and overweight, respectively, as recommended by WHO [2], may not be appropriate. These indicators appeared to have overestimated the prevalences by a magnitude of about two to three. To overcome the problem for overweight, the cutoff was set at at or above the 95th percentile, and the figures obtained are felt to be more realistic. The use of less than the 3rd percentile of the reference data for underweight would probably give prevalence data closer to those obtained by using the weight-for-height Z score.

It is important to determine whether these findings of differences in prevalences of thinness and overweight using the two methods of analysis are observed for other communities. It may be necessary to change

the cutoffs. Since investigators would be following the WHO guidelines [2] in reporting the prevalence of overweight among adolescents, these differences would have widespread implications for programs and policies.

Acknowledgments

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