Short Communication

Initiating BMI prevalence studies in Vietnamese children: changes in a transitional economy

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Background: Rapid changes in dietary patterns and lifestyles in Vietnam warrant monitoring trends of weight, height and body mass index (BMI) among children. Objective: To determine the trends of weight, height and BMI classification of Vietnamese children, 6-15 years of age, from 1992 to 2000 with reference to socioeconomic, urban and rural differences. Methods: Data in the Vietnam Living Standard Survey (1992-1993) and the General Nutrition Survey (2000) were collected from representative samples of children. Body mass index classification was determined using the International Obesity Task Force criteria to calculate the prevalence and trends in each survey, and in a pooled survey analysis. Results: Statistically significant increases were seen in children's mean weight, height and BMI between the two surveys: 2.1 kg for weight, 4 cm for height, and 0.28 kg/m^2 for BMI. Increases in height were greater in rural than urban areas, and BMI increases were smaller in rural than urban areas. Conclusions: The rising prevalence of children at risk of overweight in urban Vietnam is a concern that must be monitored to guide policy changes. The unchanging prevalence of rural underweight boys requires attention. A national nutrition program to address under- and overweight for children throughout primary school is needed.

Key Words: weight, height, BMI, Vietnamese children, overweight

INTRODUCTION

Childhood underweight remains a pervasive problem in developing countries where poverty is predominant;[1] however, when developing countries undergo rapid socioeconomic development, childhood overweight can increase and pose new challenges.[2] In Vietnam, dramatic changes brought by post-economic reform *(Doi Moi)* in dietary patterns and lifestyle make Vietnamese children vulnerable to overweight and the risks associated with it.[3-5] Close monitoring of childhood overweight prevalence is warranted to identify problems requiring intervention and to prevent increases in chronic disease.

Making identification and tracking difficult is the absence of studies of Vietnamese children's weight status using a body mass index (BMI) classification system, which resulted from a lack of agreement on a system to classify weights of children ages 6 and older.[6] Appropriate cut-off points for Asian children may differ from those currently recommended by the World Health Organization (WHO).[7,8] Body mass index is a reasonably good indicator for body fat, but the relationship between BMI and body fat is dependent on age, gender and ethnicity.[9] Asians, including Vietnamese, have lower BMI but higher percentage body fat than whites do, and their body fat is distributed differently.[10] Furthermore, monitoring weight status among children ages 6-15 years for overweight previously has not been a priority because of the high prevalence of underweight among Vietnamese children younger than 5 years of age.

This study reports within the context of socioeconomic changes the prevalence and trends of overweight, at risk of overweight, normal weight and underweight among Vietnamese children ages 6-15 years from two cross-sectional assessments, one in 1992-1993,[11] and another in 2000,[12] using the International Obesity Task Force (IOTF) guide as the selected standard.[13]

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MATERIALS AND METHODS

The data used in this study came from the Vietnam Living Standard Survey conducted from 1992 to 1993 (1992 VLSS) and the General Nutrition Survey in 2000 (2000 GNS). Details of sampling frames and data collection in the 1992 VLSS[11] and in the 2000 GNS have been described previously.[12] The study data were made publicly available by the General Statistical Office (GSO) in Vietnam and the National Institute of Nutrition (NIN) in Hanoi, and permission was granted for its use for this research.

Sampling

The 1992 VLSS, a multistage clustered sample, used a sampling frame based on the 1989 Vietnam census. At the first stage, the overall sampling frame was stratified into urban and rural groups. At the second stage, 150 of the approximately 10,000 communes in each area were selected with the probability of selection proportional to population size. In the third stage, two villages or blocks were selected in each commune with selection probability proportional to population size. At the fourth stage, 20 primary sampling units (PSUs) (households) were randomly selected. From all the selected PSUs representing the communes, 4800 households were randomly sampled. In all, 5640 children 6-15 years of age were measured. Household response rate was 70%.

The 2000 GNS

The 2000 GNS, a multistage clustered sample, used a sampling frame based on the 1999 Vietnam census. Two hundred forty localities were selected from the 165,906 localities in Vietnam, with probability of selection proportional to size. A total of 2540 blocks and 2745 villages were selected, and 7686 households were randomly sampled. A total of 9870 children 6-15 years of age were included, and household response rate was 80%.

Data collection

The household questionnaire for the 1992 VLSS was based on the format used by the World Bank in other Living Standards Measurement Study surveys, but questions were adapted to the Vietnam population. The survey team was trained, tested, and field supervised.

Anthropometric measurements

Weight and height were assessed for the 1992 VLSS and the 2000 GSN using the same kind of equipment and measurement protocol. Body weight, measured using a beam balance scale with the subject in light indoor clothing, was recorded to the nearest 0.1 kg. Height, measured using a stadiometer with the subject not in shoes, was recorded to the nearest 0.1 cm. Age was calculated in years. Household socioeconomic status (SES) was based on the Vietnam total poverty line.

Body mass index was calculated by dividing body weight (in kilograms) by the square of height (in meters) for each person, and each measure was classified into a group using the IOTF classification, which is thought to better classify Asians. Because BMI cut-offs for underweight were not available from ITOF,[13] the WHO/Must criteria were used.[14]

Statistical analyses

The sample of children ages 6-15 years with complete data for all covariates was assembled. A descriptive analysis included means for the continuous variables and proportions for the categorical variables examined by age, sex, area of residence, and SES, with differences identified as significant when $p<0.05$. All analyses were conducted using STATA (version 9.0) (STATA Corporation, College Station, Texas, USA), accounting for the complex sampling design of the respective survey. Statistical evaluation of differences in anthropometrics between two surveys required pooling data from the weighted surveys, using a procedure described by Korn and Graubard.[15]

RESULTS

The unweighted percentage of each age group was similar in both surveys, and so was the unweighted ratio of boys to girls. Of the 10 age groups, each accounted for 8.9%-11.5% in the 1992 survey and 9.2%-11.5% in the 2000 survey. Children were more than four times as likely to live in the country than the city in both surveys (83.2% versus 82.0%), and the unweighted percentage of rural households was only 1.2 percentage points different (16.8% versus 18%) (Table 1).

Boys were heavier than girls between the ages of 6 and 10 years but then lighter than girls until age 15 (Table 2). Boys were taller than girls between the ages of 6 and 9 years, shorter than girls until age 13, and then taller than girls again until age 15. Boys had a mean BMI higher than that of girls between the ages of 6 and 12 years and then lower than that of girls until age 15.

Children in urban areas and in households of higher SES were heavier and taller than their counterparts in rural areas and in lower SES households. As well, BMI was greater among urban and higher SES households (Table 3).

Prevalence of at risk of overweight and overweight, normal weight and underweight

Because the prevalence of overweight among Vietnamese children age 6 to 15 years was very low (0.03% in 1992 and 0.5% in 2000), the two categories of at risk of overweight and overweight were combined into one. In each survey, the prevalence of at risk of overweight and overweight by age and gender was low, but younger children had a higher prevalence of at risk of overweight and overweight (Figure 1chin) than did older ones. Furthermore, the percentage of children at risk of overweight or overweight was consistently higher in 2000 than it was in 1992.

The mean prevalence of at risk of overweight and overweight among Vietnamese children age 6-15 years was much higher in urban than rural areas and much higher in the rich households than in the poor households (Table 4). In 2000, at risk of overweight and overweight was fivefold higher in urban (6.2%) than in rural areas (1.2%), and fourfold higher in the very rich households (4.9%) than in the very poor households (1.2%).

The mean prevalence of at risk of overweight and overweight significantly increased—nearly ninefold (from 0.7% in 1992 to 6.2 % in 2000, $p<0.001$) in urban areas and threefold (from 0.4% in 1992 to 1.2 % in 2000,

Table 1. Characteristics of Vietnamese children ages 6–15 years—1992 VLSS and 2000 GNS

Characteristics	1992		2000	
	n	%	n	%
Age (years)				
6	570	10.1	888	9.0
7	578	10.3	1010	10.2
8	650	11.5	1003	10.2
9	582	10.3	972	9.9
10	596	10.6	1134	11.5
11	600	10.6	1013	10.3
12	515	9.1	1005	10.2
13	516	9.2	941	9.5
14	534	9.5	907	9.2
15	499	8.9	997	10.1
Gender				
Boy	2861	50.7	5059	51.3
Girl	2779	49.3	4811	48.7
Area of residence				
Urban	947	16.8	1772	18.0
Rural	4693	83.2	8098	82.0
Socioeconomic status				
Very poor	1235	21.9	2945	29.9
Poor	1248	22.1	2141	21.7
Average	1124	19.9	1817	18.4
Rich	1065	18.9	1690	17.1
Very rich	968	17.2	1277	12.9
Total	5640	100.0	9870	100.0

Table 2. Mean weight, height, and BMI among Vietnamese children by age and gender—1992 VLSS and 2000 GNS

Age (yr)	Gender	Weight (kg) Mean (SE)		Height (cm) Mean (SE)		BMI (kg/m^2) Mean (SE)	
		1992	2000	1992	2000	1992	2000
6	Boy	16.4 (0.2)	17.2 (0.2)	106.2 (0.7)	109.6 (0.4)	14.5 (0.1)	14.2 (0.1)
	Girl	15.9 (0.2)	16.4 (0.2)	106.3 (0.5)	108.6 (0.2)	14.1 (0.1)	13.9 (0.1)
7	Boy	17.9 (0.2)	19.4 (0.3)	111.5 (0.5)	115.5 (0.5)	14.4 (0.1)	14.4 (0.1)
	Girl	17.0 (0.2)	18.0 (0.1)	110.8 (0.8)	114.2 (0.4)	13.9 (0.1)	13.8 (0.1)
8	Boy	19.8 (0.2)	20.9 (0.2)	117.1 (0.4)	119.7 (0.4)	14.4 (0.1)	14.5 (0.1)
	Girl	19.1 (0.2)	20.1 (0.2)	116.4 (0.5)	119.4 (0.4)	14.0 (0.1)	14.0 (0.1)
9	Boy	21.2 (0.2)	22.7 (0.2)	120.6 (0.5)	124.2 (0.4)	14.5 (0.1)	14.7 (0.1)
	Girl	20.8 (0.2)	22.4 (0.2)	121.1 (0.5)	124.2 (0.4)	14.2 (0.1)	14.5 (0.1)
10	Boy	23.3 (0.2)	24.7 (0.3)	125.4 (0.4)	128.8 (0.6)	14.8 (0.1)	14.9 (0.1)
	Girl	22.6 (0.3)	24.3 (0.3)	124.4 (0.8)	129.2 (0.5)	14.5 (0.1)	14.5 (0.1)
11	Boy	24.9 (0.2)	26.8 (0.3)	129.1 (0.4)	132.6 (0.4)	14.9 (0.1)	15.1 (0.1)
	Girl	25.6 (0.4)	27.9 (0.3)	130.8 (0.7)	134.7 (0.5)	14.8 (0.1)	15.3 (0.1)
12	Boy	27.5 (0.3)	30.0 (0.3)	134.1 (0.5)	137.6 (0.5)	15.2 (0.1)	15.7 (0.1)
	Girl	28.8 (0.4)	30.6 (0.3)	136.6 (0.7)	138.9 (0.4)	15.3 (0.1)	15.7 (0.1)
13	Boy	30.8 (0.5)	33.2 (0.4)	138.9 (0.7)	141.4 (0.6)	15.8 (0.1)	16.5 (0.1)
	Girl	32.3 (0.5)	34.0 (0.3)	140.6 (0.7)	143.6 (0.4)	16.2 (0.1)	16.5 (0.1)
14	Boy	34.6 (0.5)	37.6 (0.4)	144.4 (0.8)	149.0 (0.6)	16.6 (0.1)	16.8 (0.1)
	Girl	36.2 (0.6)	38.0 (0.4)	144.7 (0.8)	147.0 (0.5)	17.2 (0.1)	17.5 (0.1)
15	Boy	38.8 (0.5)	41.7 (0.4)	150.1 (0.8)	153.6 (0.5)	17.1 (0.1)	17.5 (0.1)
	Girl	39.2 (0.4)	40.8 (0.4)	147.8 (0.5)	149.4 (0.4)	17.9 (0.2)	18.2 (0.1)
All	Boy	25.2 (0.2)	27.5 (0.2)	127.1 (0.2)	131.4 (0.4)	15.1 (0.04)	15.4 (0.1)
	Girl	25.7 (0.3)	27.6 (0.2)	127.9 (0.5)	131.6 (0.4)	15.2 (0.1)	15.5 (0.1)
	Total	25.4 (0.2)	27.6 (0.2)	127.5 (0.04)	131.5 (0.3)	15.2 (0.04)	15.4 (0.05)

Abbreviations: SE, standard error; BMI, body mass index.

Table 3. Differences in mean weight, height and BMI among Vietnamese children ages 6–15 years by gender, area of residence, and socioeconomic status—1992 VLSS and the 2000 GNS

Characteristics	Weight (kg) Mean (SE)			Height (cm) Mean (SE)			BMI (kg/m^2) Mean (SE)		
	1992	2000	Difference†	1992	2000	Difference†	1992	2000	Difference†
Gender									
Boy	25.2 (0.2)	27.5 (0.2)	2.3 (0.2)**	127.1 (0.3)	131.4 (0.3)	4.3 (0.4)**	15.1 (0.03)	15.4 (0.04)	0.3 (0.05)**
Girl	25.7 (0.2)	27.6 (0.2)	1.9 (0.2)**	127.9 (0.3)	131.6 (0.3)	3.7 (0.4)**	15.2 (0.04)	15.5 (0.04)	0.25 (0.06)**
Area of residence									
Urban	27.8 (0.3)	30.2 (0.3)	2.4 (0.4)**	132.3 (0.5)	134.7 (0.4)	2.5 (0.7)**	15.4 (0.08)	16.1 (0.08)	0.7 (0.11)**
Rural	25.1 (0.1)	27.1 (0.1)	1.9 (0.2)**	126.9 (0.3)	130.9 (0.2)	4.0 (0.3)**	15.1 (0.03)	15.3 (0.03)	0.2 (0.04)**
Socioeconomic status									
Very poor	23.7 (0.2)	25.1 (0.2)	1.5 (0.3)**	123.6 (0.5)	127.0 (0.3)	3.4 (0.6)**	15.1 (0.1)	15.2 (0.05)	0.1 (0.1)
Poor	24.0 (0.3)	27.1 (0.2)	3.1 (0.3)**	125.1 (0.5)	131.3 (0.4)	6.1 (0.6)**	14.9 (0.1)	15.3 (0.1)	0.3 (0.1)**
Average	25.5 (0.3)	28.1 (0.2)	2.7 (0.4)**	127.8 (0.5)	133.0 (0.4)	5.2 (0.6)**	15.2 (0.1)	15.5 (0.1)	0.3 (0.1)*
Rich	27.3 (0.3)	29.1 (0.3)	1.7 (0.4)**	131.4 (0.5)	134.3 (0.4)	2.9 (0.7)**	15.3 (0.1)	15.6 (0.1)	0.3 (0.1)*
Very rich	28.1 (0.4)	31.0 (0.3)	2.9 (0.5)**	132.4 (0.6)	136.2 (0.5)	3.8 (0.8)**	15.5 (0.1)	16.2 (0.1)	0.7 (0.1)**
All	25.4 (0.1)	27.6 (0.1)	2.1 (0.2)**	127.5 (0.2)	131.5 (0.2)	4.0 (0.3)**	15.2 (0.02)	15.4 (0.02)	0.28 (0.04)**

Abbreviations: SE, standard error; BMI, body mass index.
†Difference between the estimates of the 1992 VLSS and the 2000 GNS
*p <0.002, **p < 0.0005 (t test)

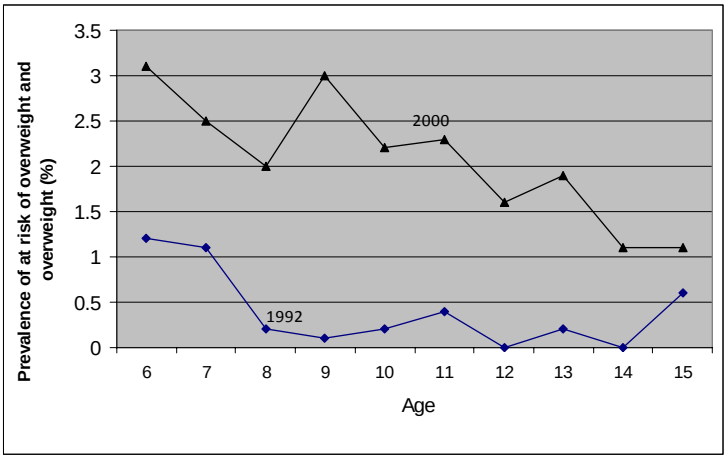

Figure 1. Prevalence of overweight and at risk of overweight by age among Vietnamese children in 1992 and 2000.

p<0.001) in rural areas. Increases in at risk of overweight and overweight were also higher in the very rich households than in the less rich households (Table 4).

The mean prevalence of underweight among Vietnamese children was lower in urban than rural areas in the 2000 GNS, but not in the 1992 VLSS (Table 4). In 2000, it was lower in urban areas (25.7%) than in rural areas (34.8%), and it was lower in the very rich households (23.5%) than in the very poor households (35.2%)

The prevalence of underweight did not significantly change during the study period. There were changes in prevalence of underweight among urban children and by SES groups. The prevalence of underweight decreased significantly in urban areas. In rural areas, the prevalence of underweight was not statistically significantly different between the two surveys. The prevalence of underweight among the children in very rich households decreased (from 31.2% in 1992 to 23.5% in the 2000 GNS, p<0.001), whereas the prevalence of underweight by SES among other households did not significantly change.

It is worthwhile to note that the mean prevalence of underweight among Vietnamese children ages 6-15 years by age and gender was high. There was an increase in underweight from ages 6 to 12 years, followed by a de-

Table 4. Prevalence of at risk of overweight and overweight, normal weight and underweight by gender, area of residence and socioeconomic status—1992 VLSS and 2000 GNS

Characteristics	At risk of overweight and overweight				Normal weight				Underweight			
	1992		2000		1992		2000		1992		2000	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Gender												
Boy	0.3	0.1-0.5	2.3	1.8-2.8*	63.9	61.9-65.9	62.9	61.3-64.4	35.8	33.8-37.8	34.8	33.3-35.3*
Girl	0.5	0.2-0.9	1.7	1.2-2.2*	66.8	64.9-68.8	66.4	64.8-68.0	32.7	30.7-34.6	31.9	30.3-33.4
Area of residence												
Urban	0.7	0.1-1.2	6.2	4.6-7.7*	62.5	59.1-66.0	68.2	65.6-70.7*	36.8	33.4-40.2	25.7	23.4-28.0*
Rural	0.4	0.1-0.6	1.2	0.9-1.5*	65.7	64.2-67.2	64.0	62.7-65.2*	33.9	32.4-35.4	34.8	33.6-36.0
Socioeconomic status												
Very poor	0.4	0.0-0.8	1.2	0.7-1.7*	65.8	62.9-68.7	63.6	61.4-65.7	33.8	30.9-36.7	35.2	33.1-37.4
Poor	0.5	0.0-1.0	1.6	0.8-2.3*	62.3	59.2-65.4	60.4	58.2-63.0	37.2	34.1-40.3	37.8	35.4-40.2
Average	0.2	0.0-0.5	1.5	0.9-2.2*	65.3	62.2-68.4	65.4	62.9-67.9	34.5	31.4-37.6	33.1	30.6-35.5
Rich	0.2	0.0-0.4	2.6	1.4-3.7*	66.6	63.5-69.7	65.5	62.8-68.2	33.2	30.1-36.4	31.9	29.3-34.5
Very rich	0.8	0.2-1.5	4.9	3.6-6.2*	68.0	64.6-71.3	71.6	68.8-74.4*	31.2	27.8-34.5	23.5	20.8-26.1*

Abbreviation: CI: confidence interval.
*p<0.001 (t test).

crease in later years. The highest prevalence of underweight observed was among children ages 10-13 years. This pattern was similar for boys and girls, except the peak prevalence of underweight among boys occurred about one year later than for girls.

Pooled prevalence of weight groups

Mean prevalence of at risk of overweight and overweight from the pooled data for all age groups increased significantly over the 8 years between studies (Table 5). In contrast, the percentage of those of normal weight shrank from 65.3% in 1992 to 64.6% in 2000, and the percentage of those who were underweight shrank from 34.3% in 1992 to 33.4% in 2000.

The prevalence of at risk of overweight and overweight increased twelvefold, from 0.6% in 1992 to 7.5% in 2000, for boys (p<0.05) and sixfold, from 0.7% to 4.6%, for girls (p<0.05). However, these patterns were not seen in rural areas. The prevalence of at risk of overweight and overweight was higher in urban boys than girls and higher in urban than in rural areas (Table 6).

DISCUSSION

This study shows increases in overweight over the 8 years between 1992 and 2000 as well as an unchanging high prevalence of underweight. This pattern has been reported by WHO in studies of transitional countries as they become more developed.[16] Sakamoto et al. reported the

Table 5. Prevalence of at risk of overweight and overweight, normal weight and underweight—1992 VLSS and 2000 GNS

Characteristics	At risk of overweight and overweight	Overweight	At risk of overweight	Normal weight	Underweight
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Year					
1992	0.4 (0.2-0.6)	0.03 (0.0-0.07)	0.4 (0.2-0.6)	65.3 (63.9-66.7)	34.3 (32.8-35.6)
2000	2.0 (1.7-2.4) *	0.5 (0.4-0.7) *	1.5 (1.2-1.8)*	64.6 (63.5-65.7)	33.4 (32.3-34.5)

Abbreviation: CI, confidence interval.
*p< 0.001 (t test).

Table 6. Comparison of the prevalence of at risk of overweight and overweight and the underweight by area of residence and gender—1992 VLSS and 2000 GNS

Characteristics		At risk of overweight and overweight				Underweight			
Area of residence	Gender	1992		2000		1992		2000	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Urban	Boy	0.6	0.0-1.2	7.5	5.3-9.7*	41.4	36.5-46.4	26.9	23.7-30.1*
	Girl	0.7	0.0-1.5	4.6	2.6-6.7*	32.3	27.6-36.9	24.3	21.0-27.6*
Rural	Boy	0.2	0.0-0.4	1.3	0.8-1.7*	35.1	33.0-37.3	36.4	34.7-38.2
	Girl	0.5	0.1-0.9	1.2	0.7-1.6*	32.7	30.6-34.8	33.3	31.5-35.0

Abbreviation: CI: Confidence interval.
*p<0.05 (t test).

prevalence of obesity among children ages 6 to 12 years in Thailand, classified as weight for height of the Bangkok reference, rose from 12.2% in 1991 to 15.6% in 1993.[17] These estimates were higher than our findings, partly because of different BMI classification standards and partly because of the more advanced socioeconomic development of Thailand. In Vietnam, the increasing prevalence of at risk of overweight and overweight children could be a result of the remarkable progress in socioeconomic developments, reflected in the doubling of per capita gross domestic product from 1992 to 2000,[18] leading to an improved standard of living and improved socioeconomic conditions for most of the population.

The increase in at risk of overweight and overweight among Vietnamese children was higher in urban than rural areas. This pattern was apparent for urban boys only in the trend analyses, not the cross-sectional analyses. This difference may be due to variations in socioeconomic development between the two areas, inasmuch as the rural areas have a lower rate of socioeconomic development than do the urban areas. Such differences in overweight and underweight as a reflection of unbalanced socioeconomic development between the urban and rural areas have also been observed in China.[19]

Furthermore, the prevalence of underweight decreased significantly in urban areas, but it remained unchanged among the rural children over the period studied. This is not consistent with the belief that prevalence of underweight in all the Vietnamese children decreased significantly. The small change in the overall prevalence of underweight children could be explained by the majority of Vietnam children living in rural areas who accounted for the high prevalence of underweight relative to the prevalence of underweight of the urban children. An additional explanation is there were relative differences in increases in weight and height between rural and urban children, which influence the trend of the prevalence of underweight among the rural children. Results from the pooled analyses indicate higher increases in height among rural children (4 cm) than urban children (2.5 cm) from 1992 to 2000 and a lower increase in weight among rural children (1.9 kg) than urban children (2.4 kg). Consequently, while there was a remarkable increase in BMI among urban children (0.7 kg/m^2), there was only a small increase in BMI in rural children (0.2 kg/m^2) (Table 3). Therefore, in terms of BMI, measured by kg/m^2, the rural children were more likely to remain underweight than were the urban ones.

A surprising finding is the dramatically higher prevalence of underweight among older children as compared with younger children —about 200%—from 15.3% at the age of 6 to 46.9% at the age of 12 in the 2000 survey. This age-associated increase may be related to parents' inability to recognize underweight as a problem in these age groups. This may also be related to differences in energy expenditure between children who are 6 to 12 years old and those who are less than five years of age. At 6, Vietnamese children begin attending primary school and engage in more physical activity than in kindergarten. These activities would cause them to expend more energy, leading them to be underweight if their energy intake was lower than the recommended requirement, especially in rural areas where children are more likely to play outside and engage in physical labor. Another explanation for this rise in prevalence may be because the current malnutrition program in Vietnam is only for kindergarten children and parents.[20]

This study provides the first population-based estimates of the prevalence of at risk of overweight and overweight, normal weight and underweight for Vietnam. These estimates are based on BMI values calculated according to the IOTF and WHO classifications, which provide realistic estimates of body size for Asian populations. Several attempts have been made to create BMI-based classification systems for children, both for national and international use. Systems created by the WHO/MDD,[14] the Centers for Disease Control and Prevention (CDC),[21] and the IOTF[13] are commonly used systems. The IOTF method was chosen for use in this study because it appears to be better than other existing methods for use with populations such as ours since its cut-offs have advantages for international use.

First, the IOTF standards are based on data from six nations that are more representative of Vietnam's population than the U.S. pediatric population**.** Second, the BMI cut-offs are linked to adult cut-offs for overweight and obesity that are good indicators of risks for adverse health outcomes. Moreover, the IOTF presents BMI trends by age, gender, area of residence and SES, providing changes in BMI during the time frame of pubertal development of Vietnamese children, allowing comparisons with other developing Asian countries.[7]

Waist circumference measures, which were not recorded in these surveys, provide additional information on risk, higher values correlating with higher risk for metabolic and cardiovascular disease[22] and death[23] and in Asians with general comorbidities.[24-26] Recent research, such as that from Ho Chi Minh City, which found that abdominal adiposity rates outpaced BMI overweight and obesity in women subjects as indicators of risk,[27] remind us that waist circumference would be an important addition to the surveys' measures and to better understanding and early detection of risk related to non-communicable chronic disease and death.

The study may be limited by non-response, which could cause selection bias; however, response rates were high in both surveys, and the post-stratification weighting does adjust for unequal categories that may have resulted. Although we adjusted for age and gender, there were no measures of sexual maturation in the survey to accurately determine the role of pubertal status on BMI estimates.[21] There may be differences in terms of the period of maturation for Vietnam's children population and the reference populations. Despite these possible limitations, this study provides the first prevalence estimates of BMI categories for Vietnam, a transitional underdeveloped country.

CONCLUSION

These results suggest the rising prevalence of at risk of overweight and overweight among children in urban Vietnam. This trend could become a public health issue in the future if the current trend continues. Because of the accompanying chronic conditions associated with over-

weight and obesity in adulthood, it is critical to monitor prevalence of children's BMI in Vietnam to guide policy changes.

At the other end of the spectrum, the unchanging prevalence of underweight children in rural areas, especially among boys, signals the need to address this important nutrition problem as long as unbalanced socioeconomic development exists in the country. Body mass index intervention information and activities need to be tailored to the needs of the socioeconomic characteristics of the rural and urban areas. A national nutrition program should enlist parents and communities to address nutrition problems in children who are underweight and in those who are overweight. Future research on Vietnamese children's BMI should incorporate these findings for comparison, continue to track trends in rural and urban settings, and incorporate measures used by others as practicable to make studies comparable among nations.

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AUTHOR DISCLOSURES

The authors declare no conflict of interest.

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Short Communication

Initiating BMI prevalence studies in Vietnamese children: changes in a transitional economy

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越南孩童身體質量指數趨勢的研究：經濟變遷下的改變

背景：越南飲食型態與生活型態的快速改變，使得有必要注意越南孩童的體重、身高、身體質量指數的變化趨勢。目的：測定 1992-2000 年間的越南 6-15 歲學童的體重、身高及身體質量指數分層趨勢，參照其社經水平及城鄉差異。方法：使用越南居住標準調查(1992-1993)及全面營養調查(2000)的資料，為越南孩童的代表性樣本。身體質量指數的分層是使用國際肥胖特別工作組的準則，計算各資料庫及兩個資料庫匯總分析的孩童肥胖盛行率及趨勢。結果：在兩個調查間，孩童的平均體重、身高、身體質量指數有顯著的增加(各為 2.1 kg、4 cm 及 0.28 kg/m^2)。身高增加的程度，鄉村的孩童大於都市的孩童；且身體質量指數的增加程度，鄉村的孩童小於都市孩童。結論：越南都市孩童過重的盛行率上升是個需要關注的問題，並需要經由政策上的改變來監控；而鄉村男孩體重過低的盛行率未改變也值得關注。需要一個整體國家的小學營養計畫來處理孩童的體重過低及過重的問題。

關鍵字：體重、身高、身體質量指數、越南孩童、體重過重