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Nutritional Status of Primary School Children from Low Income Households in Kuala Lumpur

Zalilah Mohd Shariff[1], Jenny Taylor Bond[2] and Nan E. Johson[3]

[1] *Department of Nutrition and Health Sciences, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor.*
[2] *Department of Food Science and Human Nutrition, Michigan State University, East Lansing MI 48823 USA.*
[3] *Department of Sociology, Michigan State University, East Lansing MI 48823 USA*

ABSTRACT

Growth status was examined in relation to gender and age factors in urban primary school children (6-10 years old) from low income households in Kuala Lumpur, Wilayah Persekutuan. The sample consisted of 4212 boys (53%) and 3793 girls (47%). Data on weight and height data were obtained from two sources – investigator's and teachers' measurements of the school children. This study defined mildly and significantly underweight, stunted or wasted as z-score below minus one and below minus two of the NCHS/CDC reference median, respectively. Approximately 52% (n = 4149), 50% (n = 3893) and 30% (n = 2568) of the school children were underweight, stunted and wasted, respectively. However, the majority of these undernourished children were in the mild category. Prevalence of overweight (> 2 SD of NCHS/WHO reference median) was found in 5.8% of the sample. For both, prevalence of undernutrition and overnutrition, more boys than girls were found to be underweight stunted wasted and overweight. Compared to girls, boys had lower mean z-scores for the variables height-for-age ($p<0.05$) and weight-for-height ($p<0.01$). Older children had significantly lower mean z-scores for height-for-age ($p<0.001$) but higher mean z-scores for weight-for-height ($P<0.001$) than younger children. This finding indicates that with increasing age, stunting is associated with improved weight-for-height or that the children's weights have been adapted to their short statures. In conclusion, results demonstrate a high prevalence of underweight, stunting and wasting and an increasing prevalence of overweight among these low-income school children. Efforts recommended to address health and nutrition problems among school children should include health and nutrition monitoring (e.g. growth monitoring using the existing growth data collected by schools) and interventions.

INTRODUCTION

The definition of school age corresponds approximately to the period from kindergarten through lower secondary; it begins after the period of high mortality risk in the preschool years and continues through most of the adolescent growth spurts and sexual maturation to young adulthood. School age children constitute a substantial fraction of the world's population, numbering about 24% of the population of the less developed world and about 15% of that of the industrialized world. Not only are school age children a much larger proportion of the total population in less developed than in industrialized countries, but their numbers are also growing at a substantial rate in the former (1.4% per year) and not at all in the latter. In consequence, by the year 2000, approximately 87% of the world's school age children will live in less developed countries (Bulatoa & Stephens, 1990).

Nutritional studies on primary school children in Malaysia show that undernutrition and overnutrition continue to be major health problems, both in rural and urban areas. For example, anthropometric assessment of children aged 6-12 years old from five rural communities found the prevalence of underweight among boys and girls to be 29.1% and 26.1% respectively (Khor & Tee, 1997). In these communities, an average of 34.4% boys and 24.9% girls were stunted. However, the prevalence of wasting among these children (boys = 8.2%; girls = 6.2%) was much lower compared to the other two nutritional status indicators. The prevalence of overweight for this age group (6-12 years old) was not mentioned; however, the prevalence of overweight for children aged 18 years and below was approximately 2.0% for all the five communities studied. Several studies on nutritional status of primary school children in the urban areas of Malaysia report that although undernutrition is still prevalent, the percentage of overweight children is growing. A survey by the School Health Service Unit of the Health department of the City Hall of Kuala Lumpurfound that among the 7 and 12 years old in Kuala Lumpur, 12.5% and 16.2% were underweight and 3.6% and 7.1% were overweight (City Hall Kuala Lumpur, 1990). In another study by Bong & Jaafar (1996) of primary school children (Year 1 and 6) from rural and urban schools in Selangor, the overall prevalence of overweight and obesity was 7.8% with rural and urban schools marked at 6.1% and 9.8% respectively. More boys (66.7%) than girls (33.3%) and a significantly higher proportion of the Year 6 (11.1%) than Year 1 (4.4%) were overweight and obese. In a sample of low income children between 2-10 years of age, Chee (1992) found that underweight and stunting again appeared to be a major problem among all age groups with 5 – 10 years old showing the highest prevalence of underweight and stunting. In view of the still high prevalence of undernutrition and increasing prevalence of overnutrition among younger school children, this study was conducted to assess the nutritional status (weight-for-age, height-for-age and weight-for-height) of primary school children aged 6-10 years old from low income households in Kuala Lumpur. The study also focused on gender and age differentials in the children's growth status, mainly height-for-age (an indicator for chronic malnutrition) and weight-for-height (an indicator for acute malnutrition).

MATERIALS AND METHODS

A list of 35 primary schools categorized as "schools with low income parents or guardians" in Kuala Lumpur was obtained from the Ministry of Education. There were two types of schools in the list – 21 Sekolah kebangsaan (SK)and 14 Sekolah Rendah kebangsaan (SRK). However, the present study only included school children (Year 1-3) from the 21 SK with a majority of the children belonging to the Malay ethic group. This study (research ethics and protocol) was approved by Michigan State University Committee on research Involving human Subjects (UCRIHS) and both the Ministry of Education of Malaysia and Wilayah Persekutuan Department of Education.

Anthropometric measurements (height and weight) for 8005 children were obtained from two sources – investigator's and teachers' measurements of the school children. A total of 5915 children were measured by the research investigators while 2090 children's. measurements were taken from the school reports. A validity study was conducted prior to the inception of the study to determine the accuracy of the teachers' measurements. It was found that though the teachers were using somewhat less accurate equipment (bathroom scales and measuring tapes) to measure the children, the teachers' weight and height measurements did not differ significantly from that of the investigator's measurements (using Seca beam balance and portable infant/adult measuring units). Thus, it was concluded that the teachers' measurements were valid for use in the present study (Mohd Shariff, 1988). In addition, an evaluation of the performance of teachers and MCH nurses in relation to the doctors' health examination of a sample of school children, revealed that both teachers and nurses performed extremely well with 93% and 95.8% agreement respectively with the doctors' detection of health abnormalities in children (Ayyamani, 1986).

Weight and height of the school children were measured using a Seca digital scale (Seca, Colombia, MD) and a wooden portable adult and infant measuring unit (Perspective Enterprise, Kalamazoo, MI), respectively. The weight measurement was recorded to the nearest 0.1 kg and the height measurement to the nearest 0.1 cm. Three successive measurements each of weight and height were taken and the averages of these three measurements were used for the final analyses. The three successive measurements should agree within 0.1 cm for height and 0.1 kg for weight.

Growth status was indicated by z-scores for weight-for-age (WA), weight-for-height (WH) and height-for-age (HA) in order to identify the prevalence of underweight, wasting and stunting, respectively. These z-scores of WA, WH and HA were calculated using the software Epi Info (6.04). Low height-for-age is used as an indicator of stunting, an index of chronic malnutrition, while low weight-for-height is used as an indicator of wasting, an acute condition off current malnutrition. Weight-for-age reflects current nutritional status and is primarily a composite of weight-for-height and height-for-age. It fails, however, to distinguish tall, thin children from short, well-proportioned children.

It has been proposed that in the assessment of nutritional status in cross-sectional studies, the primary emphasis should be on height-for-age as an indicator of past nutrition and weight-for-height as an indicator of current nutrition (Waterlow *et al*., 1977). Both wasting and stunting reflect different biological processes. First, a child can fail to gain weight or he can lose weight. Second, linear growth is a slower process compared to growth in body mass. Finally, although a catch up in height undoubtedly can occur, it takes a relatively long time even with a favorable environment (WHO Working Group, 1986). Therefore, only the mean z-scores for these two indices (WH and HA) were stratified according to gender, age and standard (1-3) of the children. The national Center for Health Statistics/Center for Disease Control (NCHS/CDC) standard was utilized as a growth reference (WHO, 1983). The following categories of WA, WH and HA were used to determine the growth status of the children:

Significant	=	< -2 SD of NCHS/CDC median
Mild	=	-2 SD < x < -1 SD of NCHS/CDC median
Normal	=	-1 SD < x < +2 SD of NCHS/CDC median
High	=	> +2 SD of NCHS/CDC median

Descriptive statistics were generated for the data. One way ANOVA and T-test were used to identify the mean z-score differences in HA and WH according to gender, age and standard. Bonferroni post-hoc test was conducted to detect the significant mean z-score difference. Statistical significance was set at $p<0.05$. All statistical data analyses were done with SPSS 7.5.

RESULTS

Table 1 shows the distribution of fender, age and standard of all the primary school children in the present study. There were 3793 girls (47.4%) and 4212 boys (52.6%) from Years 1 to 3. The age range of the children was 6-10 years old with an average age of 8.1±0.9 years. The distribution of children from Years 1 to 3 was almost equal (32.5%, 35.5% and 32.1%). In terms Of ethnicity, approximately 99% (n=7363) were Malay while the rest were Indian and Chinese children. In this study, although socio-economic information was recorded from the school records, the information is not reported here because some subjects did not have their information updated or it was not available. In some cases, household incomes may have been under-reported. Nevertheless, based on the available household income data (n=5610), the mean household income was RM1206±774. In addition, in another in-depth study of a subsample of these school children (n=309), it was found that the mean household income was RM1491±1171 (Mohd Shariff, 1998). Although there may be a bias in these reported household incomes, both of these mean household incomes were relatively low compared to the mean household income for the urban Malay (RM2162) or the urban citizens in general (RM2593) (Malaysian Dept. of Statistics, 1997).

Table 1. Demographic characteristics of children (n=8005)

Variable	Level	n	(%)	Mean (SD)	Median
Gender of children					
	Male	4212	(52.6)		
	Female	3793	(47.4)		
Age of children (years)					
	6.0-6.9	1598	(20.0)		
	7.0-7.9	2058	(25.7)		
	8.0-8.9	2840	(35.5)		
	9.0-9.9	1509	(18.9)		
Age of children (years) by year of schooling					
	All	8005	(100.0)	8.03 (0.98)	8.12
	Year 1	2598	(32.5)	6.89 (0.41)	6.88
	Year 2	2839	(35.5)	8.12 (0.42)	8.13
	Year 3	2568	(32.1)	9.09 (0.42)	9.09

The mean weights and heights of the school children for each age group according to gender are shown in Table 2. As there is no significant difference in age between boys and girls for all the age groups, the mean weights and heights for both gender was compared to the median values of the NCHS reference of similar age category. For age groups 6.0-6.99 and 7.0-7.99, the deficit in height attainments were similar for girls (2.8-4.3 cm) and boys (2.9-4.4 cm) but the deficit in weight attainment was higher among boys (1.8-2.2 kg) than girls (1.2-1.9 kg). However, as age increased (age groups 8.0-8.99 and 9.0-9.99), the reverse was observed in that the deficits in height and weight attainment was higher among girls (6.3-8.1 cm; 3.0-4.2 kg) than for boys (6.1-7.3 cm; 2.8-3.5 kg). In all age categories, the weight and height of boys and girls were lower than the median values of NCHS reference, thus indicating that these primary schoolchildren were lighter and shorter than their NCHS counterparts.

Table 2. Height and weight attainment of primary school children (n=8005)

Variable	Male		Female	
	Mean (SD)	Median	Mean (SD)	Median
6.0-6.9 Year				
Age (year)	6.63 (0.23)	6.65	6.60 (0.25)	6.62
Actual height (cm)	116.50 (5.76)	116.0	115.35 (5.92)	115.0
Actual weight (kg)	20.14 (3.89)	19.70	19.65 (4.03)	19.00
Reference height (cm)	119.4	118.1		
Reference weight (kg)	21.9	20.8		
	(n=867)	(n=731)		
7.0-7.9 Year				
Age (year)	7.49 (0.31)	7.48	7.49 (0.31)	7.49
Actual height (cm)	119.97 (6.45)	120.0	119.23 (6.65)	119.0
Actual weight (kg)	21.82 (4.63)	21.0	21.36 (4.67)	20.0
Reference height (cm)	124.4	123.5		
Reference weight (kg)	24.0	23.3		
	(n=1127)	(n=931)		
8.0-8.9 Year				
Age (year)	8.48 (0.28)	8.48	8.49 (0.28)	8.49
Actual height (cm)	123.52 (6.63)	123.0	123.00 (6.14)	123.0
Actual weight (kg)	23.97 (5.33)	23.0	23.58 (5.02)	23.0
Reference height (cm)	129.6	129.3		
Reference weight (kg)	26.7	26.6		
	(n=1431)	(n=1409)		
9.0-9.9 Year				
Age (year)	9.37 (0.26)	9.34	9.36 (0.25)	9.32
Actual height (cm)	126.62 (6.54)	127.0	126.12 (6.00)	126.0
Actual weight (kg)	25.73 (5.52)	25.0	25.63 (5.88)	25.0
Reference height (cm)	133.9	134.2		
Reference weight (kg)	29.2	29.8		
	(n=787)	(n=722)		

The percentages of the primary school children who were underweight, stunted and wasted according to their gender are shown in Table 3. Fifty two percent (n=4149) of the children were found to be underweight. Approximately 50% (n=3893) of the school children were stunted and 30% (n=2568) were wasted. However, the majority of these malnourished children were in the mild category. The findings also indicate that a greater percentage of boys were underweight, stunted and wasted compare to girls.

The date were also analysed to examine children who experienced both stunting and wasting (Table 3). The percentage of children who were both wasted and stunted is approximately 15% (n=1208) of the total sample (n=8005). The percentages of children who were significantly wasted and stunted (SW and SS), significantly wasted and mildly stunted (SW and MS), mildly wasted and significantly stunted (MW and SS and mildly wasted and mildly stunted (MW and MS) were 6.6% (n=80), 16.9% (n=204), 23.2% (n=280) and 53.3% (n=644), respectively. More boys than girls were in the first three categories (SW and SS, SW and MS, MW and SS) while a higher percentage of girls experienced mild wasting and stunting (MW and MS).

Table 3. Growth status distribution (weight-for-age, height-for-age and weight-for-height) among primary school children (n=8005)

Variable Level	Male		Female		Total	
	n	(%)	n	(%)	n	(%)
Weight-for-age	4212	(52.6)	3793	(47.4)	8005	(100.0)
Significantly[a] underweight	699	(16.6)	460	(12.1)	1159	(14.5)
Mildly[b] underweight	1598	(37.9)	1392	(36.7)	2990	(37.4)
Normal[c]	1784	(42.4)	1852	(48.8)	3636	(45.4)
High[d]	131	(3.1)	89	(2.3)	220	(2.7)
Height-for-age	4212	(52.6)	3793	(47.4)	8005	(100.0)
Significantly[a] stunted (SS)	761	(18.1)	572	(15.1)	1333	(16.7)
Mildly[b] stunted (MS)	1351	(32.1)	1209	(31.9)	2560	(32.0)
Normal[c]	2051	(48.7)	1989	(52.4)	4040	(50.5)
High[d]	49	(1.2)	23	(0.6)	72	(0.9)
Weight-for-height	4212	(52.6)	3793	(47.4)	8005	(100.0)
Significantly[a] wasted (SW)	419	(9.9)	318	(8.4)	737	(9.2)
Mildly[b] wasted (MW)	1031	(24.5)	800	(21.1)	1831	(22.9)
Normal[c]	2510	(59.6)	2464	(65.0)	4974	(62.1)
High[d]	252	(6.0)	211	(5.6)	463	(5.8)
Weight-for-height * Height-for-age[e]	697	(8.7)	511	(6.4)	1208	(15.1)
SW and SS	49	(7.0)	31	(6.1)	80	(6.6)
SW and MS	121	(17.4)	83	(16.2)	204	(16.9)
MW and SS	178	(25.5)	102	(20.0)	280	(23.2)
MW and MS	349	(50.1)	295	(57.7)	644	(53.3)

a = <-2 SD of the NCHS/CDC median
b = -2 SD ≤ x < -1 SD of the NCHS/CDC median
c = -1 SD ≤ x < -2 SD of the NCHS/CDC median
d = > SD of the NCHS median
e = categories of growth status based on a combination of weight-for-height and height-for-age z-scores

A comparison of the percentages of children who were 1 SD (mildly) and 2 SD (significantly) below the NCHS reference median for weight-for-age, height-for-age and weight-for-height in this sample to the 'normal' (or expected) proportion of children in the NCHS reference population (below z-score – 1 SD = 15.9%; below z-score – 2 SD = 2.3%), revealed that the percentages of children in this sample who were mildly and significantly malnourished based on these three indicators exceeded the 'expected' proportions in the NCHS reference population (mildly underweight = 37.4%, significantly underweight = 14.5%; mildly stunted = 32.0%, significantly stunted = 16.7%; mildly wasted = 22.9%, significantly wasted = 9.2%).

This study found that the prevalence of overweight (> 2 SD of NCHS median for weight-for-height indicator) is 5.8% in this sample of low income school children. Again, the prevalence of overweight was higher for male (6.0%) than female (5.6%) children. As the majority of the children were from low income households, the finding on the prevalence of overweight indicates that at least in the urban areas e.g Kuala Lumpur, overweight may no longer be associated with affluence.

As the primary emphasis is on height-for-age and weight-for-height as indicators of chronic and acute malnutrition respectively, the findings for the independent t-test and one-way ANOVA of mean z-scores for HA and WH by gender, age and standard are presented in Table 4. Separate analyses were done for age of school because there may be more than one age group in each of the Years 1 to 3; for example, there are two age groups (6-6.9 and 7-7.9) in Year 1. The results of the independent t-test on mean z-scores for HA and WH indicate that girls had significantly higher scores for both HA ($t = -2.545$; $p<0.05$) and WH ($t=-2.661$; $p<0.01$) than boys. As for age, older children had significantly lower mean z-scores for HA ($F = 117.054$; $p<0.001$) but higher mean z-scores for WH ($F=41.055$; $p<0.001$). Similarly with year of school, children in Year 3 had the lowest mean z-scores for HA ($F = 89.692$; $p<0.001$) and highest mean z-scores for WH ($F=71.467$; $p<0.001$). These findings indicate that as age of the child increases, the child is more likely to be mildly stunted but had this weight adapted to his short stature (thus, contributing to the improved WH z-scores).

Table 4. Mean z-scores of height-for-age and weight-for-height by gender, age and standard for primary school children (n=8005)

Variable	Level	n	Mean	(SD)	p-value
Height-for-Age					
Gender	Male	4212	-0.96	(1.19)	1.011*
	Female	3796	-0.89	(1.06)	
Age (years)					
	6.0 – 6.9	1598	-0.60	(1.12)	0.000**** a
	7.0 – 7.9	2058	-0.79	(1.18)	
	8.0 – 8.9	2840	-1.03	(1.07)	
	9.0 – 9.9	1509	-1.28	(1.03)	
Standard					
	Std. 1	2598	-0.70	(1.12)	0.000*** b
	Std. 2	2839	-0.99	(1.15)	
	Std. 3	2568	-1.09	(1.07)	

Weight-for-Height					
Gender					
	Male	4212	-0.35	(1.42)	0.008**
	Female	3793	-0.27	(1.34)	
Age (years)	6.0 – 6.9	1598	-0.54	(1.44)	0.000*** c
	7.0 – 7.9	2058	-0.44	(1.39)	
	8.0 – 8.9	2840	-0.20	(1.35)	
	9.0 – 9.9	1509	-0.08	(1.33)	
Standard					
	Std. 1	2598	-0.55	(1.41)	0.000*** b
	Std. 2	2839	-0.29	(1.37)	
	Std. 3	2568	-0.09	(1.34)	

* p<0.05 ** p<0.01 *** p<0.001

Bonferroni post-hoc test indicates that these groups differ from each other significantly:
a= 6.0-6.9 & 7.0-7.9; 6.0-6.9 & 8.0-8.9; 6.0-6.9 & 9.0-9.9;
7.0-7.9 & 8.0 – 8.9; 7.0-7.9 & 9.0-9.9;
8.0-8.9 & 9.0-9.9;
b= Std. 1 & Std. 2; Std. 1 & Std. 3; Std. 2 & Std. 3

c= 6.0-6.9 & 8.0-8.9; 6.0-6.9 & 9.0-9.9;
7.0-7.9 & 8.0 – 8.9; 7.0-7.9 & 9.0-9.9;
8.0-8.9 & 9.0-9.9;

DISCUSSION

In this study, approximately 52% (n = 4149), 50% (n = 3893) and 30% (n = 2568) of the children were found to be underweight, stunted and wasted respectively (Table 3). However, the majority of the children were either mildly underweight (37.4%), mildly stunted (32%) or mildly wasted (23%). Although the prevalence of mild malnutrition (underweight, stunting and wasting) is higher than the prevalence of severe malnutrition, the former cannot be ignored as it too has its implications not only on the child's consequent development (e.g. cognitive skills) (Johnston *et al*., 1987; Clarke *et al*., 1991; Grantham-McGregor & Walker, 1998) but also on his chance of survival (Pelletier, Frongillo & Habicht, 1993; Pelletier *et al*., 1995).

As stunting reflects past nutrition, the finding indicates that these children may have had experiences with poor diets and infections during their early childhood and perhaps were continuously living with similar continuously living with similar conditions as a consequence of poverty. Linear growth retardation occurs primarily in the first 2-3 years of life but is intensified between 3 and 18 months and is a reflection of the interactive effects of poor energy and nutrient intakes and infection (Martorell & Habicht, 1986). This finding also agrees with other findings on the prevalence of stunting among school children from low income households in less developed countries which indicate that shortness-for-age is a common nutritional problem among these schoolchildren compared to wasting (Ahmed *et al*., 1991; Baba, Hamadeh & Adra, 1991; Pelto et al., 1991, Sihieri, Mathias & Moura, 1996; Stoltzfus *et al*., 1997).

In a much earlier study by Chen (1976a), the prevalence of stunting and wasting among primary school children (6-9.9 years old) from schools in Kuala Lumpur and Selangor were reported to be 25% and 9% respectively (stunting is <90% of height-for-age and wasting is <80% of weight-for-height). Chee (1992) in her study of growth status among children aged 5-10 years old (n=107) from a squatter settlement in Selangor found that 19.8% were significantly stunted and 33.8% were mildly stunted. The prevalence of significantly and mildly wasted was 9.3% and 32.7%, respectively. Another study by Cheng, Rahman & Abdullah (1988) on dietary intake and growth assessment of school children (of Malay, Chinese and Indian ethnicity) from three primary schools in Selangor reported that the overall prevalence of underweight, stunting, wasting and both stunting and wasting was 22.2%, 19.8%, 11.3% and 1.4% respectively (underweight, stunting and wasting were defined as below minus 2 of the NCHS median). Our study found that the prevalence of significantly underweight (14.5%), stunting (16.7%) and wasting (9.2%) were lower than that found by Cheng *et al*., (1988) but the prevalence of both stunting and wasting (SW and SS) was higher (6.6%). However, the prevalence of undernutrition among Malay children in the study by Cheng *et al*., (1988), (underweight = 8.4%, stunting =15.3%, wasting = 2.8% and wasting + stunting = 0%) was lower compared to the findings in the present study (the majority of the school children were Malays).

Nutritionists have argued that children in less developed countries can attain their optimum weight and height if the environment is conducive to their health and nutritional status. Thus, it has been suggested that growth standards developed in industrialized countries (e.g. NCHS/CDC growth reference) are appropriate for measuring children in less developed countries (Graitcer & Gentry, 1981). However, Eveleth & Tanner (1990) described it as a misconception to assume that the growth of healthy populations is the same (at least up to the age of 5 years old) and concluded that they should not be represented by a universal standard. Chen (1976b) found that although the growth achievement of Malaysian school children from the three ethnic groups (Malay, Chinese and Indian) differed as a whole, the growth achievement of higher income group children among the three ethnic groups did not differ significantly. However, when the weights and heights of these children (all ethnic groups from lower and upper income groups) were compared to the Boston reference, even the higher income school children were lighter and shorter than the Boston children. These findings indicate that the differences in growth achievement of these children from the three ethnic groups are probably due to environmental differences, rather than genetic differences. However, environmental and perhaps genetic factors may contribute to the differences in weight and height attainment between Malaysian school children and Boston children.

Osman, Suhardi & Khalid (1993) conducted a study to compare the anthropometric measurement patterns of Malay children from wealthy families to the NCHS reference population. Eight hundred and seventy one children (3-12 years old) were measured for their heights, weight and skinfold thickness. The children had similar increment patterns of weight-for-age and height-for-age to the NCHS reference population, except that they had lower median weight-for-age which may be influenced by their birth weights and genetic factors. Body mass index and skinfold thickness (triceps and biceps) measurements of these children were also similar to that of the NCHS and HHANES reference populations. Is was concluded that Malay children from higher income groups have growth rates comparable to the children in industrialized nations and that the NCHS percentile charts are suitable as a reference for comparing the nutritional status of Malay children in Malaysia. In the present study, the prevalence of underweight, stunting and wasting among the school children may be explained by their lower socio-economic status which may influence their birth weight, dietary intakes and health status. Perhaps, if these children were given an environment which is conducive to better health and nutritional status, their growth potential may be similar to the growth of children from an upper socio-economic background or children from develop nations.

The present study also found that the prevalence of overweight is 5.8% with more male (6.0%) than female (5.6%) children being overweight. This is higher than the prevalence among 7-year-old children (3.6%) in Kuala Lumpur found by the school Health Service Unit of the Health Department of the City hall of Kuala Lumpur (City Hall Kuala Lumpur, 1990). Similarly, the prevalence of overweight in this present study is higher compared to the prevalence of overweight and obesity among Standard 1 children (from both rural and urban schools) in Selangor (4.4%) Bong and Jaafar, 1996). In another study by Kasmini et al. (1997), the prevalence of overweight (+1 SD < +2 SD) and obesity (> +2 SD) among 7-10-year-old children attending primary schools in Kuala Lumpur are 1.7% and 1.3% respectively. Again, the prevalence of overweight (5.8%) in this present study (defined as > +2 SD) is much higher compared to 1.3% found Kasmini et al., (1997).

T-test analysis indicated that male children had lower mean z-scores for weight-for-height and height-for-age (Table 4). These findings were supported b the fact that more male children in this sample were wasted and stunted than female children (Table 3). The prevalence of stunting and wasting was 50% and 34% respectively in boys and 47% and 29% respectively in girls. Gender differential in the study of nutritional status of children in the less developed countries has frequently reported that boys were favored in that they were breast-fed longer, received better quality diet, child care time, health treatment and had better nutritional status (Chen, Huq & D’Souza, 1981; Brown et al., 1982; Sen & Segupta, 1983). However, many of these studies focused on preschoolers rather than school-aged children. The present findings that more boys were at risk of stunting and wasting than girls are similar to the findings among school children in Zanzibar (Stoltzfus *et al*., 1997) but differ from the other findings among school children which revealed that more girls had poorer health or were wasted and stunted than the boys (Uloli et al., 1993; Aurelius *et al*., 1996).

There are several hypotheses as to why more boys than girls in this present study were stunted and wasted. According to Martorell, Khan & Schroeder (1994), prolongation of the growth period can make up for some of the earlier growth retardation. In other words, if maturation process is grossly delayed and the growth period is extended, then the potential for catch-up in growth will be marked. However, the effects of the maturation delay may differ in male and female children. In a longitudinal study (Satyanarayana, Nadamuni & Narasinga, 1980; Satyanarayana et al., 1981) of growth patterns for boys and girls in India (height data was analyzed at 5 and 18 years of age, the children were divided according t the degree of stunting at 5 years of age – I (above – 2 SD), II (-2 to –3 SD), III (-3 to –4 SD) and IV (below –4 SD). Among the girls, in all four groups, the differences in relation to the growth reference mean were less 18 years than at 5 years, particularly in groups III and IV. The authors suggested that the apparent catch-up growth may be attributed to the delayed menarche was given. For the boys, despite the maturation delay (timing for peak height velocity), the differences with respect to the growth reference data increased from 5 to 18 years. They concluded that growth retardation in early childhood was slightly increased by adulthood in males but decreased in females. Second, Martorell *et al*., (1994) also indicated that older children may not achieve the potential for catch-up growth if they continue to live in the same environment which gave rise to stunting in early childhood. Perhaps, in this present study, boys were less fortunate than the girls in term of their socio-economic status which did not allow them to experience catch-up growth and which consequently led to the higher prevalence of malnutrition among the male children. However, as this is a cross-sectional data, information on the duration of time that the children have been living in socio-economic deprived situations is not available. Third, the difference in the growth status among boys and girls may be attributed to other factors such as physical activity, food intake and infections. As the majority of the children were from low income households, their food intake may be inadequate in terms of quality and quantity. If boys were more physically active than girls and in the presence of inadequate food intake (assuming that both boys and girls had similar inadequate food intake), this may compromise their nutritional status or exacerbate their already poor growth status. Also, in addition to the consumption of inadequate diets, if boys were more susceptible to infection than girls, then they will be at greater risk of poor nutritional status. However, this hypothesis cannot be confirmed in this present study as data on children's food intake, physical activity and medical history was not obtained.

Analysis of variance test result revealed that there are significant differences in the mean z-scores for height-for-age and weight-for-height due to age and standard ($p < 0.001$) There was a progressive degree of stunting as age and standard increase. For example, the mean z-scores for 6-and 7-year-olds showed normal growth, while that for 8 and 9-year-olds indicate that they were mildly stunted. The possible explanation is that the older children may be stunted because they were more malnourished than the younger ones during their early childhood and not because they are growing poorly as school children. For wasting, however, a different picture emerges – as age and standard increased, the mean z-scores for weight-for-height improved. The increased z-scores for weight-for-height and the decreased z-scored for height-for-age according to age and standard among these children may reflect that their weights have been adapted to their low stature and that there is a possibility of an association between stunting and high weight-for-height (Sichieri *et al*., 1996; Popkin, Richards & Monteiro, 1996).

CONCLUSION

Among this sample of primary school children (6-10 years old), underweight and stunting as a form of malnutrition are more prevalent than wasting. Two major implications of linear growth retardation among primary school children are: (i) the process of stunting may be associated with concurrent risks to health and development of school age children and (ii) stunting in school age children may result in shorter adult height, which decreases work capacity and increases reproductive risks for women (WHO Expert Committee, 1995). Evidently, both stunting and wasting vary significantly according to the children's age and gender – as the children get older, they are at greater risk of being stunted but not wasted; male children compared to their female counterparts have a higher prevalence of stunting and wasting.

As this study found that underweight, stunting and wasting are still prevalent and that overweight is increasing among low income school children, there is a need for the Ministry of Education and Ministry of Healthy to adopt a more intensive approach to address health and nutrition issues in this age group. Health and nutrition monitoring us essential so that effective interventions can be implemented to alleviate and consequently eliminate the health and nutritional problems among these children. It is recommended that active growth monitoring (using the existing growth data collected by the schools) of the school children be implemented as it is an easy and inexpensive tool for health professionals to obtain information on the health and nutrition of the school-age population.

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