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Nutritional Status of Children below Five Years in Malaysia: Anthropometric Analyses from the Third National Health and Morbidity Survey III (NHMS, 2006)

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ABSTRACT

The Third National Health and Morbidity Survey (NHMS III) was conducted in 2006 on a nationally representative sample of population in Malaysia. Over 21,000 children aged 0-17.9 years were measured for body weight and stature according to the protocol of the World Health Organization. This article describes the nutritional status of children aged 0-59.9 months. Mean *z* score for weight-for-age (WAZ), height-for-age (HAZ) and BMI-for-age were compared with the *z*-scores tables of the WHO standards. The overall prevalence of underweight and stunting of the children were 12.9% and 17.2% respectively. These levels included 2.4% severe underweight and 6.0% severe stunting. In terms of *z* scores, the age group of 0–5.9 months showed the best nutritional status with mean WAZ of -0.33 (95%CI: -0.52, 0.15) and -0.40 (-0.57, 0.24) for boys and girls respectively, while mean HAZ was 0.64 (0.38, 0.89) for boys and 0.76 (0.54, 0.98) for girls. Mean HAZ and WAZ status was least satisfactory after about 6 months, suggesting a faltering in growth rate at an age that coincides with dependence on complementary feeding. Prevalence of overweight based on BMI-for-age for the sexes combined was 6.4%, while that based on WAZ was 3.4%. The NHMS III results indicate that Malaysian children have better nutritional status compared to children under 5 years in neighbouring countries. In order to meet the targets set in the National Plan of Nutrition (2006-2015), more effective intervention programmes are needed to accelerate the reduction of underweight and stunting, and to arrest the rise of overweight in young children.

Keywords: Children below 5 years, nutritional status, third NHMS

INTRODUCTION

Assessment of nutritional status of young children in Malaysia using anthropometric measurements may be traced to the 1930s when the Institute for Medical Research in Kuala Lumpur reported body weight and height measurements of children from poor

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villages and estates (Williams, 1934; Kingsbury & Fasal, 1940). The results were compared to British and American children and it was observed that "the pattern of the rate of growth in Malay boys from poor and prosperous communities was different from that to be found in well nourished North American children" (Burgess & Laidin, 1950). Decades later, Chen & Dugdale (1970) reported that schoolchildren from the urban areas of Kuala Lumpur and Petaling Jaya were "smaller and lighter for age when compared to American children".

Poor nutritional status of young children from low-income rural communities continued to be reported in the 1980s and 1990s. Chong *et al.* (1984) in a survey of 14 impoverished villages in Peninsular Malaysia involving 3,600 persons, found stunting in 43% of the pre-school children, 49% and 25% of the primary school boys and girls respectively. A decade later, another large scale study of low income rural communities, including rice-growing, coconut and rubber smallholdings and fishing villages in Peninsular Malaysia was carried out (Khor & Tee, 1997). In this 'Functional Groups' study, a total of 2,364 boys and 2,415 girls aged 18 years and below were assessed. Among children aged 1-6 years, 32.6% of the boys and 35.9% of the girls were underweight, while the prevalence of stunting was 28.0% among the boys and 28.8% in the girls.

Meanwhile among the low-income households in urban areas, Zalilah, Bond & Johnson (2000) also found a high prevalence of malnutrition among primary school children (4212 boys and 3793 girls aged 6-10 years), whereby approximately 52% and 50% were underweight and stunted respectively, while 5.8% were overweight. Among 3,556 school children aged 11 to 16 years in Kuala Lumpur, Moy, Gan & Mohd Kassim (2004) reported 16.2% and 13.3% of the boys and girls respectively were underweight ($< 5^{th}$ percentile of the BMI-for-age).

Since the 1990s, there has been increasing focus on the problem of overweight in children. These studies tend to focus on children older than 5 years. Bong & Safurah (1996) assessed 1,275 primary one and primary six children in urban schools in Selangor and found 9.8% of these children to be overweight. They also recorded an overweight prevalence of 6.1% among 1,431 children of similar age groups from rural schools in Selangor. In a study on 6,239 children aged 7 to 16 years attending primary and secondary schools in Kuala Lumpur, Kasimini *et al* (1997), reported 6% overweight, with significantly higher prevalence among the Indians, followed by the Chinese and the Malays. Ismail & Vickneswary (1999) reported an overweight prevalence of 9.1% in a sample size of 2,292 children aged 7-10 years. In a more recent study in the urbanised district of Klang, out of 3,333 secondary schoolchildren aged 13-17 years, 11.4% were found to be at risk of overweight and 8.2% were overweight (Rampal *et al*., 2007).

While the studies mentioned above and others have provided an insight into the anthropometric status of children, very few were national in scale in terms of being representative of the general population. Insofar as children below 5 years are concerned, until the conduct of the third National Health and Morbidity Survey (NHMS III) in 2006, there was only one study that involved a nationally representative sample namely, the national survey of the Ministry of Health Malaysia and UNICEF in 1999-2000. This national survey on a total of 5,383 children below 5 reported an underweight prevalence of 19.8% among the boys and 18.5% in girls, while the respective values for stunting were 17.5% and 15.5% (MOH, 2000). The prevalence of overweight in these children was 3.3% similar for both boys and girls.

The purpose of this article is to provide a description of the anthropometric status of male and female children aged below five years based on findings of the NHMS III.

The NHMS series which commenced in 1986 is conducted once in 10 years. The second NHMS survey in 1996 had included body mass index of adults only (aged 18 years and above), while the third NHMS included assessment of nutritional status of all ages.

METHODOLOGY

Sampling and sample design

As a national survey, the NHMS III used the sampling frame of the Malaysian Department of Statistics, in which the country is divided into contiguous geographical areas called Enumeration Blocks (EBs). These EBs constituted the sampling frame for the NHMS III. A two-stage stratified sample design was used. At the first stage, the sample unit was the EB, while at the second stage, the sample unit was the Living Quarters (LQ). All households and persons within a selected LQ were included in the survey. The EBs were selected using a probability proportionate to size linear systematic selection scheme based on the latest updated size measures. The selection of EBs was carried out independently within each state (primary stratum) and within urban or rural areas (secondary stratum) in each state, in accordance with the selection rate determined for each stratum. This was to ensure that the sample size was representative of the population at the state and national levels.

Data collection

Field data collection was conducted throughout Malaysia simultaneously spanning a continuous period of 4 months in 2006. A bi-lingual (Malay and English) pre-coded questionnaire was designed, pre-tested and piloted prior to the survey. Trained paramedical personnel conducted face-to-face interviews. For those aged below 13 years, the child's parent or guardian responded on behalf of the child, while those aged 13 years and above were required to answer the questionnaires themselves.

Eligibility of the children was based on a set of inclusion and exclusion criteria. The inclusion criteria included children aged <18 years, healthy, without any disabilities or body deformities (except deaf and blind). Children with chronic diseases over the 3 months prior to the study were excluded. These include illnesses or diseases that can influence food intake and nutritional status, for example, tuberculosis, asthma, cancer, diabetes, heart problems and blood disease (including thalassemia). Children suffering from these conditions were excluded at the beginning of the interview as well as during the pre-cleaning of the data.

Body weight and stature were taken of the eligible children. Stature was taken as recumbent length or standing height, the former for infants and young children who are unable to stand upright. Recumbent length was measured using a measuring mat (SECA 210, Germany) to the nearest 0.1 cm. Children were measured for standing height without shoes using a SECA portable body meter (SECA 206, Germany) to the nearest 0.1 cm. Body weight of infants and young children was taken by means of a digital weighing scale (Tanita 1583, Japan) to the nearest 0.01 kg. Children who were able to stand upright were weighed using a digital lithium weighing scale (Tanita 318, Japan) to the nearest 0.1 kg. Infants and children were weighed using indoor light clothing and without shoes. Measurements were taken twice for each child and the average value was used for data entry. Nurses and other health care professionals specifically trained for the third NHMS according to the protocol of the World Health Organization (WHO, 1995) took the measurements.

Data analysis

The infants and children were grouped into six chronological age categories (months) as follows: 0-5.9, 6.0-11.9, 12.0-23.9, 36.0-47.9 and 48.0-59.9. The anthropometric indi-

cators of growth status outcomes presented in this report are body weight, length / height, weight-for-age, height-for-age, and body mass index-for-age (BMI-for-age). Weight-for-height is not included as it is a less pertinent indicator of nutritional status for normal situations (Ergo, Gwatkin & Shekar, 2009).

Mean *z* scores for weight-for-age (WAZ), height-for-age (HAZ), and BMI-for-age were computed and compared with the *z*-score tables of the WHO standards (2006) in its website: *http://www.who.int/childgrowth/standards/en.* Prevalence of underweight and stunting are based on WHO recommendations *(http://www.who.int/whosis/indicators)*, using the following cut-off points for moderate and severe forms of nutritional status as shown below.

The survey data were analysed using SPSS version 15.0. The data were explored for extreme values and outliers were excluded based on the recommendations of the WHO, which used SD flag limits to identify implausible values *(http://www.who.int/entity/growthref/tools).* Children with HAZ > 6.0 or < minus 6.0, BMI-for-age z score >5.0 or < minus 5.0, and WAZ >5.0 or < minus 6.0 were considered outliers. Findings are presented as means and prevalence values (95% confidence interval).

Underweight:	WAZ < –2.0 SD (standard deviation)
Moderate underweight	WAZ < –2.0 SD to –3.0 SD
Severe underweight	WAZ < –3.0 SD
Moderate thinness	BMI-for-age Z < –2.0 SD to –3.0 SD
Severe thinness	BMI-for-age Z < –3.0 SD
Stunting:	HAZ < minus 2.0 SD
Moderate stunting	HAZ < –2.0 SD to –3.0 SD
Severe stunting	HAZ < –3.0 SD
At risk of overweight:	BMI-for-age z score ≥1 SD to < 2.0 SD
Overweight:	BMI-for-age z score ≥2.0 SD WAZ > 2.0 SD

RESULTS

A total of 22,032 eligible children aged below 18 years were measured for weight and height in the third NHMS. Of this, over 5,000 were children below five years. The exact number of these children varies somewhat among the indicators as shown in the tables. This is the result of exclusion of children based on the outlier cut-off points mentioned above.

Mean body weight and height

The mean weight between the sexes was not significantly different below 6 months of age. Subsequently, boys were significantly heavier than girls in each age category (Table 1). By 48-59.9months, boys weighed on average 15.74 kg (95% CI: 15.55, 15.93) compared to 15.06 kg (14.87, 15.25) for the girls.

A similar pattern is shown for length / height in that boys were significantly longer / taller than the girls in each age group after 6 months of age (Table 2). At 48-59.9 months, the mean height of the boys was 103.06 cm (102.55, 103.55), while that for the girls was 101.61 cm (100.97, 102.28).

Boys had a significantly higher body mass index-for-age (BMI-for-age) than girls in the first 24 months of age (Table 3). Overall, the BMI-for-age values for children below five fall within a relatively narrow range for both boys and girls. For the boys, it ranged between 14.91 kg / m^2 (14.60, 15.21) to 15.20 kg / m^2 (15.03, 15.37), while that for girls ranged from 14.51 kg / m^2 (14.21, 14.81) to 15.09 (14.91, 15.26).

Mean weight-for-age z score (WAZ)

The mean WAZ value was closest to the reference median at 0-5.9 months, being -0.33

Table 1. Mean weight (kg) by age and sex

Age (months)	*Male (n=2672)*		*Female (N=2695)*		*Sig (p) between sexes*
	N	*Mean (95% CI)*	*N*	*Mean (95% CI)*	
0-5.9	235	5.40 (5.22, 5.58)	263	5.23 (5.05, 5.41)	-
6.0-11.9	295	8.20 (8.07, 8.32)	256	7.56 (7.43, 7.68)	***
12.0-23.9	518	9.82 (9.71, 9.93)	508	9.38 (9.26, 9.49)	***
24.0-35.9	529	12.07 (11.93, 12.21)	553	11.61 (11.47, 11.75)	***
36.0-47.9	552	13.74 (13.57, 13.91)	557	13.43 (13.27, 13.59)	**
48.0-59.9	543	15.74 (15.55, 15.93)	558	15.06 (14.87, 15.25)	***

* p<0.05; ** p<0.01; *** p<0.001 - not significant

Table 2. Mean height (cm) by age and sex

Age	*Male (n=2626)*		*Female (n=2610)*		*Sig (p) between sexes*
	N	*Mean (95% CI)*	*N*	*Mean (95% CI)*	
0-5.9	232	59.11 (58.32, 59.90)	256	59.26 (58.44, 60.07)	-
6.0-11.9	283	70.97 (70.40, 71.53)	244	70.41 (69.55, 71.26)	***
12.0-23.9	506	78.94 (78.45, 79.44)	493	78.29 (77.67, 78.88)	***
24.0-35.9	515	88.59 (88.09, 89.09)	517	87.92 (87.17, 88.64)	***
36.0-47.9	542	96.17 (95.67, 96.68)	544	95.70 (95.02, 96.38)	**
48.0-59.9	548	103.06 (102.55, 103.55)	556	101.61 (100.97, 102.28)	***

* p<0.05; ** p<0.01; *** p<0.001 - not significant

Table 3. Mean body mass index (BMI)-for-age by age and gender

Age	*Male (N=2671)*		*Female (N=2673)*		*Sig (p) between sexes*
	N	*Mean (95% CI)*	*N*	*Mean (95% CI)*	
0-5.9	224	14.91 (14.60, 15.21)	248	14.51 (14.21, 14.81)	*
6.0-11.9	278	16.27 (15.99, 16.56)	242	15.41 (15.13, 15.71)	**
12.0-23.9	499	15.57 (15.38, 15.75)	485	15.43 (15.17, 15.10)	*
24.0-35.9	515	15.57 (15.40, 15.73)	523	15.42 (15.24, 15.60)	-
36.0-47.9	538	15.20 (15.03, 15.37)	552	15.09 (14.91, 15.26)	-
48.0-59.9	617	15.10 (14.94, 15.27)	623	14.92 (14.75, 15.09)	-

* p<0.05; ** p<0.01; *** p<0.001 - not significant

(-0.52, 0.15) and -0.40 (-0.57, 0.24) for male and female children respectively (Table 4). Subsequently, the mean WAZ values deviated further from the median for both boys and girls. The age group of 12.0-23.9 months showed the least favourable WAZ score, at -0.84 (-0.95, -0.74) and -0.71 (-0.81, -0.61) respectively for boys and girls. These findings suggest a faltering of body weight after approximately 6 months of age that coincides with the transition period when the infant is weaned-off breast milk and fed

Table 4. Mean weight-for-age Z score (WAZ) by age and sex

Age	*Male*		*Female*		*Sig (p) between sexes*
	N	*Mean (95% CI)*	*N*	*Mean (95% CI)*	
0-5.9	235	-0.33 (-0.52, 0.15)	260	-0.40 (-0.57, 0.24)	-
6.0-11.9	302	-0.53 (-0.67, -0.38)	258	-0.63 (-0.76, -0.50)	-
12.0-23.9	536	-0.84 (-0.95, -0.74)	520	-0.71 (-0.81, -0.61)	-
24.0-35.9	554	-0.70 (-0.81, -0.61)	570	-0.64 (-0.74, -0.54)	-
36.0-47.9	576	-0.75 (-0.86, -0.64)	579	-0.72 (-0.83, -0.62)	-
48.0-59.9	575	-0.59 (-0.71, -0.48)	581	-0.83 (-0.94, -0.72)	***
0-59.9	2778	-0.67 (-0.72, -0.62)	2768	-0.69 (-0.73, -0.64)	-

* p<0.05; ** p<0.01; *** p<0.001 - not significant

Table 5. Mean length- or height-for-age Z score (HAZ) by age and sex

Age	*Male*		*Female*		*Sig (p) between sexes*
	N	*Mean (95% CI)*	*N*	*Mean (95% CI)*	
0-5.9	226	0.64 (0.38, 0.89)	247	0.76 (0.54, 0.98)	-
6.0-11.9	282	0.27 (0.06, 0.49)	245	0.32 (0.09, 0.55)	-
12.0-23.9	508	-0.54 (-0.71, -0.37)	496	-0.41 (-0.57, -0.25)	-
24.0-35.9	525	-0.76 (-0.91, -0.62)	530	-0.73 (-0.88, -0.57)	-
36.0-47.9	559	-0.72 (-0.86, -0.58)	561	-0.77 (-0.91 -0.63)	-
48.0-59.9	565	-0.64 (-0.77, -0.51)	565	-0.88 (-1.00, -0.75)	**
0-59.9	2665	-0.46 (-0.53, -0.39)	2644	-0.47 (-0.54, -0.41)	-

* p<0.05; ** p<0.01; *** p<0.001 - not significant

complementary foods. The mean WAZ was not significantly different between the sexes, except at age 48.0-59.9 months, when the girls were significantly lighter than the boys on average.

Mean height-for-age z score (HAZ)

The mean Z scores for height-for-age (HAZ) for boys and girls aged 0-59.9 months are shown in Table 5. The age group of 0-5.9 months showed the highest mean HAZ scores of 0.64 (0.38, 0.89) for boys and 0.76 (0.54, 0.98) for girls. Like the WAZ values, the mean HAZ values deviated further from the median after 6 months of age for boys and girls. The overall mean HAZ score for ages 0-59.9 months was -0.46 (-0.53, -0.39) and -0.47 (-0.54, -0.41) for boys and girls respectively, but the difference was not significant.

Mean BMI-for-age z score

In general, the BMI-for-age *z* scores improved with increasing age. Infants showed the highest negative BMI-for-age *z* values among children under five (Table 6). The 6-11.9 months group showed mean BMI-for-age z scores of -0.83 (-1.04, -0.62) for the males and -1.06 (-1.26, -0.86) for the females among 6.0-11.9 months. In contrast, the 48-59.9 months group had BMI-for-age *z* scores of -0.27 (-0.40, -0.15) and -0.39 (-0.50, -0.27). Compared to the WHO (2006) growth charts for BMI-for-age percentiles, the mean BMI-for-age of Malaysian children was found to be close to the 50th percentile from birth,

Table 6. Mean body mass index (BMI)-for-age Z score by age and sex

Age	*Male*		*Female*		*Sig (p) between sexes*
	N	*Mean (95% CI)*	*N*	*Mean (95% CI)*	
0-5.9	224	-0.83 (-1.03, -0.62)	247	-0.95 (-1.13, -0.77)	-
6.0-11.9	278	-0.83 (-1.04, -0.62)	242	-1.06 (-1.26, -0.86)	-
12.0-23.9	499	-0.70 (-0.85, -0.55)	485	-0.55 (-0.68, -0.42)	-
24.0-35.9	516	-0.32 (-0.46, -0.18)	523	-0.25 (-0.38, -0.11)	-
36.0-47.9	538	-0.34 (-0.48, -0.21)	552	-0.33 (-0.45 -0.20)	-
48.0-59.9	548	-0.27 (-0.40, -0.15)	564	-0.39 (-0.50, -0.27)	-
0-59.9	2603	-0.48 (-0.55, -0.42)	2614	-0.49 (-0.55, -0.43)	-

* p<0.05; ** p<0.01; *** p<0.001 - not significant

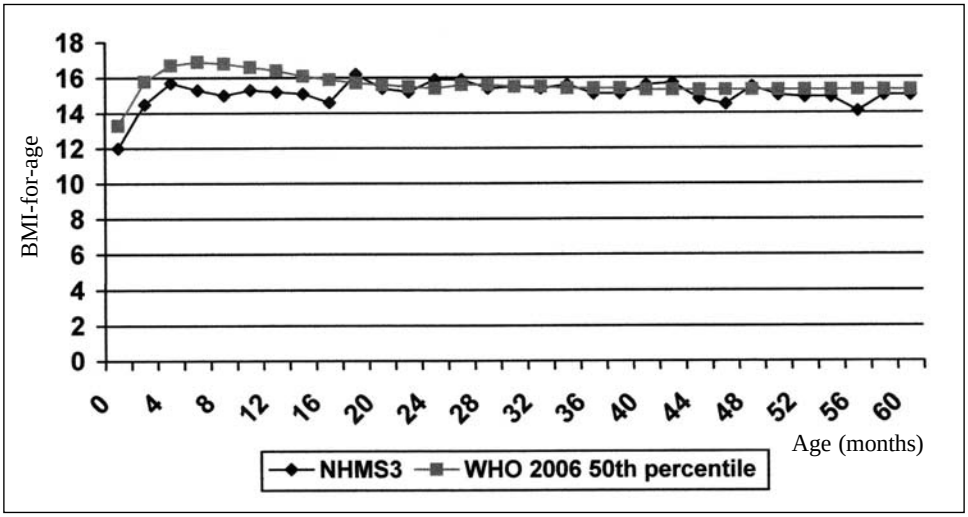

Figure 1a. Mean BMI-for-age for boys

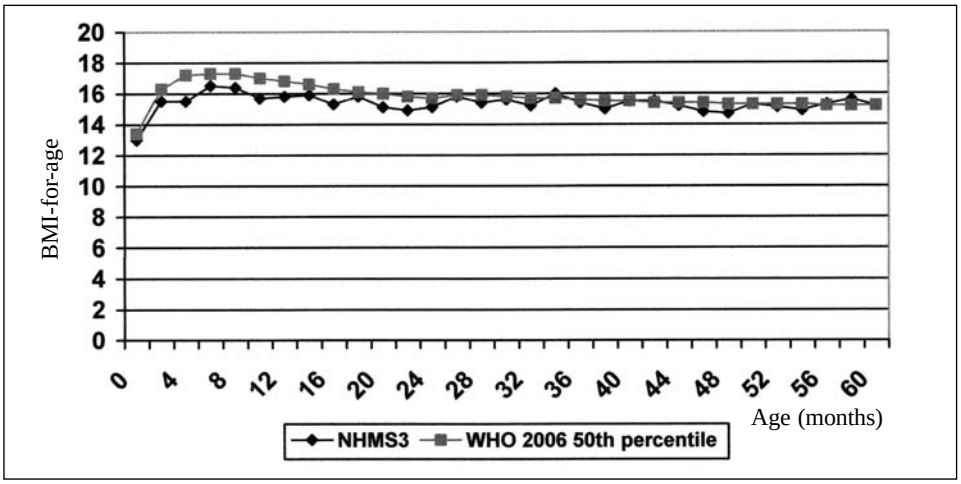

Figure 1b. Mean BMI-for-age for girls

especially after about 24 months (Figures 1a and 1b). Since the WHO (2006) standards were derived from the growth performance of children under optimum health and nutrition care ("how children should grow"), these findings indicate that on average, the growth attainment of Malaysian children below five years reaches the median level of growth expected of normal healthy children.

Prevalence of underweight

Based on the criteria of WAZ above -2SD and below 2SD, 83.7% of the children aged 0-59.9 months showed normal weight-for-age status, being 82.8% for boys and 84.7% for girls. However, about two-thirds of these children with normal weight-for-age status actually had WAZ between median and -2SD. As such, the majority (about 75%) of Malaysian children aged under five years had body weight that was below median or 50% of the reference age group.

In terms of underweight (WAZ below -2SD), the national prevalence was 12.9%, being 13.2% for the boys and 12.7% among the girls. Compared to the other age groups, the 0-5.9 months group showed the lowest prevalence of underweight, with 10.2% and 9.2% among the boys and girls respectively (Figures 2a and 2b). After 6 months of age, the prevalence of underweight increased

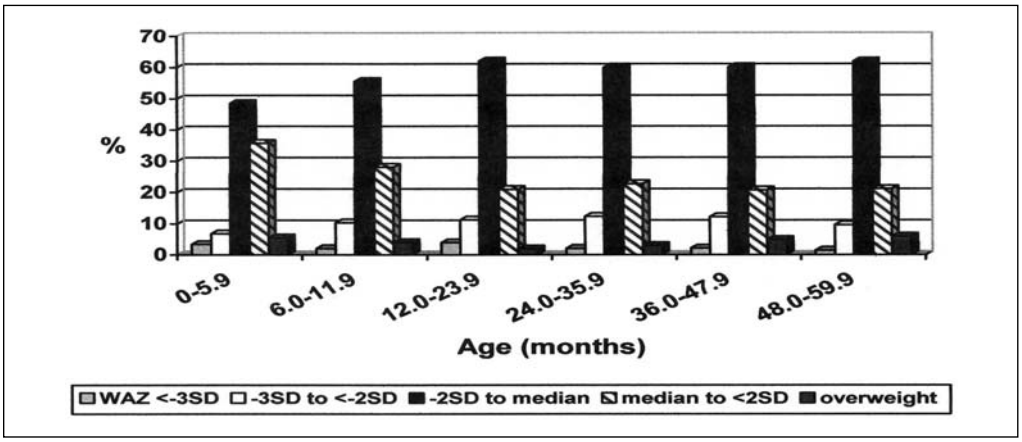

Figure 2a. Nutritional status of male children according to WAZ

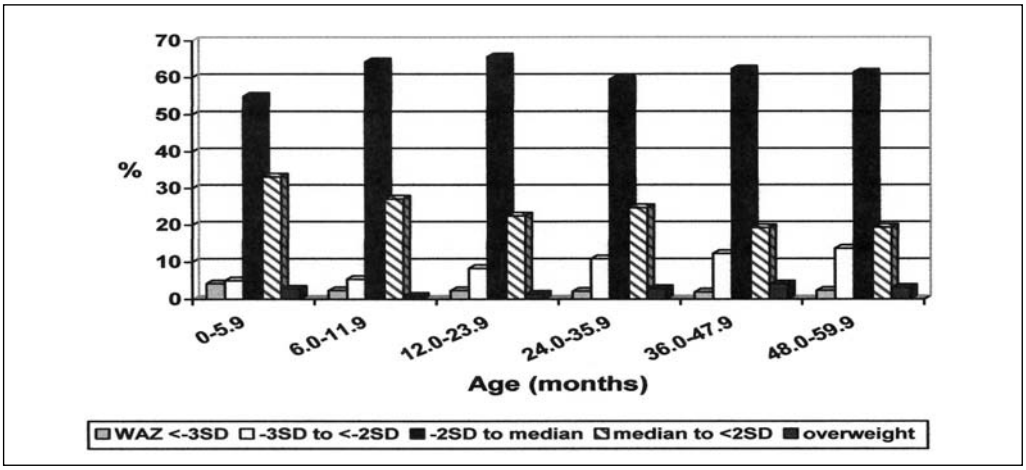

Figure 2b. Nutritional status of female children according to WAZ

reaching the highest level of 15.1% for boys at ages 12.0-23.9 months and 16.0% for e girls at ages 48.0-59.9 months.

The survey also revealed the existence of severe underweight (WAZ below -3SD) in Malaysia. Overall, out of the 12.9% under-weight (sexes combined), 2.4% were severely underweight. In other words, almost one in five among the underweight children was severely underweight. This proportion of severe underweight among the underweight was highest among 0-5.9 months, being 33.3% for boys and 45.7% for the girls. Thus, it is noteworthy that while the age group of 0-5.9 months had the lowest prevalence of underweight, yet within that category, they had the highest proportion of severe underweight, particularly among girls.

Prevalence of stunting

Overall, 82.8% of the children below 5 years had normal height-for-age, being 82.9% and 82.9% for male and female children respectively. The national prevalence of stunting (HAZ below -2SD) in this age group was 17.2%, being similar for boys and girls. Stunting prevalence was lowest among infants (below 10%) and increased with age reaching about 20% after 24 months. Among the boys, the highest stunting prevalence of 22.5% was recorded for the ages 12.0-23.9 months while that for girls was 20.9% in the age group of 24.0-35.9 months (Figures 3a and 3b).

Just as severe underweight was reported previously, this survey also identified young Malaysian children with severe stunting (HAZ below -3SD). Within the stunting category of boys and girls, approximately one-third showed severe stunting. The highest proportion with severe stunting was found within the infant group with stunting. Among infants, 56.8% of boys and 58.2% of girls within the stunting group showed severe stunting.

Prevalence of thinness according to BMI-for-age

Based on the recommendation of WHO (2006), 'thinness' describes children with BMI-for-age below -2SD. About 14.9% of children below 5 years were in the thinness category, the proportion being higher in boys (15.1%) than in girls (12.7%) (Figures 4a and 4b). These levels compared closely with the figures previously reported for prevalence of underweight (WAZ), which was 13.2% and 12.7% for boys and girls respectively.

Prevalence of overweight

Weight-for-age z score (WAZ)

Based on WAZ $\geq$ 2SD, the national prevalence of overweight among children below 5 years was 3.4%, being higher for boys at 4.1% than in the girls at 2.7% (Figures 2a and 2b). Boys showed a higher overweight prevalence than girls for each age category. The highest overweight prevalence was shown among boys aged 0-5.9 months (5.5%), while the lowest prevalence of overweight was 0.8% for girls aged 6.0-11.9 months.

BMI-for age

Overall, 3.6% of the children were at risk of overweight (BMI-for-age between 1.0SD to < 2.0SD), while another 5.3% were overweight (BMI-for-age $\geq$ 2SD). Among the boys, 4.5% and 5.8% were respectively at risk of overweight and overweight, while the corresponding figures for the girls were 2.8% and 4.8% (Figures 4a and 4b respectively). Compared to the overweight prevalence based on WAZ >2SD (3.4% overall), the results based on BMI-for-age was almost twice as high (6.4%). This is seen at 6.8% (BMI-for-age) and 4.1% (WAZ) for the boys, while the corresponding figures for the girls were 6.0% and 2.7%.

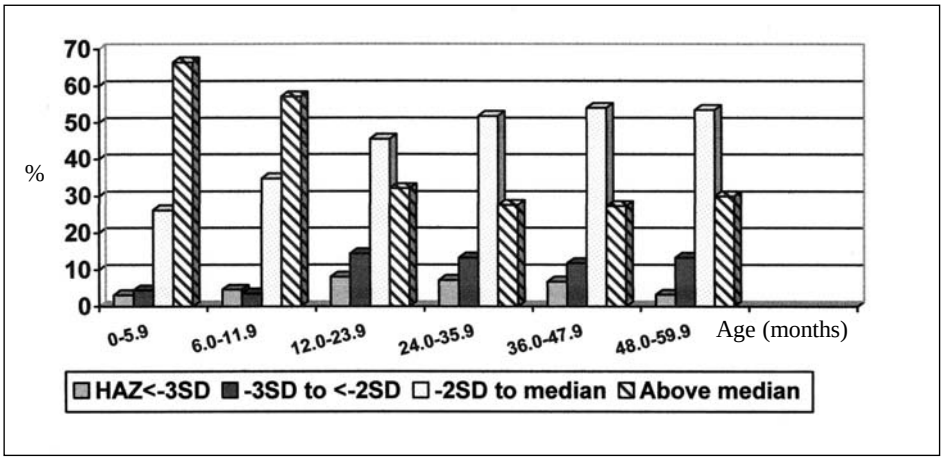

Figure 3a. Nutritional status of male children acording to HAZ

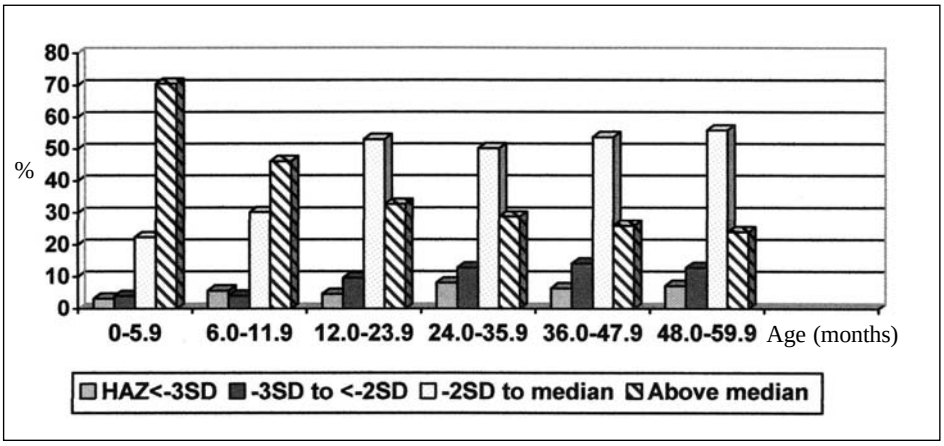

Figure 3b. Nutritional status of female children acording to HAZ

DISCUSSION

Key findings of the NHMS III will be delineated and compared with other national studies in Malaysia and neighbouring countries. Implications of the findings in relation to the second National Plan of Action for Nutrition will also be highlighted.

Underweight was found in 12.9% of the children who may be described as facing under-nutrition currently. The level is higher at 14.9% when judged by BMI-for-age (Table 7). Meanwhile stunting prevalence was identified in 17.2% of the children. How do these levels compare with past national studies? In comparing with the MOH/ UNICEF (2000) study, which is the only other national anthropometric assessment of children aged 0-59.9 months, it is seen that underweight prevalence in both sexes appear lower presently, but stunting prevalence remains close to the magnitude of a decade ago (Table 8). The MOH/ UNICEF study had reported 19.2% underweight and 16.7% for stunting

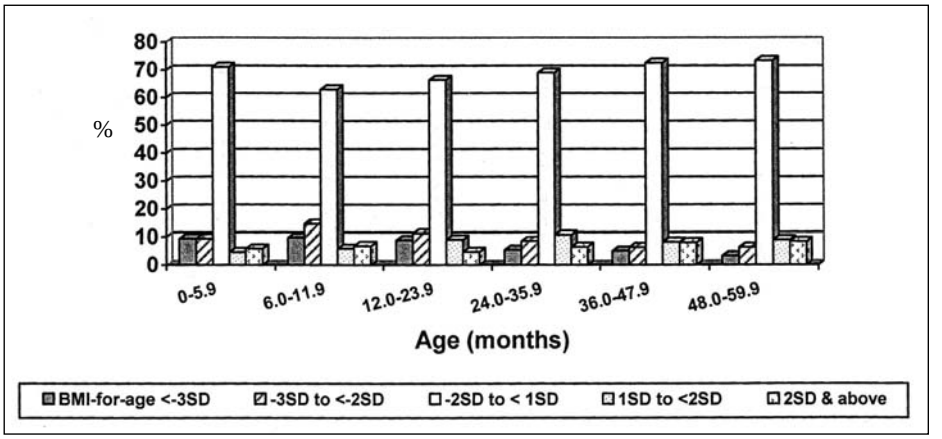

Figure 4a. Nutritional status of male children according to BMI-for-age

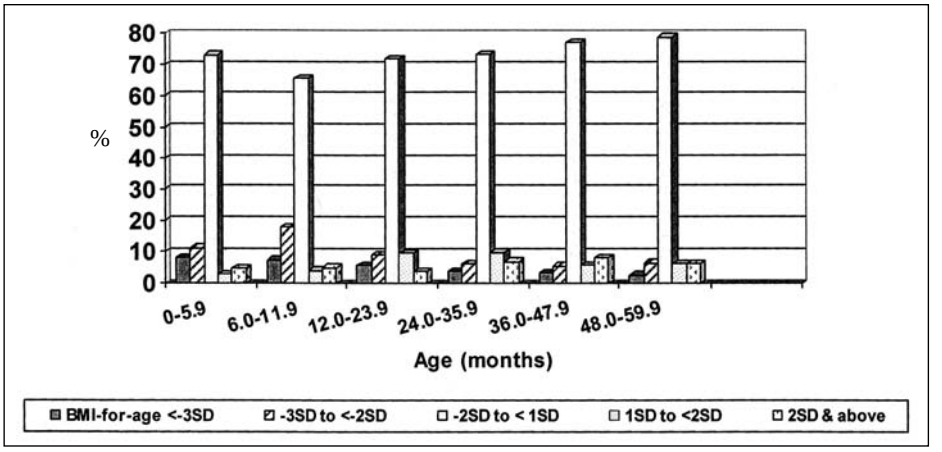

Figure 4b. Nutritional status of female children according to BMI-for-age

prevalence. Although the MOH / UNICEF study had used the NCHS reference (1977) (WHO, 1995) while the third NHMS used the WHO (2006), the differences in underweight and stunting prevalence between these two references are reportedly small (Ergo *et al.*, 2009). Thus, the lack of improvement in stunting prevalence over the past decade is noteworthy, as it is indicative of the persistence of chronic under-nutrition in a sizable proportion of young Malaysian children.

In comparing across the age groups, infants showed the lowest prevalence of underweight and stunting, both of which rises after approximately 6-11.9 months of age. While breastfeeding promotion has been much emphasised in public health interventions, the NHMS IIII findings underscore the need for greater efforts on the use of appropriate complementary foods. Efforts to introduce complementary foods often meet with behavioural and cultural challenges, as child feeding tends to be steeped in traditional practices and beliefs.

A notable revelation of the NHMS III is that whilst the infant group showed the lowest prevalence of underweight and stunting, they had the highest proportions with severe underweight and stunting. These undernourished infants do not receive sufficient nourishment possibly owing to

Table 7. Summary of prevalence (%) of malnutrition aged 0-59.9 months

Type of malnutrition	*N*	*Male & Female*	*Male*	*Female*
Underweight	5677			
WAZ <-2 SD		12.9	13.2	12.7
Moderate (between -3 SD & < -2 SD)		10.5	10.8	10.3
Severe (<-3 SD)		2.4	2.4	2.4
Thinness	5345			
BMI-for-age z score< -2 SD		13.9	15.1	12.7
Moderate (between -3 SD & < -2 SD)		8.5	8.8	8.2
Severe (<-3 SD)		5.4	6.3	4.5
Stunting	5434			
HAZ < -2 SDModerate		17.2	17.2	17.2
(between -3 SD & < -2 SD)		11.2	11.5	10.9
Severe (<-3 SD)		6.0	5.7	6.3
At risk of overweight	5345			
BMI-for-age (between 1 SD & < 2 SD)		7.7	8.4	6.9
Overweight				
BMI-for-age (≥ 2 SD)	5345	6.4	6.8	6.0
WAZ (≥ 2 SD)	5677	3.4	4.1	2.7

Table 8. Nutritional status of children below 5 years from two national surveys

	MOH Third NHMS 2006	*MOH/UNICEF 2000*
Age (years)	*0-5.9*	*0-5.9*
N	*5546*	*5383*
Reference	*WHO (2006)*	*NCHS (1977)*
Underweight (WAZ < -2 SD)		
Male	13.2	19.9
Female	12.7	18.5
Male & Female	12.9	19.2
Stunting (HAZ < -2 SD)		
Male	17.2	17.5
Female	17.2	15.6
Male & Female	17.2	16.7
Overweight (WAZ > 2 SD)		
Male	4.1	2.6
Female	2.7	2.1
Male & Female	3.4	2.4

abject poverty and its associated factors, including low maternal knowledge and difficult access to adequate health care. These important findings bring into focus the need to target improving the nutritional status of malnourished infants, especially from disadvantaged population groups located in interior communities.

Two different results were obtained for overweight when adopting the WHO (2006) standards in conjunction with BMI-for-age $\geq$ 2SD and WAZ $\geq$ 2SD. Based on the former, a higher overweight prevalence of 6.4% was derived while the latter indicator yielded 3.4%. Since 2006, however, BMI-for-age has been the preferred indicator internationally. As children undergo different rates of growth and maturation, their BMI varies with age. Consequently, BMI for children is age specific, and it compares a "child's weight adjusted for height with a reference group of children of the same age but not necessarily of the same stature" (Flegal, Wei & Ogden, 2002).

In comparing the NHMS III results with other studies from neighbouring countries, which have assessed nationally representative samples of children below five years in recent years, it is seen that generally under-nutrition levels are comparatively lower amongst Malaysian children. In the Philippines, underweight prevalence was 26.2% and stunting 27.9% in children below 5 years (FNRI, 2008). In the National Nutrition Strategy (2001-2010) of Vietnam, the nationwide prevalence of underweight and stunting for children below 5 years was 25.2% and 29.6% respectively (Vietnam MOH, 2001). As for Indonesia, according to the 2003 National Socio-economic Survey (Susenas), 27.5% of pre-school children were underweight while 45.6% were stunted (Atmarita, 2005). In comparison, the prevalence of underweight and stunting in Malaysian children below 5 years appeared considerably lower at respectively 12.9% and 17.2%. Meanwhile, the NHMS III prevalence of overweight based on WAZ at 3.4% was comparable with the national levels reported for Vietnam at 2.7% (NIN, 2006) and 2.8% in the Philippines (FNRI, 2008). It is noted that the results cited for the other countries were based on the NCHS (1977) reference, but as mentioned previously, the differences in results between the NCHS and WHO (2006) are small.

To what extent do the NHMS III results meet the targets set in the second National Plan of Action for Nutrition of Malaysia (NPAN) (MOH, 2006) for children below 5 years? The NPAN had set various targets to indicate improvement of the nutritional status of children by 2015. Firstly, the NPAN targeted a reduction in underweight prevalence from 10.6% in 2003 (MOH surveillance data) to 5% by 2015. Comparing this with the NHMS III finding of 12.9% raises some observations. First, the surveillance data of 10.6% for 2003 was arguably low in light of such data being generated from primarily rural clinics. Second, the projected 5% for 2015 was likely to have been arbitrarily set at probably halving the level in 2003. In any case, the challenge ahead lies in reducing the NHMS III finding of 12.9% to 5% by 2010. As for stunting, the NPAN target was to reduce its prevalence from 19% in 2000 to 10% by 2015. Notwithstanding the subjective manner of setting the NPAN target, it is obvious that, given the NHMS III result of 17.2%, much more resources need to be dedicated toward addressing under-nutrition among young children if the country is to achieve the NPAN goals.

The NPAN did not set targets for overweight reduction in children below 5 years. In light of the NHMS III findings of 6.4% children being overweight with another 7.7% at risk of overweight, efforts to promote healthy dietary and physical activity lifestyles should begin in early childhood.

Overall, the NHMS III results point to the need for more innovative interventions toward further improvement of the

nutritional status of young children, especially in reducing stunting. Specifically, strategies on improving household food security, promoting optimal breastfeeding and young child feeding practices, and preventing macro- and micro-nutrient deficiencies should be re-assessed and followed up with culturally appropriate interventions. This is particularly relevant in the current climate of economic uncertainties culminating in rising prices of food and services. The challenge of providing quality food and health care for the young, especially from poor households, becomes increasingly complex and formidable.

CONCLUSION

The NHMS III has provided an insight into the nutritional status of a nationally representative sample of over 5,000 children below 5 years. The majority of the children was found to have normal nutritional status. However, there is a need for specific public health strategies to address the key findings of the survey that reveal the presence of a considerable proportion of stunting, increasing prevalence of under-nutrition with age after 6-12 months, existence of severe underweight and stunting among malnourished infants and children who are at risk of overweight and overweight. Overall, the NHMS III results indicate the need for continued efforts of all stakeholders towards further improving the nutritional status of young Malaysian children.

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