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Nutritional Status of Malaysian Primary School Children Aged 8-10 Years: Findings from the 2008 National IDD Survey

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ABSTRACT

Introduction: Child malnutrition continues to be a major public health problem in developing countries. This study aims to determine the current nutritional status of Malaysian school children using the anthropometric indicators of weight for age (WAZ), height for age (HAZ), and body mass index for age (BAZ). **Methods:** A nationwide school-based survey was undertaken in all Malaysian states and territories, which included 18,078 children aged 8-10 years attending 445 primary schools. The software WHO AnthroPlus was used to calculate z-scores for the nutritional status (WAZ, HAZ and BAZ) of the target population relative to the World Health Organization (WHO) 2007 reference. **Results:** The national prevalence of underweight among school children was 13.6% and in rural areas, this rate was nearly double that of urban areas. The national prevalence rate for stunting was 10.9%, double among rural school children compared to their urban counterparts. As for thinness, the national prevalence was 6.5%. Using the WAZ indicator, we found that the national prevalence of overweight children was 7.6%. Additionally, we found that urban areas showed a higher prevalence of overweight children (8.8%) than rural areas (5.9%). **Conclusion:** The findings of this study indicate that Malaysian school children face the burden of malnutrition, suffering from both undernourishment and overweight. Malaysia must make a concerted effort to overcome the problems of malnutrition among children.

Key words: Obesity, overweight, stunted, thinness, underweight

BACKGROUND

Nutritional anthropometry as measured by body weight and height can be used to reflect an individual's past and present nutritional status. When considered in combination, anthropometric indices can be used to identify stunting (low stature), wasting (thinness), and underweight or overweight. Within a population, anthropometric measures can assess the prevalence of these nutritional problems. Although the nutritional status of school children in Malaysia has improved tremendously over the past decade, the country continues to face the burden of malnutrition, which includes both underweight and overweight.

Nutritional status is directly influenced by food intake and the occurrence of infections. Food intake is not only a result of food availability at the household level, but also of dietary quality and quantity and

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feeding practices. Optimal infant feeding practices, which include breastfeeding and timely complementary feeding, contribute to the level of food intake in infants and young children (Brown, Dewey & Allen.1998). Because parental education plays a role in ensuring proper nutrition, it is important to conduct surveys to identify geographic and demographic areas with poor nutrition status so that educational interventions can be targeted.

Child malnutrition continues to be a major public health problem in developing countries, and nutritional deficiencies are frequently used as indicators of health status. Common nutritional deficiencies in these countries are protein energy malnutrition (PEM), vitamin A, zinc, nutritional anemia, and deficiencies of iodine (Olaf & Michael, 2005).

A study in South Africa revealed a high level of stunting in three of the four communities with the highest goiter prevalence. In general, iodine deficiency in children is also associated with a high prevalence of malnutrition such as stunting (Jooste, Weight & Kriek, 1997). Supporting this finding, Mason *et al.* (2002) found that after controlling for potential confounding factors, there were significant associations between the use of iodised salt and increased WAZ, especially in the second year of life.

Here, we build on the findings of iodine deficiency and malnutrition and use data from the 2008 National Iodine Deficiency Disorder (IDD) Survey to anthropometrically describe the nutritional status of Malaysian children aged 8-10 years.

METHODS

Study design and sampling method

A cross-sectional study was conducted among school children aged 8-10 years attending primary schools registered with the Ministry of Education in 2008. They were selected because of ease of recruitment, diverse socio-economic representation, and need for a large sample size. All the primary schools in each state and Federal Territory were first divided into urban and rural areas based on current classification used by the Ministry of Education. A total of 30 schools were then randomly selected. In WP Putrajaya and WP Labuan, all the 8 and 17 primary schools had been selected respectively. A total of 445 primary schools that comprised 250 urban and 195 rural had participated in the survey with 18,078 respondents.

The required sample size was calculated based on a 95% Confidence Interval (CI), a relative precision of 5%, a design effect of 2, a non-respondent rate of 20%, and a predicted prevalence of 20%. Since this study was integrated with the National IDD Survey, the prevalence rate of malnutrition was estimated from the prevalence rate of low iodine levels (UI level <100μg / L) (State Health Department of Sabah, 2008).

Data collection

Data collection was carried out between March 2008 and June 2008, and was conducted by trained school health teams under the guidance of a state field supervisor. The questionnaires and methods used for data collection were pre-tested in selected schools to check their reliability and validity prior to the actual survey. Centralised, hands-on training sessions were held for the data collection teams and field supervisors, with two separate sessions being held for Peninsular Malaysia and the states of Sabah, Sarawak and Labuan.

The questionnaire used in student interviews consisted of both open and close-ended questions that covered socio-demographic characteristics such as age, ethnicity, and occupation of the parents. The ethnicity of the respondents was determined based on the ethnicity of their fathers.

The body weight of each subject was measured twice using an electronic digital weighing scale (TANITA 319). The subject was weighed barefooted with minimum

Table 1. Default flag limits by indicator for the WHO references (WHO, 2009).

Indicator	*Lower SD*	*Upper SD*
WAZ	-6	+5
HAZ	-6	+6
BAZ	-5	+5

clothing and weight was recorded to the nearest 0.1 kg. The height of the subject was also measured twice using a body measurement tape (SECA Bodymeter 208) to the nearest 0.1 cm. Both body weight and height were measured using the method previously described by Lohman, Roche & Martorell (1988). The reported body weight and height were the average values from both readings.

The study protocol was approved by the Medical Research and Ethics Committee, Ministry of Health Malaysia prior to the study. All the school children and their parents / guardians were informed about the objectives, procedures, potential risks, and benefits of the study. Written informed consent was obtained for each participant's parent or guardian before the study took place. The respondents were also assured that all information was strictly confidential.

Data management and analysis

Centralised data entry and data cleaning were carried out at the Institute for Public Health using a web-based system that allowed simultaneous multiple data entry. As a control measure, the same data was entered twice by two different teams. The verification and consistency of the data entered were then checked by the Principal Investigator.

Data management and analysis were done using SPSS (Statistical Package for Social Sciences) for Windows versions 15.1 (SPSS, 2006) with module for complex sample analysis. Using the software AnthroPlus (WHO, 2009), three z-scores for nutritional status (weight for age; WAZ, height for age; HAZ and BMI for age; BAZ) were calculated relative to the WHO 2007. This software uses default lower and upper SD boundaries as flag limits to identify any extreme or potentially incorrect z-score values as shown in Table 1 for children aged 61 months to 19 years.

The findings of the study were classified based on nutritional indicators as shown in Table 2 (de Onis *et al.*, 2007) and reported as the weighted estimates after taking into account the complex survey design and distribution of the children in urban and rural areas. In this respect, a weighting factor was used to account for sampling design, non-response and post stratification for stratum (urban and rural), sex, age group and ethnicity. The data are presented as percent (%) and 95% Confidence Interval (CI).

RESULTS

From a total of 18,078 school children aged 8 - 10 years who participated in the study, 18,070 and 18,077 were measured for body weight and height respectively. Weight for age (WAZ) was determined among 16,738 children, while height for age (HAZ) was obtained for 18,053 children. BMI for age (BAZ) was determined among 18,015 children.

Prevalence of underweight using WAZ

The national prevalence of underweight (<-2SD) among school children was 13.6%. This figure includes a 2.3% prevalence rate of severe underweight (<-3SD) followed by 11.3% prevalence rate of moderate underweight (-3SD-<-2SD). Data on the

Table 2. Definition of nutritional indices based on WHO 2007

Indicators	*Interpretations*
Weight-for-age	
<-3SD	Severely underweight
-3SD - <-2SD	Moderately underweight
-2SD - <+2SD	Normal WAZ
≥+2SD	Overweight
Height-for-age	
<-3SD	Severely stunted
-3SD - <-2SD	Moderately stunted
-2SD - <+2SD	Normal HAZ
≥+2SD	Tall
BMI-for-age	
<-3SD	Severe thinness
-3SD - <-2SD	Thinness
-2SD - <+1SD	Normal
≥+1SD - <+2SD	Overweight
≥+2SD	Obese

* SD: Standard Deviation

prevalence of underweight with respect to demographic characteristics are shown in Table 3.

In Malaysia, the states of Sabah, Labuan and partially in Sarawak were gazetted to receive mandatory iodised salt sales and purchase. The gazetted areas consisted of a major part of East Malaysia described as rural area, far from the sea and a population with low socio-economic status while the non-gazetted areas were Peninsular Malaysia and some parts of Sarawak which had a population with a higher socio-economic status. The gazetted IDD areas showed a higher prevalence of severely underweight children (4.0%) and moderately underweight children (20.0%) than non-gazetted IDD areas (2.0%) and (10.1%), respectively.

According to strata, rural areas had a higher prevalence of severely underweight children (3.2% vs 1.5%]) and moderately underweight children (14.2% vs 9.0%) than urban areas. This is consistent with the above findings that accessibility to seafood, particularly in the case of iodine deficiency, and affordability were the main factors affecting the achievement of a balanced nutritional status. Given the status of urban areas as trading hubs, access to food does not appear to be a problem while in rural areas there is not much variety of food.

Prevalence of severe underweight was higher among boys (2.4%) than girls (2.1%). Similarly, prevalence of moderate underweight was higher among boys (11.5%) than girls (11.1%). This can be explained by girls achieving early puberty compared to boys. As boys are also more active compared to girls, their energy expenditure is higher.

Nine-year-old school children had the highest prevalence of severe underweight at 2.6% followed by 8-year-old school children (2.2%) and 10-year-old school children (2.0%). In contrast, 8-year-old school children had the highest prevalence of moderate underweight (11.5%) followed by 9-year-old (11.4%) and 10-year-old school children [(10.9%).

Orang Asli children (aborigines of Peninsular Malaysia) had the highest prevalence of severe underweight (13.9%) while the lowest rate was among Chinese

Table 3. Prevalence of underweight (<-2SD), moderately underweight (-3SD-<-2SD) and severe underweight (<-3SD) based on weight for age Z-scores by demographic characteristics.

Demographic characteristics	*Underweight (weight for age <-2 SD)*					*Moderately underweight (-3SD-<-2SD)*					*Severe underweight (<-3SD)*				
	n	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated Population*	*%*	*95% CI*	
				Lower	*Upper*				*Lower*	*Upper*				*Lower*	*Upper*
Malaysia	2178	186114	13.6	12.7	14.5	1821	154814	11.3	10.6	12.1	357	31300	2.3	2	2.6
Peninsular Malaysia	1631	133258	11.8	11.0	12.7	1359	110389	9.8	9.1	10.6	272	22869	2.0	1.7	2.4
Located in IDD Gazetted areas															
Gazetted	312	40628	23.9	20.4	27.8	259	33915	20.0	17.1	23.2	53	6713	4.0	3	5.2
Non-gazetted	1866	145485	12.1	11.3	13.0	1562	120899	10.1	9.4	10.8	304	24587	2.0	1.7	2.4
Strata															
Urban	1085	81302	10.6	9.6	11.7	927	69450.25	9	8.2	10	158	11851.9	1.5	1.2	2
Rural	1093	104812	17.4	15.9	19.0	894	85363.49	14.2	12.9	15.5	199	19448.08	3.2	2.7	3.8
Sex															
Boys	1160	98217	13.9	12.8	15.2	957	81224.85	11.5	10.5	12.6	203	16992.02	2.4	2	2.9
Girls	1018	87897	13.2	12.1	14.4	864	73588.89	11.1	10.1	12.1	154	14308	2.1	1.8	2.6
Age															
8 years	805	66817	13.7	12.4	15.0	673	56121.65	11.5	10.4	12.7	132	10696	2.2	1.8	2.7
9 years	809	68114	14.0	12.8	15.3	676	55553.28	11.4	10.3	12.6	133	12561	2.6	2.1	3.2
10 years	564	51182	13.0	11.7	14.4	472	43138.8	10.9	9.7	12.3	92	8044	2.0	1.6	2.6
Ethnicity															
Malay	1467	110627	13.6	12.7	14.6	1231	92138	11.4	10.6	12.2	236	18489	2.3	1.9	2.7
Chinese	137	13856	5.8	4.5	7.4	121	12331	5.1	3.9	6.8	16	1525	0.6	0.4	1.1
Indian	120	13292	10.5	8.7	12.6	97	10842	8.6	7.0	10.5	23	2450	1.9	1.1	3.5
Orang Asli	65	5756	45.7	29.0	63.5	46	4006	31.8	23.2	41.9	19	1750	13.9	6.9	26.0
Sabah Bumi	221	25014	24.6	20.7	29.0	184	20716	20.4	17.1	24.1	37	4298	4.2	3.1	5.8
Sarawak Bumi	147	16573	25.1	20.7	30.1	123	13888	21.1	16.9	25.9	24	2685	4.1	2.8	5.9
Other Bumis	10	32	13.7	8.4	21.4	9	29	12.4	8.0	18.7	1	3	1.3	0.2	8.8
Others	11	964	7.9	3.2	18.3	10	864	7.1	2.7	17.4	1	100	0.8	0.1	5.2

children (0.6%). Prevalence of moderate underweight was highest among the Orang Asli (31.8%), followed by Sarawak Bumi (21.1%) and Sabah Bumi (20.4%) respectively. Similarly, the Chinese had the lowest prevalence for moderate underweight children at 5.1%. Most Orang Asli and Bumi lived in rural areas while the Chinese mostly populated the urban areas.

Prevalence of stunting using HAZ

The national prevalence of severe stunting (<-3SD) among school children was found to be 1.1%, while 9.7% were moderately stunted (-3SD-<-2SD). Data on the prevalence of stunting with respect to demographic characteristics are shown in Table 4.

In line with Jooste *et. al.* (1997), gazetted IDD areas showed a higher prevalence of severely stunted children (2.9%) and moderately stunted children (21.3%) than non-gazetted IDD areas (0.9%) and (8.0%), respectively. Children with one detected nutrient deficiency normally would also have other nutrient deficiencies.

Rural areas had a higher prevalence of severely (1.8%) and moderately stunted children (13.3%) than urban areas (0.6% and 6.9%), respectively. Parents' education level and income group in rural areas might emphasise more on earning a living and having enough food rather than quality of food and its nutrients.

Prevalence of severe stunting was higher among boys (1.3%) than girls (1.0%). Similarly, prevalence of moderate stunting was higher among boys (9.9%) than girls (9.5%). Other than hormonal differences, behaviourally, boys tend to be more rebellious and picky about food than girls. Selective avoidance of certain foods like vegetables might lead to deficiencies in certain micronutrients.

In terms of severe stunting and moderate stunting among children, the highest prevalence in children aged 9 is 1.3% and 10.1%, followed by 1.1% and 9.7% for children aged 10 years and 1.0% and 9.3% respectively for children aged 8 years..

By ethnicity, Orang Asli children had the highest prevalence of severe stunting (18.7%), while none of the Indians were severely stunted. Prevalence of moderately stunted school children was also highest among the Orang Asli (38.3%), while the Chinese had the lowest prevalence for moderately stunted children at 3.1%. Stunting might be associated with ethnicity as Orang Asli and Bumi children normally have a smaller stature compared to Indians and Chinese.

Prevalence of thinness using BAZ

The national prevalence of thinness (-3SD - <-2SD) among school children was 6.5%, while 1.3% had severe thinness (<-3SD). Data on the prevalence of thinness according to demographic characteristics are shown in Table 5.

In contrast with the other two findings, non-gazetted IDD areas showed a higher prevalence of severe thinness among school children than gazetted IDD areas (1.4% vs 0.7%). The same was found for thin school children, with 6.5% in non-gazetted IDD areas compared to 6.4% in gazetted areas although the difference was not too big.

Stratifically speaking, rural areas had a higher prevalence of severe thinness and thinness among school children (1.5% and 6.7%) than urban areas (1.2% and 6.4%). Boys had a higher prevalence of severe thinness (1.5%) compared to girls (1.1%). However, in terms of thinness, it was 6.5% for both boys and girls.

School children aged 8 and 9 years old had a similar prevalence of severe thinness, both at 1.2%. On the other hand, 9-year -old school children had the highest prevalence of thinness (6.7%) followed by 10-year-old school children (6.6%) and 8-year-old children (6.2%).

Indian school children had the highest prevalence of severe thinness (2.9%) and thinness (10.7%) while the Sarawak Bumi

Table 4. Prevalence of stunted (<-2SD), moderately stunted (-3SD-<-2SD) and severely stunted (<-3SD) school children based on height for age by demographic characteristics

	Stunted (height for age<-2 SD)					*Moderately stunted (-3SD-<-2SD)*					*Severely stunted (<-3SD)*				
Demographic characteristics	*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*	
				Lower	*Upper*				*Lower*	*Upper*				*Lower*	*Upper*
Malaysia	1881	161733	10.9	9.9	11.9	1636	144614	9.7	8.9	10.6	245	17120	1.1	0.9	1.5
Peninsular Malaysia	1268	105043	8.7	7.8	9.6	1143	95142	7.8	7.1	8.6	125	9901	0.8	0.6	1.2
Located in IDD Gazetted areas															
Gazetted	345	45176	24.2	20.2	28.7	304	39768	21.3	17.8	25.3	41	5408	2.9	2.0	4.3
Non-gazetted	1536	116558	8.9	8.1	9.9	1332	104845	8.0	7.3	8.8	204	11712	0.9	0.6	1.3
Strata															
Urban	892	62636	7.5	6.6	8.6	763	57489	6.9	6.0	7.9	129	5147	0.6	0.4	0.9
Rural	989	99097	15.1	13.4	17.0	873	87125	13.3	11.9	14.8	116	11972	1.8	1.3	2.6
Sex															
Boys	1011	85464	11.1	9.9	12.5	874	75831	9.9	8.8	11.1	137	9632	1.3	0.9	1.7
Girls	870	76270	10.5	9.5	11.7	762	68782	9.5	8.6	10.5	108	7488	1.0	0.8	1.4
Age															
8 years	611	50584	10.3	9.2	11.5	530	45554	9.3	8.3	10.4	81	5030	1.0	0.7	1.5
9 years	653	55497	11.4	10.1	12.8	562	49275	10.1	9.0	11.4	91	6222	1.3	0.9	1.8
10 years	617	55652	10.9	9.6	12.3	544	49784	9.7	8.6	11.0	73	5868	1.1	0.8	1.6
Ethnicity															
Malay	1190	90541	10.3	9.5	11.2	1045	82438	9.4	8.6	10.2	145	8103	0.9	0.7	1.2
Chinese	97	8229	3.1	2.4	4.1	94	8018	3.1	2.3	4.0	3	211	0.1	0.0	0.3
Indian	44	5614	4.1	3.0	5.6	44	5614	4.1	3.0	5.6	-	-	-	-	-
Orang Asli	94	8149	57.0	39.4	73.0	66	5473	38.3	33.4	43.4	28	2676	18.7	8.3	36.9
Sabah Bumi	261	29183	26.6	21.9	31.8	220	25375	23.1	19.0	27.8	41	3808	3.5	2.2	5.4
Sarawak Bumi	168	18948	24.8	19.8	30.4	146	16652	21.8	17.4	26.8	22	2297	3.0	1.8	5.1
Other Bumis	12	39	15.0	6.4	31.2	9	29	11.2	5.4	22.0	3	10	3.7	0.5	23.8
Others	15	1030	8.0	3.4	17.8	12	1014	7.9	3.3	17.7	3	16	0.1	0.0	0.9

Table 5. Prevalence of thinness (<-2SD) and severe thinness (<-3SD) based on BMI for age Z-Scores and tall (≥+2SD) based on height for age Z-score by demographic characteristics.

	Thinness BAZ (-3SD - <-2SD)					*Severe thinness BAZ (<-3SD)*					*Tall HAZ (≥+2SD)*				
Demographic characteristics	*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*	
				Lower	*Upper*				*Lower*	*Upper*				*Lower*	*Upper*
Malaysia	1160	96576	6.5	6.0	7.0	281	19303	1.3	1.0	1.6	211	15390	1.0	0.8	1.4
Peninsular Malaysia	974	78278	6.5	6.0	7.1	259	17624	1.5	1.2	1.8	189	13714	1.1	0.8	1.5
Located in IDD Gazetted areas															
Gazetted	92	11921	6.4	5.1	8.0	12	1371	0.7	0.4	1.5	8	970	0.5	0.3	1.0
Non-gazetted	1068	84655	6.5	6.0	7.0	269	17932	1.4	1.1	1.7	203	14419	1.1	0.8	1.5
Strata															
Urban	666	52899	6.4	5.7	7.0	148	9639	1.2	0.9	1.6	132	10887	1.3	1.0	1.8
Rural	494	43677	6.7	6.0	7.4	133	9664	1.5	1.1	2.0	79	4503	0.7	0.4	1.2
Sex															
Boys	594	49478	6.5	5.8	7.2	162	11425	1.5	1.2	1.9	105	7501	1.0	0.7	1.4
Girls	566	47098	6.5	5.9	7.2	119	7878	1.1	0.8	1.5	106	7889	1.1	0.8	1.5
Age															
8 years	391	30322	6.2	5.4	7.1	91	5830	1.2	0.9	1.5	73	5916	1.2	0.8	1.7
9 years	384	32719	6.7	6.0	7.6	93	5760	1.2	0.8	1.7	72	5739	1.2	0.8	1.8
10 years	385	33534	6.6	5.8	7.4	97	7713	1.5	1.1	2.1	66	3735	0.7	0.5	1.1
Ethnicity															
Malay	771	56174	6.4	5.9	7.0	203	12135	1.4	1.1	1.8	116	6546	0.7	0.5	1.2
Chinese	131	12214	4.7	3.6	6.0	26	1747	0.7	0.4	1.1	47	3920	1.5	1.0	2.3
Indian	132	14679	10.7	9.2	12.4	38	3935	2.9	1.9	4.4	34	3788	2.8	1.6	4.8
Orang Asli	10	921	6.4	3.6	11.1	3	282	2.0	1.0	4.0	-	-	-	-	-
Sabah Bumi	57	6356	5.8	4.1	8.1	7	831	0.8	0.3	2.0	6	537	0.5	0.2	1.2
Sarawak Bumi	47	5430	7.1	5.5	9.1	3	288	0.4	0.1	1.1	6	547	0.7	0.3	1.6
Other Bumis	1	3	1.2	0.2	6.8	-	-	-	-	-	-	-	-	-	-
Others	11	798	6.2	2.8	13.0	1	85	0.7	0.1	4.8	2	52	0.4	0.1	2.4

and other Bumi had the lowest prevalence for severe thinness (0.4%) and thinness (1.2%). Orang Asli and the Malays were somewhere in between.

Prevalence of tall children using HAZ

The national prevalence of tall stature (≥+2SD) among the school children was 1.0%. Data on the prevalence of tall stature according to demographic characteristics are shown in Table 5.

Non-gazetted IDD areas are areas with less malnutrition problems. Children in these areas showed a higher prevalence of a tall stature (1.1%) than gazetted IDD areas (0.5%).

Due to ethnic differences, urban areas had a higher prevalence of tall school children than rural areas (1.3% vs 0.7%). The rural areas have more Orang Asli and Bumi than in urban areas. Poverty and chronic malnutrition that occur more often in rural areas may also account for delayed growth. Urban areas, on the other hand, do not face the same problem.

As expected, due to hormonal differences, the prevalence of tall school children was higher among girls than boys at 1.1% and 1.0%, respectively in the age group 8 to 10 years

School children aged 8 to 9 years had almost a similar prevalence of a tall stature at 1.2% and 1.2% respectively. The lowest prevalence of a tall stature was among 10-year-old school children at 0.7%.

Indian school children had the highest prevalence of tall stature (2.8%), while none of the other Bumi and Orang Asli was tall. Perhaps this is because the genetic make-up of Indians is different from other Bumi and Orang Asli.

Prevalence of overweight and obesity

Overall, the national prevalence of overweight school children based on WAZ (≥+2SD) was 7.6%, while 10.9% were overweight based on BAZ (>+1SD - <+2SD). The prevalence of overweight school children based on WAZ and BAZ according to demographic characteristics are shown in Table 6. Meanwhile, the national prevalence of obese school children based on BAZ (≥+2SD) was 11.2%.

Non-gazetted IDD areas showed a higher prevalence of overweight school children based on WAZ (8.1%) and BAZ (11.6%) when compared to their counterparts in gazetted IDD areas (3.8% and 6.5%) respectively. Similarly, non-gazetted IDD areas showed a higher prevalence of school children with obesity based on BAZ (11.9%) than gazetted areas (6.0%). Non-gazetted IDD areas tend to have less malnutrition problems, but on the other hand, over consumption due to availability of food brings with it problems of overweight and obesity.

Urban areas showed a higher prevalence of overweight school children based on WAZ at 8.8% and BAZ at 12.5% than rural areas at 5.9% and 8.9%, respectively. By strata, urban areas had a higher prevalence of obese children (13.0%) compared to rural areas (8.8%). Urban lifestyles with frequent fast food consumption due to the convenience factor quite often results in unhealthy weight gain. The pattern of daily activity for children in rural and urban areas also contributes to differences. Rural children have more active and varied daily activities compared to urban children who spend more time indoors.

The survey found a higher prevalence of overweight boys based on WAZ (9.4%) than girls (5.6%). In line with this finding, we found a higher prevalence of overweight girls based on BAZ (11.3%) than boys (10.6%). At the same time, the prevalence of obesity was higher among boys (14.1%) than girls (8.1%). WAZ, BAZ and obesity criteria consistently show that boys put on more weight than girls.

Nine-year-old school children had the highest prevalence of overweight based on WAZ at 8.3% followed by 10-year-old school

Table 6. Prevalence of overweight (>+2SD) based on weight for age Z-score, and overweight (>+1SD) and obesity (>+2SD) based on BMI for age Z-Scores by demographic characteristics.

	Overweight WAZ (>+2SD)					*Overweight BAZ (>+1SD - <+2SD)*					*Obesity BAZ(>+2SD)*				
Demographic characteristics	*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*		*n*	*Estimated population*	*%*	*95% CI*	
				Lower	*Upper*				*Lower*	*Upper*				*Lower*	*Upper*
Malaysia	1331	103680	7.6	7	8.2	2024	162591	10.9	10.3	11.6	2076	166309	11.2	10.4	12.0
Peninsular Malaysia	1123	90257	8.0	7.4	8.7	1698	141057	11.7	10.9	12.4	1712	143928	11.9	11.0	12.8
Located in IDD Gazetted areas															
Gazetted	56	6381	3.8	2.7	5.3	102	12190	6.5	5.2	8.2	95	11194	6.0	4.6	7.8
Non-gazetted	1275	97299	8.1	7.4	8.8	1922	150401	11.6	10.8	12.3	1981	155115	11.9	11.1	12.8
Strata															
Urban	879	67929	8.8	8	9.8	1338	104364	12.5	11.6	13.5	1368	108561	13.0	11.9	14.3
Rural	452	35751	5.9	5.2	6.8	686	58227	8.9	8.0	9.9	708	57748	8.8	7.9	9.8
Sex															
Boys	856	66562	9.4	8.6	10.4	1005	80973	10.6	9.7	11.5	1350	107481	14.1	13.0	15.2
Girls	475	37118	5.6	4.9	6.3	1019	81618	11.3	10.4	12.3	726	58828	8.1	7.3	9.0
Age															
8 years	451	34245	7.0	6.2	7.9	557	41076	8.4	7.4	9.4	618	47600	9.7	8.6	10.9
9 years	523	40251	8.3	7.3	9.3	719	55557	11.4	10.3	12.7	752	56640	11.6	10.6	12.8
10 years	357	29184.0	7.4	6.4	8.5	748	65958	12.9	11.8	14.2	706	62069	12.2	10.9	13.5
Ethnicity															
Malay	817	55541	6.8	6.2	7.5	1221	88294	10.1	9.3	10.9	1320	94570	10.8	9.9	11.8
Chinese	281	26121	10.9	8.9	13.2	470	41333	15.8	14.1	17.6	406	38248	14.6	12.5	17.0
Indian	117	12683	10.0	8.2	12.2	164	20018	14.6	12.0	17.7	149	17941	13.1	11.0	15.5
Orang Asli	2	115	0.9	0.2	3.6	3	196	1.4	0.3	5.4	4	286	2.0	0.6	6.6
Sabah Bumi	48	3600	3.5	2.3	5.3	79	6231	5.7	4.2	7.6	83	6188	5.6	4.0	7.9
Sarawak Bumi	43	4056	6.2	4.0	9.3	56	5325	7.0	5.3	9.1	79	7522	9.8	6.9	13.9
Other Bumis	5	16	7.0	3.2	14.6	10	33	12.7	7.8	20.2	13	42	16.2	8.3	29.1
Others	18	1548	12.8	5.6	26.6	21	1161	9.0	4.8	16.2	22	1512	11.7	5.0	25.3

children (7.4%) and 8-year-old school children (7.0%). Ten-year-old school children had the highest prevalence of overweight based on BAZ at 12.9% followed by 9-year-old school children (11.4%) and 8-year-old school children (8.4%). Similarly, 10-year-old school children had the highest prevalence of obesity (12.2%) followed by 9-year-old school children (11.6%) and 8-year-old school children (9.7) respectively. The pattern that emerges is that older children tend to put on more weight than their younger counterparts. It could be that older children receive more pocket money to spend on snacks.

School children of other races had the highest prevalence of overweight based on WAZ (12.8%), while Orang Asli had the lowest prevalence of overweight at 0.9%. Chinese school children had the highest prevalence of overweight based on BAZ at 15.8%, while Orang Asli had the lowest prevalence for overweight school children at 1.4%. Prevalence of obesity was higher among other Bumi (16.2%), followed by Chinese (14.6%) and Indians (13.1%), respectively. As with WAZ defined overweight, Orang Asli had the lowest prevalence for obesity children by BAZ (2.0%).

DISCUSSION

Similar to the trends observed in other South-east Asian countries like Indonesia (Waters *et al.,* 2004), Vietnam (Hop, Mai & Khan 2003), and the Philippines (FNRI, 2005), the overall nutritional status of Malaysian children is improving. Here, we used anthropometric data collected in the 2008 National IDD Survey to assess the nutritional status of Malaysian school children aged 8-10 years old. Analysis of nutritional indicators WAZ, HAZ, and BAZ revealed that the national means of these measures among school children were within the normal range of the WHO 2007 reference population, although the data did skew slightly to the left.

Although the overall findings of our survey showed that nutritional status of school children aged 8-10 years attending primary schools in Malaysia was within the normal range, underweight and stunting was nearly twice as high among rural school children compared to their urban counterparts, and was particularly high among Bumi children. In agreement with our findings, a study among children aged 6-12 years old from five rural Malaysian communities found the prevalence of underweight among boys and girls to be 29.1% and 26.1%, respectively (Khor & Tee, 1997). A more recent study among low-income, urban primary school children aged 6-10 years old in Kuala Lumpur found that the prevalence of underweight, stunting and wasting among those children were approximately 52%, 50% and 30% respectively (Zalilah, Jenny & Nan, 2000). These studies, as well as our findings, highlight the fact that malnutrition remains a problem for specific regions and demographics in Malaysia.

In addition to the risk of under-nutrition, recent evidence also makes it clear that there is a growing prevalence of overweight and obesity among Malaysian children. In 1996, Bong & Jaafar reported a significant obesity rate among Malaysian school children aged 7 and 12 years old, and found that obesity was slightly more prevalent among urban students compared to rural students. The study also found that boys were significantly more likely to be obese (66.7%) than girls (33.3%), and that older students were more likely to be obese than younger students (11.1 % for 12 years old vs. 4.4 for 7 years old). Other studies have reported increased obesity of older children in both Malaysia (Ismail & Tan, 1998) and Thailand (WHO, 2003). Similar trends of high overweight and obesity prevalence have been reported in Singapore (Singapore School Health, 2000), China (Wu, 2006), and Iran (Mosavi, 2005).

CONCLUSION

Generally, the nutritional status of Malaysian school children in urban and rural areas is improving in tandem with the country's socio-economic improvement. The nutritional status of school children in urban areas is comparable with developed countries. However, there is a continued burden of malnutrition, and the improvement rate of nutritional status in rural areas lags below that in the urban areas. Although the prevalence of overweight is not very high in urban areas, there is a significant increasing trend, highlighting an emerging public health challenge.

RECOMMENDATIONS

Due to rapid changes in the food pattern and lifestyle of the population combined with the existing double burden of malnutrition in the country, multi-pronged strategies and approaches need to be undertaken by health professionals. For example, healthy school canteen programmes and supplementary feeding programmes need to be reviewed and strengthened. In the mean-time, gaps in research on dietary practices, disease pattern, behavioural and socio-economic variables are crucial to designing all levels of disease prevention and health promotion. Therefore, the National Nutritional Survey of primary school children needs to be monitored to strengthen the baseline and social diagnosis of the national nutritional status. Public intervention programmes on the standard of living of the households in rural areas should be given high priority to combat the children's under nutrition problems as evidenced by weight for age, height for age and BMI for age.

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