Short Communication

Overweight among primary school-age children in Malaysia

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This study is a secondary data analysis from the National Health Morbidity Survey III, a population-based study conducted in 2006. A total of 7,749 children between 7 and 12 years old were recruited into the study. This study seeks to report the prevalence of overweight (including obesity) children in Malaysia using international cut-off point and identify its associated key social determinants. The results show that the overall prevalence of overweight children in Malaysia was 19.9%. The urban residents, males, Chinese, those who are wealthy, have overweight or educated guardians showed higher prevalence of overweight. In multivariable analysis, higher likelihood of being overweight was observed among those with advancing age (OR=1.15), urban residents (OR=1.16, 95% CI: 1.01-1.36), the Chinese (OR=1.45, 95% CI: 1.19-1.77), boys (OR=1.23, 95% CI: 1.08-1.41), and those who came from higher income family. In conclusion, one out of five of 7-12 year-old-children in Malaysia were overweight. Locality of residence, ethnicity, gender, guardian education, and overweight guardian were likely to be the predictors of this alarming issue. Societal and public health efforts are needed in order to reduce the burden of disease associated with obesity.

Key Words: National Health and Morbidity Survey III, school children, overweight, Malaysia, IOTF

INTRODUCTION

Childhood obesity poses global public health threat and has risen to an alarming level throughout the world. Environmental factors, lifestyle preferences and culture play important roles in the rising prevalence of obesity worldwide. Overweight child are more likely to be overweight or obese in their adulthood and therefore are at greater risk of developing heart disease, diabetes, and other chronic ailments.[1-4] Children occasionally become overweight on account of medical or genetic conditions (ie, endocrine disorders). The main cause relates to poor dietary habits, inactivity (sedentary or less physical activity), or a combination of these factors.[5] These situations also pose an emerging public health issue in Asia. Different cut-off points using varied criteria in defining overweight and obesity has made the comparison between countries considerably difficult. In Asia, the prevalence of overweight children aged 10-12 years in Singapore was about 22.5%; and in Thailand, 7.9% of urban school children aged 7–9 years in the north-eastern part were overweight (weight-for-height reference, z score >2 SD) (the International Obesity Task Force (IOTF) Classification).[6-7] Indonesia reported that the prevalence of overweight (BMI ≥85th percentile) children aged 8-10 years from an urban area was 15.3% among girls and 17.8% among boys.[8] In Manila, Philippines, as high as 24.9% of private school children and 5.8% of public school children were at risk of being overweight (BMI ≥85th percentile).[9]

In Malaysia, Bong and Safurah (1996) demonstrated that the prevalence of overweight among primary school children in the state of Selangor was 7.8% (WHO 1983 reference).[10] Another study conducted among 5995 primary school children aged 7-10 years in Kuala Lumpur by Tee *et al* (2002) revealed that the overweight prevalence was 9.7% in boys and 7.1% in girls (WHO, 1995 reference).[11] In Kuala Selangor, 21.8% of children aged 10-12 years were overweight according to IOTF cut-off point (Sumarni *et al* 2006). However, the National Health & Morbidity Survey III (2006), which is based on the CDC 2000 reference (weight for age), estimated the overweight prevalence among children aged 7-13 years was 5.9%-6.8%.[12] On the other hand, Mohd Ismail *et al* (2009) reported overweight prevalence among primary school-age children in Peninsular of Malaysia (based on the WHO 2007 reference) at 20.7% in 2002 and this increased to 26.5% in 2008.[13] Regardless of the reference of cut-off points for overweight, the increasing epidemic of overweight or obesity among school age-children is of worrying state. Therefore, it is important to identify the potential socio-demographic factors associated with over-

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weight in order to provide evidence-based information to relevant stakeholders for the development and implementation of intervention programmes.

The present study determined the prevalence of overweight among Malaysian children aged 7-12 years in order to provide internationally comparable findings by using IOTF cut-off point. At present, weight-for-height z-score or percentile was applied to assess the prevalence of overweight children in population based studies in Malaysia. We will also examine the socio-demographic variables associated with overweight children, in extension of defining potential risk factors.

MATERIAL AND METHODS

Subjects

Children aged 7-12 years with completed socio-demographic and anthropometric measurements from the respective national health survey were included.

Source of data

The Third National Health and Morbidity Survey (NHMS III, 2006)

The NHMS 2006 is a national survey using the sampling frame provided by the Malaysian Department of Statistics. The country was divided into contiguous geographical areas called Enumeration Blocks (EBs). These EBs constituted the sampling frame for the NHMS 2006. A two-stage stratified sample design was used. The first-stage sampling unit was the EB and the second-stage sampling 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, which was proportionate to a size linear systematic selection scheme based on the latest updated size measurements. The selection of EBs was carried out independently within each state (as a primary stratum) and within urban or rural areas (as a secondary stratum) in accordance with the selection rate determined for each stratum. This ensured that the sample size was representative of the population national levels.

Field data collection was conducted for 4 months in 2006. A bilingual (Malay and English) precoded questionnaire was designed, pre-tested and piloted prior to the administration of the survey. Trained research assistants conducted face-to-face interviews with parents or guardians of children.

After completing the questionnaire, trained nurses obtained child weight and height measurement. A portable body meter (SECA 206, Germany) was used to measure the child's height to the nearest 0.1 cm. Body weight was measured using a digital lithium weighing scale (Tanita 318, Japan) and measurements were recorded to the nearest 0.1 kg and taken twice per child to generate an average value for data entry.

Use of variables

Children variables

The subset data of children in single age, gender, residency (urban-rural), family monthly income, ethnic group (Malay, Chinese, Indian, Other Bumi's, and Others), weight and height was extracted. Body mass index (BMI) for the children was defined as weight (kg)/height squared (m^2). Age- and sex-specific cut-offs proposed by IOTF were used to define overweight (including obesity) in our study.[14] The use of this reference, in children and adolescents, was recommended worldwide even though it was detected that it slightly varies because of the pubertal age.[14,15] It was acceptable widely for the purpose of international comparison.[14] Children aged 7-12 years were categorized into groups of non-overweight and overweight.

Guardian variables

Parental variables for level of education and nutritional status were not used due to small sample sizes. Therefore, heads of household and their spouse was defined as the guardian. Guardian's education attainment and his or her BMI status from Adult Nutrition Status in NHMS III was matched to his or her child data using household identifier .The measure of overweight included overweight and obese cut-off value. The highest education attainment between the guardians was selected as an indicator for guardian education level. The guardian was considered overweight if at least one of the guardians was overweight (BMI $\geq$25 kg/m^2).

Other Bumi's (native) and others were comprised of 47 minority ethnics groups.

Data analysis

Survey data were analysed using SPSS version 19.0 and Stata version 11.0. Descriptive statistics were used to calculate estimated prevalence of overall overweight of primary school-aged children in Malaysia and prevalence by the socio-demographic profiles. Weighting the survey data was required to map the sample back to an unbiased representation of the survey population.

Simple logistic regression was used to test for univariable measures of associated socio-demographic characteristics and overweight child.

A multiple logistic regression model was used to examine the effects of socio-demographic determinants for age, gender, residence (urban versus rural), socio-demographic factors (family background education, ethnicity), and guardian BMI status to determine the potential independent risk factors of overweight children. Preliminary assessment for the selected model was done with the evaluation of the fitted model including adjusted Wald Tests to test the contribution of individual model parameters. A diagnostic testing for the Goodness-of-Fit was also done to ensure the fit of a logistic regression model for individual cases or covariates. Interaction testing was assessed to ensure whether any interactions were scientifically relevant among the predictors that may affect the model in terms of multicollinearity. Finally, a final model is created that will include all those predictors and interactions that were significantly associated at level of $p<$ 0.05.The finding presented as crude and adjusted odd ratio with 95% confidence interval. All analyses were done using complex sampling design to ensure that sample weight and study design were accounted.

RESULTS

Socio-demographic characteristics

A total of 7749 children were included in this study and

characteristics of the participants are described in Table 1. This count was estimated to 2,843,307 of Malaysian children population aged 7-12 years old in 2006. Of these, 51% were male and 53% resided in the urban settlement. By ethnicity, 62% were Malays, 14% for both Indian and Chinese, and 10% for other ethnics.

Approximately, about 66% of the subjects fall into theless than RM 2000 household income group. A large proportion (65%) of the guardians had at least secondary education and only 6% had not attended formal education. The estimated mean for age, weight, and height of this study was (9.53±1.67 years), (31.2±11.4 kg), and (1.33±0.12 m) respectively (Table 1).

The prevalence of overall overweight

The overall prevalence of overweight among primary school-aged children in Malaysia was 19.9% (95% CI: 18.9-21.0). By socio-demographic profile, the prevalence was significantly higher in boys, 21.7% (95% CI: 20.3-23.2). The urbanite showed higher overweight prevalence, 22.6% (95% CI: 21.2-24.1). By ethnicity, the highest prevalence of overweight was among the Chinese, 26.6% (95% CI: 23.7-29.7), followed by the Indians and Malays. Guardians with tertiary education background had 22.0% overweight prevalence (95% CI: 18.6-25.8), this group was found to have the highest prevalence in having an overweight child. By guardian BMI status, the prevalence of having an overweight child was higher in the overweight guardian group, 25.1% (95% CI: 23.6-26.6). Households with higher income showed higher prevalence compared to the households with lower income. Detailed prevalence rates are shown in Table 1.

Associated factors for overweight children

The results of logistic regression analysis for overweight subjects are demonstrated in Table 3 with crude and adjusted odds ratio, 95 % confidence interval, and *p* value <0.05. Out of the variables included, other Bumi's and other ethnic groups are found to not be statistically significant in affecting the odds of being overweight in univariable analysis.

The multiple logistic regression result suggests that an additional of age increases the odd of being overweight (OR=1.15 95% CI: 1.11-1.20). Urbanite children were likely to be overweight with odds of 1.16 relatively. Boys are more likely to be overweight compared to girls (OR=1.23 95% CI: 1.08-1.41). The odds of Chinese (OR=1.45 95% CI: 1.19-1.77) was significant toward the ethnic Malays. The *p* value of the goodness of fit test showed more than 0.05, an indicator that this model has a good fit.

DISCUSSION

Results from this study demonstrated that one-fifth of Malaysian primary school children were overweight. This finding was comparable to those of Singapore and Thailand,[6-7] but was relatively higher than Indonesia and Vietnam.[16] On the other hand, the prevalence of the over-

Table 1. Socio Demographic characteristics and prevalence of overweight among primary school children in Malaysia

Socio-demographic characteristics		Total Respondent	n	Population	Prevalence %	95% CI Lower	95% CI Upper
National		7749	1498	566787	19.9	18.9	21.0
Residence							
	Urban	4154	923	1302453	22.6	21.2	24.1
	Rural	3595	575	974067	16.1	14.7	17.5
Gender							
	Male	3900	818	1126345	21.7	20.3	23.2
	Female	3849	680	1150174	18.1	16.8	19.5
Ethnicity							
	Malay	4805	891	1427097	18.9	17.7	20.2
	Chinese	1087	288	319460	26.6	23.7	29.7
	Indian	535	137	158311	26.1	22.1	30.6
	Other Bumi's	1080	155	301169	14.8	12.5	17.5
	Others	242	27	70481	12.0	7.8	18.0
Guardian	None	489	73	141862	14.9	12.0	18.4
Education	Primary	1758	314	510141	18.4	16.6	20.5
Attainment							
	Secondary	3477	725	1021741	21.3	19.9	22.8
	Tertiary	618	132	189870	22.0	18.6	25.8
Guardian BMI Status							
	Non-overweight	2680	344	846104	13.2	11.9	14.7
	Overweight	3666	900	1018017	25.1	23.6	26.6
Household income (RM)							
	≥5000	574	147	170182	25.7	22.0	29.9
	4000-4999	271	69	77402	25.9	20.3	32.3
	3000-3999	578	132	172828	23.4	19.7	27.5
	2000-2999	1102	266	318778	24.4	21.7	27.4
	1000-1999	2095	443	605196	21.8	19.8	23.8
	700-999	968	160	290241	16.6	14.1	19.5
	400-699	1307	167	386141	13.0	11.1	15.2
	<400	615	66	186500	10.9	8.5	13.9

*$1 USD=RM3.05

Table 2. Associated factors of overweight by univariable and multivariable logistic regression

Variable	Category	Crude Odd Ratio	95% CI		*p*-value	Adjusted Odd Ratio	95% CI		*p*-value
			Lower	Upper			Lower	Upper	
Age (Year)		1.12	1.08	1.15	<0.001	1.15	1.11	1.20	<0.01
Residence									
	Urban	1.53	1.33	1.74	<0.001	1.16	1.01	1.36	<0.05
	Rural	1.00							
Gender									
	Male	1.25	1.11	1.41	<0.001	1.23	1.08	1.41	<0.05
	Female	1.00							
Ethnicity									
	Malay	1.00							
	Chinese	1.55	1.38	1.84	<0.001	1.45	1.19	1.77	<0.01
	Indian	1.52	1.19	1.92	<0.001	0.99	0.60	1.65	0.964
	Other Bumi's	0.58	0.36	0.95	<0.05	0.88	0.69	1.13	0.330
	Others	0.74	0.60	0.92	<0.01	1.25	0.97	1.61	0.088
Guardian BMI status									
	Overweight	2.19	1.90	2.53	<0.001	2.16	0.87	2.52	0.750
	Non-overweight	1.00							
Household income (RM)									
	≥5000	2.82	2.01	3.97	<0.001	1.85	1.23	2.76	<0.01
	4000-4999	2.84	1.87	4.31	<0.001	1.84	1.18	2.87	<0.01
	3000-3999	2.48	1.75	3.52	<0.001	1.61	1.10	2.36	<0.01
	2000-2999	2.63	1.92	3.61	<0.001	1.75	1.24	2.47	<0.01
	1000-1999	2.26	1.68	3.05	<0.001	1.66	1.20	2.29	<0.01
	700-999	1.62	1.16	2.26	<0.001	1.25	0.88	1.77	0.213
	400-699	1.21	0.87	1.68	0.240	0.99	0.65	1.40	0.941
	<400	1.00							
Guardian education									
	No formal education	1.00							
	Primary	1.29	0.97	1.70	0.076	1.07	0.79	1.46	0.648
	Secondary	1.54	1.17	2.01	<0.05	1.20	0.80	1.50	0.550
	Tertiary	1.60	1.15	2.23	<0.01	0.99	0.67	1.46	0.952

weight child in developed countries had been shown to reach 35%.[17-18] It was clearly shown that same pattern had occurred in rapidly developing countries in Asia, which had seen a huge transformation from agriculture to industrial and services sector. The economic transformation of Malaysia from agriculture to industrial and services sectors and rapid development of Malaysia have improved the quality of life of a Malaysian citizen and thus resulted in better access and greater affordability to various food resources and luxurious activities, which in turn has also resulted in changes of dietary habits and lifestyle.[19-20]

The finding was also consistent with studies conducted among Asian populations, whereby the prevalence of overweight children was higher in urban areas.[10,21-22] The increasing rate of urban migration due to higher perceived income might be one of the contributing factors to such phenomenon. Majority of guardians working in the urban areas have long working hours and hence are unable to prepare home-made meals for their children, resulting in greater tendency of having meals with higher energy and saturated fat at the hawker stalls and fast-food restaurants.[11, 23-26]

Other studies conducted in Asian countries also supported our findings that boys had higher prevalence and were more likely to be overweight.[4,8,11,22,25,27,28] Males and females were often subjected to a different kind of socialization even in modern Asia; the parents always encouraged boys to take higher portion of energy-dense food than the girls.[29-30] In addition to a sedentary lifestyle such as watching television, playing computer games, and internet surfing, such enviroment undeniably creates positive energy balance (energy in-energy out) and thus favours increasing weight.[31-32]

Consistent with our findings, the Chinese children had the highest prevalence of overweight across all ethnicities.[21,33] [2]Soo and colleague reported that fat intake among the Chinese school children has exceeded the recommended range by Acceptable Macronutrient Distribution Ranges (AMDR).[34] Stir fry and deep frying are popular cooking methods in the Chinese cuisine, and this may possibly lead to an additional fat intake among Chinese children.[26,35] Besides, different genetic composition in lean body and fat mass of different ethnics' background has been cited as one of the plausible reasons. The interaction with other genes or environmental factors may also modify the muscularity and adiposity of body composition.[36-37]

This study also showed that the prevalence of overweight in children increased proportionally with guardians' BMI status. This finding was in agreement with those reported by Lazzeri *et al*[38] A systematic review by Plourde (2006) found that there is a 70% chance that children will be obese if both parent are obese, 50% chance if one parent is obese, and 10% chance if neither parents are obese.[39] However, after adjusting for sociodemographic factors, overweight status of the guardian became an insignificant factor in relation to having an overweight child. Such findings are opposing to those reported by Danielzik *et al* (2004), Kleiser *et al* (2009), and Wang *et al* (2002), who demonstrated that having an overweight guardian had a strong association with an overweight child.[40-42] Limited information on the

relationship between guardian and children (biological parents) in our study might be the reason for not being able to demonstrate the pontential association.

Consistent with the findings from other Asian country studies, wealthier families were more prevalent in having overweight children.[27,43-44] According to Collins *et al* (2008), child from a family with high income was three times as likely to be overweight. In Pakistan, children who lived in higher income neighborhood showed significant positive association with overweight.[22,29] Nonetheless, the present finding was inconsistent with those of a developed country where household income and overweight children showed an inverse relationship.[41,42,44] In essence, in a developed country, those within the higher income bracket tend to purchase expensive healthy food while the rich quarter in a developing country purchased food beyond their need.[19,32]

The prevalence of overweight children is higher if their parents are highly educated. This finding was supported by studies conducted in Tuscany, Italy by Lazzeri *et al* (2011) and in Vietnam by Tang *et al* (2000).[38,45] However, after adjusting for other socio-demographic factors, guardian's educational background was no longer an associated factor for overweight children. Nonetheless, Mushtaq *et al* (2011) and Tang *et al* (2010) had found that higher parental education portrayed higher odds of having overweight children.[29,45] In contrast, in a developed country, a reverse relationship was revealed, whereby higher educated parents play an effective role in stimulating the children towards healthier life.[46-48] Though there was no significant difference detected, it was interesting to note that guardian with tertiary education had the lowest odd of having overweight children.

In conclusion, the prevalence of overall overweight among Malaysian primary school-age children (7-12 years) was high (19.9%). One out of five was found to be overweight. This was consistent with the global trend of childhood obesity in a developing country. The wealthy, Chinese, urban, and male children were more likely to be overweight. These findings provide evidence-based information for relevant stakeholders and policy makers in the planning and implementation of strategic interventional programmes in combating overweight among school-age children in Malaysia.

Recommendations

Numerous recommendations have been made in other studies, such as recommendations of food intake guideline, physical activity promotion in school, media campaign on the awareness, and yet the magnitude of this epidemic is still high and worrying. Risk factors and adverse health effects should be explained in detail to the guardians and the child. A workable and comprehensive intervention should be made by the Ministry of Health and Ministry of Education through local health district offices, family physicians, and health education officers in collaboration with parent teacher associations in educating targeted groups towards a healthy lifestyle.

Limitation

This study was a cross-sectional study; therefore, causal and effect relationships could not be measured directly. A longitudinal study is the better method to assess the risk of cause-and-effect predictors. Energy intake and physical activity was not considered in this study, resulting in an inability to examine the contribution of energy intake and energy expenditure to the overweight status.

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AUTHOR DISCLOSURES

The authors declare no conflict of interest.

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Short Communication

Overweight among primary school-age children in Malaysia

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馬來西亞國小學童體重過重的狀況

本研究採用 2006 年馬來西亞全國第三次健康及疾病調查(National Health Morbidity Survey III)的二手資料，共有 7,497 位，年齡介於 7-12 歲的兒童納入研究。本研究目的在報告採用國際切點時，馬來西亞過重(包括肥胖)兒童的盛行率，並確定其相關的主要社會決定因素。結果顯示，馬來西亞整體兒童過重盛行率為 19.9%。居住在城市、男性、華裔、較富有的、家長為過重或受過教育的，這些兒童顯示有較高的過重盛行率。在多元分析中發現，過重的情況較可能發生在：較年長(OR=1.15)、居住在城市(OR=1.16，95% CI：1.01-1.36)、華裔(OR= 1.45，95% CI：1.19-1.77)、男孩(OR=1.23，95% CI：1.08-1.41)、及來自高收入家庭的孩童。結論是，馬來西亞 7-12 歲的孩童中，5 位中就有 1 位為體重過重。居住地、種族、性別、家長教育程度和過重的家長，可能是此要提高警訊的議題之預測因子。為了減少與肥胖相關的疾病負擔，社會和公共衛生的努力是必要的。

關鍵字: 第三次全國健康及疾病發病率調查、學童、過重、馬來西亞、國際肥胖問題工作組