Short Communication

Prevalence of overweight and obesity among adult Malaysians: an update

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A total of 4428 adults (>18 years old) from 5 different selected regions in Peninsular and East Malaysia participated in this health survey. Using World Health Organization recommendations for body mass index (BMI), the prevalence of overweight and obesity were found to be 33.6% (95% CI= 32.2, 35.0) and 19.5% (95% CI= 18.3, 20.7) respectively. There were more females who were obese (22.5%, 95% CI=20.9, 24.0) compared to males (14.1%, 95% CI=12.3, 15.9). Highest prevalence of obesity were among the Indians (24.6%, 95% CI=20.3, 29.3), followed closely by the Malays (23.2%, 95% CI=21.6, 24.8%) and lowest prevalence was among the Chinese subjects (8.2%, 95% CI=6.2, 10.6). More than 43% of the 531 younger subjects (<30 years old) were either overweight (20%, 95% CI=16.6, 23.6) or obese (13.9%, 95% CI=11.1, 17.2%). All subjects who claimed to be non-diabetes were required to undergo 75 g glucose tolerance test. Compared to subjects with normal BMI (18.5-24.9 kg/m^2), there was a 3- and 2-folds increase in the prevalence of newly diagnosed diabetes and impaired glucose tolerance respectively, among obese subjects (BMI >30 kg/m^2) who initially claimed to have no diabetes. This study highlights a need for more active, inter-sectoral participation advocating a health-promoting environment in order to combat obesity in this country.

Key Words: overweight, obesity, prevalence, oral glucose tolerance test, Malaysia

INTRODUCTION

Obesity has become a burden on the health care cost, reducing quality of life with increased the incidence of cardiovascular diseases (CVD) and type 2 diabetes,[1] and some type of cancers.[2,3] Prevalence of obesity is higher in developing countries,[4] with CVD as the leading cause of death and by 2030,[5] over 62% of the people predicted to develop diabetes, will be from these countries.[6] As recommended by the World Health Organization (WHO),[7] body mass index (BMI) is widely used to assess obesity, using cut-off points of 25 and 30 kg/m^2 for overweight and obesity respectively.

As with other developing countries, the prevalence of obesity has also reached epidemic levels in Malaysia. Based on the Malaysian National Health and Morbidity Survey (NHMS), the number of overweight and obese adult males increased from 20.1% and 4.0% respectively, in 1996 to 29.7% and 10.0% respectively, in 2006.[8,9] Obesity prevalence was found to be higher among adult females; from 7.6% in 1996 increasing to 17.4% in 2006. In 2008, another health survey was conducted to determine the national prevalence of metabolic syndrome and while the main findings will be reported elsewhere, we report the prevalence of overweight and obesity among the study subjects.

MATERIALS AND METHODS

This was a cross-sectional study conducted by 6 institutions between the year 2007 to 2008 in five different

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selected regions in Peninsular Malaysia and East Malaysia. The Peninsular states were divided into 4 zones, where one state was selected to represent each zone. East Malaysia was represented by the state of Sabah. For each selected state, one urban and one rural area with the most populous and mixed ethnic groups were then identified as the study sites. The main ethnic groups in Peninsular Malaysia are the Malay, Chinese and Indian while where the main ethnic groups in Sabah are the Kadazan-Dusun, Bajau and Murut. For the purpose of this study, the Kadazan-Dusun, Bajau, Murut plus several other ethnic minorities were categorized as the 'other indigenous group' and non-citizens as 'others'. The study was approved by the Medical Research and Ethics Committee, Ministry of Health Malaysia.

Sampling

Identification of study areas and use of Enumeration Blocks to select households were done by the Department of Statistics Malaysia.[10] Using KISH table for the World Health Survey, eligible subject of age ≥18 years old from each selected household was given an invitation letter to participate. Subject who agreed to participate was requested to fast for 10-12 hours prior to the study visit.

After signing informed written consent, each subject had to undergo physical and medical examinations, and answered health-related questionnaires. Body weight was measured in light clothing without shoes to the nearest tenth of a kilogram using a digital scale. Height was measured (to the nearest millimeter) without shoes using the same instrument.

Oral glucose tolerance test

Fasting venous blood was drawn for HbA1c, fasting plasma glucose (FPG) and other biochemical parameters. Subjects not known to have diabetes were additionally required to undergo oral glucose tolerance test (OGTT) using 83 mg of dextrose monohydrate (equivalent to 75 g of anhydrous glucose) in 250 ml of water and venous blood taken at 1- and 2-hour after the glucose challenge. Blood samples were processed on the same day for either plasma or serum and aliquots were transported to a central laboratory in the Institute for Medical Research, Kuala Lumpur and stored frozen at -20°C until analysis. Plasma glucose was analyzed on Selectra XL Chemistry Analyzer (Vital Scientific, NV, NL 6950 AC Dieren, Netherland) using reagents purchased from Randox Laboratories Ltd, Crumlin, Co Antrim, United Kingdom. Inter-assay CV for glucose at 6.2mmol/L and 15.1mmol/L were 5.8% and 6.7% respectively. Based on WHO recommendations,[11] diabetes was diagnosed when FPG equaled or more than 7.0 mmol/L and/or the 2-h post glucose challenge equals or more than 11.1 mmol/L; impaired glucose tolerance (IGT) if FPG was less than 7.0 mmol/L and the 2-h glucose was between 7.8 and 11.1 mmol/L. Subject was classified as impaired fasting glucose (IFG) if FPG was between 6.1 and 6.9 mmol/L and the 2-h glucose was less than 7.8 mmol/L.

Statistical analyses

Data were entered using EpiData 3.1, cleaned and analyzed using Stata version 10.1. The outcome variable was BMI status based on the WHO recommendations;[7] underweight for BMI <18.5 kg/m^2, normal for BMI between 18.5-24.9 kg/m^2, overweight for BMI between 24.9-29.9 kg/m^2 and obese for BMI ≥30 kg/m^2. Continuous variables were summarized as means and its 95% confidence interval (CI) while categorical variables were described using frequency and percentage. The group specific point prevalence of BMI status was reported along with the 95% CI obtained using the exact method which is the default method in the Stata software to calculate the 95% CI of a binomial distribution. The groups examined were gender, race (Malay, Chinese, Indians, other indigenous and others), area of residence (urban or rural), known morbidities (history of hypertension, diabetes mellitus and/or dyslipidemia), age groups (<30, 30-39.9, 40-49.9, 50-59., 60-69.9, ≥70 years old) and levels of education (tertiary, secondary school, primary school or no formal education).

A simple logistic regression via multinomial logistic regression was performed where each of the independent variables was regressed onto the dependent variable to obtain crude odds ratios. Because of the relatively small number of subjects who were underweight (n=206), they were grouped together with subjects of normal BMI and together, represented as subjects with BMI <25 kg/m^2. The dependent variable from the group with BMI <25 kg/m^2 (normal) was used as the reference category in the analysis. Two other categories of dependent variables were BMI between 25.0 to 29.9 kg/m^2 (overweight) and ≥ 30.0 kg/m^2 (obese). The independent variables were regressed simultaneously to obtain the adjusted odds ratio and their 95% CI. As this was a confirmatory observational study, variable selection was not done. Results with crude or adjusted odds ratios of more than one and *p*-value of <0.05 at two-sided level was considered to have higher chance to be associated with BMI.

RESULTS

A total of 4428 subjects participated in the study. However, data from 87 subjects (<2% of the total) had to be excluded in this report due to missing data which were required for the current analyses. The profiles of the remaining 4341 subjects, mean age of 47.8±14.5 years old are shown in Table 1. Of these 10.8%, 21.5% and 14.5% subjects claimed to have and presumably, been treated for diabetes, hypertension and dyslipidemia, respectively. The overall prevalence of overweight and obesity were 33.6% (95% CI=32.2, 35.0) and 19.5% (95% CI=18.3, 20.7) respectively, with more obese females compared to males. There was no difference in the prevalence of overweight and obesity between rural and urban areas. By ethnicity, the highest prevalence of overweight and obese subjects were among the Indians, followed by the Malays. Prevalence of obesity was lowest among the Chinese subjects (8.2%, 95% CI=6.2, 10.6). The highest proportion of overweight and obesity were found between the age groups of 60-69.9 and 40-40.9 years respectively. From a total of 531 subjects in the age group <30 years old, 106 (7.3 %) were overweight and 74 (8.7%) were obese.

Among subjects who claimed to have no diabetes at study visit, there was a marked increase in the prevalence of diabetes (newly diagnosed), impaired glucose tolerance

Table 1. Prevalence (95% confidence interval) of underweight (BM I <18.5 kg/m^2), normal (BM I ≥18.5-24.9 kg/m^2), overweight (BMI >25.0-29.9 kg/m^2) and obesity (≥30.0 kg/m^2) among study subjects, by gender, ethnicity, education status and age groups

	N (%)	BMI (kg/m^2)			
		<18.5 (n=206)	≥18.5-24.9 (n=1831)	≥25.0-29.9 (n=1457)	≥30 (n=847)
Overall	4341 (100)	4.7 (4.1, 5.4)	42.2 (40.7, 43.7)	33.6 (32.2, 35.0)	19.5 (18.3, 20.7)
Gender					
Male	1523 (35.1)	5.4 (4.3, 6.6)	46.2 (43.6, 48.7)	34.4 (32.0, 36.9)	14.1 (12.3, 15.9)
Female	2818 (64.9)	4.4 (3.7, 5.2)	40.0 (38.2, 41.9)	33.1 (31.4, 34.9)	22.5 (20.9, 24.0)
Ethnicity					
Malay	2515 (62.5)	4.4 (3.6, 5.2)	38.5 (36.6, 40.3)	34.0 (32.2, 35.8)	23.2 (21.6, 24.8)
Chinese	632 (14.6)	4.6 (3.1, 6.5)	55.1 (51.1, 59.0)	32.1 (28.5, 35.9)	8.2 (6.2, 10.6)
Indian	370 (8.5)	3.8 (2.1, 6.3)	32.2 (27.4, 37.2)	39.5 (34.4, 44.6)	24.6 (20.3, 29.3)
Other indigenous	528 (12.2)	7.0 (4.9, 9.5)	49.8 (45.5, 54.2)	30.9 (27.0, 35.0)	12.3 (9.6, 15.4)
Others	96 (2.2)	7.3 (3.0,14.4)	59.4 (48.9, 69.3)	24.0 (43.8, 17.1)	9.3 (4.4, 17.1)
Education					
Tertiary	460 (10.6)	6.3 (4.3,8.9)	47.4 (42.7, 52.1)	30.7 (26.5,35.1)	15.7 (12.5,19.3)
Secondary	2058 (47.5)	4.4 (3.5,5.3)	41.0 (38.8,43.1)	34.4 (32.4,36.6)	20.2 (18.4,22.0)
Primary	873 (20.2)	3.7 (2.5,5.1)	41.2 (38.0,44.6)	32.5 (29.4,35.8)	22.6 (19.8,25.9)
No formal	940 (21.7)	5.8 (4.4,7.5)	43.2 (40.0,46.4)	33.8 (30.8,37.0)	17.1 (14.8,19.7)
Age groups (years)					
<30	531 (12.2)	12.6 (9.9, 15.7)	53.5 (49.1, 57.8)	20.0 (16.6, 23.6)	13.9 (11.1, 17.2)
30–39.9	686 (15.8)	3.8 (2.5, 5.5)	18.8 (37.8, 45.3)	33.7 (30.1, 37.3)	21.0 (18.0, 24.2)
40–49.9	1131 (26.1)	3.6 (2.6, 4.9)	37.5 (34.7, 40.4)	35.8 (33.0, 38.7)	23.1 (20.6, 25.6)
50–59.9	1003 (23.1)	2.1 (1.3, 3.2)	39.5 (36.5, 42.6)	36.4 (33.4, 39.5)	22.0 (19.4, 24.6)
60–69.9	686 (15.8)	4.2 (2.8, 6.0)	40.7 (37.0, 44.5)	37.0 (33.4, 40.8)	18.1 (15.3, 21.2)
≥70	304 (7.0)	7.2 (4.6, 10.8)	53.3 (47.5, 59.0)	31.6 (26.4, 37.1)	7.9 (5.1, 11.5)

Table 2. Prevalence (and 95% confidence interval) of newly diagnosed diabetes, IGT and IFG among subjects with no known diabetes at baseline by BMI status

BMI (kg/m^2)	Non-diabetes	Diabetes	IGT	IFG
<18.5	79.8 (73.0, 85.5)	4.8 (2.0, 9.2)	11.9 (7.4, 17.9)	1.2 (0.1, 4.2)
18.5-24.9	68.9 (66.3, 71.4)	8.4 (6.9, 10.1)	14.1 (12.6, 16.2)	3.4 (2.5, 4.6)
25.0-29.9	54.5 (51.3, 57.7)	14.9 (12.6, 17.4)	21.2 (18.5, 24.0)	3.0 (2.0, 4.4)
≥ 30	43.9 (39.6, 48.2)	22.0 (18.3, 26.0)	25.4 (21.5, 29.6)	3.8 (2.3, 6.0)

IGT: Impaired glucose tolerance; IFG: Impaired fasting glucose; BMI: Body mass index

(IGT) and impaired fasting glucose (IFG) with increasing BMI (Table 2). Compared to subjects with normal BMI (18.5-24.9 kg/m^2), a 3- and 2-folds increase in the prevalence of diabetes and IGT respectively, was observed among those with BMI above 30 kg/m^2.

Results of the multivariable analyses for the crude and adjusted odds ratios between normal versus overweight group, and normal versus the obese group are shown in Tables 3 and 4, respectively. In general, gender, ethnicity and history of co-morbidities (hypertension, diabetes and dyslipidemia) were consistently associated with higher chance of being overweight and obese. Males had 16% and 48% less chance of being associated with overweight and obesity compared to females. While overweight was found to be significantly associated with advancing age, the odd ratios for being obese were found to be higher among those with lower education levels. Compared to the Malays, the chance of the Chinese being overweight and obese was 44% and 80% lower respectively. In contrast, among all ethnic groups, the Indians had the highest odd ratios of being overweight and obese.

DISCUSSION

The prevalence of obesity in Malaysia has increased from 4.4% in 1996 to 14.0% in 2006 with highest prevalence of 19.3% seen among adults aged between 45 to 49 years old.[8,9] The overall obesity prevalence in our cohort of 4341 adults (mean age 47.8 years old) was 19.5% and as in the 2006 survey, highest prevalence (23.1%) was among the 40-49.9 years old age group. With continued urbanization and improved socioeconomic status, and adoption of more sedentary lifestyle and unhealthy dietary habits, obesity is now a leading public health concern even among the rural communities, replacing the traditional public health problems such as malnutrition and infectious diseases.[12,13] Consistent with previous studies involving local populations and other populations,[8,9,14,15] the prevalence of overweight and obesity continued to show disparities by gender and age, and between ethnic groups. Attributed to differences in dietary habits and physical activity patterns, the Chinese, whether living in Malaysia or Singapore,[16] have always been found to be the least obese compared to the Malays and Indians. And as expected, those subjects with numerous cardiovascular risk factors such as hypertension, diabetes and dyslipidemia were more likely to be overweight and obese. This is in agreement with numerous other studies which showed a similar, strong positive association between BMI and increased incidence of hypertension, diabetes and dyslipidemia.[17,18]

Table 3. Crude- and adjusted-odds ratio (OR) of socio-demographic and co-morbidities for overweight in comparison to normal BMI using simple and multiple multinomial logistic regression analyses

Variables	Over Weight (n = 1857)			
	Crude-OR (95% CI)	*p*-value	Adjusted-OR (95% CI)	*p*-value
Age (years)	1.01 (1.01, 1.02)	<0.001	1.01(1.01, 1.02)	0.001
Gender				
Female	1		1	
Male	0.90 (0.78, 1.03)	0.121	0.84 (0.73, 0.97)	0.019
Education				
Tertiary	1		1	
Secondary	1.33 (1.06, 1.68)	0.014	1.25 (0.99, 1.59)	0.063
Primary	1.26 (0.98, 1.64)	0.069	1.01 (0.77, 1.34)	0.925
No formal	1.21 (0.94, 1.55)	0.140	0.88 (0.66, 1.19)	0.422
Ethnicity				
Malay	1		1	
Chinese	0.68 (0.56, 0.82)	<0.001	0.56 (0.45, 0.69)	<0.001
Indian	1.38 (1.07, 1.78)	0.011	1.31 (1.00, 1.71)	0.047
Others	0.64 (0.53, 0.78)	<0.001	0.77 (0.62, 0.94)	0.011
Location				
Rural	1		1	
Urban	0.93 (0.81, 1.06)	0.272	0.91 (0.78, 1.07)	0.258
History of hypertension				
No	1		1	
Yes	2.06 (1.72, 2.71)	<0.001	1.72 (1.35, 2.19)	<0.001
History of diabetes				
No	1		1	
Yes	1.86 (1.49, 2.33)	<0.001	1.36 (1.08, 1.73)	0.01
History of dyslipidemia				
No	1		1	
Yes	1.69 (1.39, 2.05)	<0.001	1.47(1.18,1.83)	<0.001

Table 4. Crude- and adjusted-odds ratio (OR) of socio-demographic and co-morbidities for obesity in comparison to normal BMI using simple and multiple multinomial logistic regression analyses

Variables	OBESE (n = 847)			
	Crude-OR (95% CI)	*p*-value	Adjusted-OR (95% CI)	*p*-value
Age (years)	1.00 (0.96, 1.00)	0.797	0.99 (0.99,1.00)	0.127
Gender				
Female	1		1	
Male	0.54 (0.45, 0.64)	<0.001	0.52(0.43,0.63)	<0.001
Education				
Tertiary	1		1	
Secondary	1.53 (1.14,2.03)	0.004	1.50(1.11,2.02)	0.009
Primary	1.72 (1.26,2.36)	0.001	1.63(1.15,2.31)	0.006
No formal	1.20(0.87,1.65)	0.265	1.12(0.77,1.64)	0.549
Ethnicity				
Malay	1		1	
Chinese	0.25 (0.19, 0.35)	<0.001	0.20(0.14,0.27)	<0.001
Indian	1.26 (0.95, 1.68)	0.011	1.15(0.85,1.56)	0.376
Others	0.38 (0.29, 0.49)	<0.001	0.45(0.34,0.59)	<0.001
Location				
Rural	1		1	
Urban	0.92 (0.79, 1.08)	0.330	0.75(0.62,0.90)	0.020
History of hypertension				
No	1		1	
Yes	3.08 (2.42, 3.93)	<0.001	2.66(2.02,3.49)	<0.001
History of diabetes				
No	1		1	
Yes	1.98 (1.53, 2.54)	<0.001	1.34(1.01,1.78)	0.04
History of dyslipidemia				
No	1		1	
Yes	1.69 (1.35, 2.12)	<0.001	1.64(1.26,2.14)	<0.001

Many concerted efforts have been made by healthcare providers, non-government organizations and other relevant bodies to educate and promote healthy lifestyle among Malaysians. The success of intervention programs conducted at the work place and on specific target groups such as school children and middle-aged women seemed to be short-lived and unsustainable.[19-21] Although obesity is most often linked to socio-cultural and behavioral factors, including eating patterns, as well as the lack of awareness or knowledge on the associated health risks, many studies have shown that physical activity such as walking and exercising, and physical inactivity such as watching television and using the computers are the two most important contributing factors that should be addressed in any intervention programs. Effectiveness and sustainability of weight loss should aim at increasing physical activity, be it at school or promoting physical activity at the workplace and the type of intervention programs used need to take into account the socio-demographic characteristics of the target groups such as gender, age, ethnicity, education status and locality (rural or urban).[22-24] This study shows that a more active, intersectoral participation is needed to combat obesity in this country. The responsibility should not only be the health sector, but all other sectors that are involved in making policies and legislations in order to create a healthier living and health-promoting environment. Housing estates, schools, workplace and even commercial buildings should be required to provide facilities to encourage physical activities. On the other hand, while the food industries should be more responsible and contribute by producing more healthy food, Malaysians themselves need to change their eating behavior and practices and learn to make healthy eating as a way of life.

This study has also recorded a much higher prevalence of newly diagnosed diabetes compared to NHMS III.[9] The difference was expected since in NHMS III, diagnosis was based on finger-pricked fasting blood glucose level while the current study was based on venous blood sampling. As shown in the NHANES II study,[25] about 75% of subjects with diagnostic 2-h plasma glucose level of ≥11.1 mmol/L had fasting glucose values below 7.8 mmol/L, the cut-off level used then.[11] Similarly, using the ADA criteria, between 32% to 72% of the population who were previously not diagnosed to be diabetic based on fasting plasma glucose of <7.0 mmol/L had 2-h plasma glucose of ≥11.1 mmol/L.[26] The significant association between BMI and the number of newly diagnosed diabetic subjects or those with IGT should be of public health concern. As abnormal glucose tolerance is strongly linked to CVD leading to premature deaths,[27,28] perhaps OGTT should be considered and more widely used when screening for diabetes in high risk subjects such as those who are overweight and obese. As shown in this study, OGTT would also identify subjects with abnormal glucose tolerance, thus allowing early intervention to reduce the CVD risk factors.

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AUTHOR DISCLOSURES

None.

REFERENCES

1. Yusuf S, Hawken S, Ounpuu S, Bautista L, Franzosi MG, Commerford P et al. Obesity and the risk of myocardial infarction in 27000 participants from 52 countries: a case-control study. Lancet. 2005;366:1640-9.
2. Hampel H, Abraham NS, El-Serag HB. Meta-Analysis: Obesity and the Risk for Gastroesophageal Reflux Disease and Its Complications. Annals Int Med. 2005;143:199-211.
3. Moghaddam AA, Woodward M, Huxley R. Obesity and risk of colorectal cancer: a meta-analysis of 31 studies with 70,000 events. Cancer Epidemiol Biomarkers Prev. 2007;16: 2533-47.
4. Hossain P, Kawar B, El Nahas M. Obesity and diabetes in the developing world – A growing challenge. N Engl J Med. 2007;356:213-5.
5. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diab Care. 2004;27:1047-53.
6. Reddy KS, Yusuf S. Emerging Epidemic of Cardiovascular Disease in Developing Countries. Circulation. 1998;97:596-601.
7. World Health Organization Expert Committee. Physical status, the use and interpretation of anthropometry. Geneva, (Technical Report Series No. 854) Switzerland: World Health organization; 1995.
8. National Health and Morbidity Survey 1996. Institute for Public Health, Kuala Lumpur. Ministry of Health, Malaysia; 1996.
9. Institute for Public Health (IPH). The Third National Health and Morbidity Survey (NHMS III) 2006, Nutritional Status. Ministry of Health, Malaysia; 2008.
10. Department of Statistics Malaysia. Population Distribution and Basic Demographic Characteristics; 2000.
11. WHO/NCD/NCS/99.2. Definition, diagnosis and classification of Diabetes Mellitus and its complications. Part 1: Diagnosis and Classification of Diabetes Mellitus. Report of a WHO Consultation. Geneva: World Health Organization; 1999.
12. Ismail MN, Chee SS, Nawawi H, Yusoff K, Lim TO, James WPT. Obesity in Malaysia. Obesity in Malaysia. Obes Rev. 2002;3:203-8.
13. Pon LW, Noor-Aini MY, Ong FB, Adeeb N, Seri SS, Shamsuddin K, et al. Diet, nutritional knowledge and health status of urban middle-aged Malaysian women. Asia Pac J Clin Nutr. 2006;15:388-99.
14. Rampal L, Rampal S, Khor GL, Zain AM, Ooyub S, Rahmat R et al. A national study on the prevalence of obesity among 16,127 Malaysians. Asia Pac J Clin Nutr. 2007;16: 561-6.
15. Ogden CL, Carroll MD, Curtin L, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA. 2006;295:1549-55.
16. Deurenberg-Yap M, Chew SK, Lin VFP, Tan BY, van Staveren WA, Deurenberg P. Relationships between indices of obesity and its comorbidities in multi-ethnic Singapore. Int J Obes. 2001;25:1554-62.

17. Stevens J, Truesdale KP, Katz EG, Cai J. Impact of body mass index on incident hypertension and diabetes in Chinese Asians, American Whites and American blacks. Am J Epidemiol. 2008;167:1365-74.
18. Brown CD, Higgins M, Donato KA, Rohde FC, Garrison R, Obarzanek E et al. Body mass index and the prevalence of hypertension and dyslipidemia. Obes Res. 2000;8:605-19.
19. Foongming Moy, Atiya AB Sallam, Meelian Wong. The results of a worksite health promotion programme in Kuala Lumpur, Malaysia. Health Promot Int. 2006;21:301-10.
20. Ruzita AT, Wan Azdie MAB, Ismail MN. The effectiveness of nutrition education programme for primary school children. Mal J Nutr. 2007;13:45-54.
21. Noor-Aini MY, Pon LW, Ong FB, Adeeb N, Seri SS, Shamsuddin K et al. Lifestyle intervention improved nutritional knowledge, dietary composition and health status of midlife Malaysian women. Mal J Nutr. 2006;12:125-46.
22. Kriemler S, Zahner L, Schindler C, Meyer U, Hartmann T, Hebestreit H et al. Effect of school based physical activity programme (KISS) on fitness and adiposity in primary schoolchildren: cluster randomised controlled trial. BMJ. 2010;340:c785.
23. Yancey AK. McCarthy WJ, Taylor WC, Merlo A, Gewa C, Weber MD et al. The Los Angeles Lift Off: a sociocultural environmental change intervention to integrate physical activity into the workplace. Prev Med. 2004;38:848-56.
24. Taylor WC, Poston WSC, Lovell Jones L, Kraft MK. Environmental justice: obesity, physical activity, and healthy eating. J Phys Act Health. 2006;3(S1):S30-S54.
25. Harris MI, Hadden WC, Knowler WC, Bennett PH. Prevalence of diabetes and impaired glucose tolerance and plasma glucose levels in U.S. population aged 20–74 year. Diabetes. 1987;36:523-34.
26. The DECODE Study Group on behalf of the European Diabetes Epidemiology Group. Is fasting glucose sufficient to define diabetes? Epidemiological data from 20 European studies. Diabetologia. 1999;42:647-54.
27. Blake DR, Meigs JB , Muller DC , Najjar SS , Andres R, Nathan DM. Impaired glucose tolerance, but not impaired fasting glucose, is associated with increased levels of coronary heart disease risk factors. Results from the Baltimore Longitudinal Study on Aging. Diabetes. 2004;53:2095-100.
28. Barr ELM, Zimmet PZ, Welborn TA, Jolley D, Magliano DJ, Dunstan DW et al. Risk of cardiovascular and all-cause mortality in individuals with diabetes mellitus, impaired fasting glucose, and impaired glucose tolerance. Circulation. 2007;116:151-7.

Short Communication

Prevalence of overweight and obesity among adult Malaysians: an update

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馬來西亞成人過重和肥胖最近的盛行率

總計有 4428 位(18 歲以上)國民參與這次健康調查，分別來自馬來半島與東馬的五個不同地區。根據世界衛生組織以 BMI 所定義的標準，發現過重和肥胖的盛行率分別為 33.6% (95% CI= 32.2, 35.0) 和 19.5% (95% CI= 18.3, 20.7) 。肥胖部分，女性(22.5%, 95% CI=20.9, 24.0)盛行率比男性(14.1%, 95% CI=12.3, 15.9)高。肥胖盛行率最高的是印度裔(24.6%, 95% CI=20.3, 29.3)，其次是馬來裔(23.2%, 95% CI=21.6, 24.8%)，最低的是華裔(8.2%, 95% CI=6.2, 10.6)。在 531 位 30 歲以下的年輕人中，超過 43%是過重(20%, 95% CI=16.6, 23.6)或肥胖(13.9%, 95% CI=11.1, 17.2%)。所有自稱沒有罹患糖尿病的參與者都接受 75 g 的葡萄糖耐受性測驗。而一開始聲稱沒有糖尿病的肥胖者，他們的糖尿病新發率和葡糖糖耐受性不佳分別是 BMI 正常者的 3 倍和 2 倍。這份研究顯示要降低國家的肥胖盛行率，需要更積極的跨部門合作，來營造促進健康的環境。

關鍵字：過重、肥胖、盛行率、葡糖糖耐受性測試，馬來西亞