COMPARISON OF BODY MASS INDEX AND BODY FAT PERCENTAGE IN THE ASSESSMENT OF OBESITY PREVALENCE AMONG SECONDARY SCHOOL STUDENTS IN PERAK STATE, MALAYSIA

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Abstract

The purpose of this study was to determine the overweight and obesity prevalence in secondary school students in Perak State, Malaysia according to United States Centers for Disease Control and Prevention (CDC) charts of body mass index (BMI) and body fat percentage (BF%). Five hundred and ninety four (594) students with aged 13 to 16 years were participated in this study. Anthropometric indicators including weight, height, BMI and BF% were determined. Overweight and obesity were defined using CDC cut-off. The prevalence of underweight, normal, overweight and obesity in secondary school students according to BMI was 5.31%, 72.6%, 11.13% and 10.96%. The obesity prevalence according to BMI cut-off point was 11.62% in boys and 10.50% in girls while according to BF% cut-off point girls was 10.53% and boys was 7.05%. Both BMI and BF% were associated with determining obesity prevalence however BMI alone do not provide accurate data and obesity prevalence is more influences to BF% value.

Keywords: Anthropometric measurements, Body composition, Body mass index, Body fat percentage, Obesity

Introduction

Growing up children needs adequate nutrients from their daily diet. Thus, taking a quality diet with correct serving size is suggested in order to

keep up with growth and development demand (Adegun et al., 2013). However, most of the children are taking unhealthy diet which then leads to weight gain problems. Recent statistic data shows at least 155 million children are overweight or obese globally (Haslam and James, 2005) where children under five year is estimated over 42 million and 35 million of these children are from developing countries (WHO, 2013).

Concerns over the prevalence of overweight and obesity and the consequences among children and school pupils in Malaysia have been epidemiologically studied and reported by several researchers (Rampal et al., 2007; Chong et al., 2012). Obesity prevalence among Malaysia children aged below 18 years was increased. According to Institute of Public Health survey in 2011, obesity prevalence was increased 6.7%, 6.3% and 4.9% for the age groups 5-9.9, 10-14.9 and 15-17.9 years old (Khor , 2012). In Malaysia, the overweight and obesity children were identified by measuring BMI. They will be classified as overweight if the BMI value is 25 to 29.9 while above as that is classified as obese.

Weight gain problem is a hallmark for metabolic diseases. It leads towards several diseases such as type 2 diabetes, cardiovascular disease, cancer and hypertension (Chong et al., 2012). Therefore, body mass index (BMI) has been used as an indicator to identify overweight and obesity status. However, it just measures the excess index of weight and height ratio. According to Razak et al., (2005) and Wang et al., (2010), the relationship between BMI, BF% and body fat distribution are differ across populations. Besides, Asian populations have higher risk of cardiovascular and type 2 diabetes diseases at lower BMI value than WHO recommendation (Habib 2013). Therefore, BF% among children also needs to be considered as early indicator for overweight and obese prevalence in Malaysia.

The purpose of this study was was to determine the overweight and obesity prevalence in secondary school students in Perak State, Malaysia according to WHO standards of BMI and BF%.

Participants and Methods

A total 594 (241 boys/ 353 girls) students from MARA Junior Science College (MRSM) aged between 13 to 16 years were included in this study. None of them have eating disorder or substance abuse. Students demographic information was collected using data retrieval form.

Anthropometric Measurements

Height: Height was measured using a wall-glued metal measuring tape while the students stood against the wall with weight equally on two feet without shoes and the head in Frankfort plane.

Weight: All the participants were lightly clothed and wore no shoes while taken anthropometric measurements. Tanita BC587 Series Body Composition Monitor (Tanita Corporation, Tokyo, Japan) was used to measured body weight and BF%. Each measurement was performed thrice and the average was used for the analysis. The BMI was calculated as the body mass in kg divided by height squared (m^2).

Statistical Analysis

Statistical analyses were performed using SPSS 11.0 (SPSS, Chicago, USA). Data were expressed as mean and standard deviation. The one-way analysis of variance (ANOVA) followed by Turkey's post hoc test was used to determine the differences in all variables between boys and girls. Level of significance was set at $p<0.05$. The associations between variables were evaluated using Pearson Correlation and $p<0.05$ was considered significant.

Results and Discussion

Demographic data of all subjects is shown in Table 1. All the parameters were compared between genders; boys and girls. Boys were significantly taller and heavier than girls. Thus, the BMI among boys were increased compared to girl. However BF% in girls was significantly higher than boys.

Table 1: Anthropometric Measurement of Subjects

	All cases	Range	Boys	Range	Girls	Range
Age (year)	14.6±1.1	13.0-16.0	14.8±1.1	13.0-16.0	14.5±1.1	13.0-16.0
Height (cm)	156.7±8.1	130.2-184.1	162.6±7.6	140.0-184.1	152.7±5.6	130.2-168.8
Weight (kg)	50.5±15.2	25.7-161.0	56.1±15.3	31.5-161.0	46.7±13.9	25.7-109.1
BMI (kg/m^2)	20.4±5.2	11.0-51.2	21.1±4.8	14.6-51.22	20.0±5.5	11.0-46.37
BF%	22.1±10.9	4.9-90.0	13.6±13.2	4.9-90.0	28.3±7.3	11.9-57.2

Values are expressed in mean ±SD. BMI: body mass index; BF%: body fat percentage.

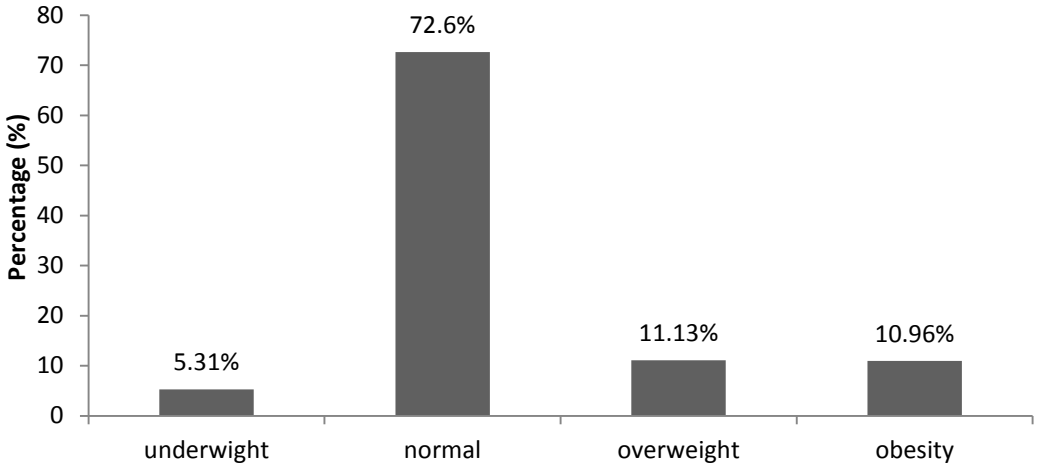

Figure 1 : Prevalence of Underweight, normal, overweight and obesity in all subjects according to CDC standard criteria.

As shown in Figure 1, the prevalence of underweight, normal, overweight and obesity in all subjects were 5.31%, 72.6%, 11.13% and 10.96% according to CDC standard criteria. The figure also revealed that the majority of the subject is in normal state followed by overweight, obesity and underweight.

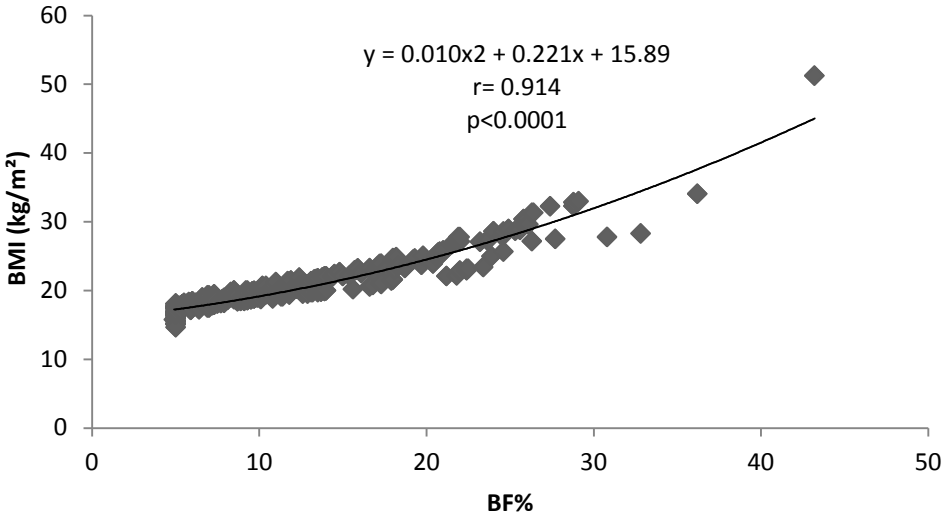

Figure 2: Correlation between in boys.

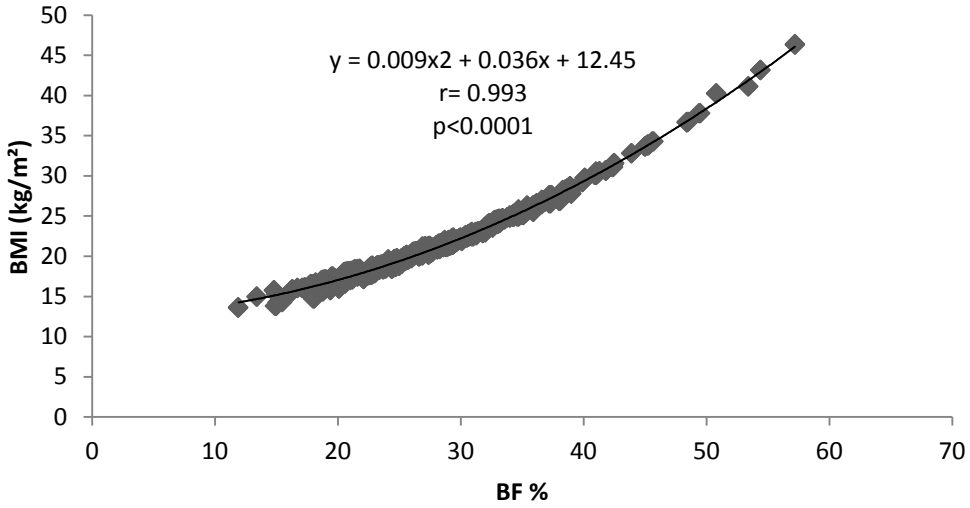

Figure 3: Correlation between BMI and BF% in girls.

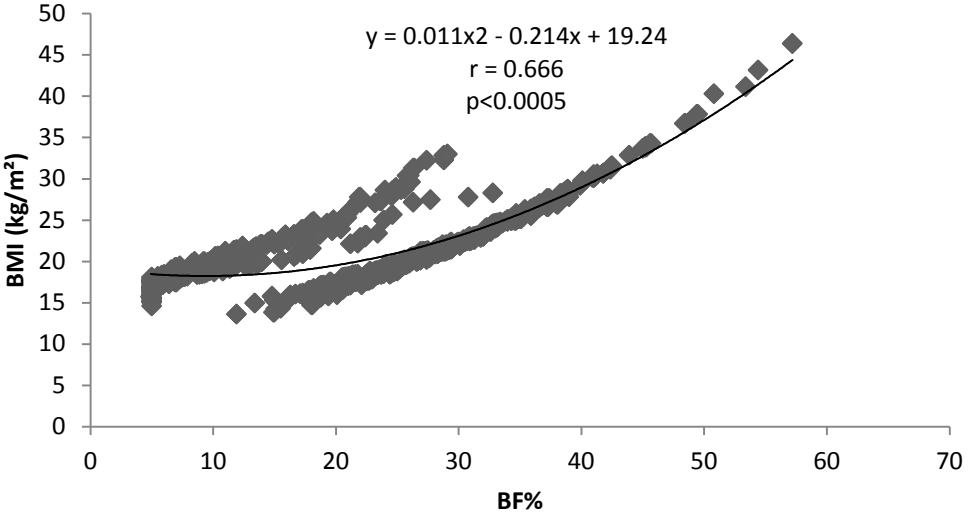

Figure 4: Correlation between BMI and BF% in all subjects.

Figure 2, 3 and 4 present the regression analysis between BMI and BF% in boys, girls and all cases. Figure 3 and 4 showed that BMI was significantly related with BF% among boys (r=0.914) and girls (r=0.993). However, girls have higher correlation of BMI and BF% compared to boys. Result in Figure 5 indicates that correlation between BMI and BF% in all cases was highly moderate.

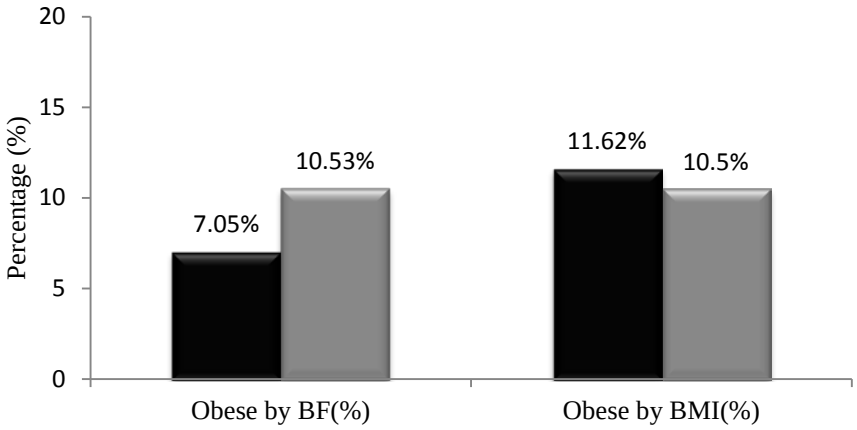

Figure 5: Obesity prevalence in boy and girl subjects according to the BF% cut-off point and BMI cut-off point.
Note: ( ) boys, ( ) girls

Obesity prevalence in boys and girls are presented in Figure 5. The obesity prevalence according to BMI cut-off point was 11.62% in boys and 10.50% in girls. Meanwhile, the data also shows that girls (10.53%) have significantly higher obesity prevalence than boys (7.05%) according to BF% cut-off point. Although the correlation between BMI and BF% was positive (Figure 2, 3 and 4), finding shows that BMI value as obesity indicator is higher than BF%. The hypothesis was rejected. It showed that there is a significant difference in BMI and BF% among boy and girl students in Perak, Malaysia.

Discussion

BMI is widely used as overweight and obesity marker to measure excess adiposity. However, it is not measure the actual fat in the body. Therefore this study has been carried out to study the comparison of BMI and BF% in the assessment of obesity prevalence among secondary school students in Perak State, Malaysia. The present study indicates that BMI in different gender is not significant (Table 1). Despite of that, there is a significant difference between genders in BF% where the girls have higher BF% than boys. This finding shows that the growth and development is normal where boys will gain more muscle and lean tissue while girls gain more fat after puberty (Cynthia et al., 2011).

This study also reports that overall prevalence of overweight and obesity among secondary students aged 13-16 was 11.13% and 10.96%. This figure is higher than the prevalence of overweight that has been reported by Rampal et al. (2007). Study done in 2007 by Rampal and his colleges showed that overweight prevalence among secondary school students aged

13-17 was 8.2%. This indicates that the number of overweight prevalence is increasing from year 2007 to 2013. Cross-sectional studies done by other Asian countries also reported the higher overweight and obesity prevalence using WHO marker for BMI. In Ho Chi Minh City, the overweight and obesity prevalence in 2013 were 17.8% and 3.2% (Nguyen et al., 2013) while in Thailand the overweight and obesity prevalence in 2007 were 12.8% and 9.4% (Sanguansak and Lakkana, 2010).

Correlation between BMI and BF% in this study shows a significantly positive (Figure 2). It was observed in both boys and girls separately as shown in Figure 3 and 4. This finding complement to several studies that been done by other researchers. Study done in Sri Lanka by Ranasinghe et al. (2013) also found that BMI and BF% has significantly positive relationship in males and females in young, middle-age and elderly. Cross-sectional study on European, Maori, Pacific Islanders and Asian Indian adults by Rush et al. (2009) also indicates significant positive correlation in BMI and BF% in all races. However, finding reported by Meeuwsen et al. (2010) shows that BMI-BF% among UK adults is not associated and it is due to BMI value is less than 25 kg/m^2 in men.

The obesity prevalence in this study was determined by BMI and BF%. Different gender affects the obesity prevalence (Figure 5) and it indicates that BMI value as obesity indicator was higher than BF%. Although obesity prevalence in girls was not significant in both BMI and BF% cut-off point, in boys the obesity prevalence was significantly different between BMI and BF% cut-off point. It shows that BF% is more applicable to be use as obesity prevalence assessment among boy. During growth and development, muscle gain among boys will interfered the result where BMI. This factor affects the accuracy of the BMI value as indicator for obesity prevalence. Although BMI is usually been used to determined overweight and obese status, it is ideal to use fatness level rather than BMI. Our finding also being supported by early study by Habib (2013) and Wang et al. (2010) where in their studies they conclude that BMI has limitation and cannot provide accurate data on obesity prevalence.

Conclusion

Our study reports the emerging data on overweight and obesity prevalence among secondary school students in Perak State, Malaysia. Moreover, this study also reveals that BMI alone do not provide accurate data and obesity prevalence is more influences to BF% value.

References:

Adegun, J.A., Ajayi-Vincent, O.B. & Alebiosu, E.O. Differences in the Nutritional Status of Young School Children from Public and Private Owned

Primary Schools in Ekiti State, Nigeria. *European Scientific Journal*. 2013; 9 (7): 32-37.
Chong, H.L., Soo, T.L. & Rahmah, R. Childhood Obesity – Prevalence among 7 and 8 year old Primary School Students in Kota Kinabalu. *Medical Journal Malaysia*. 2012; 67 (2).
Cynthia, L., Li, Y., Freedman, D.S., Borrud, L.G. & Flegal, K.M. Smoothed Percentage Body Fat Percentiles for U.S. Children and Adolescents, 1999–2004. *National Health Statistics Reports and Number*. 2011; 43.
Habib, S.S. Body Mass Index and Body Fat Percentage in Assessment of Obesity Prevalence in Saudi Adults. *Biomedical and Environmental Sciences*. 2013; 26(2): 94-99.
Haslam, D.W. & James, W.P.T. Obesity. *Lancet*. 2005; 366: 1197-1209.
Khor, G.L. Food availability and the rising obesity prevalence in Malaysia. IeJSME. 2012; 6 (1): 61-68.
Meeuwsen, S., Horgan, G.W., Elia, M. The relationship between BMI and percent body fat, measured by bioelectrical impedance, in a large adult sample is curvilinear and influenced by age and sex. *Clinical Nutrition*. 2010; 29 (5): 560–566.
Nguyen, P.V.N, Hong, T.K., Hoang, T., Nguyen, D.T. & Robert, A.R. High Prevalence of Overweight Among Adolescents in Ho Chi Minh City, Vietnam. *BMC Public Health*. 2013; 13: 141.
Rampal, G.R.L., Mohd Sidik, S., Rampal, S., Yi Jie, D.W., Lee, C.W., Shya, L.J & Shun, S.Y. Prevalence of Overweight among Secondary School Students in Klang District, Selangor. *Malaysian Journal Nutrition*. 2007; 13(1):1-8.
Ranasinghe, C., Gamage, P., Katulanda, P., Andraweera, N., Thilakarathne, D. & Tharanga, P. Relationship between Body mass index (BMI) and body fat percentage, estimated by bioelectrical impedance, in a group of Sri Lankan adults: a cross sectional study. *BMC Public Health*. 2013; 13:797.
Rush, E.C., Freitas, I. & Plank, L.D. Body size, body composition and fat distribution: comparative analysis of European, Maori, Pacific Island and Asian Indian adults. *British Journal of Nutrition*. 2009; 102 (4): 632-641.
Sanguansak, R. & Lakkana, R. Prevalence of Overweight and Obesity Among School Children in Suburb Thailand Defined by the International Obesity Task Force Standard. *Journal of Medical Association Thailand*. 2010; 93 (2): 27-31.
Wang, C., Hou, X.H., Zhang, M.L., Bao, Y.Q., Zou, Y.H., Zhong, W.H., Xiang, K.S. & Jia, W.P. Comparisson of Body Mass Index with Body Fat Percentage in the Evaluation of Obesity in Chinese. *Biomedical and Enviromental Sciences*. 2010; 23: 173-179.
World Health Organization. Fact Sheet N°311, Available at: http://www.who.int/mediacentre/factsheets/fs311/en/index.html.