Metabolic Syndrome in Obese Thai Children: Defined Using Modified 'The National Cholesterol Education Program/Adult Treatment Panel III' Criteria

Sanguansak Rerksuppaphol MD*,
Lakkana Rerksuppaphol MD**

** Department of Pediatrics, Faculty of Medicine, Srinakharinwirot University, Nakhon Nayok, Thailand*
*** Department of Preventive Medicine, Faculty of Medicine, Srinakharinwirot University, Nakhon Nayok, Thailand*

Background: *Obesity is considered to be a risk of metabolic syndrome; however, data on the prevalence of metabolic syndrome in Thai obese children are scarce.*
Objective: *The present study aims to determine the prevalence of metabolic syndrome in Thai obese children.*
Material and Method: *A cross-sectional study was conducted on 113 obese children who were students of a public elementary school in Ongkharak district, Thailand, in 2013. Anthropometric data, blood pressure and biochemical parameters were measured. Metabolic syndrome was defined using modified 'the National Cholesterol Education Program/Adult Treatment Panel III (NCEP/ATPIII)' criteria.*
Results: *The prevalence of metabolic syndrome in obese children was 50.4%. Children with metabolic syndrome had significantly higher waist circumference (86.9 vs. 82.4 cm, p-value = 0.049), biceps skinfold thickness (17.2 vs. 14.9 mm, p-value = 0.017), suprailiac skinfold thickness (36.5 vs. 31.8 mm, p-value = 0.019), systolic blood pressure (119.7 vs. 112.6 mmHg, p-value = 0.007), diastolic blood pressure (73.7 vs. 69.0 mmHg, p-value = 0.022), fasting blood glucose (97.4 vs. 93.6 mg/dL, p-value = 0.009) and triglyceride levels (140.0 vs. 85.6 mg/dL, p-value <0.001) than those without metabolic syndrome. HDL-cholesterol was significantly lower in children with metabolic syndrome than those in without metabolic syndrome (48.7 vs. 63.1 mg/dL, p-value <0.001).*
Conclusion: *Of the sample, approximately half of children with obesity had metabolic syndrome. The prevalence of metabolic syndrome appears to be on the increase. Strategies for childhood obesity and metabolic syndrome prevention are urgently needed for Thai children.*

Keywords: *Child, Cholesterol, Metabolic Syndrome, Obesity, Triglycerides*

J Med Assoc Thai 2015; 98 (Suppl. 10): S88-S95
Full text. e-Journal: *http://www.jmatonline.com*

Prevalence of childhood obesity has increased worldwide during the past few decades, in both developed and developing countries[1]. In Thailand, the increasing prevalence of childhood obesity follows the trend found in other countries[1-3]. Obesity is associated with the development of co-morbidities such as metabolic syndrome (MetS), sleep apnea, gall bladder diseases, dermatological conditions, as well as with the social and psychological consequences of contracting such co-morbidities[4]. Metabolic syndrome, a cluster of cardiovascular diseases (CVD) risk factors, was first defined for diagnosis in adults by the World Health Organization (WHO)[5]. Following the releasing of the WHO criteria, the National Cholesterol Education Program/Adult Treatment Panel III (NCEP/ATPIII) and the International Diabetes Federation (IDF) released their definitions of metabolic syndrome in adults in 2001 and 2005 respectively[6,7]. All definitions encompassed CVD risk factors including obesity, dyslipidemia, hyperglycemia and hypertension, with few differences in threshold levels. There was evidence that MetS had been developing in some subjects since childhood[8,9] and that there was a strong association with the presence of metabolic syndrome in adulthood[10]. Prevalence of MetS in children varied among studies, where obesity and ethnicity were found to possibly be major contributors[8,11].

There are a scant data of the prevalence of

Correspondence to:
Rerksuppaphol S, Department of Pediatrics, Faculty of Medicine, Srinakhariwirot University, Nakhon Nayok 26120, Thailand.
Phone: +66-81-7231766
E-mail: sanguansak_r@hotmail.com

metabolic syndrome in Thai children[12,13]. Allowing for the passage of time, and using more detailed diagnosis criteria for metabolic syndrome, we hypothesized that the prevalence of metabolic syndrome in obese Thai children had increased since the previous report. Therefore, the present study aimed to report the current level of prevalence of metabolic syndrome in obese Thai children.

Material and Method

A cross-sectional study was performed in school children who were students of a public elementary school in Ongkharak district, Nakhon Nayok province, Thailand, in 2013. Obese children who were currently studying in this school were eligible for the study. In order to classify each participant for obesity, body weight and height of all schoolchildren were measured and their body mass index was calculated. Children who had a BMI $\geq$2SD by sex- and age-specific criteria of the World Health Organization (WHO) were classified as obese[14] and were invited to participate in the study.

Children with a known history of chronic illnesses, bleeding tendency or who had been commenced on any medications that might interfere with blood sugar or serum lipid levels were excluded from the study. Children who could not stand upright, who bore their weight on their legs for measuring their height and weight, who were absent on the assigned examination date, were also excluded from the study. The study was approved by the Ethics committee of the Faculty of Medicine, Srinakharinwirot University, Thailand. Written informed consent and assent were obtained from the children's parents or guardians as well as from the participating children.

Demographic characteristics and anthropometric data including body weight, height, waist and hip circumferences, mid arm circumference, skin fold thicknesses and body fat composition were collected by trained staff. Body weight was measured to the nearest of 100 g using a digital scale (Tanita body composition analyzer, Model BF-680W, Tokyo, Japan) and height was measured to the nearest 0.1 cm using a height rod (Seca, Model 220, Humburg, Germany). Body mass index (BMI) was calculated as the ratio of weight/height^2 [kg/m^2]. Waist and hip circumferences were measured at the mid-point between the lower costal margin and the top of the iliac crest and at the maximum circumference over the buttock, respectively, by using a non-elastic flexible tape whilst the subject was in a standing position[8]. Waist to height ratio and waist to hip ratio were calculated as the ratio of waist circumference to height and the ratio of waist circumference to hip circumference, respectively. Mid arm circumference was measured at the mid-point between the olecranon process and the acromion process of the left arm. Triceps and biceps skinfold thickness were measured over the tricep and bicep muscles, respectively, at the same level as measurement of the mid-arm circumference. Subscapular skinfold thickness was measured at 1cm below to the lower angle of left scapular. Suprailiac skinfold thickness was measured at 1 cm above to the left anterior superior iliac crest. A Lang skinfold caliper was used for measurement of all skinfold thicknesses. Body fat percentage was measured by bioelectrical impendence using a body composition analyzer (Tanita, Model BF-680W, Tokyo, Japan). Blood pressure was measured twice at a 1 minute interval in a sitting position after rest for 5 minutes, using an automated oscillometric measurement device (Omron, Model HEM-7211, Kyoto, Japan). The average of two readings of systolic and diastolic blood pressure was used to represent systolic blood pressure (SBP) and diastolic blood pressure (DBP).

After approximately 10 hours of overnight fasting, blood samples were collected via a finger prick into a heparinized hematocrit tube. Blood glucose was measured by the enzymatic cleavage method using an Accu-Check Advantage (Roche Diagnostics, Mannheim, Germany). Total cholesterol, HDL-cholesterol and triglyceride were measured by the reflectance photometry method (Cardiochek, Indianapolis, USA). The LDL-cholesterol level was calculated using a Cardiochek machine based on the Friedewald formula[15].

Metabolic syndrome was defined using a modified NCEP/ATPIII criteria proposed by de Ferranti et al[16]. Children who had 3 or more of the following were defined as having metabolic syndrome: (1) fasting triglycerides equal to or higher than 100 mg/dL; (2) HDL-cholesterol in boys <45 mg/dL, in girls <50 mg/dL; (3) fasting glucose equal to or higher than 100 mg/dL; (4) waist circumference >75 percentile of the same age and sex for Thai children[17]; (5) SBP and/or DBP >90th percentile of the same age and sex[18].

Statistical analysis

Sample size was estimated from an anticipated prevalence of metabolic syndrome in obese children at 17% and estimated effect size of 0.5. The desired sample size of 109 obese children was required when using 5%

absolute precision with 95% level of significance.

Continuous variables were tested for the normal distribution using the Kolmogorov-Smirnov test, and it was found that all of them distributed normally. Continuous data was descriptively presented in the form of mean averages, and standard deviations and categorical data was presented as numbers and percentages. The students' t-test and Chi-square test were used to compare the differences of continuous variables and categorical variables, respectively, between obese children with or without metabolic syndromes. Statistical analysis was performed using the SPSS 19.0 software package (SPSS Inc., Chicago, IL). A two-tailed *p*-value of less than 0.05 was considered statistically significant.

Results

Of the 735 children who were currently studying in the school, 10 children were missing the data measurement schedule and were therefore not included into the analysis. Of the remaining 725 children who were measured for body weight, height and BMI, 113 children (15.6%) were diagnosed as obese. All 113 obese children consented to participate in research and further anthropometric data and demographic characteristics were obtained. Of the 113 obese children, 71 (62.8%) were male. The mean age, weight, height and BMI of the study population were 10.1 years (SD 1.8; range 7.1 to 13.0 years), 52.3 (SD 17.1) kg, 139.8 (12.6) cm and 26.2 (SD 5.1) kg/m^2, respectively. None of the obese children had ever smoked but 70 (61.9%) lived with smokers. 4 (3.5%), 5 (4.4%) and 35 (31.0%) obese children had family history of dyslipidemia, premature cardiovascular diseases (CVD) and diabetes mellitus, respectively.

Metabolic syndrome was diagnosed in 57 (50.4%) of the obese children. Demographic characteristics and anthropometric data of the study population are separately showed, according to the present or absent of metabolic syndrome, in Table 1. Obese children with metabolic syndrome had higher all anthropometric characteristics including weight, height, BMI, body circumferences, skinfold thicknesses and body fat percentage than those of obese children without metabolic syndrome, however, only waist circumference, biceps skinfold thickness and suprailiac skinfold thickness were deemed statistically significant (Table 1). There were no statistically significant differences in age, sex, level of habitation with smokers, degree of family history of dyslipidemia, premature cardiovascular diseases or diabetes mellitus between groups of study.

The mean total of cholesterol, HDL-cholesterol, LDL-cholesterol, triglyceride levels and fasting blood glucose in obese children were 165.3 (7.8) mg/dL, 56.0 (14.8) mg/dL, 86.7 (35.0) mg/dL, 113.0 (53.6) mg/dL and 95.5 (7.8) mg/dL, respectively. Children with metabolic syndrome had significantly higher levels of triglyceride, fasting blood glucose, systolic and diastolic blood pressures than those of children without metabolic syndrome. The HDL-cholesterol level in children with metabolic syndrome was significantly lower than those in children without metabolic syndrome (Table 2). There were no significant differences in total cholesterol and LDL-cholesterol levels between children with and without metabolic syndrome.

Discussion

The present study demonstrated that the prevalence of metabolic syndrome was high in obese Thai children and had shown an increasing trend from the previous survey. Obese children with MetS had higher blood pressure and body fat parameters including waist circumference, biceps and suprailiac skinfold thicknesses than obese children without MetS. Moreover, obese children with MetS showed a trend of being older and heavier than obese children without MetS. This study also found that the presenting of metabolic syndrome in obese children was not related to their demographic characteristics, such as smokers in the family or a family history of metabolic syndrome. With regards to biochemistry parameters, the present study found that children with MetS had higher fasting blood glucose, triglycerides but had lower HDL-cholesterol than in children without MetS.

This trend of increasing obesity prevalence in Thai children correlates to several other studies, especially from developing countries[1-3]. Savva et al[2] reported that the prevalence of obesity among Cyprus school-aged children had increased from 5.9% in 2000 to 8.1% in 2010. The increasing trend of obesity was supported by a long-term, 25-year comparative study (1985-2010) among Chinese children, which revealed a 9% annual increase of obesity or overweight condition[3]. A meta-analysis study among Indian children also confirmed the increasing trend of childhood obesity during the last decade, in which results were divided into 3 levels of prevalence ranging from 6% (95% CI, 6-7%) for the low-prevalence group, to 18% (95% CI, 17-18%) for the intermediate-prevalence group, and 36% (95% CI, 34-37%) for

Table 1. Demographic characteristics and anthropometric data of obese children with or without metabolic syndrome*

	Without metabolic syndrome (n = 56)	With metabolic syndrome (n = 57)	*p*-value
Male; n (%)	38 (67.9)	33 (57.9)	0.332
Age (years)	9.9 (1.7)	10.4 (1.8)	0.180
Weight (kg)	49.4 (16.0)	55.2 (17.7)	0.070
Height (cm)	138.0 (12.7)	141.6 (12.5)	0.131
Body mass index (kg/m^2)	25.4 (4.9)	26.9 (5.3)	0.111
Waist circumference (cm)	82.4 (11.6)	86.9 (12.6)	0.049
Hip circumference (cm)	87.7 (11.5)	91.2 (10.2)	0.092
Waist/height ratio	0.60 (0.06)	0.61 (0.07)	0.175
Waist/hip ratio	0.94 (0.05)	0.95 (0.07)	0.258
Mid arm circumference (cm)	26.1 (4.0)	27.5 (3.5)	0.055
Biceps skinfold thickness (mm)	14.9 (4.6)	17.2 (5.8)	0.017
Triceps skinfold thickness (mm)	22.9 (6.2)	24.9 (6.3)	0.085
Subscapular skinfold thickness (mm)	28.9 (9.5)	32.4 (9.7)	0.060
Suprailiac skinfold thickness (mm)	31.8 (10.3)	36.5 (10.7)	0.019
Body fat percentage (%)	33.8 (8.4)	36.1 (6.4)	0.106
Smoker in family; n (%)	34 (60.7)	36 (63.2)	0.848
Family history of; n (%)			
Dyslipidemia	0	4 (7.0)	0.118
Premature CVD**	1 (1.8)	4 (7.0)	0.364
Diabetes mellitus	17 (30.4)	18 (31.6)	1.000

* Present as mean (SD) unless otherwise indicated
** CVD = cardiovascular diseases

Table 2. Blood pressure and biochemical data of obese children with and without metabolic syndrome

	Without metabolic syndrome (n = 56)	With metabolic syndrome (n = 57)	*p*-value
Systolic blood pressure (mmHg)	112.6 (12.8)	119.7 (14.6)	0.007
Diastolic blood pressure (mmHg)	69.0 (10.8)	73.7 (10.8)	0.022
Fasting blood glucose (mg/dL)	93.6 (6.6)	97.4 (8.4)	0.009
Total cholesterol (md/dL)	162.5 (35.1)	168.1 (39.3)	0.432
HDL-cholesterol (mg/dL)	63.1 (14.9)	48.7 (10.7)	<0.001
LDL-cholesterol (mg/dL)	81.9 (31.1)	91.4 (38.0)	0.147
Triglyceride (mg/dL)	85.6 (35.2)	140.0 (55.2)	<0.001

the high-prevalence group. The previous study in 2007 found that 9.4% of schoolchildren in Ongkharak district, Thailand were diagnosed as obese[19]. This had increased to 12.9% in 2008[20] and reached 15.6% in the present study (2013). The increased prevalence of childhood obesity may be explained by the influence of rapid economic growth and urbanization which leads toward to a sedentary lifestyle and Westernized diet. The difference in degree of prevalence of obesity between the studies may be explained by the different uses of the standard diagnostic criteria and growth references. However, the overall prevalence of childhood obesity in Thailand has highly increased and new national policies are urgently needed to fight this surging problem.

The previous study in Ongkharak district using a modified NCEP/ATPIII criteria[16], the same criteria as in the present study, found that 17.6% of obese/overweight Thai children in year 2009 were diagnosed with metabolic syndrome[12]. Another report

in 2007 using the IDF criteria found that 16.9% of obese children, aged 4-18 years old, had metabolic syndrome[13]. However, due to the IDF criteria not including diagnostic criteria for children aged less than 6 years old, the interpretation of the results in those studies may not be entirely complete or reliable. In order to compare the prevalence of MetS to previously, the present study elected to use a modified NCEP/ATPIII by de Ferranti et al[16] as a diagnostic criteria for MetS in children, which defined criteria for all ages. The impact of obesity on the risk of having MetS in children, such as found in the present study, was in line with previous studies from various countries. The high prevalence of MetS amongst obese children was reported in Korea (24 to 35%)[21], Brazil (32 to 36%)[22], China (33%)[23], the United Arab Emirates (40%)[24] and Mexico (44%)[25]. The present study found that half of obese Thai children had MetS, which is a significantly higher rate than the numbers reported other countries. The difference in prevalence of MetS in obese children between studies may be explained by the different diagnostic criteria used and the differences in ethnic backgrounds[11]. Criteria used for diagnosis of MetS in children have been variably adapted from existing adult definitions, adjusted for sex and age for the cut-off levels. Almost all classifications of MetS in children included the following 5 criteria[7,8,16]: (1) increased waist circumference; (2) an elevated fasting glucose level; (3) an elevated triglyceride level; (4) a reduced HDL-cholesterol level; and (5) a raised blood pressure.

Currently, there is no consensus to define the best criteria for classifying MetS in children. However, the pediatric MetS definitions by de Ferranti et al[16], which were modified from the National Cholesterol Education Program Adult Treatment Panel III (NCEP/ATPIII) criteria, have been widely accepted as one of the most suitable diagnostic criteria. Compared the prevalence of MetS in the present study with other studies using the same criteria, prevalence was mostly closely in line with a study from Korea, which showed prevalence in children at 45% to 47%[26].

The finding of the increasing trend of MetS among obese Thai children in the present study is simultaneously supported by other studies[21,27]. Increasing trend of MetS in children may be explained by the corresponding increase prevalence of childhood obesity. Obesity is regarded as the key factor of MetS development[11]. Pathogenesis and hypothesis on the relationship between obesity and MetS was extensively reviewed elsewhere[28]. In summary, obesity has a clear impact on the development of MetS via the aberrant of lipid partitioning pattern (the pattern of lipid storage). The majority of excess fat in obese patients tends to store upon the conventional sites, such as the insulin-sensitive tissues (e.g. liver and muscle) and intra-abdominal (visceral) fat compartment. This abnormal pattern of lipid storage has influence on the levels of adipokinases which lead to elevation of free fatty acids and inflammatory cytokines levels, along with the reduction of adiponectin levels. The combination of these changes leads to peripheral insulin resistance and endothelial dysfunction, which derives the development of alter glucose metabolism and cardiovascular disease.

The strength of the present study is that it is a follow-up to the previous report that investigated the same demographic area[12]. Comparison of the two studies has illustrated the clear trend of metabolic syndrome in childhood obesity. Moreover, the present study estimated abdominal obesity based on the specific percentile cut-off values for Thai children instead the cut-off values from other ethnicities. It has clearly evidenced that ethnic disparity has an influence on the distribution of abdominal fat distribution[29]. Using the international cut-off standards may not be suitable for classifying metabolic syndrome for Thai children; therefore, the prevalence of metabolic syndrome in the present study could be more accurate for Thai children.

There are some limitations in the present study. Firstly, the data is limited to a cross-sectional study from a single district of Thailand, which may make it far from being a good representation of the whole nation. Finally, blood pressure was measured twice in a single visit and an average of two values was used for identify cardiovascular risk of metabolic syndrome. In general, classification of hypertension is based upon two or more separate occasions of elevated blood pressure before diagnosis. However, measuring blood pressure on multiple occasions may cause a false positive for hypertension due to anxiety. As the present study had the aim of detecting hypertension and not diagnosis, the twice-measuring of blood pressure on a single visit was the best method to achieve a more realistic result.

Conclusion

The present study indicates a high prevalence of metabolic syndrome among obese school children in Ongkharuk district, Nakhon Nayok province, Thailand, and shows an increasing trend from previous studies. Obesity and metabolic syndrome are

considered as the primarypublic health problems leading to the evolution of these conditions track into adulthood. Urgent effort is needed to prevent childhood obesity and metabolic syndrome in Thailand, which is in a realm of fast economic development and nutritional transition.

What is already known on this topic ?

Prevalence of childhood obesity and metabolic syndrome has increased worldwide.

There are very few studies available on the prevalence of metabolic syndrome in Thai obese children and the evidence showed that metabolic syndrome in Thai children was moderate.

Lack of a study that reported the prevalence trend of metabolic syndrome in Thai children from the same area of population.

What this study adds ?

Prevalence of obesity in Thai children is continuing rising through the observation periods from 9.4% in 2007, to 12.9% in 2008 and 15.6% in the present study (2013).

Prevalence of metabolic syndrome in Thai obese children has increased over recent years, from 17.6% in 2009, to 50.4% in 2013.

Acknowledgement

The present study was supported by grants from the Faculty of Medicine, Srinakharinwirot University, Thailand. The authors would like to thank Ms. Kulwadee Roblou for her support of the study.

Potential conflicts of interest

None.

References

1. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014; 384: 766-81.
2. Savva SC, Kourides YA, Hadjigeorgiou C, Tornaritis MJ. Overweight and obesity prevalence and trends in children and adolescents in Cyprus 2000-2010. Obes Res Clin Pract 2014; 8: e426-e434.
3. Sun H, Ma Y, Han D, Pan CW, Xu Y. Prevalence and trends in obesity among China's children and adolescents, 1985-2010. PLoS One 2014; 9: e105469.
4. Bell LM, Curran JA, Byrne S, Roby H, Suriano K, Jones TW, et al. High incidence of obesity co-morbidities in young children: a cross-sectional study. J Paediatr Child Health 2011; 47: 911-7.
5. Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med 1998; 15: 539-53.
6. Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III). JAMA 2001; 285: 2486-97.
7. Alberti KG, Zimmet P, Shaw J. The metabolic syndrome—a new worldwide definition. Lancet 2005; 366: 1059-62.
8. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988-1994. Arch Pediatr Adolesc Med 2003; 157: 821-7.
9. Chen W, Bao W, Begum S, Elkasabany A, Srinivasan SR, Berenson GS. Age-related patterns of the clustering of cardiovascular risk variables of syndrome X from childhood to young adulthood in a population made up of black and white subjects: the Bogalusa Heart Study. Diabetes 2000; 49: 1042-8.
10. Baker JL, Olsen LW, Sorensen TI. Childhood body-mass index and the risk of coronary heart disease in adulthood. N Engl J Med 2007; 357: 2329-37.
11. Cruz ML, Goran MI. The metabolic syndrome in children and adolescents. Curr Diab Rep 2004; 4: 53-62.
12. Rerksuppaphol L, Rerksuppaphol S. Prevalence of Metabolic Syndrome in Thai Children: A Cross-sectional Study. J ClinDiagn Res 2014; 8: C04-C07.
13. Iamopas O, Chongviriyaphan N, Suthutvoravut U. Metabolic syndrome in obese Thai children and adolescents. J Med Assoc Thai 2011; 94 (Suppl 3): S126-32.
14. World Health Organization. Growth reference 5-19 years [Internet]. 2014 [cited 2014 Jul 9]. Available from: http://www.who.int/growthref/who2007_bmi_for_age/en/index.html
15. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem 1972; 18: 499-502.

16. de Ferranti SD, Gauvreau K, Ludwig DS, Neufeld EJ,Newburger JW, Rifai N. Prevalence of the metabolic syndrome in American adolescents: findings from the Third National Health and Nutrition Examination Survey. Circulation 2004; 110: 2494-7.
17. Rerksuppaphol L, Rerksuppaphol S. Waist circumference and waist-to-height ratio percentiles of Thai school-aged children. Int J Collab Res Intern Med Public Health 2013; 5: 19-29.
18. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004; 114: 555-76.
19. Rerksuppaphol S, Rerksuppaphol L. Prevalence of overweight and obesity among school children in suburb Thailand defined by the International Obesity Task Force Standard. [corrected]. J Med Assoc Thai 2010; 93 (Suppl 2): S27-31.
20. Rerksuppaphol S, Rerksuppaphol L. Optimal cut-off points of weight for height, waist circumference and waist-to-height ratio for defining overweight and obesity in Thai school-aged children. J Res Health Sci 2013; 13: 13-8.
21. Lee HA, Park H. Overview of noncommunicable diseases in Korean children and adolescents: focus on obesity and its effect on metabolic syndrome. J Prev Med Public Health 2013; 46: 173-82.
22. Campos LA, Amancio OM, Costa e Forti. Impact of obesity on metabolic syndrome in Brazilian adolescents: a population-based study. Diabetes Care 2013; 36: e139-40.
23. Liu W, Lin R, Liu A, Du L, Chen Q. Prevalence and association between obesity and metabolic syndrome among Chinese elementary school children: a school-based survey. BMC Public Health 2010; 10: 780.
24. Mehairi AE, Khouri AA, Naqbi MM, Muhairi SJ, Maskari FA, Nagelkerke N, et al. Metabolic syndrome among Emirati adolescents: a school-based study. PLoS One 2013; 8: e56159.
25. Guzman-Guzman IP, Salgado-Bernabe AB, Munoz Valle JF, Vences-Velazquez A, Parra-Rojas I. [Prevalence of metabolic syndrome in children with and without obesity]. Med Clin (Barc) 2015; 144: 198-203.
26. Seo SJ, Lee HY, Lee SW. The prevalence of the metabolic syndrome in Korean children and adolescents: comparisons of the criteria of Cook et al., Cruz and Goran, and Ferranti et al. Yonsei Med J 2008; 49: 563-72.
27. Girvalaki C, Vardavas C, Papandreou C, Christaki G, Vergetaki A, Tsiligianni IG, et al. Trends in metabolic syndrome risk factors among adolescents in rural Crete between 1989 and 2011. Hormones (Athens) 2014; 13: 259-67.
28. Weiss R, Bremer AA, Lustig RH. What is metabolic syndrome, and why are children getting it ? Ann N Y Acad Sci 2013; 1281: 123-40.
29. Gishti O, Kruithof CJ, Felix JF, Raat H, Hofman A, Duijts L, et al. Ethnic disparities in general and abdominal adiposity at school age: a multiethnic population-based cohort study in the Netherlands. Ann Nutr Metab 2014; 64: 208-17.

กลุ่มอาการเมตาโบลิกในเด็กโรคอ้วนนิยามโดยเกณฑ์ปรับปรุงของ The National Cholesterol Education Program/Adult Treatment Panel III

สงวนศักดิ์ ฤกษ์ศุภผล, ลัดนา ฤกษ์ศุภผล

ภูมิหลัง: โรคอ้วนเป็นปัจจัยเสี่ยงก่อให้เกิดกลุ่มอาการเมตาโบลิก อย่างไรก็ตามข้อมูลเกี่ยวกับความชุกของกลุ่มอาการเมตาโบลิกในเด็กไทยที่เป็นโรคอ้วนมีอยู่จำนวนน้อย

จุดประสงค์: ประเมินความชุกของกลุ่มอาการเมตาโบลิกในเด็กไทยที่เป็นโรคอ้วน

วัสดุและวิธีการ: การศึกษาแบบตัดขวางในเด็กโรคอ้วน 113 คน ที่เรียนอยู่ที่โรงเรียนแห่งหนึ่งในอำเภอองครักษ์ในปี พ.ศ. 2556 โดยเก็บข้อมูลประชากร วัดความดันโลหิต และตรวจค่าเคมีในเลือด การวินิจฉัยกลุ่มอาการเมตาโบลิกโดยใช้เกณฑ์ปรับปรุงของ The National Cholesterol Education Program/ Adult Treatment Panel III

ผลการศึกษา: ความชุกของกลุ่มอาการเมตาโบลิกในเด็กโรคอ้วนเท่ากับร้อยละ 50.4 โดยเด็กที่มีภาวะกลุ่มอาการเมตาโบลิกจะมีค่าเฉลี่ยของค่าต่าง ๆ ต่อไปนี้มากกว่าเด็กที่ไม่มีภาวะกลุ่มอาการเมตาโบลิกได้แก่ เส้นรอบวงเอว (86.9 ต่อ 82.4 ซม., p-value = 0.049) ความหนาของชั้นผิวหนังบริเวณกล้ามเนื้อแขนด้านหน้า (17.2 ต่อ 14.9 มม., p-value = 0.017) ความหนาชั้นผิวหนังบริเวณเหนือกระดูกเชิงกราน (36.5 ต่อ 31.8 มม., p-value = 0.019) ความดันโลหิตค่าบน (119.7 ต่อ 112.6 มม.ปรอท, p-value = 0.007) ความดันโลหิตค่าล่าง (73.7 ต่อ 69.0 มม.ปรอท, p-value = 0.022) ระดับน้ำตาลในเลือด (97.4 ต่อ 93.6 มก./ดล., p-value = 0.009) และไขมันไทรกลีเซอไรด์ในเลือด (140.0 ต่อ 85.6 มก./ดล., p-value <0.001) ส่วนระดับไขมัน HDL-cholesterol ในเด็กที่มีกลุ่มอาการเมตาโบลิกจะมีระดับต่ำกว่าเด็กที่ไม่มีกลุ่มอาการเมตาโบลิก (48.1 ต่อ 63.1 มก./ดล., p-value <0.001)

สรุป: เด็กโรคอ้วนประมาณครึ่งหนึ่งจะพบมีกลุ่มอาการเมตาโบลิกความชุกของกลุ่มอาการเมตาโบลิกเพิ่มมากขึ้นกว่าอดีต จึงควรมีมาตรการโดยรีบด่วนเพื่อป้องกันโรคอ้วนและกลุ่มอาการเมตาโบลิกในเด็กไทย