Upper Lower Segment Ratio Comparison between Obese and Normal Children Aged 7 to 10 Years Old

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Abstract

Background: Upper lower segment ratio is an anthropometric measurement that often used to detect the presence of abnormal growth. Growth is affected by many factor, one of them is nutrional status. Obesity prevalence in Indonesian children increases annually. These children show an accelerated growth in pre-puberty compared to normal children in their age. This study aimed to analyze the difference in upper lower segment ratio between obese and normal children aged 7 to 10 years old.
Methods: A cross sectional study was carried out in children aged 7 to 10 years old in three Elemantary School in Bandung during September–October 2013. Height and weight were measured to calculate body mass index (BMI) score and were grouped into obese (BMI >95th percentile) and normal (BMI 10th–85th percentile). The upper lower segment ratio was compared between obese and normal children and the level of the significant difference were analyzed by unpaired T-test.
Results: From a total of 200 children recruited, 90 were obese and 110 were normal. There was no significant difference between upper lower segment ratio in obese and normal children (p=0.603) with mean ratio 1.137 and 1.142 respectively. The mean of upper lower segment ratio in obese boys was higher than normal boys (mean ratio 1.15 and 1.14 respectively), but obese girls had a lower ratio compared to normal girls (mean ratio 1.12 and 1.14 respectively).
Conclusions: There is no difference between upper lower segment ratio in obese and normal children aged 7 to 10 years old. **[AMJ.2016;3(1):147–51]**

Keywords: Children, obesity, upper lower segment ratio

Introduction

Upper lower segment ratio is a component of growth anthropometric measurement in children. This measurement is often used to detect the presence of abnormal growth especially in school-aged children.[1] Change of upper lower segment ratio can cause abnormal body proportions. This can affect psychosocial aspect in school-age children.[2] The measurement of upper lower segment ratio is affected by several factors, such as age, gender, and race.[1]

Obesity is one of nutritional status disorders that can affect growth in children. . Obese children as those who have body mass index (BMI) more than 95th percentile in CDC BMI-for-age growth chart.[3] World Health Organization (WHO) stated that obesity was ranked as the fifth leading cause of death globally. WHO estimates that there are more than 1.4 billion adults and 40 million children in the world considered overweight and obese.[4] According to the study of de Onis et al.[5] the prevalence of overweight and obese children in Southeast Asia showed an increasing for every 5 years. According to Riset Kesehatan Dasar (Riskesdas) conducted by Indonesia Department of Health in 2010, the number of obese children aged 6 to 12 years reached 12%.[6]

In pre-pubertal age, most of obese children experience growth velocity earlier than other children at their age.[7] Hormonal changes is one of the factor that caused obese. Hormonal changes that occurs such as presence of abnormalities in the Growth hormone-Insulin-like growth factor-1 axis (GH-IGF-1

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axis), increased aromatization of androgen into estrogen, and increased level of leptin.8 This study aimed to observe the difference in upper lower segment ratio between obese and normal children aged 7 to 10 years old.

Methods

A cross sectional study was carried out from October to November 2013 in 7 to 10 years old children from three elementary schools in Bandung which were selected by multistage random sampling. The first stage randomization was done at subdistrict level, the 3 selected subdistricts were Mandalajati, Bandung Kulon, and Sumur Bandung. Each subdistrict represented east, west, and central Bandung region, respectively. The second stage randomization was performed at the school level in each district, the 3 selected schools were Elementary School (Sekolah Dasar/SD) Negeri Jatihandap 2, SD Negeri Tunas Harapan, and SD Kartika Siliwangi IX-1.

The primary data were collected with minimal sample of 84 children for each group, whether their BMI status were obese or normal. An informed consent regarding the procedure of this study was informed to the children's parents a week prior to the measurement. This study included healthy boys and girls aged 7-10 years old who hadBMI designated as obese and normal in Bandung. Subject were excluded if their parents did not give consent, had chronic disease or other disease e.g. body dysplasia, Klinefelter syndrome, Marfan syndrome, or was undergoing specific therapy i.e. radiation therapy that could interfere upper lower segment ratio measurement.

All measurements were performed by team of 3 medical students who had been trained and standardized. Each measurement performed twice by the same observer, and the final value were the mean valueof these measurements.

Weight was measured by weight scales. The subjects were measured without shoes, and subjects were asked to remove any object from their pocket that could affect the measurement results.

Height was measured with microtoise. The subjects were asked to remove their shoes and socks. The observer made sure that the heels, buttock and occiput were contact to the wall or vertical measure. The subjects were instructed to look straight ahead, relax their shoulder, and place part of their lower margin of the eye parallel to external auditory meatus (Frankfurt plane).

Sitting height was measured after height measurements were complete. A 40 centimeters chair was placed just below the location of microtoise and parallel to the wall. The subjects were asked to sit on the chair with their buttock and occiput were contact to the wall. They were asked to look straight

Table 1 Characteristic of Subjects

Characteristic	Obese n (%)	Normal n (%)	Total
Age (years old)			
7–< 8	16 (17.8)	20 (18.2)	36 (18)
8–< 9	21 (23.3)	25 (22.7)	46 (23)
9–< 10	31 (34.4)	35 (31.8)	66 (33)
10–< 11	22 (24.4)	30 (27.3)	52 (26)
Sex			
Male	45 (50)	55 (50)	100 (50)
Female	45 (50)	55 (50)	100 (50)
Height, mean (SD) in cm	133.8 (8.6)	125.03 (8.7)	128.98 (9.7)
Weight, mean(SD) inkg	44.3 (9.9)	25.28 (5.2)	33.84 (12.2)
BMI, mean (SD)	24.46 (3.0)	15.99 (1.48)	19.80 (4.81)
Total	90	110	200

Note: SD= Standard Deviation; Obese= >95th percentile; Normal= 10th–85th percentile

Table 2 Comparison of Upper Lower Segment Ratio between Obese and Normal Children

	Obese	Normal	p-value
US/LS ratio			
Mean	1.13	1.14	0.60
SD	0.08	0.04	

Note: US/LS ratio= Upper lower Segment ratio; SD= Standard Deviation

Table 3 Means of Upper Lower Segment Ratio in Obese and Normal Boys Based on Age

Age	Obese			Normal			p-value
	n	US/LS ratio	SD	n	US/LS ratio	SD	
7	9	1.19	0.03	10	1.20	0.02	0.61
8	7	1.13	0.07	10	1.18	0.03	
9	18	1.13	0.11	20	1.14	0.03	
10	11	1.15	0.04	15	1.09	0.02	
Total	45	1.15	0.08	55	1.14	0.05	

Note: US/LS ratio= Upper lower Segment ratio; SD= Standard Deviation

ahead, with their part of the lower margin of the eye parallel to external auditory meatus (Frankfurt plane). The subjects were asked to relax the shoulder when the measurement was performed. Upper segment was calculated by subtracting the sitting height with height of chair (40 cm). Lower segment was calculated by subtracting height with upper segment. The upper lower segment ratio was calculated by dividing the upper segment with lower segment.

The BMI was obtained after all measurements were completely performed. The BMI was calculated by dividing body weight with square of height in meters, then BMI was plotted to BMI for age based on Centers for Disease Control and Prevention (CDC) BMI-for-age growth chart to classify BMI category of all subject. Obese category wasdetermined if BMI of the children was above 95th percentile, while normal category wasdetermined if BMI of children was in range of 10th to 85th percentile.

The data that was obtained were analyzed to normality distribution test using Kolmogorov-Smirnov test. If the p value >0.05, it could be concluded that the data had normal distribution. Moreover, the data were analyzed by unpaired T-test to assess the level of significantdifference upper lower segment ratio in obesity and normal children aged 7 to 10 years old. This study was approved by Health Research Ethics Committee, Universitas Padjadjaran (No.327/UN6/C2.1.2/KEPK/2013) and Bandung Department of Education (No.070/5511-Disdik/2013).

Results

From the three elementary schools, there were

Table 4 Means of Upper Lower Segment Ratio in Obese and Normal Girls Based on Age

Age	Obese			Normal			p-value
	n	US/LS ratio	SD	n	US/LS ratio	SD	
7	7	1.15	0.06	10	1.18	0.02	0.21
8	14	1.12	0.07	15	1.16	0.04	
9	13	1.13	0.11	15	1.14	0.02	
10	11	1.10	0.09	15	1.10	0.02	
Total	45	1.12	0.08	55	1.14	0.04	

Note: US/LS ratio= Upper lower Segment ratio; SD= Standard Deviation

200 children recruited in this study and ninety subjects defined as obese children. Most of the children were above 9 years old.

There was no significant difference between upper lower segment ratio in obese children and normal children aged 7 to 10 years ($p>0.05$, unpaired T-test).

The upper lower segment ratio has no significant different ($p=0.61$) among obese and normal boys. Interestingly, there was a tendency that the value decreased from aged 7 to 9. However, the ratio was increased again in the age of 10 (Table 3).

There was no significant different between both group obese and normal girls ($p=0.21$) (Table 4). Overall, the means of upper lower segment ratio in obese girls was lower than normal girls, and tendency, similar to the boys, that there were decreasing ratios from aged 7 to 10

Discussion

The upper lower segment ratio has been used for growth anthropometric measurement in children. This study reveals that the upper lower segment ratio decrease gradually from age 7 to 10 in both obese and normal children. These results are similar to a study conducted in healthy Turkish children.[9] These differences might be due to the age that influence the measurement upper lower segment ratio. The upper lower segment ratio at birth is about 1.7 and decrease to 1.3 at 3 years old. At the age 7 to 10, the ratio is decrease to 1.0, and in adult it gradually decreases to 0.9.[10] The age influences on upper lower segment ratio were also be seen in the body proportion in sickle cell anemia11 and in Dutch children origin at age 0 to 21 years old.[12]

The ratio in boys aged 7–10 years old in Turkey shows higher upper lower segment compared to girls.[9] These results were similar to this study. However, when comparing between Turkish children with Indonesian children, the result showed that the means of upper lower segment ratio in Indonesian children is higher than Turkish children. Most likely, this is due to racial difference between Turkey and Indonesia, where race is one of the components that influence the measurement result of upper lower segment ratio. There is a significance racial difference in upper lower segment ratio, where Caucasian and African American have a longer leg than Asian.[1], 13 Therefore, when Asian was compared to Caucasian and African American, Asian was more likely has higher upper lower segment ratio in the same age. Furthermore, study performed in Yucatecans and Poles also has shown racial factor that influence upper lower segment ratio measurements.[14]

Other factors contributing to difference measurement upper lower segment can be explained by secular trends, socioeconomic and environmental factor. In Japanese children, it showed 10% secular increase in height and 40% secular increase in body weight in the period 1985 to 2000. Secular increase in height was due to increased sub-ischial leg length that can affect the lower segment as well as the upper lower segment ratio.[15] A study conducted in China[16] also showed a significant secular increase in growth from 1985 to 2010. The study also revealed that there were different characteristic trends in socioeconomic levels. Mean stature in small and moderate cities were lower than in big cities. Study comparing Maya children living in United States and Guatemala showed different height, weight, and sitting height ratio for each group. This study revealed that Maya children in United States were significantly taller at all ages than Maya children in Guatemala.[17]

In pre-pubertal age, most of obese children experience growth velocity earlier than normal children at their age.[7] This study also revealed that same phenomenon. Height difference did not significantly affect the upper lower segment ratio possibly because the upper segment grows as rapid as the lower segment. So, there was no significant difference between the upper lower segment ratio in obese and normal children.

Some other factors such as arm-span measurement, race, and socioeconomic status contributing to difference measurement of upper lower segment ratio in children were not analyzed, and it contributed to the limitations of this study.

To conclude, this study shows no difference between upper lower segment ratio in obese and normal children aged 7 to 10 years. This ratio might impact other races and is served as anthropometric measurements. Further study about exploring arm-span measurement, race, and socioeconomic status might reveal the significant difference.

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