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WEIGHT-TO-HEIGHT RATIO IN ASSOCIATION TO LIPID PROFILE AMONG ADOLESCENT IN KABANJAHE, NORTH SUMATERA: A CROSS-SECTIONAL STUDY

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ABSTRACT Weight-to-height ratio (WtHR) as a central adiposity marker is well-established in predicting cardio-metabolic risk in adults, nevertheless, epidemiological data for this association in children are still not well defined. Cross-sectional study was conducted in October-December 2018 on adolescents aged 10-16 years in SMP Negeri 1 Kabanjahe, North Sumatera, Indonesia. Students with BMI ≥ P85th and met the inclusion and exclusion criterias were randomly selected. Sample were divided into two groups (WtHR <0.6 and WtHR ≥0.6) and lipid profile examination were subsequently performed. Data were available for 63 subjects consisted of 10 (15,9%) overweight students and 53 (84.1%) obese students. Based on WtHR, the subjects were categorised as WtHR <0.6 and ≥0.6 which were 34 (54%) and 29 (46%), respectively. Elevated total serum cholesterol levels, elevated serum triglycerides levels, elevated serum low-density lipoproteins (LDL) levels, and decreased serum high-density lipoproteins (HDL) levels were observed among 51.4% (*P*=0.451;OR=1.7), 51.1% (*P*=0.279; OR=2.3), 52.9% (*P*=0.348;OR=1.8), and 31.6% (*P*=0.216; OR= 0.4) of subjects with WtHR ≥0.6, respectively. The mean value for WtHR for all the subjects was 0.59 (range: 0.50-0.75). The mean values for total cholesterol, HDL, LDL and triglycerides were 175.44mg/dl, 51.27mg/dl, 114.40 mg/dl, and 122.75 mg/dl, respectively. Chi square test were carried out with 95% confidence interval and P<0.05 was defined as statistically significant. There is no statistically significant association found between WtHR and the lipid profile of overweight and obese adolescents in this study.

KEYWORDS : weight-to-height ratio, lipid profile, body mass index, adolescents

INTRODUCTION

Obesity is a worldwide health problem due to the increasing prevalence of overweight and obese children in the world from 4.2% in 1990 to 6.7% in 2010, and are expected to reach 9.1% in 2020. This subsequently associated with many comorbidities, such as high blood pressure, atherosclerosis, left cardiac ventricular hypertrophy, obstructive sleep apnea, asthma, polycystic ovarian syndrome, type 2 diabetes, fatty liver, dyslipidemia, and metabolic. Task Force on Nutrition and Metabolic Disorder-Indonesian Pediatric Society (2014) explained that dyslipidemia is the most common comorbid with the highest incidence, approximately 88.4% in Indonesia and 45.8% worldwide, commonly asymptomatic in early state, however, it may lead to cardiovascular diseases later in life and requires further laboratory investigations such as lipid profile. (Task Force on Nutrition and Metabolic Disorder-Indonesian Pediatric Society, 2014).

Khoury, Manlhiot, & McCrindle, (2013) found that waist-to-height ratio (WtHR) is better in predicting cardiometabolic risks as a central adiposity marker in adults, however, data in children are limited. WtHR >0.50 was considered as an indicator of central obesity in adults. A cross-sectional study in Canada reported that subjects with obesity and WtHR value ≥0.6 would have a 26% increase in LDL lipoprotein and as many as 32% would have metabolic syndrome. Marroda et al., (2013) researched that in the United States on 649 childrens aged 2–18 year old that described children with central obesity with a WtHR ≥0.5 and <0.55, and WtHR ≥0.55 identified central obesity with a high probability of cardiometabolic risks. (Khoury, Manlhiot, & McCrindle, 2013; Marroda et al., 2013)

According to Research and Health Development Division-Indonesian Minister of Health (2007), obesity in adults is common among four cities in North Sumatera, with over 20% in Karo regency, Padang Sidempuan, Pematang Siantar, and Tanjung Balai. Karo regency was the second highest prevalence for central obesity, accounts of 16.2%. Karo Regency had the highest number population of overweight and obese population aged 15 and above in both sexes with a prevalence of 32.4%. To investigate the association between WtHR and lipid profile among adolescents in Kabanjahe, North Sumatera. (Research and Health Development Division-Indonesian Minister of Health, 2007).

METHODS

This cross-sectional study was conducted in *Sekolah Menengah Pertama* (SMP) Negeri 1 in Kabanjahe from October to Desember 2018. A total of 973 students from 30 classes underwent anthropometric measurements. Body weights were measured using a GEA digital scale with a capacity up to 150 kg. Body weights were recorded to the nearest 0.1 kg. The children were asked to wear light clothing, remove footwears, belts, and empty their pockets. Heights were recorded using a GEA stature meter made of metal, with a capacity up to 2 m. The students were asked stick both feet together and stand straight against the wall where the stature meter was hung. The head, back, buttocks, and feet were in a straight line and pressed against the wall with the student looking straight ahead. The stature meter was then pulled until it touches the top of the head and the result was recorded to the nearest 0.1 cm. Waist circumference was measured with a GEA non elastic measuring tape made of steel. The waist circumference was measured at the level right above iliac crests at the end of normal expiration to the nearest 0.1 cm. Each measurement was done twice, if the results differed by ≤0.5, the average of the two values was recorded. If the results differed by >0.5 cm, a third measurement was done and the average was calculated. All measurements were recorded to

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the nearest 0.1 cm.

The subjects were selected based on inclusion and exclusion criteria. The inclusion criteria were: (1) students aged 11 to 16 years old; (2) classified as overweight or obese; and (3) undergoing junior high education in Kabanjahe. The exclusion criteria were: (1) students that were unable to stand up during height measurement; (2) obese children taking medications or suffering from any illness; (3) children with spinal disorders such as scoliosis, lordosis, kyphosis, spinal fracture, or gibbus; (4) students with linear growth disorders such as achondroplasia or osteogenesis imperfecta; and (5) children with abdominal tumor. Parents and their children were given an informed consent stating an agreement to run a blood examination.

The sample were classified according to WtHR value that is body height divided by waist circumference. Blood specimens were taken from the vein of the left arm. Students were asked to fast for 12 hours before blood examination. Lipid profile, namely total cholesterol (TC), high-density lipoprotein (HDL), triglycerides (TG), and low-density lipoprotein (LDL), were examined using Architect tools in a laboratorium in Kabanjahe, 3 ml of blood without solvent were taken and then centrifuged to get the serum for examination.

Data were analyzed using a statistical software SPSS Statistics ver. 20.0. Age, sex, and BMI are presented in distribution and frequencies, while body weight (BW), body height (BH), waist circumference, cholesterol, triglycerides, HDL and LDL cholesterols were presented in mean, standard deviation, median, modes, minimum and maximum values. WtHR and lipid profile were analyzed using Chi square test with 95% confidence interval. Statistical significance was considered at P value < 0.005.

RESULTS

A total of 973 students that consisted of 416 (42.8%) male and 557 (57.2%) female students. Anthropometric measurements were conducted to all students that were present (932 students), 41 students were absent. The number of students that fulfilled inclusion and exclusion criteria was 192 students. As many as 63 subjects were chosen by random sampling for lipid profile examination (Figure 1). The baseline characteristics of the subjects were shown in Tabel 1. Females were more than males. There were also more obese subjects with BMI >P95th compared to overweight subjects. The mean value for WtHR was 0.59±0.05 with a range between 0.50-0.75. According to Table 2, subjects with WtHR <0.6 was 34 (54%) and subjects with WHtR ≥0.6 was 29 (46%). BMI was significantly associated with WtHR ≥0.6 (P_{value} = 0.016). WtHR ≥0.6 was more common in females compared to males and was more common at the age of 15, and number of students with WtHR ≥0.6 were at BMI >P95th that is 52.8%, whereas in BMI between P85th–P95th, there were only one (10%) student.

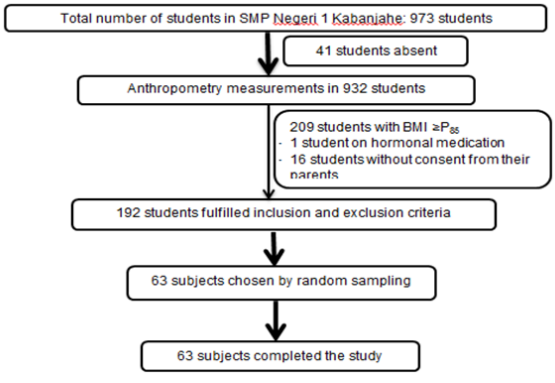

Figure 1. Subject flowchart

Table 1.Characteristics of the subjects

Characteristics	Number of subjects (n=63) (n,%)
Sex	
Male Female	23 (36.5) 40 (63.5)
Age (years)	
12 13 14 15	12 (19.0) 9 (14.3) 32 (50.8) 10 (15.9)
BMI (kg/m^2)	
85– 95 (overweight) > 95 (obese)	10 (15.9) 53 (84.1)

BMI: body mass index

Table 2. Characteristics of the subjects based on waist-to-height ratio

Characteristics	WtHR (n=63)		P*	OR (95% CI)
	< 0.6 (n=34)	≥ 0.6 (n=29)		
Sex				
Male	13 (56.5)	10 (43.5)	0.963	1.176 (0.419 – 3.301)
Female	21 (52.5)	19 (47.5)		
Age (year)				
12	6 (50.0)	6 (50.0)	0.080	
13	3 (33.3)	6 (66.7)		
14	22 (68.8)	10 (31.2)		
15	3 (30.0)	7 (70.0)		
BMI (kg/m^2)				
> 95th	25 (47.2)	28 (52.8)	0.016	0.095 (0.011 – 0.807)
85th – 95th	9 (90.0)	1 (10.0)		

*P : represent the association between the characteristics and WtHR ≥0.6

WtHR : waist to height ratio, BMI: body mass index, OR: odds ratio, CI: confidence interval

Table 3 Distribution of anthropometric variables

	Mean± Std. Deviation	Median	Mode
Body weight (kg)	71.61±11.30	68.40	64.40a
Height (cm)	1.55±0.08	1.54	1.49
BMI (kg/m^2)	29.73±3.40	29.01	27.39a
Waist circumference (cm)	91.62±8.24	90.00	100.00
WtHR	0.59±0.05	0.59	0.60

a: descriptive study with more than one mode
BMI: body mass index, WtHR: waist to height ratio

The mean values for total cholesterol, HDL, LDL and triglycerides were 175.44mg/dl, 51.27mg/dl, 114.40 mg/dl, and 122.75 mg/dl, respectively. Statistical analysis using chi square test to examine the relationship of WtHR value ≥0.6 and lipid profile did not show a significant association. Odds ratio were 1.689 (95% CI; 0.609–4.682) for total cholesterol, 1.841 (95% CI; 0.672–5.045) for LDL, 0.421 (95% CI; 0.136–1.310) for HDL, and 2.296 (95% CI;0.690–7.636) for triglycerides. Subjects with WtHR ≥0.6, 51.4% had elevated total cholesterol, 51.1% had elevated triglycerides, 52.9% had elevated LDL and 31,6% had decreased HDL.

Table 4. The relationship of WtHR with lipid profile

Characteristics	WtHR (n=63)		P*	OR
	< 0.6 (n=34) (n,%)	≥ 0.6 (n=29) (n,%)		(95% CI)
Total cholesterol (mg/dl)				
< 170	16 (61.5)	10 (38.5)	0.451	1.689 (0.609 – 4.682)
≥ 170	18 (48.6)	19 (51.4)		

LDL (mg/dl)				
< 110	18 (62.1)	11 (37.9)	0.348	1.841 (0.672 – 5.045)
≥ 110	16 (47.1)	18 (52.9)		
HDL (mg/dl)				
> 45	21 (47.7)	23 (52.3)	0.216	0.421 (0.136 – 1.310)
≤ 45	13 (68.4)	6 (31.6)		
Triglycerides (mg/dl)				
< 90	11(68.8)	5 (31.3)	0.279	2.296 (0.690-7.636)
≥ 90	23 (48.9)	24 (51.1)		

*P: expressed the relationship of lipid profile WHtR ≥0,6

WtHR: waist-to-height ratio, BMI: body mass index, OR: odds ratio, CI: confidence interval

DISCUSSION

Larsson, (1991) argued abdominal fat reserves, especially intraabdominal visceral adipose tissue are increasing because it is considered as the most dyslipidemic and atherogenic. Wajchenberg, (2000) suggest the main examination of abdominal visceral fat is imaging techniques that are costly and accompanied by adverse effect namely radiation, and there by requiring antropometric measurement that is easier, simpler, and more practical. (Larsson, 1991; Wajchenberg, 2000)

In this study, the number of overweight and obese adolescents were 13.5% and 8.9%, which is higher than the prevalence in Jakarta. According to Health Research and Development, Indonesian Minister of Health (2007), Karo Regency had the highest prevalence of overweight and obese population that was >15 years old (both sexes) at 32.4%, but the prevalence of obesity in adolescents in Karo Regency was still unknown.

Anthropometric measurements (weight, height, BMI) and total or central body fat (skinfold thickness, waist circumference) increased significantly in both sexes. However, WtHR remained constant which proved that WtHR value is stable during growth period and supported WtHR usage as a body fat percentage predictor. (Mokha, Srinivasan, & Dasmahapatra, 2010; Seidell, Perusse, & Despres, 2001; Nutrition and Metabolic Disorder Association, 2014). This finding supports our result that there were no significant differences in WtHR values based on age and sex (P_{value}>0.05). Based on gender, WtHR ≥0.6 were more commonly found in women compared to men, 47.5% (19) vs. 43.5% (10).

BMI was significantly related to WtHR value (P_{value} =0.016). A BMI increase will increase visceral and subcutaneous fat as well, but with different proportion that is affected by age. In students with BMI >P95th, we found 28 (52.8%) students with WtHR ≥0.6 and only 1 (10%) student in P85th–P95th group. The average BMI was 31.39±3.58 and 28.32 ± 2.55 for WtHR ≥0.6 and <0.6 groups respectively.

A study by Khoury, Manlhiot, & McCrindle, (2013) found on a group of 8–15 year old children reported that children the highest level of adipocity (WtHR ≥0.6 and BMI ≥P_{95}) were more likely to have an elevated level of non-HDL lipoproteins and approximately 32% would have metabolic syndrome. Increased adiposity was related to increased cardiometabolic risks in both genders, but it was more pronounced in males. (Khoury, Manlhiot, & McCrindle, 2013) This finding however, contradictory with ours, whereas WtHR ≥0.6 and lipid profile did not have a significant association. The proportion of adolescents with WtHR ≥0.6 that had abnormal lipid profile was considerable and the average values of each lipid profile was above normal references, but the mean value of HDL was still in the normal range.

CONCLUSION

The prevalence of overweight and obese students in SMP Negeri 1 Kabanjahe were 13.5% and 8.9% respectively. There is no statistically significant association found between WtHR and the lipid profile of overweight and obese adolescents in this study. However, considerable proportion of adolescents with WHtR ≥0.6 with lipid profile abnormalities was demonstrated on this study. The use of WtHR parameter as a screening tool in adolescents may improve clinicians' awareness to evaluate cardiometabolic risk factors, especially in overweight and obese adolescents. Public health message on the importance keeping your waist to less than half your height in children and adolescents may prevent long-term cardiometabolic risk factors because obesity tends to persist from adolescents until adulthood. The cutoff points for WtHR value from studies in different countries with different races are pretty diverse, so further studies on a larger sample that includes adolescents with normal BMI and WtHR <0.5 should be carried out.

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