



Prevalence of hypertension and its risk factors among obese adolescents in Yogyakarta, Indonesia

Neti Nurani^{1,2*}, Navilah Hidayati², Delvira Anggraini², Nurkharisma Kusumawardani², Retno Palupi-Baroto^{2,3}

¹Nutrition and Metabolic Disease Division, Department of Child Health Sardjito General Hospital, ²Faculty of Medicine, Public Health and Nursing Universitas Gadjah Mada, ³Division of Nephrology, Department of Child Health Sardjito General Hospital, Yogyakarta

ABSTRACT

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Obesity and overweight are considerable health problems with increasing prevalence among adolescents. In Indonesia, basic health research data from Riskesdas shows an increase in the prevalence of obesity in adolescents aged 13-15 y.o, from 2.6% in 2010 to 6.7% in 2013. This high prevalence of overweight and obesity is related to various factors. This study aimed to determine the factors associated with hypertension and obesity in adolescents. This study was conducted on an overweight population, obese, and super-obese adolescents aged 13-15 year in the Yogyakarta City, Indonesia. Demographic data included the history of breastfeeding, birth weight, gender, history of premature birth, lifestyle, and physical activity were gathered. Anthropometric data included the weight, height, and body mass index (BMI) were also measured and gathered. Hypertension was measured using a manual sphygmomanometer. The relationship was analyzed using Pearson chi-square and the risk value was demonstrated from the odds ratio (OR). A significant relationship between gender and diastolic hypertension was observed (OR= 2.4; 95%CI = 1.23 – 5.09; p < 0.021). A significant difference related to the number of boy subjects between the 2 groups of overweight and obesity was also observed. Compared with girls, boys had a higher risk of obesity (OR = 3.23). Other factors including breastfeeding, history of premature birth, low birth weight, and physical activity were not statistically significant between two groups in this study (p>0.05). In conclusion, there is a relationship between gender and diastolic hypertension incidence among obese adolescents. Boys are more at risk of obesity compared to girls.

ABSTRAK

Obesitas dan kegemukan merupakan masalah kesehatan yang prevalensinya semakin meningkat di kalangan remaja. Di Indonesia, data dari Riset Kesehatan Dasar (Riskesdas) menunjukkan peningkatan prevalensi obesitas pada remaja usia 13-15 tahun, dari 2,6% tahun 2010 menjadi 6,7% tahun 2013. Tingginya prevalensi kegemukan dan obesitas ini berkaitan dengan berbagai faktor. Penelitian ini bertujuan untuk mengkaji faktor-faktor yang berperan dalam terjadinya hipertensi dan obesitas pada remaja berusia 13-15 tahun. Penelitian ini dilakukan pada populasi remaja dengan berat badan berlebih, obesitas, dan obesitas super berusia 13-15 tahun di Kota Yogyakarta, Indonesia. Data demografi yang dikumpulkan meliputi riwayat menyusui, berat badan lahir, jenis kelamin, riwayat kelahiran prematur, gaya hidup, dan aktivitas fisik. Sedangkan data antropometri yang diukur adalah berat badan, tinggi badan, dan indeks masa tubuh (IMT). Hipertensi diukur menggunakan sphygmomanometer manual. Signifikansi hubungan diuji dengan menggunakan *Pearson chi-square* dan nilai risiko dilihat dari odds ratio (OR). Hasil penelitian menunjukkan adanya hubungan yang bermakna antara jenis kelamin dengan hipertensi diastolik (OR= 2,4; 95%CI = 1,23 – 5,09; p < 0,021).

Keywords:
hypertension;
risk factor;
overweight;
obesity;
adolescence;

Ada perbedaan bermakna (p -value = 0,01) terkait jumlah subjek anak laki-laki antara 2 kelompok obesitas dan kelebihan berat badan (p = 0.01). Anak laki-laki juga lebih berisiko mengalami obesitas dibandingkan anak perempuan (OR = 3.23). Faktor lain yaitu menyusui, riwayat kelahiran prematur, berat badan lahir rendah, dan aktivitas fisik tidak berbeda bermakna antara kedua kelompok (p >0,05). Dapat disimpulkan, ada hubungan antara jenis kelamin dan kejadian hipertensi diastolic di antara remaja dengan obesitas. Anak laki-laki lebih berisiko mengalami obesitas dibandingkan anak perempuan.

INTRODUCTION

Obesity is defined as an abnormal condition or excessive accumulation of fat in adipose tissue that can interfere with health.¹ According to the center for disease control and prevention, defining childhood obesity (2016), a person is classified as obese if the body mass index (BMI) examination results are above the 95th percentile, whereas it is said to be overweight if the BMI examination results are above the 85th percentile but less than the 95th percentile.²

Obesity and overweight are health problems with increasing prevalence. A study by De Onis *et al*,³ showed that globally the prevalence rate for obesity and overweight was 4.2% in 1990, then increased to 6.7% in 2010 and it is predicted to increase to 9.1% in 2020. In Indonesia, data from the basic health research (*Riskesdas*) showed an increase in the prevalence of obesity in adolescents aged 13-15 years, from 2.6% in 2010 to 6.7% in 2013.⁴ This increase was also found in the 16-18 years. group, from 4.1% in 2010 to 7.2% in 2013.⁴ There are 15 provinces in Indonesia that have obesity prevalence at the 13-15 y.o. that is above the national level, one of which is Yogyakarta.^{4,5}

According to the Ministry of Health of the Republic of Indonesia in 2012, the high prevalence of overweight and obesity is related to various factors. These factors are genetic and environmental factors, which include eating patterns that exceed portions, lifestyle, and lack of physical activity.⁶ Changes in lifestyle

and eating habits also greatly affect the occurrence of obesity, this can be seen from the many eating places that provide fast food such as burgers, pizza, hot dogs, and canned foods such as corned beef.⁷

In addition to these factors, there are other factors that thought to influence the occurrence of obesity.⁸⁻¹⁰ This study aimed to investigate the factors associated with hypertension and obesity in adolescents, specifically, those aged 13-15 years.

MATERIALS AND METHODS

Design and subjects

This study was conducted in a population of overweight, obesity and super-obesity adolescents aged 13-15 years in the city of Yogyakarta, Indonesia. Demographic data were collected using a questionnaire that was tested in the Pediatric Clinic at Dr. Sardjito General Hospital, Yogyakarta, Indonesia. Demographic data included the history of breastfeeding, birth weight, gender, history of premature birth, lifestyle, and physical activity were gathered.

Protocol of study

Anthropometric data included the weight, height and BMI were measured. Bodyweight was measured with a digital stampede scale and height was measured with a stadiometer. Finally, hypertension is measured using a manual sphygmomanometer.

Statistical analysis

This study uses analytic descriptive method, more specifically the cross section. The data obtained were processed in descriptive analysis and inferential statistics. In this study, the normality of the data was tested using Shapiro Wilk, the significance of the relationship was tested using Pearson chi-square and the risk value was seen from the odds ratio. A p value < 0.05 was considered to be significant.

RESULTS

Characteristics of the subject

This study subjects were taken from 9 Public Junior High Schools/PJHS (*Sekolah Menengan Pertama/SMP*) from provinces of Yogyakarta Special Region. The total numbers of subject were 127. Characteristics of the subject are attached in the following TABLE 1.

A total of 127 subjects consisted of 76 (59.8%) boy subjects and 51 (40.2%) girl subjects were involved in this study. A total of 76 (59.8%) subjects were 13 years old, 39 (30.7%) subjects were 14 years old and 12 (9.4%) subjects were 15 years old. Distributions of the data collection area were 6 (4.7%) samples taken from Kulon Progo, 37 (29.1%) from Sleman, 47 (37%) from Yogyakarta City, 22 (17.3%) from Bantul, and 15 (11.8%) Gunung Kidul. Distribution of schools samples were 6 (4.7%) samples from PJHS 2 Wates, 6 (4.7%) from PJHS 1 Gamping, 3 (2.4%) from PJHS 2 Gamping, 16 (12.6%) from PJHS 3, Depok, 12 (9.4%) from PJHS 5, Depok, 20 (15.7%) from PJHS 3, Yogyakarta, 27 (21.3%) from PJHS 15, Yogyakarta, 12 (9.4%) from PJHS 1, Jetis,

10 (7.9%) from PJHS 2, Banguntapan, 7 (5.5%) from PJHS 1, Nglipar, and 8 (6.3%) from MJHS 1, Wonosari.

Distribution of factors that influence obesity and overweight

The distribution of factors that influence obesity and overweight can be seen in the following TABLE 2.

TABLE 1. Subject characteristics

Characteristics	Total n (%)
Gender	
• Boys	76 (59.8)
• Girls	51 (40.2)
Age	
• 13 y.o.	76 (59.8)
• 14 y.o.	39 (30.7)
• 15 y.o.	12 (9.4)
Area distribution	
• Kulon Progo	6 (4.7)
• Sleman	37 (29.1)
• Yogyakarta City	47 (37)
• Bantul	22 (17.3)
• Gunung Kidul	15 (11.8)
School distribution	
• PJHS 2 Wates	6 (4.7)
• PJHS 1 Gamping	6 (4.7)
• PJHS 2 Gamping	3 (2.4)
• PJHS 3 Depok	16 (12.6)
• PJHS 5 Depok	12 (9.4)
• PJHS 3 Yogyakarta	20 (15.7)
• PJHS 15 Yogyakarta	27 (21.3)
• PJHS 1 Jetis	12 (9.4)
• PJHS 2 Banguntapan	10 (7.9)
• PJHS 1 Nglipar	7 (5.5)
• MJHS 1 Wonosari	8 (6.3)

PJHS: Public Junior High School; MJHS: Muhammadiyah Junior High School

TABLE 2. Distribution of factors affecting obesity and overweight

Risk factor	n (%)	Obese 36 (%)	Overweight 46 (%)	OR (95% CI)	p
Breastfeeding	79 (96.3)	35 (97.2)	44 (95.7)	0.62 (0.05 - 7.22)	1.00
Exclusive breastfeeding	51 (62.2)	23 (63.9)	28 (60.9)	0.87 (0.35 - 2.16)	0.78
Gender (boy)	44 (53.7)	25 (30.6)	19 (58.7)	3.23 (1.28 - 8.10)	0.01*
Premature birth	4 (4.9)	2 (5.6)	2 (4.3)	1.29 (0.17 - 9.66)	1.00
Birth weight < 2500 g	7 (8.5)	2 (28.6)	5 (71.4)	2.07 (0.37 - 11.36)	0.45
Physical activity < 90 min	20 (24.4)	8 (22.2)	12 (26.1)	1.23 (0.44 - 3.44)	0.16

*significant value, p < 0.05

Distribution of classification of BMI, incidence and classification of hypertension

Based on the classification of BMI/age, obesity had BMI with a standard deviation between +2 to +3 and super obesity had BMI with standard deviation of more than +3. There were 107 (84.3%) subjects were classified as obese and 20 (15.7%) subjects were classified as super obese.

Overall, 69 (54.3%) subjects had systolic hypertension, while 58 (45.7%) subjects did not have systolic

hypertension. Forty (31.5%) subjects had normal blood pressure, 18 (14.2%) subjects had pre-hypertension, 44 (34.6%) subjects had stage 1 hypertension, and 25 (19.7%) subjects had stage 2 hypertension. Of the 127 subjects, 74 (58.3%) subjects had hypertension and 53 (41.7%) subjects did not have hypertension. Regarding diastolic hypertension, 34 (26.8%) subjects had normal blood pressure, 19 (15%) subjects had pre-hypertension, 49 (38.6%) had stage 1 hypertension and 25 (19.7%) subjects had stage 2 diastolic hypertension.

TABLE 3. Frequency of data (n or %) regarding the amount of BMI classification per age, systolic hypertension and diastolic hypertension

Variables	Total (n=127)
Obesity	107 (84.3)
Super obesity	20 (15.7)
Systolic hypertension	69 (54.3)
Without systolic hypertension	58 (45.7)
Classification of systolic hypertension	
• Normal blood pressure	40 (31.5)
• Pre-hypertension	18 (14.2)
• Stage I hypertension	44 (34.6)
• Stage II hypertension	25 (19.7)
• Diastolic hypertension	74 (58.3)
• Without diastolic hypertension	53 (41.7)
Classification of diastolic hypertension	
• Normal blood pressure	34 (26.8)
• Pre-hypertension	19 (15)
• Stage I hypertension	49 (38.6)
• Stage II hypertension	25 (19.7)

There were 69 (54.3%) subjects who had systolic hypertension while 58 (45.7%) subjects did not experience systolic hypertension. There were 40 (31.5%) subjects with normal blood pressure, 18 (14.2%) subjects with prehypertension, 44 (34.6%) subjects with level 1 hypertension and 25 (19.7%) subjects with level 2 hypertension. Of 127 subjects, 74 (58.3%) subjects had hypertension and 53 (41.7%) subjects did not have hypertension. There were 34 (26.8%) subjects with normal blood pressure, 19 (15%) subjects with prehypertension, 49 (38.6%) subjects with

level 1 hypertension and 25 (19.7%) subjects with level 2 hypertension.

Relationship between BMI, age and gender with hypertension in adolescent obesity

A significant relationship between gender and diastolic hypertension was observed in this study (OR= 2.4; 95%CI = 1.23 – 5.09; $p < 0.021$) as shown in TABLE 4. Super obesity was associated with diastolic hypertension (OR=3.38; 95% CI=1.06-10.78).

TABLE 4. Relationship of BMI, age and gender with hypertension in adolescents obesity

Variables	Systolic hypertension		Diastolic hypertension	
	OR (95% CI)	p	OR (95% CI)	p
Super obesity	1.69 (0.63 - 4.57)	0.29	3.38 (1.06 - 10.78)	0.032*
Obesity	1		1	
13 y.o.	1.11 (0.33 - 3.76)	0.87	2.15 (0.62 - 7.39)	0.23
14 y.o.	1.44 (0.39-5.27)	0.58	2.01 (0.54 - 7.48)	0.29
15 y.o.	1		1	
Gender (girl)	1.78 (0.86 - 3.66)	0.12	2.4 (1.13 - 5.09)	0.021*

DISCUSSION

Factors affecting overweight and obesity

Gender

This study showed that there is a significant difference of the number of boy subjects between the overweight and obesity groups ($p=0.01$). Boys are also more at risk of obesity than girls (OR = 3.23). This is consistent with the study conducted by Albert *et al.*¹¹ which reported that boys are significantly more at risk for obesity or overweight than girls. This might be because boys watch TV and play video games more often than girls, leading to reduced physical

activity and altered eating patterns, with their intake not in balance with the commensurate activity.^{11,12}

Breastfeeding and exclusive breastfeeding

The study showed that there was no significant difference between the two groups (overweight or obese) in the number of adolescents who were breastfed as infants ($p=1.00$). The same applies to the number of children who received exclusive breastfeeding between the 2 study groups ($p = 0.78$). Although not statistically significant, breastfeeding and exclusive breastfeeding decreased the risk of obesity in children (OR = 0.62 and 0.87 respectively). Von Kriess *et al.*¹³ showed that an increased duration of

breastfeeding decreases the incidence of obesity. Similarly, Uwaezuoke *et al.*¹⁴ found that a shorter duration of breastfeeding led to an increased risk of obesity. Being breastfed as an infant can decrease the occurrence of obesity in adolescence and adulthood. The mechanism by which this occurs is thought to be related to the hormones leptin and insulin. According to Yan *et al.*¹⁵ breast milk contains calories and nutrients in moderate portion. The milk composition can change over the course of time and influenced by the mother's diet.

Saputri¹⁶ and Butte *et al.*¹⁷ documented that obesity in adolescence can be avoided by exclusive breastfeeding. Providing exclusive breastfeeding provides a very important role in preventing obesity.^{16,17} Breastfed infants can adjust their amount of intake, which balances their leptin and insulin levels. Leptin is a hormone that plays a role in regulating energy balance. If there is an excess amount of energy stored in the body, the amount of leptin will rise, thus increasing the occurrence of obesity. Leptin works by inhibiting the anabolism and catabolism pathways, whose end result is to reduce food intake and increase energy expenditure. In children who are given formula milk, the endocrine system is stimulated to secrete higher amounts of insulin and growth factors, which increase body fat levels. Insulin levels are higher in children who are given formula milk, and this can cause the formation of fat tissue in the body.^{15,18,19}

History of prematurity

In this study, there were no significant differences of children born prematurely between the overweight or obese groups ($p=1.00$). However, a history of prematurity can increase risk factors for obesity in children ($OR = 1.29$). This is in accordance with

research done by Vasylyeva *et al.*²⁰ which reported children with premature birth can lead to obesity in adolescence. The postnatal period is a critical period where nutrition greatly influences life. If good nutrition not given during this time, it can affect metabolic disorders and can lead to obesity. Babies who are born prematurely are typically given supplemental nutrition to ensure proper growth and development. As they grow, these children might be more accustomed to eating food in larger quantities, which can lead to obesity.²¹

According to Jornayvaz *et al.*²¹ other factors that can lead to later obesity in premature babies are related to the hormone leptin. Leptin is produced by adipose tissue, and this hormone plays a role in obesity and can be elevated in those with type 2 diabetes. Children who were born prematurely can have increased leptin levels during a period of adjustment while the body catches up on growth, and these increased levels can result in leptin resistance.²¹

History of low birth weight (<2500 g)

In this study there were no significant differences of birth weight between the *overweight* and obese groups ($p = 0.45$). However, a history of low birth weight can increase risk factors for obesity in children ($OR=2.07$). One of the factors that can affect birth weight is the lack of nutrition during pregnancy. Babies born with lower nutritional levels will need more nutrition at birth to catch up and can cause the body to store more fat reserves, triggering later obesity.

This is also in accordance with study conducted by Kato *et al.*²² which reported that birth weights of less than 2500 g can lead to overweight or obesity. According to Meyre *et al.*²³ the genetic role of modulating insulin can contribute to fetal growth and obesity, and that the genetic role is also involved in obesity in children.

Physical activity

The study was found that children with moderate-heavy physical activity duration <90 min were more at risk of obesity compared with duration >90 min (OR=1.23). This is consistent with the study conducted by Teleford²⁴ which reported lack of physical activity can cause obesity. There is an imbalance between the intakes of food consumed with the energy expended. Another factor related to low physical activity that causes obesity are family income and nutritional intake. Moderate-to-high income family can lead to greater risk of obesity because of the higher rate of low physical activity.^{25,26}

Obesity and occurrence of hypertension

There was an relationship between gender and the incidence of diastolic hypertension, with obese adolescent girls at higher risk of suffering from diastolic hypertension compared to obese boys (OR= 2.4; 95%CI = 1.23 – 5.09; $p < 0.021$). In addition, BMI per age was associated with a higher risks of diastolic hypertension incidence (OR= 3.4; 95%CI = 1.06 – 10.78; $p < 0.032$). In our study, super obesity was significantly associated with diastolic hypertension; however this should be interpreted with cautious as there are a few subjects involved hence resulting a wide range of confidence interval.

This is consistent with previous studies that reported the value of systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure were higher with an increase in body mass index, but not with weight gain.²⁷⁻²⁹ Das *et al.*³⁰ reported that an increase in age and BMI status increases the prevalence of hypertension in boys and girls. Al-Bachir *et al.*³¹ reported that obese adolescents have more abdominal

fat associated with alteration factors affecting cardiometabolic such as an increase in LDL, triglycerides and blood pressure which in turn will lead to the risk of cardiovascular disease.

CONCLUSION

In conclusion, there is a relationship between gender and diastolic hypertension among obese adolescents. Moreover, boys are more at risk of obesity than girls. Further studies are necessary to investigate the relationship between the suspected factors and hypertension such as breastfeeding, history of premature birth, low birth weight, and physical activity.

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