CHAPTER IV

RESULT AND DISCUSSION

A. Description of Research Location

According to Abadi (2007) SMA Muhammadiyah 3 Yogyakarta was built on August 5th 1953. It consisted of two units, unit I was placed in KP.Tendean Street of Yogyakarta and unit II was placed in Wates Kadipiro Street of Yogyakarta. It was known as SMA MUGA. Its slogan was "Subulussalam" which means the way to safety.

As a part of Departemen Pendidikan which was covered under Yayasan Muhammadiyah, especially Majelis Dikdasmen Kota Yogyakarta, this school had vision as "*Bermintaq*, Educated and Superior In Quality". *Bermintaq* means as a guideline for schools in educating their students as Luqman educate his children (Abadi, 2008).

According to secondary data from administrator of SMA Muhammadiyah 3 Yogyakarta (2010), currently SMA Muhammadiyah 3 Yogyakarta had 720 students. The students had been divided into seven classes in 10th grade, and 6 classes in 11th grade, and 7 classes in 12th grade. It had 50 teachers, 20 staffs, and 4 medical staffs

A. Result

1. Characteristics of Respondents

a. Characteristics of Respondents based on Gender

Table 4.1. Characteristics of Research Respondents based on gender among Overweight Students in SMA Muhammadiyah 3 Yogyakarta, 2010

No.	Gender	Frequency	%
1.	Female	9	30%
2.	Male	21	70%
	Total	30	100%

Source: *Primary data (2010)*

Table 4.1. described the characteristic of respondents based on gender. The most of respondents of this research were male (70%), while female were only 30%.

b. Characteristics of Respondent based on Age, Systolic and Diastolic Blood Pressure

Table 4.2. Characteristics of Research Respondents based Age, Systolic and Diastolic Blood Pressure among Overweight Students in SMA Muhammadiyah 3 Yogyakarta, 2010

No.	Characteristics of Respondents	Frequency	%	Mean
1.	**Age**			
	15 years old	3	10%	16
	16 years old	14	47%	years
	17 years old	13	43%	old
	Total	30	100%	
2.	**Systolic Blood Pressure**			
	110 mmHg	2	7%	128
	120 mmHg	9	30%	mmHg
	130 mmHg	12	40%	
	140 mmHg	7	23%	
	Total	30	100%	
3.	**Diastolic Blood Pressure**			
	80 mmHg	8	27%	89
	90 mmHg	16	53%	mmHg
	100mmHg	6	20%	
	Total	30	100%	

Table 4.2 showed the characteristics of respondents based on age, systolic blood pressure, diastolic blood pressure. Mean of age was 16 years old, mean of systolic blood pressure was 128 mmHg, and mean of diastolic blood pressure was 89 mmHg.

Mostly, age of research respondents were 16 years of age (47%). It was followed by respondents aged 17 years old 43%, and the least was respondents aged 15 years old (10%).

The most frequent of systolic blood pressure level among research respondents was 130 mmHg (40%), and the least frequent of systolic blood pressure was 110 mmHg (7%). Percentage of systolic blood pressure level as 120 mmHg was 30% and 140 mmHg was 23%.

The most frequent of diastolic blood pressure level among research respondents was 90 mmHg (53%), and the least frequent of diastolic blood pressure was 100 mmHg (20%). Percentage of diastolic blood pressure level

c. Characteristics of Respondent based on Height, Weight, BMI, and Waist Circumference

Table 4.3. Characteristics of Respondent based on Height, Weight, BMI, and Waist Circumference among Overweight Students in SMA Muhammadiyah 3 Yogyakarta, 2010

No.	Characteristics of Respondents	Frequency	%	Mean
1.	**Weight**			
	67-76 kg	4	13%	86
	77-86 kg	13	43%	
	87-96 kg	7	23%	
	97-106 kg	5	17%	
	110 kg	1	3%	
	Total	30	100%	
2.	**Height**			
	150-159 cm	7	23%	164
	160-169 cm	17	27%	
	170-179 cm	5	17%	
	181 cm	1	3%	
	Total	30	100%	
3.	**BMI**			
	29-31 kg/m^2	18	60%	32
	32-34 kg/m^2	7	23%	
	35-37 kg/m^2	3	10%	
	38-40 kg/m^2	2	7%	
	Total	30	100%	
4..	**Waist Circumference**			
	79-88 cm	4	13%	98
	89-98 cm	12	40%	
	99-108 cm	9	30%	
	109-118 cm	4	13%	
	120 cm	1	3%	
	Total	30	100%	

Source: *Primary data (2010)*

Table 4.2 showed the characteristics of respondents based on weight, height, BMI, and waist circumference. Mean of weight was 86 kg, mean of

height is 164 cm, mean of BMI was 32 kg/m^2, and mean of waist circumference was 98 cm.

Mostly, weight of research respondents were at range of 77-86 kg (43%), and the least frequent of weight of research respondent was 110 kg (3%). There were 12% of research respondents who weighted at range of 67-76 kg, 7% of research respondents who weighted at range of 87-98, and 5% of research respondents who weighted at range of 77-106 kg.

The most frequent of body height of research respondents were at range of 160-169 cm (27%), and the least frequent of body height of research respondent was 181 cm (3%). There were 7% of respondents who heighted at range of 150-159 cm, and 5% of respondents who heighted at range of 170-179 cm.

According to BMI level, the most frequent level of BMI were at range of 29-31 kg/m^2 (60%), and the least frequent of BMI of research respondents were at range of 38-40 kg/m^2 (7%). There were 23% of research respondents who had BMI as 32-34 kg/m^2 and 10% of research respondents who had BMI as 35-37 kg/m^2.

The most frequent of waist circumference level of research respondents were at range of 89-98 cm (40%), and the least frequent of waist circumference level of research respondents was 120 cm (3%). There were 13% of research respondents who had waist circumference as at range of 79-88 cm, 30% of research respondents who had waist circumference as at range

of 99-108 cm, and 13% of research respondents who had waist circumference as at range of 109-118 cm.

2. Correlation among Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure

Table 4.4. Correlation among Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure of Overweight Students in SMA Muhammadiyah 3 Yogyakarta, 2010

Blood Pressure	Waist Circumference	
	Correlation Coefficient (r)	p
Systolic Blood Pressure	.573	.001
Diastolic Blood Pressure	.468	.009

Source: *Primary data (2010)*

The analysis showed waist circumference had a positive and significant correlation with systolic blood pressure ($p = .001$; $r = .573$) and diastolic blood pressure ($p = .009$; $r = .468$).

3. Correlation among Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure among Overweight Male Students

Table 4.5. Correlation among Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure of Overweight Male Students in SMA Muhammadiyah 3 Yogyakarta, 2010

Blood Pressure	Waist Circumference	
	Correlation Coefficient (r)	p
Systolic Blood Pressure	.658	.001
Diastolic Blood Pressure	.308	.174

The analysis for correlation between waist circumference and blood pressure among male students showed that waist circumference had a positive and significant correlation with systolic blood pressure (p = .001 ; r = .658). However, waist circumference had no significant correlation with diastolic blood pressure (p = .174 ; r = .308).

4. Correlation among Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure of Overweight Female Students

Table 4.6. Correlation among Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure of Overweight Female Students in SMA Muhammadiyah 3 Yogyakarta, 2010

Blood Pressure	Waist Circumference	
	Correlation Coefficient (r)	p
Systolic Blood Pressure	.142	.716
Diastolic Blood Pressure	.552	.123

Source: *Primary data (2010).*

The analysis for correlation between waist circumference and blood pressure among female students showed that waist circumference had no significant correlation with both systolic blood pressure (p = .716 ; r = 142) and diastolic blood pressure (p = .123; r = .552)

C. Discussion

1. Characteristics of Respondents

a. Gender and Age

Characteristics of respondents based on gender were dominated by male (70%), and based on age were dominated by students aged 16 years old (47%). It was followed by students aged 17 years old (43%), and 15 years old (10%).

Students aged 15 to 17 years old were classified to secondary high school students or middle adolescents (Depdiknas, 2010), which is a period of a spurt of physical growth (WHO, 2005). Adolescent in this age often feel hungry and usually eat a large quantity of food for both boys and girls. They usually do not pay much attention to the nutritional value of their diet (Guyton and Hall, 2006). These probably influence them for being overweight as they became older.

Gender and age were very useful in determining overweight status of students because the students are adolescents. They were also useful in determining the status of blood pressure value and waist circumference level.

b. Body Height and Weight

Mostly, weight of research respondents were at range of 77-86 kg (43%), and the least frequent of weight of research respondent was 110 kg (3%). The most frequent of body height of research respondents were at

range of 160-169 cm (27%), and the least frequent of body height of research respondent was 181 cm (3%).

Characteristics of body height and weight were useful to determine level of BMI. Mean of height of respondents was 164 cm and mean of weight of respondents was 86 kg were classified the students to be overweight because from the calculation of BMI value, it was found the BMI values was 32 kg/m^2.

Body height was also useful to determine the level of blood pressure for both male and female. Body height percentile chart was made to determine the level of blood pressure for adolescents. Mean of height was 5^{th} percentile when the level of height in centimeters was compared to age based on the stature-for-age percentile.

c. BMI

Characteristics of respondents based on BMI were dominated by BMI value as 29-31 kg/m^2 (60%). These criteria put the students into overweight if the BMI values were compared to BMI-for-age percentile charts for both male and female, because the result of this comparison showed that BMI of students is more than or equal to 95^{th} percentile of age.

Considering to the characteristics of adolescents, overweight among students in SMA Muhammadiyah 3 Yogyakarta probably caused by overeating. Overeating is a behavior that begins for many during adolescence (Ackard, 2003). The students of SMA Muhammadiyah 3 Yogyakarta were surrounded by many food shops providing many snacks and meal which

contribute to overeating. Other factors which contribute to overweight in students, such as genetic factors, molecular and metabolic factors, diseases, and psychological factors were not being investigated during research.

d. Systolic Blood Pressure

Characteristics of respondents based on systolic blood pressure showed that the levels of blood pressure vary from 110 mmHg to 140 mmHg. With systolic blood pressure level as 110 mmHg, the students seems to have normal value of systolic blood pressure (less than 90^{th} percentile) when compared to height percentile and age. However, when the level of systolic blood pressure rose to be 140 mmHg, the students seem to have high level of systolic blood pressure when compared to age and height percentiles.

High level of systolic blood pressure means that there was a high production of pressure when left ventricle contracts and pushes blood into the aorta (Waugh and Grant, 2006). High systolic blood pressure in adolescents was commonly caused by a definite cause (Pierce at al., 2007).

Factors that seem to contribute to primary hypertension in adults were possibly in children, such as hereditary cause, high blood cholesterol levels, being overweight, inactivity, and smoking (Porth and Matfin, 2009). In this research, high blood pressure among respondents was probably caused by all of those factors, except smoking because smoking had been controlled during research. Students who are smoking were not participated in this research.

Mostly systolic blood pressure of students was 130 mmHg. If this value was compared to age and height percentile, it was found that both male and female students had high-normal level of systolic blood pressure ($\geq 90^{th}$ and $< 95^{th}$ percentile). The causes of this level of blood pressure were same to causes of hypertension in respondents. High-normal blood pressure is considered to pre-hypertension. Pre-hypertension or high-normal hypertension associated with an increased risk of cardiovascular disease (Vasan, at.al., 2001).

e. Diastolic Blood Pressure

Characteristics of respondents based on diastolic blood pressure showed that the levels of blood pressure vary from 80 mmHg to 100mmHg. With diastolic blood pressure level as 80 mmHg, the students seems to have high-normal value of diastolic blood pressure ($\geq 90^{th}$ and $< 95^{th}$ percentile) when compared to height percentile and age. However, when the level of diastolic blood pressure rose to be 100 mmHg, the students seem to have high level of diastolic blood pressure when compared to age and height percentiles ($\geq 95^{th}$ percentile).

High level of diastolic blood pressure means that there was a high production of pressure within the arteries when complete cardiac diastole occurs and the heart is resting following the ejection of the blood (Waugh and Grant, 2006). Cause of this condition were similar to the causes of increasing systolic blood pressure include hereditary cause, high blood cholesterol levels, being overweight, inactivity, and smoking (Porth and Matfin, 2009).

f. Waist Circumference

Characteristics of respondents based on waist circumference showed that the levels of waist circumference vary from 79 cm to 120 cm. With waist circumference level as 79 cm, the students seems to have normal level of waist circumference (<90th percentile) when compared to age percentile. However, when the level of waist circumference rose to be 120 cm, the students seem to have high level of waist circumference when compared to age percentiles (≥ 90th percentile).

The most frequent waist circumference level among research respondents were at range of 89-98 cm (40%). This means that mostly, students had a high level of waist circumference when compared to age percentiles (≥90th percentile).

Waist circumference described fat distribution all over body. Generally, fat distribution is influenced by age, genetic inheritance, race, but to a greater extent by gender-specific hormones (Ciokan, 2010). It described fat distribution in abdominal area. Higher waist circumference means high level of fats accumulations in abdominal area. High level of waist circumference among overweight students, as in adult, relates better with visceral adipose tissue and is a better predictor of cardiovascular disease (Okosun, at al., 2009).

2. Correlation between Waist Circumference and Blood Pressure

The result of this study showed that when waist circumference compared to blood pressure values of the students, there was a significant correlation for both

systolic blood pressure (p = 0.001 ; r = 0.573), and diastolic blood pressure (p = 0.009 ; r = 0.468) making the null hypothesis is not accepted. However, when the correlation was done based on gender, it showed that there is significant and positive correlation between waist circumference and systolic blood pressure only in male students (p= 0.001 ; r= 0.658), not in female student (p= 0.716; r= 0.142). While diastolic blood pressure had no significant correlation to waist circumference in both male (r= 0.174; p= 0.308) and female students (p= 0.123; r= 0.552).

According to Dahlan (2004), the power of coefficient correlation (r) was classified into very weak (0.000 to 0.199), weak (0.200 to 0.399), moderate (0.400 to 0.599), strong (0.600 to 0.799), and very strong (0.800 to 1.000). This determines the power of correlation between waist circumference and blood pressure in this research. Correlation between waist circumference and systolic blood pressure was categorized into moderate significant correlation (r = 0.573), waist circumference and diastolic correlation was also categorized into moderate significant correlation (r = 0.468).

On overall the research showed that there is a positive correlation between waist circumference and blood pressure values among students. These findings coincides with that of Sung at al. (2007) who found the high correlation of waist circumference had a high correlation with systolic blood pressure in Chinese children. Research conducted by Guimaraes at al. (2008) also found that body mass index and waist circumference values have a strong influence on blood

pressure values in adolescents. High systolic blood pressure and diastolic blood pressure were 3.9 and 3.4 times more frequent among boys and 2.2 to 2.0 times more frequent among girls with waist circumference more than 75th percentile.

Huerta (2009) described the levels of blood pressure and prevalence of high blood pressure was higher in overweight and obese children and adolescents. In both genders, the prevalence of systolic blood pressure and diastolic blood pressure increased directly correlated with increments in age, body mass index and waist circumference, although prevalence and odd ratios of high blood pressure were higher in individuals with increased waist circumference in comparison to body mass index.

Overweight is known to be a major risk factor for many diseases such as cardiovascular disease. According National Heart, Lung, and Blood Institute (2003), excessive weight commonly is associated with hypertension. Weight reduction of as little as 4.5 kg can produce a decrease in blood pressure in a large portion of overweight people with hypertension. However, it has been suggested that fat distribution might be a more critical indicator of hypertension risk than actual weight (Porth and Matfin, 2009).

Central obesity described excess fat accumulation in abdominal region both subcutaneous abdominal adipose tissue and visceral fat (intra-abdominal adipose tissue). One of the characteristics of visceral fat is the release of adipokines (such as TNF-α and adiponectin) and fatty acids directly to the liver before entering the systemic circulation, having potentially greater impact on hepatic function (Porth

and Matfin, 2009). Higher level of these adipokines and circulating free fatty acids in overweight persons are thought to be associated with many of the adverse effects of obesity.

Research conducted by Wang at al. (2008) explained the correlation between free fatty acid to alteration of blood pressure. This research compared fasting serum free fatty acid composition between essential hypertension patients and nonhypertensive subjects and found that essential hypertension patients had marked alteration in fasting serum free fatty acid composition.

These findings were strengthened by a research conducted by Azekoshi at al. (2010) that explained the effect of free fatty acids to increasing angiotensin II activation. This research found that increased free fatty acid level significantly enhanced angiotensin II in human mononuclear and polymorphonuclear cells. Free fatty acid caused angiotensin II activation and impaired endothelial function.

Furthermore, a research conducted by Venogupal (2008) explained that presence of fat accumulation in abdominal region induces sympathetic nerve system in maintaining sodium retention. On average, hypertension is salt-sensitive in overweight patient therefore high sodium retention in overweight patient with abdominal obesity results in increasing blood pressure.

In conclusion, abdominal fat accumulations are thought to induce altered blood pressure. Free fatty acids, cytokines, and leptin hormone are thought to be responsible in altering blood pressure. Finding of these researches proved that distribution of body fat contribute to altered blood pressure. The development of

CT scan and MRI may leads to determine the differences between visceral and subcutaneous fat. This was golden standard in measuring visceral fat (Wajchenberg, 2000).

Overweight-related metabolic abnormalities and impairment of cardiovascular function may be present even at young age and progress asymptomatically for decades before clinical manifestations set in. It is conceivable that these early abnormalities found in young overweight subjects might facilitate the future development of hypertension independently of other traditional risk factors (Cassidy at al., 2005).

Waist circumference measurement was very useful to determine fat distribution in overweight and obese person. The higher level of waist circumference described higher fat accumulation in abdominal region and result in higher risk for altering blood pressure