The Correlation Between Body Fat Distribution and Insulin Resistance in Elderly

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ABSTRACT

Aim: to find the correlation between total body fat, truncal subcutaneous fat, peripheral subcutaneous fat, waist circumference and insulin resistance in elderly

Methods: a cross sectional study was conducted in patients aged 60 years or more who visited the Geriatric Outpatient Clinic at Department of Internal Medicine, Cipto Mangunkusumo National Central General Hospital, Jakarta. Subcutaneous fat thickness was measured by using caliper at 5 different sites. Truncal subcutaneous fat was measured at subscapular, suprailiaca and abdomen; whereas peripheral subcutaneous fat was measured at tricep and thigh region. Total body fat was assessed by using Bioelectrical Impedance Analysis. Index of insulin resistance was measured by using HOMA-IR.

Results: from November 2008 to January 2009, there were 55 elderly subjects who fulfilled criteria. There were significant correlations between HOMA-IR and percentage of total body fat (r=0.318; p=0.018), truncal subcutaneous fat (r=0.347; p=0.01), peripheral subcutaneous fat (r=0.296; p=0.028), and waist circumference as index of visceral fat (r=0.361; p=0.007). Other results included our finding on the correlation between BMI and percentage of total body fat (r=0.8; p=0.000), truncal subcutaneous fat (r=0.844; p=0.000), peripheral subcutaneous fat (r=0.706; p=0.000), and waist circumference (r=0.874; p=0.000). There were tendencies of decreasing body fat distribution, BMI and HOMA-IR along with increasing age. Moreover, there was also a tendency of increasing HOMA-IR with increasing BMI.

Conclusion: this study showed a positive correlation between percentage of total body fat, truncal subcutaneous fat, peripheral subcutaneous fat, waist circumference and insulin resistance in elderly.

Key words: body fat distribution, insulin resistance, elderly.

INTRODUCTION

Epidemiological studies show that glucose metabolism disorder, hypertension, obesity, and dyslipidemia are conditions underlying and are associated with cardiovascular and cerebrovascular disease, as well as type 2 diabetes mellitus. Up to now, the prevalence of those diseases has remained high in elderly. Such diseases are the risk factors of morbidity and mortality in elderly. Either the disease itself or the underlying risk factors are known to be associated with insulin resistance, which has become an important key of metabolic syndrome.¹⁻¹¹

Insulin resistance starts to increase once a person reaches the age of 50 years. Several factors are known to be responsible for initiating insulin resistance in the elderly. Those factors are alterations of body composition including decreased muscle mass and increased body fat, especially the visceral fat; reduced physical activity; hormonal alteration; high carbohydrate intake; oxidative stress; diminished mitochondria function; and resistance towards leptin effect.¹²⁻¹⁹ Studies show that insulin resistance in elderly ranges from 35% to 50%.¹⁷⁻²⁰

In other studies, obesity as a metabolic syndrome is also found to be increasing along with increasing age. Obesity is a strong predictor on the development of diabetes mellitus.^{6,9,21} Studies in two centers in Indonesia showed that the prevalence of metabolic syndrome and obesity were 24.6% and 44.9%- 48.97% respectively, where the prevalence of metabolic syndrome was found to be increasing (54.2%- 57.6%) in the subjects aged above 55 years.²²⁻²⁵ Body Mass Index (BMI) and central obesity have positive correlation with insulin resistance.²⁵⁻²⁷ Furthermore, several studies in adults and elderly population show a positive correlation between body fat, visceral fat, subcutaneous fat and insulin resistance; however, there is still interstudy differences on correlation between peripheral subcutaneous fat and insulin resistance.²⁶⁻³¹

Different ethnics have different body composition and body fat distribution. For matching age, gender, and BMI, the Asian have more total fat mass and truncal subcutaneous fat than Caucasian ethnic.³¹⁻³⁵ The world's elderly population is increasing; including in Indonesia.³⁶ Such a fact affects increasing prevalence of diseases which are associated with insulin resistance. By knowing the fact that fat mass and obesity increased in the elderly, it is then necessary to recognize further the association between body fat distribution in elderly and insulin resistance. There are several facts that generate interest for the researchers to study this issue including the difference of body composition characteristics in elderly and adult population; the difference of body composition characteristics and body fat distribution between Asian and Caucasian populations; the interstudy differences on the role of fat distribution to insulin resistance; and there has not been any study on the association of body fat distribution, especially subcutaneous fat, and total fat to insulin resistance in Indonesian elderly population.

The aim of this study was to evaluate the correlation between total body fat, truncal subcutaneous fat, peripheral subcutaneous fat, waist circumference and insulin resistance in elderly populations. We expect that the results of the study can provide additional information for better understanding on the correlation between body fat and insulin resistance, and can be a reference for further studies on insulin resistance, especially in elderly population.

METHODS

This was a cross-sectional study conducted from November 2008 to January 2009 at the Geriatric Outpatient Clinic, Department of Internal Medicine, Cipto Mangunkusumo General Hospital.

The accessible population of this study included elderly patients who had their treatment at the Geriatric Outpatient Clinic, Department of Internal Medicine, Cipto Mangunkusumo Hospital. Sample subjects were the accessible population that fulfilled study criteria and were recruited using consecutive sampling technique.

The inclusion criteria were patients aged 60 years old or more and were willing to participate in the study. The exclusion criteria were patients with congestive heart failure functional class III-IV, pneumonia, acute exacerbation of COPD, receiving one or more insulin medication and or oral hypoglycemic agents.

All subjects had complete data, from medical

history, physical examination to medical record. Data about their name, age, height, weight, waist circumference, skin fold thickness (subcutaneous fat) measured by using Holtain skinfold caliper at 5 sites, i.e. subscapular, suprailiac, abdomen, triceps, and thigh, and also total fat measured by using Bioelectrical Impedance Analysis (BIA) instrument from Maltron (BioScan 916) was obtained. Subjects had to have fasting period for at least 10 hours and had to return on the next morning for fasting blood glucose level test and fasting insulin test for HOMA-IR test.

The study result data were recorded on the research form, also all of collecting and data analyses collected were performed by using SPSS 16.0 for windows. Descriptive data was illustrated on text, tables, and figures. Univariate analysis was performed by calculating mean, median, standard deviation, minimum and maximum interval. The correlation between two qualitative variables was evaluated by using Pearson correlation method when the normality requirement was fulfilled, or evaluated by using Spearman correlation when the normality requirement was not fulfilled. We considered a value of p < 0.05 as significant.

RESULTS

Subject Characteristics

There were 55 subjects participating in this study. The age distribution ranged from 62 years to 90 years, mean 72.4 years (SD 6.35). The majority of the subjects were female (65.5%). Moreover, the study result revealed that the mean of BMI was 22.59 kg/m² (SD 4.37), mean of total fat was 17.36 kg (SD 8.41), mean of total fat percentage was 28.64% (SD 9.53), mean of truncal subcutaneous fat was 59.69 mm (SD 1.85), median of peripheral subcutaneous fat was 37.5 mm (SD 1.11), mean of waist circumference was 87.21 cm (SD 1.06), and median of HOMA-IR was 1.53. The characteristics of the study subjects are shown on **Table 1**.

According to age group, the highest score for mean body fat distribution, BMI, and HOMA-IR fell on the age group of 60-69 years. On this age group, the mean of total fat percentage was 29.53% (SD 8.67), mean of total fat was 18.33 kg (SD 6.83), mean of truncal subcutaneous fat was 66.16 mm (SD 1.37), mean of peripheral subcutaneous fat was 38.93 mm (SD 7.86), mean of waist circumference was 88.88 cm (SD 9.21), mean of BMI was 23.68 kg/m² (SD 2.91), and mean of HOMA-IR was 2.08 (SD 1.2). Body fat distribution, BMI, and HOMA-IR according to age groups are shown on **Table 2**.

Variables	Ν	%	Mean (SD)	Median	Interval
Age			72.4 (6.35)		62-90
Gender					
Males	19	35.5			
Females	36	65.5			
Height (cm)				159.28	148.82-177.12
Weight (cm)			58.24 (1.26)		34.1-86.6
BMI (kg/m2)			22.67 (4.37)		14.02-32.84
Total fat (%)			28.64 (9.53)		14.4-50.7
Total fat (kg)			17.36 (8.41)		6-41.9
Subscapular subcutaneous fat (mm)*				15.8	5.9-2.9
Suprailliac subcutaneous fat (mm)			18.03 (5.81)		6-29
Abdomen subcutaneous			59.69 (1.85)		1-95
Triceps subcutaneous fat (mm)				19.5	4-32
Thigh subcutaneous fat (mm)			18.03 (5.81)		6-29
Truncal subcutaneous fat (mm)			56.69 (1.85)		18-95
Peripheral subcutaneous fat (mm)*				37.5	11.2-58.8
Waist circumference (cm)			87.21 (1.06)		63-108
Fasting blood glucose (mg/dL)*				93	83-135
Fasting insulin (pmol/L)*				6.6	2.3-18.1
HOMA-IR*				1.52	0.53-4.46

* abnormal distribution

Table 2. Body fat distribution, BMI, and HOMA-IR according to age groups

Variables	60-69 years	70-79 years	<u>></u> 80 years
	(n=19)	(n=26)	(n=10)
Total fat (%)*	29.53 (8.67)	28.7 (9.83)	26.79 (1.1)
Total fat (kg)*	18.33 (6.83)	17.36 (9.12)	15.5 (9.7)
Truncal	66.16 (1.37)	58.57 (1.88)	50.32 (2.24)
(mm)* Peripheral subcutaneous fat	38.93 (7.86)	37.82 (1.14)	32.8 (1.51)
Waist circumference (cm)*	88.88 (9.21)	86.98 (1.14)	84.6 (1.14)
BMI (kg/m2)*	23.69 (2.91)	22.79 (4.64)	20.41 (5.15)
HOMA-IR	2.08 (1.2)	1.6 (0.68)	1.58 (0.85)

* mean (SD)

Body Mass Index was further categorized into underweight (<18.5 kg/m²), normal (18.5-22.9 kg/m²), overweight (23-24.9 kg/m²), and obese (\geq 25 kg/m²). According to BMI, the highest score for mean of body fat distribution and HOMA-IR fell to the obese group. On this group, the mean of total fat percentage was 36.47% (SD 8.77), mean of total fat was 26.69 kg (SD 7.14), mean of truncal subcutaneous fat was 75.75 mm (SD 9.41), mean of peripheral subcutaneous fat was 45.21 mm (SD 8.58), mean of waist circumference was 98.53 cm (SD 5.36), and mean of HOMA-IR was 2.13 (SD 1.04). Body fat distribution and HOMA-IR according to BMI groups are shown on **Table 3**.

Correlation Between Body Fat Distribution and Insulin Resistance

In this study, the data distribution of HOMA-IR and peripheral subcutaneous fat was abnormal, thus transformation was performed. Once transformed, we found normal distribution of HOMA-IR, but the distribution of peripheral subcutaneous fat data was still abnormal. Pearson correlation test was used to evaluate the correlation between total body fat, truncal subcutaneous fat, waist circumference and HOMA-IR logarithm transformation. Spearman correlation test was used to evaluate the correlation between peripheral subcutaneous fat and HOMA-IR.

There was significant correlation between body fat distribution and HOMA-IR, all parts of body fat and total fat are significantly correlated to HOMA-IR. The strongest correlation was for waist circumference, with r=0.361 (p=0.007).

Correlation between body fat distribution and HOMA-IR is shown on **Table 4**, and the scatter-plots are shown on **Figure 1-4**.

Additional Results

There was significant correlation between BMI and body fat distribution. The details were significant correlation between BMI and total fat percentage (r=0.8, p=0.000), truncal subcutaneous fat (r=0,844; p=0,000), peripheral subcutaneous fat (r=0.706; p=0,000), and waist circumference (r=0.874; p=0,000).

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<18.5 kg/m² (n=11)	18.5-22.9 kg/m² (n=15)	23-24.9 kg/m ² (n=13)	<u>≥</u> 25 kg/m² (n=16)
19.86 (5.76)	23.51 (5.07)	32.34 (7.42)	36.47 (8.77)
8.56 (2.68)	12.19 (2.62)	19.28 (4.06)	26.69 (7.14)
35.43 (1.61)	52.24 (8.73)	69.06 (8.45)	75.75 (9.41)
24.29 (1.03)	33.75 (6.35)	42.62 (6.7)	45.21 (8.58)
75.55 (7.14)	80.76 (6.6)	90.58 (4.4)	98.53 (5.36)
1.27 (0.61)	1.69 (0.78)	1.81 (1.06)	2.13 (1.04)
	<18.5 kg/m ² (n=11) 19.86 (5.76) 8.56 (2.68) 35.43 (1.61) 24.29 (1.03) 75.55 (7.14) 1.27 (0.61)	<18.5 kg/m² 18.5-22.9 kg/m² (n=11) 18.5-22.9 kg/m² 19.86 (5.76) 23.51 (5.07) 8.56 (2.68) 12.19 (2.62) 35.43 (1.61) 52.24 (8.73) 24.29 (1.03) 33.75 (6.35) 75.55 (7.14) 80.76 (6.6) 1.27 (0.61) 1.69 (0.78)	<18.5 kg/m² 18.5-22.9 kg/m² 23-24.9 kg/m² (n=11) (n=15) 23-24.9 kg/m² 19.86 (5.76) 23.51 (5.07) 32.34 (7.42) 8.56 (2.68) 12.19 (2.62) 19.28 (4.06) 35.43 (1.61) 52.24 (8.73) 69.06 (8.45) 24.29 (1.03) 33.75 (6.35) 42.62 (6.7) 75.55 (7.14) 80.76 (6.6) 90.58 (4.4) 1.27 (0.61) 1.69 (0.78) 1.81 (1.06)

Table 3. Body fat distribution and HOMA-IR according to BMI groups

* mean (SD)

Table 4. Correlation of body fat distribution and HOMA-IR

Variables	HOMA-IR		
Valiables	r	р	
Total fat (%)* Truncal subcutaneous fat (mm)* Peripheral subcutaneous fat (mm)	0.318 0.347 0.296	0.018 0.01 0.028	
Waist circumference (cm)*	0.361	0.007	

* correlation was performed using HOMA-IR logarithm







Figure 2. Scatterplot showing correlation between truncal subcutaneous fat and HOMA-IR







Figure 4. Scatterplot showing correlation between waist circumference and HOMA-IR

DISCUSSION

Subject Characteristic

The study was conducted by cross-sectional method with 55 eligible elderly patients as the subject samples who had their treatment at Geriatric Outpatient Clinic, Department of Internal Medicine, Cipto Mangunkusumo Hospital.

It has been known that body fat, especially abdominal and visceral fat, increases along with increasing age. Our study demonstrated different results. We found that according to the age groups, there is a tendency of lower BMI and body fat distribution in older age group. Such a result is comparable with a study in elderly (411 males and 819 females) conducted by Santos et al in Santiago regarding measurements of BMI, waist circumference, and triceps skin fold thickness.³⁷ Tyagi et al conducted a study in females aged 20 years to 80 years measuring subcutaneous fat by using caliper. They found that there was a tendency of increasing body subcutaneous fat at biceps, triceps, abdomen, subscapular, suprailiac, and thigh region up to 70 years old and then followed by declining of body subcutaneous fat at the older age. They also found increasing BMI up to 70 years old to which then followed by a tendency of BMI decline.³⁸ A study by Rico et al in elderly females also demonstrated body fat decline along with increasing age, with the lowest decline at over 80-year old age group.³⁹ Decreasing food intake and absorption is presumed to be the cause of this, which subsequently causes lesser calories and nutrition intake in elderly. The fact that elderly are starting to lose their teeth is also an important factor in decreasing calories intake that consequently lowers BMI and body fat mass. In addition, there is a possibility of declining function of gastrointestinal tract organs. For example, decreasing stomach motility that causes longer stomach emptying period, thus elderly eat less due to bloated sensation in the stomach. Carbohydrate absorption also decreases. Decreasing secretion of stomach enzymes is also going to prevent fat and protein digestion. All of these are going to bring implication on decreasing food and nutrition intake in elderly.40,41

Insulin resistance also increases along with increasing age. A study by Barbieri et al in 466 healthy subjects whose age ranged from 28-110 years old demonstrates that increasing insulin resistance, assessed by using HOMA-IR, is consistent with increasing age, at peak age of 80-90 years then but then decline in age above 90 years.¹⁸ Our study demonstrates different result, showing a tendency of decreasing insulin resistance, assessed by using HOMA-IR, in consistent

with increasing age. We assume that it may be caused by different subject characteristics, i.e. our subjects have co-morbidity diseases. Moreover, we assume that it may also be caused by decreasing body fat, including visceral and truncal fat in our study, thus insulin resistance decreased. Although fat is not the only factor contributing to the development of insulin resistance; however, our study demonstrated that obviously there is another factor of body fat in developing insulin resistance. Other possibility includes the survival effect, i.e. people with obesity and high insulin resistance of the related population who also have high mortality; therefore, causing these people to be excluded from study. As the result, the elderly who survive are at much older age, with lower BMI and insulin resistance as well as lesser body fat compared to younger population of elderly. The possibility of genetic contribution still cannot be ruled out. Further study is necessary to clarify the tendency of decreasing body fat and insulin resistance in elderly.

As we all know, obesity is a strong predictor in the development of insulin resistance and type-2 diabetes mellitus.^{6,9,21} Obesity can be measured by using BMI, but high BMI does not simply indicate high fat mass. Our study demonstrates that according to BMI groups there was a tendency of increasing body fat in several compartments and also a tendency of increasing HOMA-IR in consistent with increasing BMI. The additional results also demonstrated significant correlation of BMI and all body fat compartments. Such a result demonstrates no difference from a study conducted by Chandalia et al in Asian, Indian and Caucasian ethnics, that found significant correlation BMI and body fat percentage (r=0.71 and r=0.69 respectively), truncal skin fold thickness (r=0.74 and r=0.7 respectively), abdominal subcutaneous fat (r=0.81 and r=0.74 respectively), and intraperitoneal fat (r=0.78 and r=0.62 respectively).³¹ A study by Fend et al also demonstrates significant correlation of BMI and HOMA-IR (r=0.4-0.43).27

Referring to insulin resistance condition score in the available publications, the score is established based on HOMA-IR was greater than the 75th percentile. In this study, the value of HOMA-IR greater than 75th percentile was 2.48. A study conducted by Nasution in elderly female at a nursing home demonstrated a value of HOMA-IR of 2.67.²⁵ The insulin resistance condition score can differ between one population to another, influenced by gender, ethnic, and age.

Correlation Between Body Fat Distribution and HOMA-IR

Our study found a significant positive correlation of total body fat and HOMA-IR. The results of other

studies are also no different. Wannamethee et al demonstrated significant correlations of insulin resistance against total body fat percentage and absolute fat mass (r=0.32 and r=0.42 respectively).⁴² A study by Feng et al also showed a significant correlation between total body fat percentage and insulin resistance measured by HOMA-IR (r=0.43–0.49).²⁷ We assume that it is associated with the function of body fat tissue as an endocrine organ which affects insulin action through release of free fatty acid and protein secretion. Increased free fatty acid and protein secretion. Increased free fatty acid and protein secretion such as TNF- α and IL-6 will increase insulin resistance.^{11,43,44}

Truncal subcutaneous fat is closely associated with insulin resistance. Our study demonstrated a positive correlation of truncal subcutaneous fat and HOMA-IR. Such a finding does not differ from other studies. A study by Chandalia et al compared body composition and insulin resistance in Asian Indian males next to Caucasian ethnic. Their study indicated a negative correlation between insulin sensitivity, which was assessed by using euglycemic hyperinsulinemic clamp, and truncal subcutaneous fat (r=0.55; p<0.001 and r=0.61; p<0,002 respectively for each ethnic).³⁴

Several studies demonstrate better correlation between truncal subcutaneous fat and insulin sensitivity compared to visceral fat, either in diabetic or nondiabetic subjects. The underlying mechanism is still vague, but it has been known that similar to the visceral fat, truncal subcutaneous fat also has higher free fatty acid or non-esterified fatty acid (NEFA) than gluteofemoral region. Such a high NEFA concentration increases fatty acid on muscle and inhibits glucose oxidation.³⁴ A study by Abate et al in type-2 diabetes mellitus subjects found greater correlation between truncal fat and insulin sensitivity compared to intraperitoneal fat.⁴⁵

Peripheral fat is said to have negative correlation with insulin resistance. Our study demonstrated different result, i.e. there was a significant positive correlation between peripheral subcutaneous fat and HOMA-IR; however, the correlation was weaker than fat in other areas of the body. Studies by Sievenpiper JL et al and Abate et al demonstrate different result. They found a negative correlation between peripheral subcutaneous fat and insulin sensitivity (r=0.7; p<0.001 and r=0.56; p=0.0003 respectively).^{29,45} Sievenpiper et al demonstrated a positive correlation between peripheral subcutaneous fat thickness and fasting plasma glucose, 2 hours postprandial plasma glucose, fasting plasma insulin, and insulin sensitivity index.²⁹ A study by Goodpaster et al found that thigh subcutaneous fat, as one indicator of fat deposition in peripheral tissue, is a

significant predictor of insulin sensitivity.⁴⁶ This issue is still controversial. Other studies found that thigh subcutaneous fat compartment had no correlation with insulin sensitivity; while subfacial and thigh intramuscular fat, assessed by using CT, had a negative correlation with insulin sensitivity.^{31,46} Such data clarify that peripheral fat depot may mediate glucose and insulin homeostasis.

It is said that gluteofemoral fat has a protective role, i.e. adipocytes in that region is relatively insensitive to lipolysis stimulus and is sensitive to anti-lipolysis stimulus. Lipoprotein lipase (LPL) enzyme has an important role on free fatty acid uptake in circulation. On observation, it is found that femoral fat depot has relatively high LPL activity and lower lipolysis-stimulated activity. Therefore, gluteofemoral region is more effective in releasing free fatty acid into circulation and tend to release less free fatty acid into the circulation. Free fatty acid uptake present in that region causes lower ectopic fat deposition in liver, skeletal muscle, and pancreas. In human, the role of subcutaneous fat is illustrated by observation that adipose tissue deficiency (lipoatrophy or lipodistrophy) is found in ectopic fat tissue, insulin resistance, and type 2 diabetes mellitus.⁴⁷

Waist circumference represents abdominal and visceral fat. Waist circumference is an index and surrogate marker of abdominal fat mass because it has a good correlation on abdominal subcutaneous and intraabdominal/visceral fat mass; and also a good predictor of cardiometabolic disease risk.48 Similar to other studies, our study found a significant positive correlation between waist circumference and HOMA-IR. A study by Wannamethee et al in elderly subjects demonstrated a significant correlation between waist circumference and HOMA-IR (r=0.47).42 A study by Banerji et al in Asian Indian males demonstrated that insulin sensitivity was inversely associated with waist circumference (r=0.63; p=0.003).49 However, a study by Carantoni et al in elderly subjects aged > 80 years old found a significant correlation between fasting plasma insulin and waist circumference (r=0.48).²⁶

Waist circumference also has good correlation with MRI and CT scan regarding the abdominal and visceral fat measurement.⁴⁸ Although indirect abdominal fat measurement by means of measuring the waist circumference cannot differentiate subcutaneous abdominal from visceral fat, but there is a study that demonstrates no difference among one measuring method to the others, including waist circumference, DXA, and CT scan, regarding their use as strong predictor in assessing metabolic risk factor.⁵⁰

It is said that visceral fat has more anti-lipolysis and

cytokine secretion activity than other fat compartment. However, several studies found a controversy on which abdominal fat compartment is metabolically associated with insulin resistance, either subcutaneous or visceral. Some studies demonstrate that abdominal subcutaneous fat has stronger correlation with insulin resistance compared to the visceral fat. A study by Raji et al in Asian Indian and Caucasian ethnic demonstrated a positive correlation between insulin sensitivity and abdominal fat, including for total abdominal fat (r=0.61; p<0.0001), subcutaneous (r=0.47; p<0.001), and visceral (r=0.55; p<0.005).³⁵

Visceral fat is more sensitive to lipolysis stimulus and less sensitive to anti-lipolysis stimulus (such as insulin) compared to subcutaneous fat. Thus, visceral fat more readily releases free fatty acid into circulation, causing ectopic fat deposition in muscle, liver, and pancreas. The contribution of visceral fat on increasing free fatty acid concentration in circulation is still a dispute. This may partially due to larger number of subcutaneous fat compared to visceral fat, thus quantitatively the greater part of free fatty acid in circulation are contributed by subcutaneous fat. On the other hand, the release of free fatty acid from visceral fat into portal veins which goes straight to the liver, causes decreased insulin clearance in liver, increased gluconeogenesis and dyslipidemia. In rats, visceral fat removal prevents insulin resistance and glucose intolerance; while subcutaneous fat removal on the same amount has less effect.47

The role of insulin resistance is multi-factorial. Our study demonstrates that at as a person ages, there is a tendency of decreased insulin resistance and body fat in all compartments, the findings of which seen to conduct the literature. It may be caused by the fact that in this study, we only measured one of parameters that have role in developing insulin resistance, i.e. body fat distribution; while other contributing factors, such as physical activity, food intake pattern, inflammation, and also ethnic factor associated with body composition had not been explored. Therefore, further study is necessary to identify the role of ethnic factor on body fat distribution and the incidence of insulin resistance in multi-ethnics Indonesia population, and also to identify the correlation of physical activity, food intake patter, inflammation, body fat and insulin resistance in elderly population.

CONCLUSION

Our study found a positive correlation between total body fat percentage, truncal subcutaneous fat, peripheral subcutaneous fat, waist circumference and insulin resistance in elderly.

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