# Visceral Fat Level Correlate with Increase of Fasting Blood Glucose in Overweight and Obese Adult

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**Abstract.** Overweight and obesity is a condition of excess body fat that can increase flux of free fatty acid that effect insulin sensitivity which is risk factor for increased fasting blood glucose levels (FBG) or diabetes. This study aims to evaluate correlation of body fat indicator, body mass index (BMI) and physical activity (PA) with fasting blood glucose in overweight and obese adult. Total of 75 adult ranging from 20-57 years with BMI ≥ 25 kg/m2 were recruited. Anthropometric measurements including body weight, percent body fat (BF) and visceral fat level (VF) were measured using Biolectrical Impedance Analysis (BIA) method. Physical activity determined with International Physical Activity Questionnaire (IPAQ). Fasting blood glucose were analysed using hexokinase method. There is significant different of BF, VF and level of physical activity in men and woman (p=0.000). Age was positively correlated with VF (r=0.219;p=0.059) and FBG (r=0.307; p=0.007). There is not correlation between PA and FBG. VF showed a positive correlation with FBG (r=0.229; p=0,048). Fasting blood glucose increases with age and visceral fat in overweight and obese adult. Control of body weight and routine measurement of body fat is important for reduce diabetes risk in adult above 40 years old.

**Keywords:** *body fat percent, visceral fat, fasting blood glucose, overweight, obesity*

## 1. INTRODUCTION

Indonesia is one of the countries in Southeast Asia with an increasing prevalence of overweight and obesity. Riset Kesehatan Dasar (RISKESDAS) in Indonesia showed that obesity rate continues to increase in adults aged > 18 years, from 10.5% in 2007 to 14.8% in 2013 and increased to 21.8% in 2018.Central obesity rates at the age of > 15 years also increased from 18.8% in 2007, to 26.6% in 2013 and increased to 31% in 2018 [1]. Compared to men, risk of obesity is more in women [2]. Obesity is a condition in which excessive body fat deposits can disrupt energy homeostasis by modifying fat metabolism and spreading adipocytes to other organs, which triggers insulin resistance and increases the risk of type DM [3]. This increase in adipocyte tissue is related to the insulin resistance [4]. Fat tissue is the main metabolic organ that regulates energy homeostasis in the body. Changes secretion of

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adipokine, fatty acid flux, and adipocyte death caused by change of size and number of adipocytes. The occurrence of fat cell hypertrophy especially visceral fat in obese people causes an increase in free fatty acids, *proinflammatory* cytokines and a decrease in serum adiponectin and insulin sensitivity, which causes endothelial dysfunction and signal insulin resulting in insulin resistance[5]–[7]. Fasting blood glucose is one of the most sensitive parameters to detect the occurrence of Type 2 Diabetes Mellitus [8].

Several studies have shown that chronic disease occur because of overweight and obesity, although 30% among obese people do not show metabolic disorders [9]. Low Physical fitness is a one factor that causes metabolic disorders [10]. Data from the Indonesian Ministry of Health notes that obesity is one of the factors causing the occurrence of type 2 diabetes. Diabetes occurs in 14.8% of adults (> 18 years) obese, and 26.6% in central obesity [1]. Elderly is a one of factors the most increase in fasting blood glucose beside of female workers and dibetes history [8].

## 2. METHOD

Cross sectional study carried out between February and March 2019 in the Serengan District of Surakarta City. The subject in this study is 75 adult ranging from 20-57 years and chosen by purposive sampling from participant in Pos Pelayanan Terpadu Penyakit Tidak Menular (POSBINDU PTM) with the inclusion criteria consists of nutritional status is overweight and obesity (BMI ≥ 25kg/m2) and have never been diagnosed with diabetes. Research has received aprrovel from Health Research Ethics Committee of The Faculty of Medicine, Sebelas Maret University Surakarta. Subject who participated in this study had to sign an informed concent.

Anthropometric measurements including body weight, percent body fat and level of visceral fat using Biolectric Impedance Analysis (BIA) method with Tanita BC 541 and height using microtoice with precision 0.1 cm. Body fat expressed in percent of body fat and visceral fat level [11]. Level of physical activity measured by IPAQ. Total PA obtained from total walking (3,3x minute x days/weak)+ moderate (4 x minute x days/weak) + vigorous (8 x minute x days/weak) and stated in MET.minute/weak [12]. Measurements of fasting blood glucose using hexokinase method by analyst from sertified clinic laboratory. Data analysis using Statistical Package of Social Science (SPSS) 23 version with independent T-test to see difference of mean overweight and obesity indicator in male and female. Spearmen correlation test to show correlation between variables.

## 3. RESULT AND DISCUSSION

### 3.1 Characteristic of Subject

Table 1 show that more of 88 percent of the research subjects were women and most were over 40 years old. There were 50.7 percent of subjects is obese with a mean value of BMI 30.77 ± 3.59 kg/m2. Body fat with obese category occurs in more than 70 percent of subject. Above 50 percent of subject have visceral fat > 10, this can be an indication of the risk of metabolic disorders. Total 80 percent of subject have low physical activity with mean 504.1±488.2 MET.min/weak. This is because most subjects are housewives who use more free time at home. Lack of physical activty is one of factors causing overweight and obesity [13]. Based on the mean (99.97 ± 32.55 mg/dl) it is known that in overweight and obese adult subject have normal fasting blood glucose and about 25.2 percent subject have fasting blood glucose > 100 mg/dl.

**Table 1**. Characteristics of Subjects

| | Total | | | | Min | Max | Mean±SD |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | | | |
| Sex | | | | | | | |
| Men | 9 | 12 | 75 | 100 | | | |
| Woman | 66 | 88 | | | | | |
| Age (years) | | | | | | | |
| 20-29 | | | 1 | 1.3 | | | |
| 30-39 | | | 10 | 13.3 | 25 | 57 | 46.3±6.35 |
| 40-49 | | | 37 | 49.3 | | | |
| 50-59 | | | 27 | 36 | | | |
| BMI (kg/m$^2$) | | | | | | | |
| Overweight (≥25-29,9) | | | 37 | 49,3 | | | |
| Obese I (30-34,9) | | | 28 | 37.3 | 25.2 | 40.7 | 30.77±3.59 |
| Obese II (35-40) | | | 7 | 9.3 | | | |
| Obese III (> 40) | | | 3 | 4 | | | |
| Body Fat (%) | | | | | | | |
| Men | | | | | | | |
| Overfat (21-27) | | | 4 | 5.3 | 21.9 | 34.1 | 27.52±3.60 |
| Obese ( ≥ 27) | | | 5 | 6.7 | | | |
| Woman | | | | | | | |
| Overfat (34-39) | | | 16 | 21.3 | 36.5 | 54.6 | 43.05±4.43 |
| Obese (≥39) | | | 50 | 66.7 | | | |
| Viseral Fat Level | | | | | | | |
| Health (1-9) | | | 33 | 44 | 7 | 20 | 10.55±2.73 |
| Moderate Risk (10-14) | | | 35 | 46,7 | | | |
| High Risk ( ≥15) | | | 7 | 9.3 | | | |
| Physical Activity (MET.minute/weak) | | | | | | | |
| Low (<600) | | | 60 | 80 | 231 | 3360 | 504.1±488.2 |
| Moderate (600-1500) | | | 12 | 16 | | | |
| High (> 1500) | | | 3 | 4 | | | |
| Fasting Blood Glucose (mg/dl) | | | | | | | |
| Normal (< 100) | | | 56 | 74,7 | 73 | 260 | 99.97±32.55 |
| Prediabetes (100-125) | | | 10 | 13.3 | | | |
| Diabetes (≥ 126) | | | 9 | 12 | | | |

*Source: Primer Data (2019)*

There are mean difference of body fat percent between men (27.52±3.60) and woman (43.05±4.43). The result of independent T Test in table 2 indicates significant difference percent body fat and visceral fat in men and woman. The higher body fat percentage owned by woman than men (p=0,000). This is consistent with studies that state body fat accumulation or obesity is more at risk for women with higher body fat [2]. Women have a higher body fat mass meanwhile a significant difference in visceral fat levels in men and women shows that fat tissue accumulation in men is greater in the trunk and abdomen [14].

**Tabel 2.** Different Test of Several Paramaters in Man and Woman

| | Mean ±SD | | p |
|---|---|---|---|
| | Men | Woman | |
| Body Mass Index (kg/m$^2$) | 30.32±2.31 | 30.83±3.74 | 0.695 |
| Body Fat (%) | 27.52±3.60 | 43.05±4.43 | 0.000* |
| Visceral Fat Level | 15.67±2.29 | 9.85±1.92 | 0.000* |
| Physical Activity (Met.min/weak) | 1037.3±1052.0 | 431.4±300.6 | 0.000* |
| Fasting Blood Glucose (mg/dl) | 114±28.42 | 98.06±32.80 | 0.185 |

* significant differences with T test

### 3.2 Correlation Several Variables with Blood Glucose Level in Overweught and Obese Adult

Table 3 shows a significant correlation between age and blood glucose in overweight and obese adult (r=0,307; p=0,007). The more age increases fasting blood glucose level or prediabetes risk. The decrease of muscle mass in elderly affects the decrease of muscle function in glucose uptake. On the other hand elderly is associated with changes in glucose metabolism and decreased beta cell function that causes insulin resistance [15]. Beside of woman workes and diabetes history, elderely is one of factors that can increase blood glucose [8]. There is no significant correlation between BMI and blood glucose (r=0,003;r=0,983). BMI has correlate with adiposit and excess of body weight, but it can't describe total of body fat. We also can not distinguish between weight from fat or muscle mass. We can not using BMI for estimate distribution of fat [16]. The higher BMI, percent of body fat and visceral fat distribution also increases. However the determination of obesity based on BMI has not been able to describe how much body fat is. Measurement of percent body fat using the Bioelectric Impedance Analysis (BIA) method is sufficient to describe adipocytes in the body [17].

There is no correlation between physical activity and blood glucose level (r=0.018; p=0.877). This is different from the other research that states physical activity is significantly correlate with blood glucose levels, but in subjects with normal body weight. Physical activity is more general than physical exercise and is usually valued in physical activity at leisure [18]. From this study it is known that most subjects have low activity and use more free time to sit than do activities such as walking or cycling. Physical exercise such as aerobics at least 5 times a week with a duration of 30 minutes or 150 minutes a week can control blood glucose [19].

**Tabel 3.** Correlation of Severals Indicators with Fasting Blood Glucose Levels in Overweight and Obese Adult

| | Correlation Coefficient | p |
|---|---|---|
| Age | 0.307 | 0.007* |
| BMI | 0.003 | 0.983 |
| Physical Activity | 0.018 | 0.877 |
| Body Fat | -0.006 | 0.957 |
| Visceral Fat | 0.229 | 0.048* |

*signifikan with Spearman Correlation Test

The positive correlation between visceral fat and blood glucose indicates that the higher of visceral fat level, the faster of blood glucose level will be (p=0,229; 0.048). Measurement of visceral fat with BIA method is one of the strong predictors of insulin

resistance in young male adults [11]. Measurement of visceral fat with magnetic resonance imaging methods related to the diagnosis of new diabetes in Chinese Adult [20]. Visceral fat can describe fat accumulation that is susceptible to inflammatory response and cytokine production thereby disrupting liver fuction and signals of insulin [5], [21]. High levels of FFA that occur chronically in obese cause *lipotoxicity* which has an impact on pancreatic beta cell dysfunction and apoptosis [22]. Tol Like Receptor (TLR4) is one of immune cell recepter that activated by free fatty acid can reduce glucose homeostatis and insulin sensitivity. This is the trigger for insulin resistance and causes the occurrence of Type 2 Diabetes [3]. Visceral fat can be predictor the presence of metabolic disorders especially insulin resistance rather than BMI and abdominal circumference [23]. The risk of insulin resistance is 7.6 times higher in people with high visceral fat [24].

## 4. CONCLUSION

Fasting blood glucose increases with age and visceral fat in overweight and obese adult. Measurement of body fat indicators with BIA method in community is easier and can be predictor for prediabetes risk. Control of body weight and routine measurement of body fat, especially visceral fat is important for reduce prediabetes risk in adult above 40 years old.

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