The Association between Adiponectin Gene Polymorphism and Waist Circumference Changes in Obese/Overweight Adults after Aerobic Exercise and Diet Treatment

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Abstract: *Background*: The Indonesian basic health research survey reports that the prevalence of overweight/obese (ow/ob) adults was increased from 15% in 2010 to 20% in 2013 for male, and 26% in 2010 to 35% in 2013 for female. Adiponectin is associated with various parameters of metabolic syndrome. This study aimed to investigate the effect of adiponectin gene polymorphism on waist circumference of ow/ob adults after aerobic exercise.

Method: This experimental study was conducted on n=36 ow/ob women. This study used one group pre-posttest design. Respondents were instructed to perform alternately between aerobic exercise and OCD diet. The aerobic exercise was conducted three times a week. After conducting aerobic exercise, respondents performed OCD diet the following day. This alternating pattern was performed for 6 weeks. After performing 6-weeks aerobic exercise, waist circumference was then measured again. The measured variables were variation of adiponectin gene and waist circumference. The gene variation was performed at the Nechri Laboratory.

Result: Overall, waist circumference was lowered from 80.42+-7.16 to 89.11+-6.67. The proportion of genetic variation proportion was found the highest in TT gene variation (75%). After aerobic exercise, waist circumference was significantly reduced in all TT and GT gene variation ($p<0.001$). There was no significant difference in waist circumference changes between gene variations.

Conclusion: Gene variation did not directly contribute to the changes of waist circumference, but through the aerobic exercise practice *plus* OCD diet. Further study on a larger population and from a different characteristic and nutritional status is needed to see the effect of polymorphisms on anthropometric indices.

Keywords: Gene variation, adiponectin, aerobic exercise, waist circumference, obesity.

INTRODUCTION

According to the Indonesian Basic Health Surveys (Riskesdas) in 2010 and 2013, the prevalence of overweight and obesity increased significantly in both male and female. It was an increase from 15% to 20% for male and an increase from 26% to 35% for female [1]. Recent studies suggest that abdominal obesity is better associated with cardiovascular events and other metabolic diseases [2,3]. Abdominal obesity is defined as waist circumference more than 89.99 cm for male and 79.99 for female [4]. Prasad *et al*. (2011) [4] reviewed that socio-economic, culture, low birth weight status, and ethnicity are determinant of abdominal obesity.

As one of clinical parameters for metabolic syndrome, abdominal obesity is associated with elevated visceral fat deposits (adiposity) increasing the risk for dysfunctional adipose tissue [5]. On the other hand, adiponectin, a protein secreted by adipose tissue, was found to be decreased in obese people, indicating that adiponectin is important in body fat regulation [6]. A study reports an inverse association between adiponectin and obesity as well as the risk of type 2 diabetes. The major polymorphisms dominantly found in many studies were G-to-T and T-to-G polymorphisms [7]. Distribution of polymorphisms, both wild type (TT) and heterozygous / variant (GT / GG), found to be significantly associated with type 2 diabetes mellitus [8]. Differences among variant type of polymorphisms were also shown in a study in Japan. This study showed that these variances resulted differences in plasma adiponectin levels. The GG genotype had a lower plasma adiponectin compared to the TT genotype [9]. In addition, study in adolescent shows that the adiponectin level in obese persons was 50% lower than their counterparts [10].

Although many studies confirmed the effect of adiponectin gene polymorphisms on various metabolic markers, the effect on anthropometric scores showed inconsistency. Genetic factor seems to be important in body fat regulation as heritability studies showed that genetic contributes about 47 – 80% to obesity occurrence, indicating that gene variation may affect adiponectin levels [11]. However, the contribution of

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gene variation is still in the controversy area, since environmental factor, according to many epidemiological studies, has been the major cause of obesity. Therefore, this study aims to investigate the effect of adiponectin gene polymorphism on waist circumference of ow/ob adults after aerobic exercise.

MATERIALS AND METHODS

This was an experimental study with one-group pre-posttest design. This study was conducted on n=36 ow/ob women. Inclusion criteria were women with normal body mass index (>23 kg/m^2), aged 17-20 years old, without metabolic complications, such as heart disease, ascites, hepatomegaly, and diabetes mellitus, no special diet and medication, no involvement in weight loss program. Respondents were excluded when using contraception, pregnant, and having high fever. Respondents were selected using purposive sampling method.

Respondents were instructed to perform alternately between aerobic exercise, in the form of gymnastics, and OCD diet. The aerobic exercise was performed three times per week with modest intensity (60-70%) of the maximum effort. Duration of the exercise in a round was 30-40 minutes. During the gymnastic exercise, all respondents were supervised in order to ensure that they have same intensity and duration. After conducting aerobic exercise, respondent performed OCD diet in the following day. This pattern was alternately performed for six months. OCD diet was performed with the pattern as following: respondents were free to eat anything within 7 am to 3 pm and fast to eat within 3 pm to before 7 am next day (excluded drink mineral water). The measured variables were variation of adiponectin gene and waist circumference. After 6-weeks aerobic exercise and OCD diet were done, waist circumference was measured again.

DNA extraction method was GSB (Geneid) and the extracted DNA was then used for amplification of the adiponectin gene using PCR (DNA thermal cycler). and performed at the Nechri Laboratory, Hasanuddin University. There were only two genes (TT and GT) could be statistically analyzed as GG group was only consisted of 1 person.

RESULT

Table **1** shows the age distribution of the study respondents. From 36 respondents, majority of respondent was 18 years (47.2%). All respondents were students and normal nutritional status (100.0%).

Table 1: Characteristics of Respondents

Characteristics	n	%
Age		
17 years	5	13.9
18 years	17	47.2
19 years	9	25.0
20 years	5	13.9
Nutritional status		
Overweight/obese	36	100.0
Occupation		
Student	36	100.0

Table **2** shows the waist circumference changes by gene variances. After intervention, waist circumference was reduced in all gene groups. However, only TT and GT were significantly different ($p<0.001$) and because GG had only 1 respondent, it could not be statistically analyzed. Spearman correlation analysis was also performed, and the result shows significant correlation between WC and adiponectin gene, with moderate degree ($r=0.411$).

DISCUSSION

The findings of this study indicate that waist circumference in all genotype showed a downward tendency after aerobic exercise and OCD diet give for

Table 2: The Role of Genes Against WC Alteration after Undergoing a 6-Week OCD Combination Aerobic Practice Program

Genotype of Adiponectin gene	Mean (SD) WC (cm)			p*
	Before	After	Difference	
TT (n=27)	88.44 (6.94)	80.37 (7.46)	8.07	<0.001
GT (n=8)	90.75 (5.95)	80.25 (6.92)	10,50	<0.001
GG(n=1)	94.00	83.00	11.00	
p$^{\#}$	0.538	0.938	0.20	

p*= Mann Whitney test; p$^{\#}$= Kruskal Wallis test. The Spearman correlation test between genotype of adiponectin gene was also performed (r=0.411 and p=0.001).

6 weeks. Although GG genotype could not be statistically analyzed as it only had one respondent, the trend of declining was also shown. All genotype found to be decreased was probably due to the fact that the majority of respondents were overweight, and only a few were obese. This finding is in line with the result of the study by Lemes *et al.* (2018) [12], in which the blood pressure and waist circumference were decreased after aerobic training. Another meta-analysis study shows that aerobic exercise was significant in reducing visceral adiposity tissue (VAT) compare to traditional training [13].

The impact of genotype on modifying the effect of aerobic training *plus* OCD diet resulting in waist circumference changes has not seen in this study. However, heterozygous GT genotype tended to be more expressed after the treatments resulting in a greater reduction in WC compared to TT genotype. It may be due to the characteristics of GT genotype in which carries two different alleles (T and G allele) categorized this genotype as risk genotype. A study showed that the presence of G allele was associated with a high risk of obesity [14]. T allele is a normal carrier, while G is an abnormal carrier. Thus, GT was more expressed after the treatments compared to T alleles alone.

As Hall discuss, expressed genes from visceral adiposity tissue and subcutaneous in humans (20% and 30%, respectively) stimulate to produce a bioactive secretory protein called adipocytokine, including adiponectin. Adiponectin can decrease the number of triglycerides and increase insulin signals in the skeletal muscle meaning that with aerobic exercise triglycerides contained in the skeletal muscle will break down into ATP and energy, so the abdominal circumference decreases and weight decreases [15]. Decreased levels of fat in adipose tissue can be affected by aerobic activity with a frequency of 3 x / week for 6 weeks, light intensity 60- 70%, tempo / duration 30-40 minutes done regularly and calorie restriction or OCD diet with the first 8 hours of fasting lead to increased metabolic processes in fat (triglycerides) visceral and intra-abdominal in adipose tissue causing decreased abdomen (WC), which can prevent the occurrence of central obesity and metabolic syndrome.

A combination of regular exercise and diet by restricting calories can produce balanced calories, lower body fat and metabolic process, in which this combination is more useful than the exercise or diet alone. The combination of regular exercise and a diet with a calories restriction can reduce body fat up to 1 pound (0.45 kg) per week [16]. If the aerobic exercise in combination with OCD diet is routinely performed to at least 6 weeks, it may significantly reduce the body fat approximately 2.7 kg during the treatments. According to this finding, the treatments can potentially reduce waist circumference until 10.50 cm on genotype GT and 8.07 cm on genotype TT.

The intensity of exercise may also contribute to WC changes in moderate-to-vigorous intensity shows the beneficial effects. In agreement with this finding, a study revealed that moderate and high intensity of aerobic training was significantly reduced WC (7.20 cm and 7.60, respectively) [17]. Also, the majority of movement in aerobic training focuses on abdominal site. Thus, more such of this training will potentially transform the fat mass into muscle. Additionally, intermittent fasting through OCD diet may improve the metabolic process by which converting more fat in adipose tissue into energy. A study indicates that every other day fasting (EODF) increase energy expenditure and optimize energy metabolism. However, it is also raised the potential mechanism by which the gut microbiota mediating the beneficial effect of EODF on host's metabolism [18].

The important actions that should be done by obese people, whether they have GT or GG genotype, are providing health education and advocating for routine aerobic practice and OCD diet, in this case, fasting. Thus, metabolic syndrome disease and heart disease could be reduced. And for individuals who have genotypes TT to maintain a better lifestyle may be necessary to avoid diseases.

Some limitation should be noted. First, the sample size was small and therefore, one group of genetic variances should be excluded in the statistical analysis (genotype GG, n=1). As a result, it is difficult to determine the significant relationships from the data. Second, the use of purposive sampling method made the result of the study is difficult to represent the population (adolescent). However, the strength of this study was the approach for the treatment combining aerobic exercises with the current popular diet in Indonesia population, OCD diet.

CONCLUSION

This recent study concludes that the gene polymorphisms may contribute to the reduction of waist circumference after aerobic exercise and OCD diet were performed. Although no differences in WC

reduction by gene variations, the way of these genotypes expression in response to diet and other treatment may influence the anthropometric results, including waist circumference. It is suggested that regular training and intermittent fasting should be performed by obese people in order to prevent abdominal obesity and obesity-related diseases in the future. Further study on a larger larger population and from a different characteristic and nutritional status to see the effect of polymorphisms on anthropometric indices.

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