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The Impact of Weight Loss Program in Metabolic Profile and Body Fat Improvement among Indonesian Young Obese: A Randomized Clinical Trial

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Summary Abdominal obesity is defined as an accumulation visceral fat in abdomen region. It is linked to metabolic disorders that contribute to chronic diseases. Triglyceride (TG) to high density lipoprotein (TG/HDL) ratio is considered as an insulin resistance (IR) marker. The waist to height ratio (WHtR) has been advocated as an effective and convenient measurement of central adiposity that could potentially be superior instead of BMI in determining cardiometabolic risk. The objective of this study was to investigate the effect of 8-wk-high protein diet and exercise on TG/HDL ratio, waist to height ratio (WHtR), body fat (BF) and body weight (BW). This study was a randomized clinical trial in 43 subjects with BMI >25 kg/m^2. Subjects were randomized into 3 groups: High Protein Diet and Exercise (HPDE; n=15) High Protein Diet (HPD; n=15) and Control Group (CG; n=13). The prescribed diet consisted of 1,200 calories; while the exercise was conducted for 5 times/wk for 8 wk. The hypocaloric diet comprised of 55% carbohydrate, 25% protein, and 20% fat. In the end of the study, HPDE group had greater weight loss (−2.3±1.9 kg) than HPD (−1.8±2.2 kg); while CG increased in weight (1.8±1.3 kg). HPDE group had significantly improved TG, HDL, TG/HDL ratio and WHtR by −26.6 mg/dL, 12.7 mg/dL, −1.02, −0.02 respectively (p<0.05). There were significant differences between 3 groups, with ΔTG (p=0.008), ΔHDL (p=0.001), and ΔTG/HDL ratio (p=0.004) and WHtR (p=0.001). In conclusion, t hypocaloric diet combined with exercise has a beneficial effect in weight loss among young obese.

Key Words obesity, TG/HDL ratio, WHtR, diet, exercise

Global obesity epidemic is now a pandemic both in developed and developing countries (*1–3*). Based on Indonesian Basic National Health Research, the obesity prevalence in Indonesian young people increases tremendously from 18.8 to 31% in the last 10 y (*4*). Obesity is characterized by fat accumulation from long term positive energy balance (*5, 6*). The increase of obesity is parallelwith the increase inprevalence of diabetes mellitus type 2, stroke, cardiovascular disease, and cancer (*7, 8*).

Obesity is associated with chronic low-grade inflammation (*9*) and insulin resistance (*10, 11*). Elevated levels of free fatty acids, inflammatory cytokines, and lipid intermediates in nonadipose tissues contribute to impaired insulin signaling and the insulin-resistant state that is present in obese individuals (*12*). There is strong evidence that nutrient composition and exercise are able to modulate inflammation and improve metabolic profile (*13, 14*). Weight loss is the cornerstone of therapy for obese individuals, because it can resolve the metabolic risk factors. The principle of weight loss diet is to consume energy less than the expended energy, so there will be a mobilization of stored energy.

High protein diet affects appetite and satiety level. Mechanisms which explain protein-induced satiety are nutrient-specific and consist mainly of synchronization with elevated amino acid concentrations (*15*). The relatively high protein diets all consist of 25–30% of energy from protein (*16*). However, this recommendation seems to be conducted only on few studies in young obese.

Comprehensive interventions through the management of diet and exercise resulted in greater weight loss than single therapy (*17, 18*). Thus, this study was

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aimed to examine the effect of high protein diet and exercise in improvement of metabolic profile and body fat among Indonesian young obese.

MATERIALS AND METHODS

Study design. This study was an open-randomized clinical trial that was conducted to abdominal young obese for weight loss program as a widely part study in assessing the effect of combining high protein diet and exercise in body weight, triglycerides, HDL, waist circumference, TG/HDL ratio and WHtR. There were 3 groups in this study: the group treated with high protein diet exercise (HPDE), the group treated with high protein diet (HPD), and control group (CG). The diet menu was composed and distributed by the researchers. The calorie given to the subject was 1,200 calories based on the mean basal metabolic rate and the exercise was given 5 times/wk in 45 min. The interventions were conducted for 8 wk.

Subject and sample size. In this study, obesity is defined as body mass index above 25 kg/m^2 (*19*), waist circumference >80 cm for women and >90 cm for men. The final subjects were preceded by screening young adults aged 19–20 y who were students in Diponegoro University. The initial screening was conducted via interview to determine the eligibility of the subjects. The basic data obtained from the screening were weight (kg), height (cm), and waist circumference (cm). The eligible subjects were contacted by phone to take part in the study. The subjects were excluded if they experienced weight loss more than 10% from the actual weight in the last three months, had smoking behavior, consumed medicine or supplement for weight loss diet, had the history of chronic diseases or suffered from-chronic diseases such as cardiovascular disease, diabetes mellitus, and kidney failure. At the end of screening process, 45 eligible subjects were divided into 3 groups and 2 subjects from control group were removed due to the lost of follow-up. To detect the difference between groups, a total of 45 participants were needed, with a two-tailed α of 0.05 and a (1-β) of 0.90 and a possible drop out of 20%.

Dietary intervention. The CG group was instructed to maintain their usual diet. The HPDE group was assigned to have the intervention diet for breakfast, lunch, dinner, and twice snacks which consisted of 55% carbohydrate, 25% protein, and 20% fat. The mixture of red beans was considered as complex carbohydrate which was used to improve the satiety state. The amino acids were gained from tempe, corn, beans, and banana. The fat percentage was minimized by providing stir-fries, soup meal, and little coconut milk. The menu cycle was 7 d for 8 wk. Fiber content og approximately 30 g was obtained from both main meal and snack, mainly from vegetables and fruits. The subjects were instructed to drink 500 mL water before consuming the meal in order to increase the satiety. Dietary data was collected daily using 24-h recall form provided by Food and Agriculture Organization of the United Nation (FAO) 2018.

Exercise intervention. The given exercise program was called Belly gym. The exercise was anaerobic type with mild-high intensity to achieve 70–80% maximum heart rate (HR). The exercise was assisted by a professional trainer. Belly gym consisted of 30–45 min exercise session and was conducted 5 times per week for 8 wk. HR during the exercise was monitored using H-7 Pollar.

Blood biochemistry. A 3 mL of overnight fasting blood sample in the beginning and at the end of the study was taken *in vena ante cubii* by trained laboratory staff. The blood was immediately transferred to Diponegoro National Hospital, Semarang. The blood sample was incubated for an hour in 25°C then centrifuged at 2,500–3,600 rpm for 10–20 min. TG and HDL were assessed by photometric method (Indiko, USA).

Anthropometric assessment. The anthropometric assessment was comprised of weight, BMI, and body fat which were assessed by SECA body analyzer (SECA 201). Body weight measurement was done by wearing light clothing and no shoes. Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape (*20*). All measurements were assessed in the baseline and in the end of the study (week 8).

Ethical clearance. This study has been approved by Health Research Ethical Committee of Faculty of Medicine DiponegoroUniversity-Kariadi Hospital, Semarang with approval number 427/EC/FK-RSDK/VII/2018. The informed consent was signed by participants in the prior of the study.

Statistical analysis. Kolmogorov-Smirnov test was used to examine the normal distribution of data and Levene test to test the homogeneity of variance. The three groups were compared for TG, HDL, TG/HDL ratio, waist, waist/height ratio using ANOVA test, followed by post-hoc Bonferroni test. All data were expressed as median (minimum; maximum). All statistical tests were two-sided. The data were analyzed using SPSS version 21.0 for Windows (IBM, Armonk, NY, USA) and were considered as significant at $p<0.05$.

RESULTS

Figure 1 shows the flow of participants in this study. Among 296 candidates, only 45 subjects were eligible. All subjects were randomly allocated into 3 groups: HPDE ($n=15$), HPD ($n=15$), and CG ($n=15$). In the middle of the study, 2 participants dropped out mainly due to out of contact. The remaining participants in each group were: HPDE ($n=15$), HPD ($n=15$), and CG ($n=13$).

The general characteristics of the participants were listed in Table 1. At baseline, there was no significance in age, weight, BMI, WC, TG, and HDL between groups. The subjects of this study were 39 obese female and 4 obese male. Females seem to experience higher levels of excessive body weight than male.

Table 2 shows the mean differences of HDL, TG, TG/HDL ratio, WC, WHtR. HPDE group lost higher amount

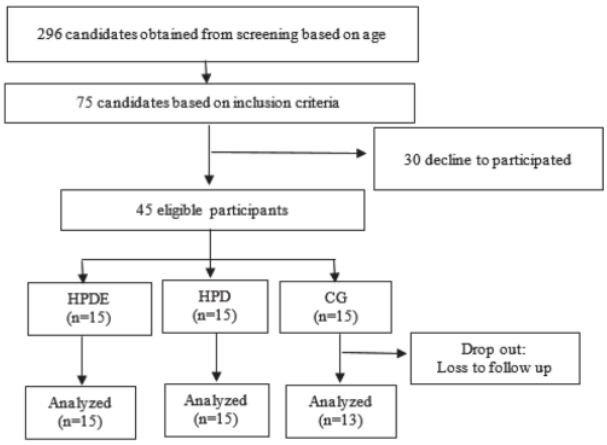

Fig. 1. Flow diagram of subjects.

Table 1. Participant's characteristics in HPDE, HPD, and CG.

Variables	HPDE (n=15)	HPD (n=15)	CG (n=13)	p^a
Age (y)	19.3±0.6	18.9±0.6	19.5±0.5	0.354
Height (cm)	159.6±6.7	155.2±3.7	163.1±7.7	0.008*
Weight (kg)	79.7±14.7	69.7±7.5	80.6±13.2	0.186
BMI (kg/m^2)	31.1±4.0	28.9±3.0	30.1±2.5	0.215
Energy intake (kcal)	2,407.8±270.4	2,282.5±127.4	2,300.6±202.9	0.010*
Waist circumference (cm)	87.2±10.0	85.0±3.8	95.8±8.9	0.095
TG (mg/dL)	115.1±71.6	92.6±58.9	119.85±56.3	0.468
HDL (mg/dL)	38.8±8.2	49.3±13.4	45.0±10.1	0.392

*Homogenity value and be considered significant at $p<0.05$.
The data performed as mean±standard deviation.

of BW than HPD group. In the CG group, there was an escalation of BW. The combination of restricted calorie intake and physical activity resulted in beneficial result, since HPDE group experienced significant decrease of WC (−3.3±1.7), TG (−26.6±25.8), WHtR (0.02±0.01), TG/HDL ratio (−1.02±1.37), and body weight (−2.3±1.9), and occurred significant increase of HDL (12.6±11.0). Subjects in HPD group experienced lower result than HPDE group, with TG and TG/HDL ratio which were not significantly decreased and HDL level which was notably decreased. Changes in TG, HDL, BF and WHtR were shown to be higher in HPDE group than HPD group (Fig. 2).

DISCUSSION

This study examined the effect of 8-weeks diet and exercise on metabolic profile and body fat. The findings of this study found that young females had the tendency to be easier becoming obese (*21*). This could be caused by more females than males significantly participated in light PA. Findings of the previous study showed that participants who engaged in light PA were more at risk in becoming obese as determined by BMI (*22*).

At the end of study, weight loss was associated with decreased WC, Percent Body Fat (PBF), ratio TG/HDL and WHtR. These results indicate that dietary and exercise are more effective than diet only. Diet alone is not an effective method for achieving weight loss, although most obese people tend to choose diet as the first interventional choice. Diet in combination with exercise effectively resulted in changes of body composition and biomarkers of metabolic profile. High protein and fiber diet were able to increase satiety and inhibit fat absorption (*23, 24*). The high-protein diet was more effective than hypocaloric, or the traditional low fat diet within the spectrum of examined diet options (*18*). The impact of exercise was the reduction of body fat mass and retention of muscle mass during the treatment. Some of the findings were in line with previous research on the effect of diet and exercise-induced weight loss on metabolic profile and body fat (*25*). This study showed subsequently, using combined intervention, that diet and exercise induced greater weight loss than a single intervention.

In this study, a reduction of 39% in ratio TG/HDL-c in the HPDE group at week 8, whereas the ratio in-

Table 2. Changes in anthropometry and metabolic profile during intervention.

Variables	HPDE (n=15)	HPD (n=15)	CG (n=13)	p
Body Weight (kg)				
Pre	79.7±14.7	69.7±7.5	80.6±13.2	
Post	77.4±14.5	67.8±7.3	82.4±13.6	
p value	<0.001	0.005	<0.001	
Change BW	−2.3±1.9	−1.8±2.1	1.7±1.3	0.003
Waist circumference (cm)				
Pre	87.2±10.0	85.0±3.8	95.8±8.9	
Post	83.9±9.9	83.1±4.9	96.7±8.7	
p value	<0.01	0.049	<0.01	
Change WC	−3.3±1.7	−1.9±3.5	0.9±0.5	<0.001
Percent body fat (%)				
Pre	36.1±3.1	35.5±2.1	35.6±2.5	
Post	33±2.8	34.8±2.1	35.1±2.9	
p value	0.025	<0.01	<0.01	
Change PBF	−2.5±2.3	−0.75±0.1	−0.56±0.27	0.005
TG (mg/dL)				
Pre	115.1±71.6	92.6±58.9	119.85±56.3	
Post	88.5±57.5	82.1±51.3	124.3±52.8	
p value	0.001	0.067	0.555	
Change TG	−26.6±25.8	−10.7±20.4	4.6±26.4	0.007
HDL (mg/dL)				
Pre	38.8±8.2	49.3±13.4	45.0±10.1	
Post	51.4±14.7	38.4±6.8	42.3±9.6	
p value	0.001	<0.001	0.045	
Change HDL	12.6±11.0	−10.9±8.9	−2.7±4.3	<0.001
TG/HDL ratio				
Pre	3.3±2.5	2.4±2.6	2.7±1.4	
Post	2.1±1.8	2.3±1.9	2.9±1.3	
p value	0.001	0.770	0.402	
Change TG/HDL ratio	−1.02±1.37	−0.34±1.89	0.22±0.92	0.096
WHtR				
Pre	0.54±0.05	0.54±0.03	0.58±0.03	
Post	0.52±0.05	0.52±0.04	0.59±0.03	
p value	<0.001	0.002	<0.001	
Change WHtR	−0.02±0.01	−0.02±0.02	0.006±0.003	<0.001

*The comparison value and be considered significant at p<0.05.
The data performed as mean±standard deviation.

creased in the control group. Moderate weight loss, defined as a 5–10% reduction in baseline weight, is associated with clinically meaningful improvements in obesity-related metabolic risk factors. Whereas in this study, a 3% weight loss could improve the TG/HDL-c ratio in the short term. There is evidence that the plasma concentration ratio of TG/HDL-c identifies insulin resistance and increased cardiometabolic risk (*26*, *27*). To our knowledge, this is the first time that ratio TG/HDL reduction was found after a combination ofdiet and exercise intervention.

We could only speculate that the changes in TG/HDL ratio after weight loss affected the modulation of insulin in obese subjects, and future studies should investigate this relationship further.

Body fat decreased significantly in all groups after the treatment. In addition, diet and exercise contributed in higher fat mass loss than single treatment. A previous study by Ounis et al (*25*) also showed improvement in body fat in the combination diet with exercise. These results indicate that diet may help the increase of fat oxidation and exercise will maintain muscle mass. Complementary to muscle mass retention, higher protein diet also contribute in increased fat mass loss (*23*).

The strength of this study was the effectiveness of incorporating diet and exercise for weight loss. Recommendation of diet alone results in minimal weight loss, which can frustrate some patients. The study had some limitations. First, the small sample size and the relatively short duration of the intervention may have limited the power to detect changes in some outcomes. Second, dietary food records were used during the follow-up as an indirect marker of dietary compliance. In addition for future studies, it is also necessary to assess the diet motivation.

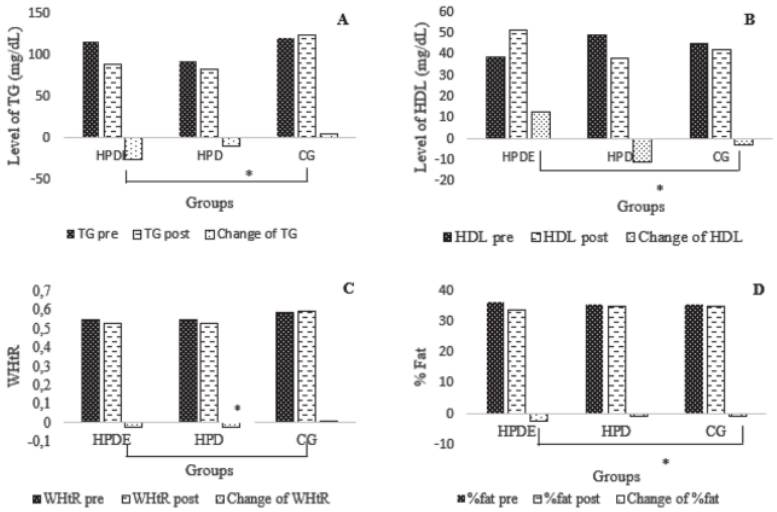

Fig. 2. (A) Level of TG before and after intervention; (B) Level of HDL before and after intervention; (C) WHtR before and after intervention; (D)% Fat before and after intervention. Data are presented as mean±SD. *Data was considered as significance at <0.05 in the comparation of the change of TG, HDL, and WHtR.

Disclosure of state of COI

No conflicts of interest to be declared.

Acknowledgments

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