



The Effect of Resistance Training Using Push, Pull, and Leg Methods on Skeletal Muscle Percentage and Body Fat Percentage

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ABSTRACT

Background: Non-communicable diseases (NCDs) constitute a major global health problem. In Indonesia, the prevalence of NCDs has increased since 2013, influenced by factors such as increased body fat mass and decreased muscle mass. Maintaining a high percentage of skeletal muscle and a low percentage of body fat is essential for health. One effective strategy to achieve this is resistance training using the push, pull, and leg (PPL) method.

Objective: This study aimed to examine the effect of weight training using the push, pull, and leg method on skeletal muscle percentage and body fat percentage.

Methods: This study employed a quasi-experimental design with a pretest–posttest non-equivalent comparison group approach. A total of 40 participants were recruited using non-probability total sampling. Body composition data were measured using bioelectrical impedance analysis (Omron Karada Scan Body Composition Monitor HBF-375). Data were analyzed using the Shapiro–Wilk test, paired sample *t*-test, and independent *t*-test.

Results: Weight training using the push, pull, and leg method had a significant effect on increasing skeletal muscle percentage ($p = 0.001$) and decreasing body fat percentage ($p = 0.001$).

Conclusion: Weight training using the push, pull, and leg method is effective in increasing skeletal muscle mass and reducing body fat mass.

KEYWORDS: Body fat mass, Push–Pull–Leg method, Skeletal muscle mass, Weight training.

INTRODUCTION

Non-communicable diseases (NCDs) represent a major global health problem and are the leading cause of mortality worldwide. According to data from the World Health Organization (WHO) in 2022, NCDs cause approximately 41 million deaths annually and account for 74% of all global deaths. In addition, around 17 million people die from NCDs before reaching the age of 70 years. In Indonesia, nearly 80% of deaths are caused by non-communicable diseases.¹

The results of the 2018 Basic Health Research (Riskesmas) indicate that the prevalence of NCDs has increased compared to 2013. The prevalence of cancer increased from 1.4% to 1.8%; stroke from 7% to 10.9%; chronic kidney disease from 2% to 3.8%; diabetes mellitus from 6.9% to 8.5%; and hypertension from 25.8% to 34.1%. The increasing incidence of NCDs is influenced by various factors, one of which is the high level of body fat mass.^{2,3}

Fat mass is one of the components of body composition and serves as the largest source of energy for the body. Fat functions to maintain body temperature, protect vital organs, and act as a solvent for vitamins A, D, E, and K.⁴ However, excessive accumulation of body fat can lead to health problems, one of which is obesity.⁵ The prevalence of obesity among adults worldwide has increased annually, including in Indonesia.⁵ Data from Riskesdas 2018 show that the prevalence of obesity among Indonesian adults aged over 18 years reached 21.8%.² The adverse effects of obesity can increase morbidity and mortality.⁶



In addition to fat mass, muscle mass also plays an important role in the development of non-communicable diseases. Muscle is a connective tissue whose primary function is contraction, enabling body movement and supporting homeostasis.⁷ Muscle mass is a critical component of health because it contributes to movement, force production, and glucose utilization. Adequate muscle mass is essential from a health perspective, as low muscle mass is associated with an increased risk of diseases such as type 2 diabetes mellitus, metabolic syndrome, and cardiovascular disease.^{8,9}

Various strategies can be employed to reduce fat mass and increase muscle mass in order to improve health status, one of which is resistance training (RT). Resistance training is a primary form of exercise used to induce increases in muscle mass.⁸ Resistance training has been shown to provide numerous benefits, including increasing muscle mass and reducing fat mass.^{10,11} Insufficient physical activity can result in an energy surplus, which is subsequently stored as fat in the body.¹²

According to Baechle (2014), resistance training can improve muscle strength, muscular endurance, neuromuscular coordination, and bone density (thereby helping to prevent osteoporosis), as well as enhance cardiovascular health by lowering blood pressure and exerting positive effects on cholesterol control and lipoprotein levels.¹³ However, based on the 2018 Riskesdas results, the proportion of Indonesians with insufficient physical activity increased from 26.1% in 2013 to 33.5% in 2018.² This is noteworthy given the substantial evidence supporting the benefits of resistance training.

A study conducted by Soethama et al. (2016) demonstrated that resistance training in adults aged 21–40 years resulted in a more significant increase in the muscle mass of the pectoralis major and biceps compared to adolescents aged 15–20 years.¹⁴ Furthermore, research by Geant (2021) showed that a push and pull training method performed for six weeks induced upper-body muscle hypertrophy.¹⁵ A systematic review and meta-analysis by Wewege et al. (2022) confirmed that resistance training effectively reduces body fat percentage, fat mass, and visceral fat in healthy adults.¹⁰ Similar findings were reported by Nduru and Dinata (2021), who observed a significant effect of weight training on the thickness of superficial back fat among male members of Jaguar Gym Padang.¹⁶

Based on the adverse health effects associated with increased fat mass and decreased muscle mass, as well as evidence from previous studies, this study aims to investigate the effect of resistance training using the push, pull, and leg method administered over a four-week period on skeletal muscle percentage and body fat percentage.

METHODS

This study employed a quasi-experimental design using a pretest–posttest non-equivalent comparison group approach. The participants were divided into two groups, namely an intervention group and a control group. Prior to the intervention, both groups underwent baseline measurements (pretest) of skeletal muscle percentage and body fat percentage.

The intervention group received resistance training using the push, pull, and leg method three times per week for four weeks, resulting in a total of twelve training sessions. In contrast, the control group did not receive any resistance training intervention. After the four-week intervention period, measurements of skeletal muscle percentage and body fat percentage were repeated (posttest) in both groups to evaluate the effect of resistance training using the push, pull, and leg method on skeletal muscle percentage and body fat percentage.

This study was conducted at the Sacred Heart Monastery Seminary, located on Claret Street, East Penfui, Central Kupang District, East Nusa Tenggara, Indonesia. The research was carried out from September to November 2023.

Sample selection was performed using a non-probability sampling method with a total sampling technique, resulting in a total sample size of 40 participants.

Data analysis was conducted in two stages. Univariate analysis was performed to describe the characteristics of the respondents, including age, body mass index (BMI), and physical activity level. Subsequently, bivariate analysis was conducted using the paired sample *t*-test and independent *t*-test. Prior to these analyses, data normality was assessed using the Shapiro–Wilk test.

RESULTS

Respondent Characteristics

The characteristics of respondents in both the intervention and control groups are presented in Table 1. Variables observed included age, body mass index (BMI), and physical activity status.



Table 1. Baseline Characteristics of Respondents

Variable	Intervention (n=20)	Control (n=20)
Age (years), n (%)		
18	3 (15)	3 (15)
19	1 (5)	5 (25)
20	7 (35)	5 (25)
21	2 (10)	4 (20)
22	1 (5)	2 (10)
23	2 (10)	1 (5)
24	3 (15)	0 (0)
25	1 (5)	0 (0)
BMI category, n (%)		
Underweight	1 (5)	0 (0)
Normal	16 (80)	20 (100)
Overweight	1 (5)	0 (0)
Obese	0 (0)	0 (0)
Physically active, n (%)		
Yes	18 (90)	19 (95)
No	2 (10)	1 (5)

Based on Table 1, the majority of participants in both groups were aged 19–20 years. Most respondents had a normal BMI and were physically active, indicating comparable baseline characteristics between the intervention and control groups.

Univariate Analysis

Univariate analysis was conducted to describe the distribution of skeletal muscle percentage and body fat percentage in both groups before and after the intervention.

Table 2. Descriptive Statistics of Body Composition in the Intervention Group

Variable	Pretest (Mean ± Range)	Posttest (Mean ± Range)
Skeletal muscle (%)	36.36 (30.5–39.9)	36.78 (31.4–40.7)
Body fat (%)	13.04 (5.5–26.3)	12.03 (4.5–25.0)

As shown in Table 2, the mean skeletal muscle percentage in the intervention group increased after the training period. Conversely, the mean body fat percentage decreased following the four-week resistance training intervention.

Table 3. Descriptive Statistics of Body Composition in the Control Group

Variable	Pretest (Mean ± Range)	Posttest (Mean ± Range)
Skeletal muscle (%)	36.41 (34.0–39.0)	36.27 (34.1–39.0)
Body fat (%)	11.83 (6.7–17.2)	12.19 (6.8–17.6)



Table 3 shows that the control group experienced a slight decrease in mean skeletal muscle percentage and an increase in mean body fat percentage between pretest and posttest measurements.

Bivariate Analysis

The bivariate analysis was conducted to examine changes in skeletal muscle percentage and body fat percentage before and after the intervention, as well as to compare the mean differences between the intervention and control groups. The results of the paired sample t-test and independent sample t-test are summarized in Table 4.

Table 4. Comparison of Skeletal Muscle Percentage and Body Fat Percentage Between Intervention and Control Groups

Variable	Group	Pretest Mean	Posttest Mean	Mean Difference	p-value
Skeletal Muscle Percentage (%)	Intervention	36.355	36.775	0.42	0.001*
	Control	36.410	36.265	-0.145	0.074
Body Fat Percentage (%)	Intervention	13.035	12.025	1.01	0.001*
	Control	11.825	12.185	-0.36	0.001*

Table 4 shows that the intervention group experienced a statistically significant increase in skeletal muscle percentage (mean difference = 0.42; $p = 0.001$) and a significant reduction in body fat percentage (mean difference = 1.01; $p = 0.001$) after four weeks of weight training using the push, pull, and leg method.

In contrast, the control group showed no significant change in skeletal muscle percentage ($p = 0.074$), while a significant increase in body fat percentage was observed (mean difference = -0.36; $p = 0.001$). Furthermore, the independent comparison demonstrated significant differences in mean changes between the intervention and control groups for both skeletal muscle percentage and body fat percentage ($p = 0.001$), indicating that the push, pull, and leg weight training method effectively improves body composition.

DISCUSSION

Based on the results of this study, it was found that weight training using the push, pull, and leg method had a significant effect on skeletal muscle percentage and body fat percentage. This was demonstrated by the significant effect of push, pull, and leg weight training on skeletal muscle percentage and body fat percentage ($p < 0.05$), with body fat percentage showing a p-value of 0.001 ($p < 0.05$). Therefore, it can be concluded that H_0 was rejected and H_1 was accepted, indicating that push, pull, and leg weight training has a significant effect on skeletal muscle percentage and body fat percentage in the intervention group compared to the control group ($p = 0.001$).

In the intervention group, statistically significant differences were observed between pretest and posttest values for both skeletal muscle percentage ($p = 0.001$) and body fat percentage ($p = 0.001$). These changes occurred because the intervention group received structured weight training using the push, pull, and leg method.

Weight training using the push, pull, and leg method is a form of resistance training that targets different muscle groups. This training was performed routinely and consistently three times per week and was divided into push exercises (pushing movements), pull exercises (pulling movements), and leg exercises (focused on lower limb muscles).¹⁵ The training program consisted of three different sessions: push training on Mondays, pull training on Wednesdays, and leg training on Fridays, with each session comprising four different exercises.

Each training method involved different muscle groups: the push method targeted the chest, deltoid, and triceps muscles; the pull method targeted the back and biceps muscles; while the leg method focused on the muscles of the lower extremities. This type of training method has become popular among bodybuilders and recreational exercisers because it optimizes recovery time between training sessions and supports muscle hypertrophy and fat burning.¹⁵

Resistance training has been shown to increase muscle mass, reduce body fat, strengthen bones, lower blood pressure, and improve glucose utilization. Muscle hypertrophy occurs as a result of increased muscle fiber size, capillary density within the muscle, and connective tissue development.¹⁷ Muscle hypertrophy also occurs when skeletal muscle receives stimuli that cause disruption of myofibers and the associated extracellular matrix. Intensive resistance training can increase muscle size up to two or



three times due to increases in myofibril size and actin and myosin filaments, which are activated during strong muscle contractions. Additionally, increased strength and quantity of connective tissue, tendons, and ligaments also contribute to muscle enlargement.¹⁸

The increase in muscle mass during resistance training is also influenced by hormonal factors. Growth hormone (GH), which contains natural steroids, plays an important role in increasing muscle mass. Resistance training causes micro-damage to muscle tissue, and GH functions to repair this damage by increasing the synthesis of actin and myosin, thereby increasing muscle fiber diameter. This increase in actin and myosin significantly affects the size of the muscle contractile unit, leading to enhanced muscle contractility.¹⁴

The findings of this study are consistent with research conducted by Soethama et al., which demonstrated that resistance training significantly increased the muscle mass of the pectoralis major and biceps in adults compared to adolescents.¹⁴ Similar results were reported by Mansur et al., who found that free weight training using barbells significantly increased muscle hypertrophy, with a mean pretest–posttest difference of 2.45% and a hypertrophy increase of 4.97%.¹⁹

Further support comes from a study by Tambing et al., which showed significant differences in upper arm circumference before and after resistance training, indicating increased muscle mass.¹⁸ Resistance training has also been shown to be effective in increasing muscle strength and size in older adults.²⁰ In addition, research conducted by Geant demonstrated that push and pull training methods significantly increased upper body muscle hypertrophy.¹⁵

In addition to increasing muscle mass, resistance training has been shown to reduce body fat levels. This reduction occurs due to increased fat oxidation during and after exercise.²¹ One of the mechanisms involved in fat reduction is mediated by interleukin-6 (IL-6), a cytokine produced by various cells, including adipocytes, lymphocytes, and macrophages. Recent evidence suggests that IL-6 also functions as an anti-inflammatory cytokine. When released from contracting muscle tissue, IL-6 acts as an anti-inflammatory myokine and is one of the first cytokines to be upregulated after exercise, leading to increased whole-body lipolysis and β -oxidation.²² IL-6 also plays regenerative and anti-inflammatory roles, particularly when secreted by skeletal muscle during physical activity. It promotes anti-diabetogenic effects such as increased muscle glucose uptake, stimulation of pancreatic insulin secretion, and enhanced lipolysis and oxidation. Furthermore, IL-6 regulates several physiological processes, including skeletal muscle hypertrophy.²³ When IL-6 is released into circulation, it promotes energy availability for contracting muscles by increasing lipolysis and gluconeogenesis throughout the body. IL-6 also indirectly increases energy mobilization by inducing cortisol secretion and enhances muscle energy uptake by increasing insulin receptor sensitivity. Additionally, IL-6 reallocates energy toward muscle tissue by temporarily downregulating other energy-consuming processes. The energy allocated by IL-6 during and after exercise is used for muscle contraction and muscle recovery.²³

Reductions in body fat may also occur due to increased overall physical activity, including resistance training. Increased activity elevates cardiac output and stimulates lipolysis to compensate for increased energy expenditure.²⁴ A study by Uga et al. demonstrated a significant reduction in triglyceride levels among older adults after one month of resistance training ($p < 0.05$), indicating a significant effect of resistance training on lipid metabolism.²⁴ Similar findings were reported by Nduru and Dinata, who observed a reduction in superficial back fat thickness following weight training.¹⁶ A systematic review and meta-analysis by Wewege et al. further confirmed that resistance training significantly reduces body fat percentage, fat mass, and visceral fat in healthy adults.¹⁰

In the control group, no significant difference was observed between pretest and posttest skeletal muscle percentage ($p = 0.074$), likely due to the absence of resistance training intervention. However, a significant difference was observed in body fat percentage ($p = 0.037$), which may be attributed to other uncontrolled physical activities. Previous studies have shown that aerobic exercise can reduce fat mass and body weight.²⁵

Overall, the findings of this study confirm that weight training using the push, pull, and leg method significantly increases skeletal muscle percentage and reduces body fat percentage, as evidenced by statistically significant changes between pretest and posttest measurements in the intervention group.

CONCLUSION

This study concludes that weight training using the push, pull, and leg method has a significant effect on body composition, particularly in increasing skeletal muscle percentage and reducing body fat percentage. The implementation of a structured push, pull, and leg training program performed three times per week for four weeks resulted in a statistically significant increase in skeletal muscle percentage and a significant decrease in body fat percentage in the intervention group. These findings indicate that the push,



pull, and leg weight training method is an effective and practical training approach for improving muscle mass and reducing fat mass, thereby contributing positively to overall health and the prevention of non-communicable diseases.

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