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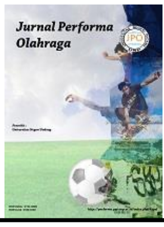

THE EFFECT OF STRUCTURED SWIMMING TRAINING ON BLOOD PRESSURE REDUCTION AND BODY COMPOSITION IN NON-ATHLETE ADULTS

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ABSTRACT

High blood pressure and increased body fat are major risk factors for cardiovascular and metabolic diseases in adult men. Regular physical activity, particularly water aerobic exercise such as swimming, has significant potential for lowering blood pressure and improving body composition, but has been little systematically studied in adult non-athlete populations. This study aimed to evaluate the effects of a structured swimming training program on systolic and diastolic blood pressure, and body fat percentage in non-athlete adult men. This study used a one-group pretest-posttest experimental design. Twenty non-athlete men aged 25–40 years participated in a six-week swimming training program, three times per week, for 30 minutes each session. The program consisted of moderate-intensity freestyle swimming training (60–75% HRmax). Statistical analysis was performed using a paired t-test ($p < 0.05$). There was a significant decrease in systolic (pretest = 132.4 ± 6.3 mmHg; posttest = 125.1 ± 5.7 mmHg; $p < 0.001$) and diastolic (pretest = 84.7 ± 5.1; posttest = 79.3 ± 4.8; $p < 0.01$) blood pressure, as well as a decrease in body fat percentage from 24.1 ± 3.2% to 21.8 ± 2.9% ($p < 0.01$). Structured swimming training significantly reduced blood pressure and body fat in non-athlete adult men. This intervention is worthy of recommendation as a water exercise-based preventive strategy.

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INTRODUCTION

Non-communicable diseases (NCDs), particularly hypertension and obesity, are currently the leading causes of premature mortality worldwide. According to the World Health Organization (2023), approximately 1.28 billion adults globally suffer from elevated blood pressure, and more than 39% of adults are classified as overweight or obese. These conditions have a direct impact on public health systems, increase economic burden, and reduce both individual productivity and quality of life, particularly among adults in their most productive years.

A significant contributor to the increasing prevalence of NCDs is the adoption of sedentary lifestyles. Technological advancements and modern work demands have led to decreased physical activity and prolonged sedentary behavior, especially among non-athlete adults (Goyal & Rakhra, 2024). This inactivity disrupts physiological balance and contributes to a range of metabolic and cardiovascular disorders. Without regular exercise, the risk of developing hypertension, central obesity, and insulin resistance increases significantly (Syeda et al., 2023).

Regular physical activity, especially aerobic exercise, is widely recognized as a non-pharmacological strategy to prevent and manage hypertension and obesity. Meta-analytic evidence suggests that moderate-to-high-intensity aerobic exercise can reduce systolic blood pressure by 5–8 mmHg, thereby significantly lowering the risk of cardiovascular diseases (Tian & Meng, 2019). In addition, aerobic training enhances insulin sensitivity, improves endothelial function, and supports a healthier body composition by reducing fat mass and increasing lean muscle mass (Colberg et al., 2016).

Swimming as a water-based aerobic exercise, offers unique physiological advantages over land-based exercises. The resistance provided by water enables a full-body workout with minimal impact on the joints, making it especially suitable for overweight or previously inactive individuals (Izquierdo et al., 2021; Zhu et al., 2023). The aquatic environment also assists in thermal regulation and allows prolonged cardiovascular engagement with lower perceived exertion. These characteristics support swimming as an accessible and safe exercise modality for adults seeking to improve health outcomes.

Swimming has been associated with increased parasympathetic activity and reduced sympathetic tone, which are beneficial in lowering resting heart rate and blood pressure (Lakin et al., 2018; Medeiros et al., 2004). Additionally, regular swimming contributes to favorable changes in anthropometric parameters, including significant reductions in body fat percentage and body mass index (BMI). A meta-analysis conducted by (Zhu et al., 2023) demonstrated that a 6 to 12-week swimming program could reduce body fat by 2–4% in previously inactive adults, indicating swimming's potential as an effective intervention for body composition management.

The most existing studies on the physiological effects of swimming focus on athletic populations or individuals with high baseline fitness. There remains a paucity of research targeting non-athlete adult men, particularly those in their working years who are at elevated risk for metabolic syndrome due to declining physical activity. This demographic often lacks structured fitness interventions tailored to their health status and lifestyle limitations, underscoring the need for applied research in this population segment.

Therefore, the purpose of this study is to investigate the effects of a structured swimming training program—consisting of 30-minute sessions, three times per week for six weeks—on systolic and diastolic blood pressure, as well as body fat percentage in non-athlete adult men. The findings of this study are expected to provide empirical evidence supporting the implementation of swimming as a practical, safe, and effective form of preventive exercise for adults at risk of hypertension and obesity-related complications.

METHOD

This study employed a quantitative experimental approach with a one-group pretest-posttest design, aiming to evaluate the effects of a structured swimming training program on blood pressure and body composition in non-athlete adult men. This design was selected because it allows for the direct observation of physiological changes within the same individuals before and after the intervention, thereby minimizing inter-subject variability.

The population targeted in this study consisted of non-athlete adult men aged 25 to 40 years residing in Bangkalan Regency, East Java, Indonesia. A total of 20 participants were recruited through purposive sampling based on the following inclusion criteria:

1. Medically healthy (confirmed through a general medical screening),
2. No history of severe hypertension (≥180/110 mmHg) or cardiovascular disease,
3. Not currently undergoing pharmacological treatment for blood pressure or weight control,
4. Not engaged in any structured physical exercise program in the last three months,
5. Able to swim at least 25 meters using basic freestyle technique.

Exclusion criteria included:

- The presence of an active musculoskeletal injury,
- The inability to complete swimming tasks due to technical or physical limitations,
- Inconsistent attendance (<80%) during the training program.

Swimming Training Program

The structured swimming training program lasted for six weeks, with a frequency of three sessions per week, and a duration of 30 minutes per session. Each session followed a consistent format:

- Warm-up (5 minutes): Dynamic stretching and land-based mobility drills.
- Main swimming set (20 minutes): Freestyle swimming at an intensity of 60–75% of estimated maximum heart rate (HRmax). Training intensity was determined using the Karvonen formula and monitored using a Polar H10 heart rate monitor worn during exercise. The swimming distance varied from 400 to 600 meters per session, progressively increasing over the weeks based on individual capacity and adaptation.
- Cool-down (5 minutes): Low-intensity swimming or floating followed by light stretching.

All sessions were conducted in a 25-meter public swimming pool with standardized water temperature (27–29°C) and were supervised by a certified swimming coach to ensure participant safety, training consistency, and appropriate intensity adherence.

Data Collection Instruments

- Blood Pressure Measurement: Systolic and diastolic blood pressure were assessed using the Omron HEM-7120 digital sphygmomanometer, which has been clinically validated. Measurements were taken in the seated position, in the morning at rest, on two consecutive days, and the average value was recorded to ensure accuracy.
- Body Composition Analysis: Body fat percentage was measured using a Tanita BC-545N bioelectrical impedance analysis (BIA) device. Participants were instructed to avoid caffeine, alcohol, and intense physical activity 24 hours before testing. Measurements were taken two hours after their last meal and under standard hydration conditions.

Data Analysis

Data normality was assessed using the Shapiro–Wilk test. If data were normally distributed, a paired samples t-test was used to compare pretest and posttest values of systolic blood pressure, diastolic blood pressure, and body fat percentage. Statistical significance was determined at a threshold of $p < 0.05$. All analyses were performed using IBM SPSS Statistics version 26.0.

RESULT AND DISCUSSIONS

Research Result

All subjects completed a six-week swimming training program, and blood pressure and body composition were repeated to evaluate the intervention's effects. Statistical analysis revealed significant changes in most of the observed variables. Details of the pretest and posttest data for each variable are shown in Table 1.

Table 1. Mean and Statistical Test of Blood Pressure and Body Fat Percentage Before and After Swimming Exercise Intervention

Variables	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Δ Mean	t value	p-value	Information
Systolic Blood Pressure	132.4 ± 6.3 mmHg	125.1 ± 5.7 mmHg	-7.3	6.87	< 0.001	Significant
Diastolic Blood Pressure	84.7 ± 5.1 mmHg	79.3 ± 4.8 mmHg	-5.4	5.23	< 0.01	Significant
Body Fat Percentage	24.1 ± 3.2 %	21.8 ± 2.9 %	-2.3	5.79	< 0.01	Significant

A six-week structured swimming training program conducted by participants showed a significant decrease in systolic blood pressure, with a pretest average of 132.4 ± 6.3 mmHg to 125.1 ± 5.7 mmHg at posttest ($p < 0.001$). Similarly, diastolic blood pressure decreased from 84.7 ± 5.1 mmHg to 79.3 ± 4.8 mmHg ($p < 0.01$). In addition to cardiovascular parameters, participants' body composition also showed improvements. The average body fat percentage decreased from 24.1 ± 3.2% to 21.8 ± 2.9% after the intervention ($p < 0.01$). All variables showed statistically significant differences based on paired t-test results. These results indicate that a swimming training program with moderate frequency and duration has a significant positive impact on the cardiometabolic health of non-athlete adult men, even though it is carried out for a relatively short time.

Discussions

The results of this study showed that six weeks of structured swimming training significantly reduced systolic and diastolic blood pressure and body fat percentage in non-athlete adult men. This suggests that water-based physical activity, such as swimming, has a positive effect on cardiometabolic regulation, even in a previously inactive population (Ferreira et al., 2020). This effect is important in the context of primary prevention of non-communicable diseases, the prevalence of which continues to increase in those of productive age.

The resulting reduction in blood pressure can be explained by the physiological adaptation of the cardiovascular system to repeated aerobic stimuli. Swimming, as a low-impact aerobic exercise, increases plasma volume expansion, improves endothelial function, and decreases systemic vascular resistance, all of which contribute to blood pressure reduction (Nystoriak & Bhatnagar, 2018). It also increases baroreceptor sensitivity and parasympathetic tone, important mechanisms in the control of blood pressure homeostasis (SALAH et al., 2025). A study by (Ghadieh & Saab, 2015) showed that moderate-to-high-intensity aerobic exercise for at least 4 weeks effectively reduced systolic blood pressure by 5–8 mmHg, supporting the findings of this study. The 7.3 mmHg reduction in this study strengthens swimming's position as an effective non-pharmacological intervention, particularly because it engages all major muscle groups without causing undue stress on the musculoskeletal system.

This positive impact is reinforced by the findings of (Bergamin et al., 2013), who stated that water-based exercise results in a more dominant activation of the parasympathetic nervous system compared to land-based exercise, especially in subjects with borderline blood pressure. This activation helps lower resting heart rate and blood pressure by chronically decreasing sympathetic tone. Thermal factors and the hydrostatic pressure of the water contribute to accelerating stable and sustained hemodynamic adaptation. In addition to the effect on blood pressure, body fat percentage also showed a significant decrease of 2.3%. This may be attributed to the metabolic characteristics of swimming, which can increase energy expenditure through the simultaneous rhythmic contraction of large muscles. According to (Fauzi Antoni et al., 2022) moderate-intensity swimming for ≥30 minutes can increase post-exercise fat oxidation and accelerate basal metabolism.

These findings are also supported by a study by (Golbidi & Laher, 2014) which found that regular aerobic-based physical activity reduced pro-inflammatory adipokine levels, improved lipid metabolism, and decreased visceral fat accumulation. Thus, even with a duration of only six weeks, consistent and structured exercise can trigger significant changes in body composition, especially in previously inactive individuals. The participants' age range of 25–40 years also contributed to the effectiveness of adaptation. At this age, the cardiovascular and muscular systems are still in a responsive phase to aerobic stimuli. According to a report by (Distefano & Goodpaster, 2018) productive-age adult men who become physically active have a greater chance of reversing the risk of metabolic syndrome compared to older age groups, due to their still high physiological plasticity.

Adaptations that occur during interventions are not only functional but also structural. Swimming training promotes increased muscle capillarization, mitochondrial enzyme expression, and peripheral tissue insulin sensitivity. (Jung et al., 2024) reported that structured aerobic activity for 6–12 weeks increased nitric oxide synthase expression in vascular endothelium, which improved arterial elasticity and lowered basal blood pressure systemically. However, the effectiveness of swimming as an intervention is determined not only by duration and intensity, but also by participant compliance and engagement. (Tang et al., 2022) stated that engagement levels in water-based exercise programs tend to be higher due to their enjoyable nature and minimal risk of injury. This contributes to the success of the intervention in the short term and its potential for long-term sustainability.

Limitations of this study lie in the absence of a control group and comparison variables such as diet or psychological stress, which can influence blood pressure and body composition. Future studies with a randomized controlled trial (RCT) design and nutritional monitoring could improve the validity of the results. Nevertheless, these findings provide preliminary evidence that a structured swimming training program could be an applicable preventive and therapeutic strategy in community settings.

CONCLUSSION

Six weeks of structured swimming training, with a duration of 30 minutes per session and a frequency of three times per week, has been shown to have a significant positive impact on systolic blood pressure, diastolic blood pressure, and body fat percentage in non-athlete adult men. The statistically significant reductions in these three variables indicate that swimming is an effective, safe, and applicable form of aerobic physical activity to support cardiometabolic health in the productive age group.

Physiologically, adaptations that occur through swimming training include improved vascular function, increased parasympathetic tone, and metabolic efficiency, which support blood pressure regulation and reduce body fat accumulation. Swimming's low-impact benefits also make it suitable for non-athletes seeking to improve fitness without risking joint injury.

These findings provide empirical evidence that a moderate-intensity swimming program can be integrated as part of a promotive and preventive strategy to prevent hypertension and obesity. Therefore, similar interventions are recommended for community-based or primary healthcare settings to improve the quality of life of working-age individuals who are not yet physically active.

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