Analysis Of Blood Pressure After Swimming Exercise (Study Case in Sport Science Students at Universitas Ngudi Waluyo)

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Abstract

Swimming is an aerobic exercise that provides substantial cardiovascular benefits by improving cardiac function, vascular elasticity, and autonomic regulation. Acute swimming exercise induces physiological changes in blood pressure, reflecting cardiovascular adaptation to increased metabolic demand. Although these responses have been widely investigated among athletes and clinical populations, evidence regarding Sport Science students remains limited. This study aimed to analyze blood pressure changes after moderate-intensity swimming exercise among Sport Science students at Ngudi Waluyo University. A quantitative descriptive study design was conducted involving 46 Sport Science students selected through purposive sampling. Blood pressure was measured immediately after a 30-minute moderate-intensity swimming session using a calibrated digital sphygmomanometer. Descriptive statistics were used to summarize participant characteristics. Results of this study was the mean systolic blood pressure was 126.02 ± 12.49 mmHg and diastolic blood pressure was 80.30 ± 9.11 mmHg. Conclusion of this study was Moderate-intensity swimming exercise was blood pressure after exercise is pre-hypertension.

Introduction

Hypertension remains one of the most significant public health problems worldwide because it is a major risk factor for cardiovascular disease, stroke, heart failure, and chronic kidney disease. According to the World Health Organization, more than one billion adults worldwide experience elevated blood pressure, and many remain undiagnosed or untreated. Lifestyle modification, particularly regular physical activity, is recognized as the primary non-pharmacological strategy for maintaining normal blood pressure and reducing cardiovascular risk (Igarashi & Nogami, 2018).

Aerobic exercise improves cardiovascular function through multiple physiological mechanisms, including enhanced endothelial function, increased nitric oxide production, reduced arterial stiffness, improved autonomic nervous system balance, and decreased peripheral vascular resistance. These adaptations contribute not only to long-term reductions in resting blood pressure but also to improved cardiovascular efficiency during physical activity (Saco-Ledo et al., 2021).

Swimming is considered one of the safest forms of aerobic exercise because it combines rhythmic muscular activity with water immersion. Unlike land-based exercise, swimming minimizes joint loading through buoyancy while simultaneously increasing venous return due to hydrostatic pressure. Consequently, swimming provides effective cardiovascular stimulation with relatively low orthopedic stress. During swimming, hydrostatic pressure increases central blood volume, resulting in greater ventricular filling and stroke volume. Cardiac output consequently rises to satisfy increased oxygen demand from active skeletal muscles. This physiological response generally produces a transient elevation in systolic blood pressure while diastolic blood pressure remains relatively unchanged because peripheral vasodilation offsets increased cardiac output (Igarashi & Nogami, 2018).

Another important physiological response following aerobic exercise is post-exercise hypotension (PEH), characterized by blood pressure reductions below baseline values several minutes to hours after exercise cessation. PEH is associated with sustained vasodilation, reduced sympathetic nervous system activity, and improved endothelial function. Systematic

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reviews indicate that aquatic exercise can induce clinically meaningful reductions in blood pressure, particularly among individuals with hypertension.

Sport Science students represent an appropriate population for investigating acute cardiovascular responses because they routinely engage in physical activity as part of their academic curriculum. However, individual differences in aerobic fitness, body composition, and training history may influence cardiovascular adaptation to exercise. Evaluation of blood pressure responses following swimming may therefore provide valuable information regarding cardiovascular fitness and exercise tolerance. Although numerous studies have investigated chronic effects of aquatic exercise among hypertensive adults, limited evidence exists regarding acute blood pressure responses immediately after swimming among healthy university students. Therefore, this study aimed to analyze blood pressure after moderate-intensity swimming exercise among Sport Science students at Ngudi Waluyo University.

The findings are expected to contribute to exercise physiology research while providing practical recommendations for swimming-based exercise programs in higher education.

Methods

This study employed a quantitative descriptive study design. This design was selected to evaluate the acute effect of moderate-intensity swimming exercise on blood pressure among Sport Science students. Blood pressure was measured before and immediately after the swimming intervention, allowing each participant to serve as his or her own control (Creswell & Creswell, 2018). Participants were instructed to avoid strenuous physical activity, caffeine, alcohol, smoking, and energy drinks for at least 12 hours before the experiment to reduce potential confounding factors affecting blood pressure measurements (American College of Sports Medicine [ACSM], 2022). The study population consisted of undergraduate students enrolled in the Sport Science Department at Universitas Ngudi Waluyo. The sample in this study consisted of 46 individuals, selected using the purposive sampling technique. Blood pressure was measured using a calibrated automatic digital sphygmomanometer (Omron HEM-7156) with an accuracy of ±3 mmHg. Blood pressure was measured immediately after a 30-minute moderate-intensity swimming session using a calibrated digital sphygmomanometer. Descriptive statistics were used to summarize participant characteristics.

Results and Discussion

A total of 46 Sport Science students participated in this study. All participants completed the swimming intervention and blood pressure measurements. The participants were healthy young adults with no history of hypertension or cardiovascular disease.

Table 1. Characteristics of Respondens

Variable	Min	Max	Mean ± SD
Age	17	29	19 ± 1.9
Weight	40	81	54.93 ± 8.7
Height	147	178	160.58 ± 6.1
Blood Pressure			
a. Sistolic	97	156	126.02 ±12.49
b. Diastolic	64	104	80.3 ± 9.1

Research results indicate that systolic blood pressure rises following moderate-intensity swimming. This finding represents a normal physiological response to aerobic exercise and does not necessarily indicate cardiovascular impairment. During physical activity, the muscles' demand for oxygen and nutrients increases significantly, requiring the cardiovascular system to enhance its capacity to pump blood to active tissues. This state is achieved through increased sympathetic nervous system activity, which leads to elevated heart rate, myocardial contractility, and stroke volume. Consequently, cardiac output rises, resulting in a temporary increase in systolic blood pressure.

The rise in systolic blood pressure following swimming exercise observed in this study aligns with exercise physiology theory, which posits that the magnitude of the blood pressure increase is influenced by exercise intensity, the muscle mass involved, and the individual's fitness level. The greater the metabolic demand during exercise, the higher the cardiac output required to maintain oxygen supply to the muscles. Consequently, the post-exercise increase in systolic blood pressure represents an acute adaptation necessary to sustain tissue perfusion during physical activity.

Swimming differs from land-based aerobic exercise because it takes place in an aquatic environment. The hydrostatic pressure of the water enhances venous return to the heart, thereby increasing the volume of blood filling the ventricles at the end of diastole. This condition boosts stroke volume via the Frank-Starling mechanism, enabling the heart to pump a larger volume of blood with each beat. This increase in stroke volume contributes to a rise in systolic blood pressure immediately following a swimming session; however, in healthy individuals, this elevation remains within physiological limits (Mutter et al., 2017).

Meanwhile, the absence of a significant increase in diastolic blood pressure during the study aligns with the normal response to aerobic exercise. During physical activity, vasodilation occurs in the arterioles supplying active muscles due to increased production of nitric oxide and other vasodilatory mediators. This vasodilation reduces total peripheral resistance, thereby counterbalancing the increase in cardiac output. Consequently, diastolic blood pressure tends to remain stable or undergo only minor changes, even as systolic blood pressure rises (Green et al., 2022).

These research findings are consistent with various previous studies reporting that systolic blood pressure rises during and immediately after aerobic exercise, whereas diastolic blood pressure remains relatively stable. Schultz (2018) explains that the increase in systolic blood pressure during exercise is a normal response to the increased cardiac workload, while changes in diastolic blood pressure in healthy individuals are typically less than 10 mmHg. This response reflects the cardiovascular system's ability to maintain a balance between increased cardiac output and decreased peripheral resistance (Schultz, 2018).

The rise in blood pressure observed immediately after exercise must be distinguished from the phenomenon of post-exercise hypotension (PEH). In this study, measurements were taken immediately after participants completed their swimming session, meaning the body was still in the acute response phase to physical activity. During the recovery period—ranging from a few minutes to several hours—blood pressure typically begins to drop below pre-exercise levels due to sustained vasodilation, reduced sympathetic nervous system activity, and increased baroreceptor sensitivity. Consequently, if measurements were taken 30–60 minutes post-exercise, blood pressure would likely show a downward trend compared to the readings obtained immediately after the workout (Romero et al., 2017).

In addition to being influenced by exercise intensity, blood pressure response is also affected by cardiorespiratory fitness levels. Sports science students generally engage in higher levels of physical activity than the general population, resulting in superior cardiovascular system adaptations. Individuals with good fitness levels exhibit more optimal endothelial function, greater vascular elasticity, and faster autonomic nervous system recovery following exercise. These factors enable blood pressure to return to resting levels more quickly compared to less active individuals (Hoch et al., 2026).

The findings of this study have practical implications for sports instruction in higher education. An increase in systolic blood pressure immediately following swimming exercise need not be viewed as a pathological condition, provided it remains within the physiological range and returns to normal during the recovery phase. Therefore, blood pressure measurements for hypertension screening purposes should be conducted after participants have rested for at least 5–10 minutes—rather than immediately after physical activity—to ensure the results reflect true resting blood pressure (Schultz, 2018).

Nevertheless, an exaggerated blood pressure response during exercise warrants attention. Several studies indicate that individuals who experience a marked rise in systolic blood pressure during exercise are at greater risk of developing hypertension in the future. Therefore, monitoring blood pressure during exercise sessions can serve as part of the health assessment for students, particularly those with a family history of hypertension or other cardiovascular risk factors (Hoch et al., 2026).

Overall, the results of this study indicate that the rise in blood pressure following swimming exercise is a normal physiological response reflecting increased cardiac workload to meet metabolic demands during physical activity. This response demonstrates that the students' cardiovascular systems are capable of effectively adapting to aerobic exercise. Thus, swimming remains a safe and effective form of exercise for improving cardiorespiratory fitness and maintaining cardiovascular health, provided it is performed according to proper training principles.

Conclusion

The respondent's blood pressure after swimming exercise fell into the prehypertension category, with the mean of systolic blood pressure was 126.02 ± 12.49 mmHg and diastolic blood pressure was 80.30 ± 9.11 mmHg. This indicates that the respondent engaged in strenuous physical exercise, which can raise blood pressure.

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