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THE EFFECT OF 30 MINUTES OF SWIMMING TRAINING ON VO_2MAX IN 30-YEAR-OLD NON-ATHLETES

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Abstract

Maximal oxygen volume (VO_2Max) is a major indicator of aerobic capacity and cardiovascular health. At the age of 30 years, there is a gradual decline in cardiorespiratory function if not balanced with adequate physical activity. Swimming training is categorized as a low-impact aerobic activity that involves many muscle groups simultaneously and has the potential to increase VO_2Max in non-athlete populations. This study aims to evaluate the effect of 30-minute swimming training on increasing VO_2Max in 30-year-old non-athlete individuals. The design of this study was a one-group pretest-posttest with a quantitative approach. A total of 20 male subjects aged 30 years (±1 year), who were physically inactive and had no history of chronic disease, participated in a swimming training program for six weeks, three times a week, each for 30 minutes. VO_2Max was measured using a multistage fitness test (beep test) before and after the intervention. Statistical analysis used a paired t-test with a significance level of $p < 0.05$. The results showed a statistically significant increase in VO_2Max (mean pretest = 35.2 ± 3.4 ml/kg/min; posttest = 39.1 ± 3.6 ml/kg/min; $p < 0.001$), indicating a positive adaptation to aerobic training in water. Regular 30-minute swimming training has been shown to be effective in increasing VO_2Max in non-athlete 30-year-old individuals. This training can be recommended as an efficient and low-risk fitness strategy for the productive age group.

Keywords: *VO_2Max; swimming; aerobic capacity;*

INTRODUCTION

Aerobic capacity or Maximal Oxygen Volume (VO_2Max) is one of the main physiological indicators that reflects the efficiency of a person's cardiovascular and respiratory systems in meeting metabolic needs during high-intensity physical activity. Optimal VO_2Max values are positively correlated with physical fitness and increase the ability to cover the daily activities, metabolic function, and reduced risk of morbidity and mortality from non-communicable diseases such as heart disease, hypertension, and type 2 diabetes (Herold et al., 2019; Ross & Myers, 2023).

Physiologically VO_2Max capacity experiences a gradual decline starting from the mid-20s to the 30s, with a rate of decline of around 1%–2% per year if not balanced by adequate physical activity (Letnes et al., 2023). The age of 30 is the beginning of the middle adulthood phase where changes in body composition and decreased cardiorespiratory function begin to appear, especially in individuals with a sedentary lifestyle. Unfortunately, individuals in this age group, especially those who are not athletes, tend to have limited time and motivation to do structured physical activity, making them a risk group for decreased cardiorespiratory fitness (Arena et al., 2022).

Regular aerobic exercise has been shown to significantly increase VO_2Max. Activities such as running, cycling, and swimming are forms of aerobic exercise that are effective in increasing oxygen consumption, strengthening the heart muscle, and improving muscle perfusion (Crowley et al., 2022). Among these forms of exercise, swimming is an ideal choice because it is low-impact, activates almost all large muscle groups, and has minimal risk of musculoskeletal injury. In addition, swimming has a good adaptive effect on the cardiovascular and respiratory systems without causing excessive mechanical stress, making it suitable for the productive age population who are not yet accustomed to high-intensity exercise (Meredith-Jones et al., 2011).

Recent studies have shown that swimming training can have a positive impact on VO_2Max, even in short durations when done regularly. However, most of these studies have focused on groups of athletes, adolescents, or the elderly. Research on the effect of 30-minute swimming training on increasing VO_2Max in non-athlete individuals aged 30 years is still very limited, even though this approach has great potential as a practical and realistic intervention for the general population (Lahart & Metsios, 2018; Sideravičiūte et al., 2006)

Therefore, this study aims to evaluate the effect of 30-minute swimming training per session on increasing VO_2Max in 30-year-old non-athlete individuals. The results of this study are expected to enrich the literature on swimming-based fitness interventions and provide a scientific basis for the development of adaptive training programs for productive age groups.

METHOD

This study used a quantitative experimental approach with a pretest-posttest one group design to evaluate the effect of 30-minute swimming training on increasing VO_2Max in non-athlete individuals aged 30 years. The subjects of the study were 20 male individuals aged 30 years (±1 year) who had no history of being athletes and had not participated in a structured physical training program for the past six months. Subjects were selected using a purposive sampling technique with the following inclusion criteria: (1) physically healthy, (2) able to swim freestyle for at least 30 minutes, and (3) had no history of cardiovascular disease or musculoskeletal disorders.

The training program was conducted for 6 weeks, with a frequency of 3 times per week and a duration of 30 minutes per session, excluding warm-up and cool-down. Swimming training was performed at an intensity of 60–75% of maximum heart rate, monitored using a heart rate monitor. VO_2Max was measured before and after the intervention using a beep test (multistage fitness test), which is valid for non-athlete adult populations.

VO_2Max was estimated through beep test results. Attendance and compliance with exercise were recorded through daily exercise journals. Data were analyzed using paired t-test if the distribution was normal (with Shapiro-Wilk test), or Wilcoxon test if the distribution was not normal. Significance was set at $p < 0.05$.

RESULT AND DISCUSSION

This study involved 20 non-athlete participants aged 30 years who participated in a six-week swimming training program, with each session lasting 30 minutes. Aerobic capacity was measured using the VO_2Max beep test before and after the intervention. Based on the results of measurements using the beep test, it was found that there was an increase in VO_2Max values after a 6-week swimming training program intervention. The average VO_2Max value increased from 35.2 ml/kg/min to 39.1 ml/kg/min, or an increase of 3.9 ml/kg/min.

Table 1. Statistical Description of VO_2Max

Measurement Stage	Average (Mean)	(SD)	Minimum	Maximum
Pretest	35.2 ml/kg/min	3.4	30.1	40.7
Posttest	39.1 ml/kg/min	3.6	33.8	44.2

Table 2. Paired T-test

Statistic test	Statistic	Sig. (p-value)
Shapiro-Wilk (pretest)	0.959	0.240
Paired t-test	$t(19) = 9.21$	$p < 0.001$

The Shapiro-Wilk normality test showed that the data were normally distributed ($p = 0.240$). Therefore, the analysis was continued with a paired sample t-test. The t-test results showed a significant difference between VO_2Max values before and after training ($t(19) = 9.21$, $p < 0.001$), indicating that the 6-week swimming training program had a positive effect on increasing aerobic capacity.

Discussion

The results of this study indicate that a 30-minute swimming training program per session, for 6 weeks, significantly increased VO_2Max in 30-year-old non-athletes. The mean increase of 3.9 ml/kg/min indicates positive physiological adaptations to water-based aerobic training. Physiologically, the age of 30 is the beginning of the middle adulthood phase, where a number of biological changes begin to occur slowly. Although individuals at this age are generally still at peak functional capacity, several body systems begin to show signs of declining performance, especially in the cardiovascular, respiratory, and muscle metabolism aspects if not accompanied by an active lifestyle (Leon, 2017). One indicator that begins to decline in this phase is VO_2Max, which can decrease by around 1%–2% per year if not balanced with adequate physical activity (Buttar et al., 2019).

Swimming training as a form of aerobic exercise has specific physiological advantages in increasing VO_2Max. From an exercise physiology perspective, swimming training increases the efficiency of oxygen transport and utilization through several mechanisms: (1) Increased stroke volume and cardiac output, (2) Pulmonary ventilation adaptations such as increased tidal volume and strengthening of respiratory muscles, (3) Peripheral adaptations such as increased capillary density and number of mitochondria in aerobic muscle fibers (Hellsten & Gliemann, 2024). Physiologically, individuals at the age of 30 begin to enter early middle adulthood, during which biological functions gradually decline. This decline particularly affects cardiac, pulmonary, and muscular functions, which directly impact VO_2Max if not counterbalanced with regular physical activity (Cartee et al., 2016). In this context, swimming emerges as an effective intervention to maintain and enhance aerobic capacity, as it is low-impact yet provides comprehensive stimulation to the cardiovascular and respiratory systems.

Swimming improves VO_2Max through three primary mechanisms. First, from a cardiovascular perspective, it increases stroke volume and cardiac output, allowing greater oxygen delivery to the tissues. Second, from a respiratory perspective, it enhances tidal volume and strengthens respiratory muscles due to the hydrostatic pressure of water and the rhythmic breathing pattern involved in swimming. Third, on a peripheral level, it boosts capillary density and mitochondrial count in aerobic muscle fibers, improving oxygen utilization efficiency at the cellular level (Costa et al., 2015). Moreover, the aquatic environment in swimming offers even resistance across the body, enhancing overall neuromuscular coordination. Water also helps regulate body temperature, enabling participants to exercise at a moderate intensity without overheating. This factor plays a crucial role in maintaining optimal training duration and consistency (Zhu et al., 2023).

At the age of 30, basal metabolism begins to slow down. Without adequate physical activity, muscle mass tends to decrease and body fat increases, both of which negatively affect metabolic efficiency and aerobic capacity (Nurpratiwi et al., 2025; Palmer & Jensen, 2022). Swimming can effectively address this issue by stimulating comprehensive muscular activity and promoting optimal calorie expenditure. This study aligns with findings by (Jakše et al., 2024), who reported that an eight-week swimming program significantly increased VO_2Max and reduced body fat in adults—yielding even better outcomes than walking. These findings reinforce the notion that swimming as an aerobic exercise offers dual benefits for cardiovascular and muscular systems due to the unique properties of water.

Additionally, from a psychological standpoint, swimming activates the parasympathetic nervous system, helping reduce stress, improve sleep quality, and maintain hormonal balance. These factors indirectly support VO_2Max improvement by enhancing recovery and adaptation processes following exercise (O'Connor et al., 2022). Thus, a swimming program proves to be a physiologically effective, safe, and enjoyable alternative for aerobic training, especially for individuals in their productive years. These results strengthen the evidence that moderate-duration exercise, when performed consistently, can bring meaningful improvements to physical capacity.

Swimming activities are carried out in water media that provide even resistance throughout the body. This creates overall muscle stimulation and improves neuromuscular coordination, which contributes to the efficiency of oxygen metabolism. Water temperature also supports the body's physiological stability during exercise, thus facilitating exercise in optimal duration without the risk of overheating (Zhang & Liu, 2024). Swimming also has an impact on metabolic function and body composition, especially at the age of 30 years where the metabolic rate begins to slow down and muscle mass tends to decrease if not done regularly with weight training or aerobics. Decreased muscle mass can interfere with basal metabolic efficiency and accelerate body fat accumulation, which in turn reduces cardiovascular efficiency and suppresses VO_2Max (Lee et al., 2022). By doing swimming exercises, metabolic adaptation and energy use become more optimal, especially with a structured training pattern as in this study.

Other studies also support that swimming can significantly increase aerobic capacity, even in non-athlete populations. Research by (Cox et al., 2010) showed that adults who swam for 8 weeks experienced an increase in VO_2Max and a decrease in body fat levels, with better effects than walking training. This reinforces that training in an aquatic environment has the advantage of stimulating the cardiovascular and muscular systems simultaneously. Additional effects of swimming training at age 30 also include improved posture, flexibility, core strength, and decreased stress levels through activation of the parasympathetic system, which helps maintain hormonal balance and sleep quality (Stanley et al., 2013). This physiological balance is essential for maintaining aerobic capacity and overall metabolic function.

Considering various physiological and psychological aspects at the age of 30, swimming can be positioned as a very effective, safe, and adaptive form of exercise to maintain and improve VO_2Max. This study adds to the evidence that even moderate exercise duration (30 minutes) can provide significant effects if done consistently, especially for the productive age population who tend to have limited time.

CONCLUSION

Based on the findings, it can be concluded that a structured 30-minute swimming program conducted over six weeks significantly improves VO_2Max in non-athlete individuals aged 30. This improvement reflects positive physiological adaptations in response to water-based aerobic activity. Swimming has been proven effective in enhancing cardiovascular and respiratory efficiency, while also supporting healthy metabolism and body composition during early adulthood.

REFERENCES

Arena, R., Hall, G., Laddu, D. R., Phillips, S. A., & Lavie, C. J. (2022). A tale of two pandemics revisited: Physical inactivity, sedentary behavior and poor COVID-19 outcomes reside in the same Syndemic City. In *Progress in cardiovascular diseases* (Vol. 71, pp. 69–71). https://doi.org/10.1016/j.pcad.2021.11.012

Buttar, K., Scholar, Saboo, N., & Kacker, S. (2019). *A review: Maximal oxygen uptake (VO2 max) and its estimation methods*. 24–32.

Cartee, G. D., Hepple, R. T., Bamman, M. M., & Zierath, J. R. (2016). Exercise Promotes Healthy Aging of Skeletal Muscle. *Cell Metabolism*, *23*(6), 1034–1047. https://doi.org/10.1016/j.cmet.2016.05.007

Costa, M. J., Balasekaran, G., Vilas-Boas, J. P., & Barbosa, T. M. (2015). Physiological Adaptations to Training in Competitive Swimming: A Systematic Review. *Journal of Human Kinetics*, *49*, 179–194. https://doi.org/10.1515/hukin-2015-0120

Cox, K., Burke, V., Beilin, L., & Puddey, I. (2010). A comparison of the effects of swimming and walking on body weight, fat distribution, lipids, glucose, and insulin in older women--the Sedentary Women Exercise Adherence Trial 2. *Metabolism: Clinical and Experimental*, *59*, 1562–1573. https://doi.org/10.1016/j.metabol.2010.02.001

Crowley, E., Powell, C., Carson, B. P., & W Davies, R. (2022). The Effect of Exercise Training Intensity on VO(2)max in Healthy Adults: An Overview of Systematic Reviews and Meta-Analyses. *Translational Sports Medicine*, *2022*, 9310710. https://doi.org/10.1155/2022/9310710

Hellsten, Y., & Gliemann, L. (2024). Peripheral limitations for performance: Muscle capillarization. *Scandinavian Journal of Medicine & Science in Sports*, *34*(1), e14442. https://doi.org/https://doi.org/10.1111/sms.14442

Herold, F., Müller, P., Gronwald, T., & Müller, N. G. (2019). Dose-Response Matters! - A Perspective on the Exercise Prescription in Exercise-Cognition Research. *Frontiers in Psychology*, *10*, 2338. https://doi.org/10.3389/fpsyg.2019.02338

Jakše, B., Gilić, B., Đurović, M., & Šajber, D. (2024). The Effects of an Eight-Week Swimming Program on Body Composition and Assessment of Dietary Intake in Post-COVID-19 Patients. *Journal of Nutrition and Metabolism*, *2024*, 3037784. https://doi.org/10.1155/2024/3037784

Lahart, I. M., & Metsios, G. S. (2018). Chronic Physiological Effects of Swim Training Interventions in Non-Elite Swimmers: A Systematic Review and Meta-Analysis. *Sports Medicine (Auckland, N.Z.)*, *48*(2), 337–359. https://doi.org/10.1007/s40279-017-0805-0

Lee, J.-H., Kim, S.-Y., & Kim, D.-I. (2022). Association of muscle strength and body mass index with risk factors for metabolic syndrome and its prevalence in Korean adult women. *BMC Public Health*, *22*(1), 2060. https://doi.org/10.1186/s12889-022-14520-y

Leon, A. S. (2017). Attenuation of Adverse Effects of Aging on Skeletal Muscle by Regular Exercise and Nutritional Support. *American Journal of Lifestyle Medicine*, *11*(1), 4–16. https://doi.org/10.1177/1559827615589319

Letnes, J. M., Nes, B. M., & Wisløff, U. (2023). Age-related decline in peak oxygen uptake: Cross-sectional vs. longitudinal findings. A review. *International Journal of Cardiology. Cardiovascular Risk and Prevention*, *16*, 200171. https://doi.org/10.1016/j.ijcrp.2023.200171

Meredith-Jones, K., Waters, D., Legge, M., & Jones, L. (2011). Upright water-based exercise to improve cardiovascular and metabolic health: A qualitative review. *Complementary Therapies in Medicine*, *19*(2), 93–103. https://doi.org/https://doi.org/10.1016/j.ctim.2011.02.002

Nurpratiwi, R., Solikah, N. L., Susanti, S., & Ayuningtyas, T. R. (2025). The Relationship between Body Mass Index (BMI) and VO 2 Max in Sports Students. *Journal of Sport Medicine and Physiotherapy*, *1*(1), 33–39.

O'Connor, E., Mündel, T., & Barnes, M. J. (2022). Nutritional Compounds to Improve Post-Exercise Recovery. *Journal of Sport Medicine and Physiotherapy*, *14*(23). https://doi.org/10.3390/nu14235069

Palmer, A. K., & Jensen, M. D. (2022). Metabolic changes in aging humans: current evidence and therapeutic strategies. *The Journal of Clinical Investigation*, *132*(16). https://doi.org/10.1172/JCI158451

Ross, R., & Myers, J. (2023). Cardiorespiratory Fitness and Its Place in Medicine. *Reviews in Cardiovascular Medicine*, *24*(1), 14. https://doi.org/10.31083/j.rcm2401014

Sideravičiūte, S., Gailiūniene, A., Visagurskiene, K., & Vizbaraite, D. (2006). The effect of long-term swimming program on body composition, aerobic capacity and blood lipids in 14-19-year aged healthy girls and girls with type 1 diabetes mellitus. *Medicina (Kaunas, Lithuania)*, *42*(8), 661–666.

Stanley, J., Peake, J. M., & Buchheit, M. (2013). Cardiac parasympathetic reactivation following exercise: implications for training prescription. *Sports Medicine (Auckland, N.Z.)*, *43*(12), 1259–1277. https://doi.org/10.1007/s40279-013-0083-4

Zhang, G., & Liu, X. (2024). the Impact of Swimming Training on Physiological and Psychological Indicators in Individuals of Different Age Groups: a Cross-Sectional Study. *Revista Internacional de Medicina y Ciencias de La Actividad Fisica y Del Deporte*, *24*(94), 164–181. https://doi.org/10.15366/rimcafd2024.94.012

Zhu, H., Jin, J., & Zhao, G. (2023). The effects of water-based exercise on body composition: A systematic review and meta-analysis. *Complementary Therapies in Clinical Practice*, *52*, 101766. https://doi.org/https://doi.org/10.1016/j.ctcp.2023.101766

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