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The Role of Dryland Training Up and Down Stairs on Freestyle Swimming Kick Speed of STKIP PGRI Bangkalan Students

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ABSTRACT

Dryland training is a crucial component in developing swimming performance, particularly in enhancing the strength and endurance of the lower body muscles that contribute to kick speed in freestyle. This study aims to analyze the effect of stair climbing training, a form of dryland training, on freestyle kick speed in non-athletic students. The research method used was a quasi-experimental design with a one-group pretest-posttest design. The subjects of the study consisted of 20 male non-athlete students aged 18–22 years, who were selected using a purposive sampling technique. The intervention was carried out for six weeks with a frequency of three times per week, consisting of 4–6 sets of stair climbing for 30 minutes each session. Swimming kick speed was measured with a stopwatch in a 15-meter track with a streamline position using a footboard. Data were analyzed using a paired t-test to see the difference before and after training. The results showed a significant increase in kick speed ($p < 0.05$) after following the dryland training program. The average travel time decreased from 18.4 seconds to 16.7 seconds. These results indicate that stair climbing provides dynamic force transfer to the major muscles involved in the swimming kick, such as the quadriceps and gluteus muscles. In conclusion, stair climbing is an effective dryland training method to improve freestyle kick performance in non-athlete college students.

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B. Acquisition of data;
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INTRODUCTION

Swimming is a sport that requires harmonious integration between muscle strength, flexibility, movement efficiency, and neuromuscular coordination. Freestyle is the fastest and most widely used swimming technique, both in competitive and recreational contexts. One of the technical components that plays an important role in freestyle efficiency is the ability of the legs to produce a push or kick, which contributes around 10–30% to the total swimming speed, depending on the skill level and physical condition of the swimmer (Barbosa et al., 2013).

An effective kick requires strength and coordination of the major muscles of the lower extremity, including the quadriceps, gluteus maximus, hamstrings, and gastrocnemius muscles. In this context, dryland training—physical strengthening exercises outside the water—plays a strategic role in supporting swimming performance. One form of dryland training that is easy, economical, and effective is stair climbing, which involves explosive and repetitive movements of the leg muscles and can increase local endurance and dynamic strength (Kaur & Saini, 2014; Hufadz et al., 2025). This exercise also supports the development of the power component, which is very relevant to the speed of muscle contraction when kicking.

From the perspective of sports physiology, stair climbing exercises are included in the category of plyometric exercises that can increase motor unit activation, nerve firing frequency, and the efficiency of muscle anaerobic energy use (Oliver et al., 2024). This exercise can increase muscle elasticity and eccentric capacity, which directly contribute to movement efficiency when kicking in the water. This adaptation is very important, especially for non-athlete swimmers who do not yet have an optimal leg muscle strength foundation.

College students aged 18–23 years are an age group that is at the peak of their physical and physiological development phase. In this age range, the cardiovascular, musculoskeletal, and neuromuscular systems have a high capacity for adaptation to exercise stimuli. According to a report from the World Health Organization (2023), young adulthood is a critical phase for the formation of active lifestyle habits, because the adaptive response to physical exercise is much more optimal compared to older age groups. Therefore, training interventions in this age group have great potential to produce changes in performance in a relatively short time.

However, most students tend to have a decreased level of physical activity due to academic burden and a sedentary lifestyle. A study by (Morouço et al., 2012) showed that more than 60% of students in Indonesia have a low to moderate physical activity category, which is at risk of decreasing general physical fitness. In the context of swimming, this condition causes low technical efficiency, including in the leg kick phase, which requires specific strength and fine motor coordination.

The importance of dryland training to improve specific swimming components has been demonstrated in various studies, but most of them focus on weight training or core training. There is still very limited research that specifically assesses the effects of stair climbing and descending training on kick speed variables in freestyle swimming. Therefore, this study attempts to fill this gap by examining the effect of stair-based dryland intervention on kick speed in non-athlete students, with a physiological approach that is relevant to the characteristics of young adults.

METHODS

This study uses a quantitative approach with a quasi-experimental design of group pretest-posttest design, which aims to test the effect of dryland stair climbing training

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on freestyle kick speed in non-athlete students. This design allows researchers to compare conditions before and after the intervention without a control group.

The subjects in this study were 20 non-athlete male college students, aged 18–23 years, who had not been involved in a professional swimming training program or competitive sports activities in the last three months. Inclusion criteria included: (1) able to swim freestyle for at least 25 meters, (2) in good health and no history of lower extremity injuries, and (3) willing to follow the training program for six full weeks. The sampling technique was purposive sampling based on these criteria.

The intervention was conducted for six weeks, with a training frequency of three times per week, carried out at the campus facility. The training consisted of stair climbing (2–3 levels) at a moderate to high speed, 4–6 sets per session, with repetitions between 15–25 times per set. The training began with a dynamic warm-up and ended with a light cool-down. The intensity and volume of the training were adjusted progressively every two weeks. The program was designed to target the quadriceps, gluteus, and gastrocnemius muscles as the main muscle groups in the freestyle kick movement.

Measurements were made on freestyle kick speed using a 15-meter streamline kick test with a footboard. Subjects swam in a streamline position without arm movement, and time was recorded using a digital stopwatch by two independent observers. Measurements were taken twice (pretest and posttest) with a time interval of 48 hours before and after the intervention. Results were recorded in seconds, and the average value was used as the final data.

Data were analyzed using a paired sample t-test to determine the significance of the difference between the pretest and posttest results. The significance test was conducted using SPSS version 26 software, with the significance level set at $\alpha = 0.05$. Before the inferential test, a data normality test was conducted using Shapiro-Wilk to ensure that the parametric assumptions were met.

RESULTS AND DISCUSSION

After the intervention of dryland training up and down stairs for six weeks, significant changes were obtained in the freestyle kick speed of non-athlete students. The results of the measurement of the freestyle kick travel time on the 15-meter track are shown in Table 1 below:

Table 1.
Pretest-posttest freestyle kick measurements

Respondents	Pretest (seconds)	Posttest (seconds)	Difference (seconds)
R1	18.4	16.7	1.7
R2	19.1	17.3	1.8
R3	18.7	16.9	1.8
R4	17.9	16.2	1.7
R5	18.2	16.3	1.9
R6	18.6	16.8	1.8
R7	19.0	17.1	1.9
R8	18.3	16.5	1.8
R9	18.8	17.0	1.8

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R10	18.1	16.2	1.9
R11	18.9	17.0	1.9
R12	18.5	16.6	1.9
R13	17.8	16.0	1.8
R14	18.6	16.7	1.9
R15	18.4	16.5	1.9
R16	18.2	16.4	1.8
R17	18.9	17.0	1.9
R18	19.2	17.3	1.9
R19	18.7	16.8	1.9
R20	18.5	16.6	1.9
Average	**18.54**	**16.70**	**1.82**

Source: Primary data from kick speed measurements (2025)

Table 2.
Paired Samples Statistics

	Mean	N	Std.dev	Std. Error Mean
pretest	18.540	20	0.386	0.086
Post test	16.695	20	0.366	0.082

The average time in the pretest was 18.540 seconds, while in the posttest it decreased to 16.695 seconds. This decrease indicates an increase in task completion speed after the intervention. The standard deviation in the pretest was 0.386, while in the posttest it was 0.366, indicating the data were relatively homogeneous and not too spread out.

Table 3.
Paired Sample Test

	Mean	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Pre - Post	1.845	0.069	0.015	1.815	1.875	120.220	19	0.0000000000759

Since the p-value is <0.05, H_0 is rejected, and it can be concluded that there is a significant difference between the pretest and posttest times. This means that the treatment given succeeded in significantly improving the respondents' performance, which is indicated by the reduction in time required. The results of the paired sample t-test show that the intervention given has a significant impact on improving respondents' performance. Task completion time significantly decreased after the treatment was given, as evidenced by the average time difference of 1.845 seconds and a very low significance value (p <0.001). Thus, it can be concluded that the treatment is effective.

Discussion

The results showed that dryland stair climbing training for six weeks was able to significantly increase freestyle kick speed in non-athlete students. The decrease in average travel time from 18.54 seconds to 16.70 seconds indicated an increase in movement efficiency and strength of the relevant leg muscles in the swimming propulsion phase. This exercise has been shown to produce neuromuscular and mechanical adaptations that contribute to kick speed in water, although it is not done directly in water media (Kaur & Saini, 2014).

Stair climbing involves functional movement patterns that resemble the push and lift phases of the swimming kick. This activity activates large muscle groups such as the quadriceps, gluteus maximus, and gastrocnemius, which are also the main muscles in the freestyle kicking technique. Repeated activation of these muscles through concentric and eccentric contractions strengthens motor coordination and increases functionally specific strength (Slimani et al., 2016). Physiologically, this exercise also triggers an increase in the efficiency of muscle energy use through the recruitment of type IIa and IIb muscle fibres, which are known to be responsible for fast and powerful contractions. This adaptation is especially important in the context of kicking, as rhythmic and fast contractions are needed to maintain swimming speed. Previous research has shown that stair-based plyometric training can increase the speed of lower extremity muscle contractions in a short duration (Ramirez-Campillo et al., 2020).

College students aged 18–23 years are at the peak of their physiological adaptation capacity. The musculoskeletal and neuromuscular systems of this age group are still very plastic and are able to provide maximum responses to training stimuli. According to (Lee et al., 2018) strength or endurance training interventions in young adults show faster and more significant performance improvements than older adults due to the high efficiency of muscle metabolism and anabolic hormones. In addition to muscle strength, stair climbing also improves cardiovascular aspects and local endurance, which indirectly support improvements in kicking technique. Increased local aerobic capacity in the leg muscles reduces premature fatigue and maintains kicking rhythm throughout the speed test. (Costa et al., 2015) and (Hughes et al., 2018) stated that moderate to high intensity aerobic exercise has a significant impact on local anaerobic endurance of the leg muscles, especially when performed with one's body weight.

Increased kicking speed also reflects increased neuromotor efficiency. The up-and-down stair movement requires simultaneous coordination between agonist and antagonist muscle contractions and postural stability. The efficiency of the central nervous system in regulating motor signals rhythmically and in balance supports the improvement of smoother and more effective kicking movement patterns. This is reinforced by the findings of (Ghosal & Chandrasekaran, 2024), which stated that consistent plyometric training can increase neuromuscular transmission speed and explosive movement efficiency. From a swimming technique perspective, kick speed is greatly influenced by movement amplitude and kick frequency. Dryland training, such as up-and-down stairs, allows athletes to develop explosiveness in the vertical motion trajectory that can be transferred to horizontal kicking frequency in the water. A study by (Gemaini et al., 2023) emphasized the importance of developing leg muscle propulsion through land-specific training to increase the contribution of the legs to overall swimming speed. In addition, this exercise has practical and economical advantages because it does not require special equipment and can be done in various locations. This is important for students who have limited access to a swimming pool every day. Thus, dryland stair climbing training is an applicable and efficient alternative training solution for the student and college population (Ramirez-Campillo et al., 2020).

However, it should be noted that the increase in speed is not solely influenced by muscle strength, but also involves hip flexibility, streamlined technique, and kick rhythm. Therefore, although this exercise is effective, a combination with swimming technique training is still needed for more optimal results. Further research combining dryland training with specific technique training in the water can provide a more comprehensive understanding of the effect of these interventions on swimming speed (Đurović et al., 2024). Overall, the results of this study indicate that stair-based dryland training has a significant positive effect on increasing freestyle kicking speed in non-athlete students. These findings have broad implications, especially in the development of effective, cost-effective, and accessible swimming training programs for academically active, productive age groups.

CONCLUSION

The results of this study indicate that dryland stair climbing training significantly increases freestyle kick speed in non-athlete students aged 18–23 years. The average 15-meter kick test time showed a significant decrease after six weeks of intervention, reflecting improvements in motor efficiency, leg muscle strength, and neuromuscular coordination. Physiologically, this training provides positive adaptations to the musculoskeletal and neuromotor systems that are relevant to the kicking movement requirements in freestyle swimming.

Stair climbing and descending exercises have been proven to be an effective, inexpensive, and applicable alternative to dryland exercises, especially for students who have limited access to swimming pools. This exercise contributes to improving aquatic sports performance even though it is done outside the water medium.

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