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IS PNF REALLY BETTER THAN WALKING RECOVERY?

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Abstract
The pulse rate gradually increases depending on the intensity of the activity performed and can potentially cause fatigue. Walking recovery and PNF (Proprioceptive Neuromuscular Facilitation) can lower the pulse rate and prevent fatigue. The research aims to prove the effects and differences resulting from walking recovery and PNF. The study uses a pretest and posttest design with impact and difference tests. Ten samples were selected purposively and underwent two recovery interventions. A 1600-meter run protocol was used to increase the pulse rate. The results showed that walking recovery could reduce the pulse rate by up to 15.49%, while passive recovery reached 29.35%. Each recovery method significantly reduced the pulse rate (p < 0.05), but there was no significant difference between the two recovery methods (p > 0.05).
Keywords: *pulse rate, PNF, walking recovery*

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INTRODUCTION

Pulse rate is one of the indicators that can be used to assess the condition of someone experiencing fatigue after activity or exercise. Nengah Sandi (2016) stated that pulse rate is the pulsation felt in the body's arteries due to the heart pumping blood. The acute effects of an increased pulse rate include an increase in respiratory frequency, body temperature, blood pressure, and lactic acid levels (Sandi et al., 2016). Several factors that influence the pulse rate include gender, age, body position, and physical activity (McArdle, 2010) Among the factors mentioned above, physical activity is a determining factor that can increase pulse rate frequency, while body position is a recovery factor that can decrease pulse rate frequency.

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Physical activity with moderate to high intensity can gradually and quickly increase pulse rate frequency. This is because of the increased need for oxygen to meet the demands of the active body muscles. On the other hand, there is an accumulation of carbon dioxide in the blood, accompanied by increased body temperature and blood lactate levels. Tanzila & Bustan (2017) mentioned that pulse rate increased by 78.8% in non-athletes after performing high-intensity interval training. Additionally, the study by Sandi et al. (2016) found that 2 x 30-minute sessions of static cycling could increase pulse rate by up to 123%. These two studies were further reinforced by research from Brastangkara & Jatmiko (2019) which stated that there was a difference in basal pulse rate change of 10.04% in the high-intensity interval training intervention, the basal pulse rate changed by 10.04%, and in the continuous running intervention, it changed by 7.73%. The studies mentioned above show that if the intensity of physical activity is increased, the pulse rate frequency will also increase, and vice versa.

Physical activities that potentially increase pulse rate frequency include submaximal to maximal physical activity intensity with work times ranging from 6 minutes to 15 seconds and predominantly 70-90% anaerobic (Edition, 2019). Bushman (2017) mentioned that the percentage of submaximal to maximal work exceeds 80% of the speed and strength output. Pulse rates during physical activities with submaximal to maximal intensity exceed 170 beats per minute (Kenney et al., 2021). In addition to physical activity intensity, pulse rate frequency is also influenced by environmental temperature (Rahadian, 2018; Wulandari & Ernawati, 2018), Vo2max (Fahmi, 2022; Hutama & Yuliastrid, 2017; Wulandari & Ernawati, 2018), region altitude (Ardianto & Junaidi, Said, 2015; Kasenda & Wungouw, 2017), and workload (noise) (Izzadini et al., 2022). Several studies above indicate that pulse rate frequency can vary depending on the conditions the body faces during work or physical activities.

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Continuing with an increased pulse rate up to its maximum within a few seconds can potentially lead to fatigue (Chai et al., 2019), ventricular tachycardia (Darmadi et al., 2020), and even fainting (Wen, 2014). Efforts to reduce the negative impacts of increased pulse rate include reducing the intensity of physical activity, rehydration (Krisnawati et al., 2011), and active and passive recovery (Lesmana & Padli, 2019; Syaefulloh Ivan & Purbodjati, 2022). This research focuses on active and passive recovery efforts using walking and proprioceptive neuromuscular facilitation (PNF) interventions. The selection of recovery methods mentioned above sparks debate over which recovery approach is more effective and efficient to use. Research by Laksana et al. (2019) shows that there is no significant difference between active recovery through jogging and passive recovery through dynamic rest. Syaefulloh & Purbodjati (2022)confidently state that jogging recovery can significantly reduce pulse rate by 27%, which differs markedly from cooling down, which reduces pulse rate by 8%. Meanwhile, Pramono et al. (2018) mention that passive recovery involving standing, sitting, and lying down (without additional activity) results in a more than 20% reduction in pulse rate.

Based on the discussion above, several journals indicate that active recovery methods such as walking and jogging are more effective than passive recovery methods (Andriana et al., 2022; Connolly et al., 2003; Hurrie & Giesbrecht, 2020; Puji Ratno, 2017; Shimoyama & Wada, 2015). However, some studies suggest the opposite, stating that passive recovery is better than active recovery (Hurrie & Giesbrecht, 2020; Pramono et al., 2018; Scanlan & Madueno, 2016; Sinaga & Martua Sihombing, 2019). Meanwhile, there are studies indicating that there is no significant difference between passive and active recovery (Laksana et al., 2019; Pramono et al., 2018; Syaefulloh Ivan & Purbodjati, 2022). Therefore, further research is needed on the interventions of active and passive recovery after submaximal activity regarding pulse rate frequency.

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METHOD

The research uses a quantitative approach with an experimental design. A pre-test and post-test design was used to obtain heart rate data after physical activity. The value obtained from measuring the pulse rate has the potential to produce different variations in results, so that variations in results can be tested until it is found which active or passive recovery is effective in restoring the recovery pulse rate after physical activity. In this study, two experimental groups were involved: experimental group I which was given active walking recovery and experimental group II which was given PNF passive recovery. The population in this study were 10 IKOR Class of 2020 students at Surabaya State University. Samples were taken randomly and then treated three times. Inclusion criteria include men with an ideal BMI aged 21-23 years, active UNESA students who like to exercise at least twice a week and are willing to take part in all stages of the research. The research was conducted in May 2024 and carried out on the UNESA athletic field. Study variables included active walking recovery, PNF passive recovery, and heart rate. The research instrument uses a smartwatch as a tool to measure time and pulse before. The Strava application was used to measure the respondent's speed when running. Before carrying out the test, respondents were given an explanation of the purpose and benefits of conducting this research. Then respondents were given a attendance register and warmed up before running. On the first day, after running 1600 meters, respondents were given recovery by walking for 2 minutes. On the second day, respondents ran 1600 meters again and were given four PNF recovery movements with each movement lasting 30 seconds. On the third day, respondents ran 1600 then recovered without treatment (control).

RESULT AND DISCUSSION

This study compared active recovery and passive recovery of pulse rate in 10 IKOR Class of 2020 students who like to exercise at least twice a week. The

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research used pre-test and post-test methods which were carried out in three meetings with a gap of four days for recovery. At the first meeting the respondent carried out active recovery by walking. At the second meeting the respondent carried out passive recovery with PNF. And at the third meeting the respondent restored control by not being given any treatment.

Table 1. Sample characteristics

Variable	Group	N	Mean	SD	p-Homogen	p-sig
Age	-	10	22,2	,632	1,000	1,000
Height	-	10	171,60	8,154	1,000	1,000
Weight	X1	10	61,140	4,9992	1,000	,995
	X2	10	61,520	5,1976		
	X3	10	61,700	5,0520		
BMI	X1	10	20,8334	2,07771	1,000	1,000
	X2	10	20,9524	2,02753		
	X3	10	21,0226	2,08551		
Running time	X1	10	14,00	3,771	0,115	,115
	X2	10	13,00	3,651		
	X3	10	11,70	1,829		
Average running speed	X1	10	8,7520	2,35555	0,112	,112
	X2	10	8,1350	2,29292		
	X3	10	7,3140	1,14175		
Pulse before running	X1	10	86,20	11,033	0,003	,003
	X2	10	94,80	22,832		
	X3	10	80,40	12,554		

Table 1 shows that the sample characteristics in all intervention categories are balanced (homogeneous) and do not differ significantly from each other (nothing is more prominent, $p > 0.05$). Except for the characteristics of the pulse rate before treatment, there were significant differences ($p < 0.05$).

Normality and Homogeneity Test

Table 2. Normality and Homogeneity Test

No	Variable	Kel.	N	p-normalitas	p-homogenitas	Notes
1	Pulse after running	X1	10	,889	,869	Normal-homogen
		X2		,157		Normal-homogen
		X3		,825		Normal-homogen
2	Pulse rate after treatment	X1	10	,688	,382	Normal-homogen
		X2		,464		Normal-homogen
		X3		,261		Normal-homogen

Table 2 shows the results of the normality and homogeneity tests for each intervention group with the majority of results being normal and homogeneous ($p > 0.05$). Next, hypothesis analysis was carried out to test the influence of the pulse

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rate variable after running with recovery intervention using the paired t-test. Meanwhile, a difference test was carried out on the pulse item after running and after the recovery intervention using the one way ANOVA test.

Table 3. Influence Test

Variable	Group	After running	After recovery Mean SD	p-sig
Pulse	X1	130,4 ± 27,08	110,2 ± 23,26	,001*
	X2	132,5 ± 34,66	93,6 ± 16,94	,001*
	X3	126,6 ± 34,3	97,5 ± 21,05	,005*

Table 3 shows that each intervention group had a significant effect on reducing heart rate after being given treatment ($p < 0.05$). The highest difference in decline was in the passive recovery intervention (PNF) group with a percentage of 29.35%, followed by the control intervention group (free from any recovery) with a percentage of 22.98%, and the active recovery intervention group (walking) with a percentage of 15.49 %.

Table 4. Difference Test

No	Variabel	Group	Mean ± SD	p-sig
1	Pulse after running	X1	130,4 ± 27,08	,281
		X2	132,5 ± 34,66	
		X3	126,6 ± 34,3	
2	Pulse after recovery intervention	X1	110,2 ± 23,26	,817
		X2	93,6 ± 16,94	
		X3	97,5 ± 21,05	

Table 4 shows the results of tests of differences between all study groups after running and recovery interventions. In each test, there was no significant difference in heart rate after running and intervention ($p > 0.05$). The highest differences in heart rate values after running were in the passive recovery (PNF), active (walking) and control (free from any recovery) intervention groups. Then the difference in the decrease in heart rate values after recovery was the highest in the passive, control and active intervention groups, respectively.

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DISCUSSION

The increase in heart rate after running 1600 meters was influenced by several factors in this study, especially the characteristics of the study sample. These characteristics include initial heart rate before running, body weight, running time, and age. From table 4.1 sample characteristics from each group, the range of values for each variable in each group is balanced or not significantly different as proven by the ANOVA difference test value ($p < 0.05$). With these results, there is little possibility of influencing the results of the hypothesis test in this study.

The results of the paired t test showed significant results for the walking and PNF interventions ($p < 0.05$), so that these two interventions had an effect in reducing the heart rate after running 1600 meters. Walking recovery was able to reduce the pulse rate by 15.49%, while PNF recovery was 29.35%. The results of this research are supported by research by Tsalis (2016) and Arifushalat (2019) which shows that active and passive recovery can reduce heart rate after physical activity.

Recovery for walking in this study was to carry out the process of walking for two minutes after running 1600 meters and then measuring the pulse afterwards. Walking intensity is carried out at a low intensity (30-50%) of the ability to inhale the maximum volume of air (VO2max). The walking recovery intervention aims to reduce lactic acid in the body's blood and muscles which is a waste product of metabolism in movement and muscle coordination with the effect of stimulating fatigue and reducing sports performance if left untreated. The low intensity of VO2max ability improves the body's coordination in managing incoming oxygen, thus accelerating the decomposition and burning of lactic acid into carbon dioxide and water, so that the rate of accumulation of lactic acid is lower and the threshold for anaerobic stimulation is increased, muscle pumps are more active and aerobic power is increased. PNF recovery is part of a passive recovery, where a person's body will remain still, rest in a supine position and

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then be helped by stretching the muscles using the principle of muscle lengthening. The goal of passive recovery is to reduce levels of lactic acid and the enzyme creatine kinase. The implementation of PNF in this study was carried out with the body lying down, thus helping the process of lowering the pulse rate better compared to sitting or standing positions. This is in line with research by Pramono et al (2018), which revealed that restoring the pulse rate in a supine or lying position lowers the pulse rate more than restoring the body position by sitting or walking.

Walking recovery (active) and PNF (passive) interventions did not provide a significant difference in reducing heart rate ($p > 0.05$). This means that neither active nor passive recovery is better at intervening in reducing heart rate after sports activities. This is in line with several studies by Afonso et al (2021), Mulyawan (2020), and Patra (2023) which reveal that there is nothing better between passive and active recovery in intervening in reducing heart rate.

The passive recovery intervention experienced a greater decrease in heart rate, namely 29.35%, while the active recovery intervention was only 15.49%. This happens because during active recovery (walking) the heart rate remains high after sports activities because there are still some muscle contractions when walking is done at low intensity. Meanwhile, passive recovery can result in a high decrease in heart rate due to parasympathetic nerve activity which is controlled by central nerve cells due to stopping sports activities without further movement or muscle contractions.

Another thing that is worth taking into account is the duration of recovery after sports activities. This research designed a recovery duration of 120 seconds, so it has the potential to not make a significant difference, especially since the sample background was not studied in depth, especially in terms of their endurance capacity. Other factors that also need to be considered are the intensity of exercise activity, rehydration, sample size, and the selected recovery protocol.

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CONCLUSION

Based on the research findings, it can be concluded that there is a significant effect of walking and PNF interventions on reducing heart rate after sports activities. There was no significant difference between walking recovery intervention and PNF, so there was nothing better between walking intervention and PNF in reducing heart rate.

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