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THE EFFECT OF CALF RAISE EXERCISE ON HEART RATE, OXYGEN SATURATION, AND BLOOD PRESSURE IN ANESTHESIOLOGY NURSING STUDENTS

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ABSTRACT
Physical exercise is a body activity that is carried out in a planned, structured and repetitive manner with the aim of improving or maintaining physical fitness and overall health. The busyness experienced by students in terms of theoretical and practical learning makes students do less physical exercise, and this can have implications for decreased muscle flexibility and the risk of muscle injury. Lack of physical exercise has a significant impact on the cardiovascular system, especially on heart rate (HR), oxygen saturation (SpO2), and blood pressure (BP). The purpose of this study was to determine the effect of the calf raise exercise on heart rate, oxygen saturation and blood pressure. This research method is using a pre-experimental with a pre-post one-group design. This research method is using a pre-experimental with a pre-post one-group design. The number of samples in this study was 170. Using the total sampling technique by using inclusion we're resting HR less than 100 x/min and BP within normal limits, namely systolic less than 120 mmHg and diastolic less than 110 mmHg, the statistical test in this study was the Friedman test. The mean results after the calf raise training for heart rate were 93.47±8.65, oxygen saturation 98.27±1.26, systolic blood pressure 120.28±10.97, and diastolic blood pressure 79.97±7.25. The conclusion of this research is that there are differences in heart rate variables, oxygen saturation, blood pressure at six measurement time points with a p-value of 0.000 each.

Keywords: blood pressure; calf raise exercise; heart rate; oxygen saturation

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INTRODUCTION

Exercise is an effective way to maintain a healthy heart and improve overall fitness. One important component of cardiovascular fitness is an increase in heart rate, which can be measured as an indicator of a person's aerobic capacity. Students, as a group with activities that tend to be sedentary and busy with academic activities, often ignore the importance of routine physical exercise (Jufri et al., 2024). Students aged 19-23 years are known as early adulthood (productive age), where health can be influenced by food, physical activity and effective stress management. Students are usually busy with various lecture activities, plus the habit of sitting in the wrong position and too long can cause decreased muscle flexibility (Romadhoni et al., 2022).

In the learning process, there is a lot of static time with various sitting postures. Students who are very active will certainly experience physical limitations, especially those who have a habit of sitting for a long time in non-ergonomic positions; this habit affects the muscles of the spine and lower extremity muscles (Romadhoni et al., 2022; Štursová et al., 2023). With limited time and facilities, a type of exercise that is easily accessible, practical, and still provides significant health benefits is needed. One of them is the *calf raise,* which can be performed without special equipment and in a short time (Jufri et al., 2024).

The calf *raise* exercise is a movement that targets the calf muscles (gastrocnemius and soleus). The movement involves lifting the heels from a standing position, holding for a moment, and then lowering them again. This exercise can be performed with many variations, including using

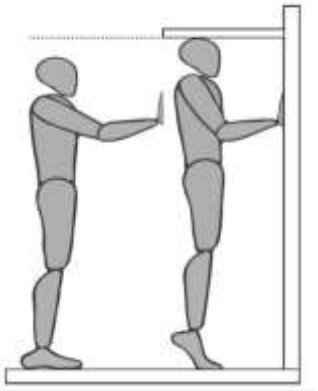
additional weights or just your own body weight. *Calf raise* is used to improve stability, coordination of motion and contraction strength in the ankle joint (Anjasmara et al., 2021).

Calf raise exercises, which involve strengthening the calf muscles, are gaining increasing attention in the context of physical fitness and rehabilitation. The calf muscles, which consist of two main muscles – gastrocnemius and soleus – play an important role in various physical activities, such as walking, running and prolonged standing. *Calf raise* exercises aim to improve the strength, endurance and flexibility of the calf muscles, which have a huge impact on a person's posture, stability and mobility. *Calf raises* can help strengthen the muscles that support the foot and ankle. This reduces the risk of muscle strain-related injuries, which are often experienced by athletes or physically active individuals. Research on *calf raise* exercise technique and frequency can help identify effective ways of preventing injuries such as sprains or Achilles tendon injuries (Anjasmara et al., 2021; Green & Pizzari, 2017).

This exercise is often used in rehabilitation of calf or ankle muscle injuries. Therefore, research examining the impact of calf raise exercise in the post-injury recovery process is essential to ascertain its effectiveness in restoring muscle strength and flexibility. As we age, loss of muscle mass becomes one of the major problems, which can affect a person's quality of life. Calf raise exercises can help maintain calf muscle strength and prevent problems such as difficulty walking or difficulty maintaining body balance. The purpose of this study was to determine the effect of the calf raise exercise on heart rate, oxygen saturation and blood pressure (Anjasmara et al., 2021).

METHOD

In general, the method used in this research is pre-experimental, with *a pre-post one-group design*. The study was conducted for 2 weeks with 3 times a week *calf raise* exercises and examinations. Heart rate, oxygen saturation, and blood pressure, were measured at six time points, namely in Week 1 Day 1 (M1 H1) Heart rate, oxygen saturation, and blood pressure before *calf raise* exercise, while in Week 1 Day 2 (M1 H2), Week 1 Day 3 (M1 H3), Week 2 Day 1 (M2 H1), Week 2 Day 2 (M2 H2) and Week 2 Day 3 (M2 H3), Heart rate, oxygen saturation, and blood pressure were measured after *calf raise* exercise.



In the *calf raise* exercise seen in the picture, the respondent's starting position is barefoot, and they use the fingers of their hands to support the wall (at shoulder height) to maintain balance with elbows slightly bent, keeping the spine in a neutral position, legs spread at the hips, and knees straight. The respondent raises his/her heels as high as possible, with the knees fully raised, then lowers them until they touch the floor, and repeats this movement as many times as possible within a period of 30 seconds. The tools needed in the *calf raise* exercise are the following equipment for emergencies: stopwatch/timer, tensimeter, pulse counter, and pulse oximeter. Preparation of research samples, namely samples wearing comfortable clothes and recommending the previous night to get enough rest.

The population in this study was 170 students of the Anaesthesiology Nursing study programme of the Applied Bachelor Programme, Faculty of Health Sciences, UNISA Yogyakarta Batch 2024 using *total sampling*. The inclusion criteria in this study were resting HR less than 100 x/min and BP within normal limits, namely systolic less than 120 mmHg and diastolic less than 110 mmHg. Exclusion criteria were samples with systemic disease or fever, congestive heart failure, unhealed or infected post-heart surgery wounds, and uncontrolled Diabetes Mellitus. Statistical tests used the *Friedman* test to determine differences at six measurement time points. This study passed ethics at Universitas Aisyiyah Yogyakarta with No. 4652/KEP-UNISA/VII/2025.

RESULT

Table 1.
Respondent characteristics (n= 170)

Respondent characteristics	f	%
Age		
18-20	158	92.9
21-23	12	7.1
Gender		
Female	102	60
Male	68	40

The characteristics of the respondents in table 1 show that the largest age group is 18-20 years with 158 (92.95) and the majority gender is female with 102 (60%).

Table 2.
Mean and differences in hear rate (x/menit)

Variable	Mean±Std. Dev	p-value
M1 H1 Pre	89.72±11.48	0.000
M1 H2 Post	87.24±9.54	
M1 H3 Post	88.51±9.66	
M2 H1 Post	91.22±13.33	
M2 H2 Post	90.48±12.21	
M2 H3 Post	93.47±8.65	

In table 2 there is a statistically significant difference in heart rate variables at six measurement time points after the *calf raise* exercise intervention, as shown by the *p-value* of 0.000 ($p < 0.05$), with the largest heart rate at M2 H3 with 93.47 beats/minute.

Table 3.
Mean and differences in oxygen saturation (%)

Variable	Mean±Std. Dev	p-value
M1 H1 Pre	97.55±1.22	0.000
M1 H2 Post	97.77±0.91	
M1 H3 Post	97.70±0.97	
M2 H1 Post	97.35±1.04	
M2 H2 Post	97.58±1.04	
M2 H3 Post	98.27±1.26	

In table 3 there is a statistically significant difference in the SPO2 variable at six measurement time points after the *calf raise* exercise intervention, as shown by the p-value of 0.000 ($p < 0.05$), with the largest mean oxygen saturation at M2 H3 with 98.27%.

Table 4.
Mean and differences in systolic (mmHg)

Variable	Mean±Std. Dev	p-value
M1 H1 Pre	117.29±11.49	0.000
M1 H2 Post	117.74±9.25	
M1 H3 Post	115.11±11.11	
M2 H1 Post	116.12±14.15	
M2 H2 Post	110.15±13.85	
M2 H3 Post	120.28±10.97	

In table 4 there is a statistically significant difference in systolic blood pressure variables at six measurement time points after the *calf raise* exercise intervention, as shown by the p-value of 0.000 ($p < 0.05$), with the largest mean systolic pressure at M2 H3 with 120.28 mmHg.

Table 5.
Mean and differences in diastolic (mmHg)

Variable	Mean±Std. Dev	p-value
M1 H1 Pre	77.76±8.42	0.000
M1 H2 Post	76.87±7.02	
M1 H3 Post	77.11±6.73	
M2 H1 Post	76.31±8.80	
M2 H2 Post	73.51±12.47	
M2 H3 Post	79.97±7.25	

In table 5 there is a statistically significant difference in diastolic blood pressure variables at six measurement time points after the *calf raise* exercise intervention, as shown by the p-value of 0.000 ($p < 0.05$), with the largest mean diastole pressure in M2 H3 with 79.97 mmHg.

DISCUSSION

Physical exercise such as calf raises is a form of resistance training that is often used to strengthen the calf muscles, especially the gastrocnemius and soleus muscles. Calf raises also serve to improve lower-body muscle strength, balance and stability. Research has shown that physical exercise that focuses on these large muscles can have an impact on various physiological systems in the body, including the cardiovascular system (Green & Pizzari, 2017).

In Table 2, the results of the average heart rate show that there are differences at six measurement time points, with an average at pre (M1 H1) of 89.72 x/min and an increase in the last week (M2H3) with an average of 93.47 x/min. The increase in heart rate during calf raise exercise occurs due to the body's need for increased blood supply to the working calf muscles. As the calf muscles contract, blood vessels are compressed, which leads to an increase in vascular resistance and, ultimately, triggers the heart to pump blood more forcefully (Wolper & Stopka, 2014)

Heart rate is often used as an indicator of the work of the cardiovascular system during and after physical activity. Resistance exercises, such as calf raises, affect heart rate through increased intra-abdominal pressure and increased blood flow to the working muscles. According to Hellsten & Nyberg (2016), when a person performs resistance exercise, the increase in exercise intensity results in an increased load on the cardiovascular system, which leads to an increase in heart rate. This occurs as a form of the body's adaptation response to increase oxygen supply to active muscles so that it will affect the results of oxygen saturation (Schroeder et al., 2019).

In Table 3, the average results of oxygen saturation show that there are differences at six measurement time points, with an average at pre (M1 H1) of 97.55% and an increase in the last week (M2 H3) with an average of 98.27%. This proves that calf raise exercise can increase oxygen saturation because there is an increase in blood circulation needs during exercise every week. Oxygen saturation refers to the percentage of haemoglobin in the blood that is saturated with oxygen. When a person performs calf raise exercise, there is an increased demand for oxygen by the calf muscles. Under normal conditions, the body will respond by increasing blood flow to fulfil the oxygen demand. According to research conducted by several experts, resistance exercises such as calf raises can help improve cardiovascular endurance and increase the effectiveness of oxygen distribution throughout the body (Lin et al., 2022).

In Table 4 the systole results show that there are differences at six measurement time points, with an average at pre (M1 H1) of 117.29 mmHg and an increase in the last week (M2 H3) with an average of 120.28 mmHg, while in Table 5 the diastole results show that there are differences at six measurement time points, with an average at pre (M1 H1) of 77.76 mmHg and an increase in the last week (M2 H3) with an average of 79.97 mmHg. This proves that calf raise exercise can

improve circulation. Although calf raise is a localised exercise and focuses more on the leg muscles, it can also help improve blood circulation.

The up-and-down motion of the calf raise stimulates more efficient blood pumping from the legs to the rest of the body, which supports overall circulation. If light aerobic exercises are performed for a high number of repetitions, they can increase heart rate and provide mild cardiovascular benefits, similar to low-intensity aerobic exercise. This can help improve general cardiovascular health, especially for people who are just starting physical activity (Fujisawa et al., 2015). Exercises such as calf raises have a direct effect on blood pressure, as the contraction of calf muscles can increase venous return, which in turn can temporarily increase blood pressure. Studies show that light to moderate resistance exercises, such as calf raises, can help lower blood pressure in the long term, as they help improve blood vessel elasticity and lower peripheral resistance(Schroeder et al., 2019). Calf raise exercises involve strengthening the calf muscles (gastrocnemius and soleus) and can have several positive influences on the body, including the muscles, heart, and lungs.

Calf raise exercises focus on strengthening the calf muscles, which are responsible for plantar flexion (the downward pressing movement of the foot). This is essential for everyday mobility, such as walking, running and climbing stairs. Muscles Involved: In addition to the calf muscles (gastrocnemius and soleus), this exercise also engages other muscles in the leg, such as the peroneus and tibialis posterior muscles, to support stability and strength. Calf muscle strengthening can improve leg strength and flexibility and prevent injuries to the ankle, knee and lower back areas (Bordoni & Varacallo, 2025).

The effect on the lungs is an increase in breathing capacity; although calf raises focus more on muscle strength, doing this exercise in long sets or combined with cardio exercise (such as walking or running) can help increase lung capacity. When the body needs more oxygen during intense exercise, the lungs have to work harder to provide oxygen to the active muscles. It also helps strengthen the respiratory system, although the effect is not as great as intense aerobic exercise such as running or cycling. However, for beginners or people who are not used to exercising, calf raises can be the first step to training the lungs' ability to perform under active conditions (André et al., 2016; Fujisawa et al., 2015).

CONCLUSION

The conclusion of this research is that there are differences in heart rate variables, oxygen saturation, blood pressure at six measurement time points with a p-value of 0.000 each.

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