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COMPARISON OF THE STEP EXERCISE METHOD FOR RESTING PULSES AND RECOVERY PULSE RATES IN TBM FKIK WARMADEWA

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ABSTRACT

Being a member of the Tim Bantuan Medis (TBM) is required not only to have excellent health but also to have optimal physical fitness, bearing in mind that Indonesia is a disaster-prone area where disasters can occur anytime and anywhere. The research was conducted on members of the TBM of Fakultas Kedokteran dan Ilmu Kesehatan (FKIK) Warmadewa, aiming to compare the step exercise (SE) method to the resting pulse rate and recovery pulse rate in TBM students. The research was conducted at the Physiology Laboratory of FKIK Warmadewa, with ethical clearance Number: 323/Unwar/FKIK/EC-KEPK/IV/2023. This study used 71 samples of TBM students who were divided into 3 groups using a simple random method. P1 group did SE at a frequency of 100 x/minute for 216 seconds, group P2 did SE at a frequency of 110 x/minute for 196 seconds, group P3 did SE at a frequency of 120 x/minute for 180 seconds, exercises were carried out 3 times per week, during 4 weeks. All subjects were tested for cardiorespiratory fitness with the Harvard Step Test and compared the pre and post exercise results. Data analysis was performed using the paired t test method to see a comparison of the step exercise method on resting pulse and recovery pulse rate. The results showed that at P1 and P3 there was no significant decrease in the pre-post resting pulse ($p>0.05$), whereas in the recovery pulse there was a significant decrease ($p <0.05$). At P2 there was a significant decrease in both resting and recovery pulses ($p <0.05$). The conclusion from this study was that only at P2 there was a significant improvement in both the resting pulse and recovery pulse.

Keywords: *step exercise method, resting pulse, recovery pulse*

ABSTRAK

Menjadi anggota Tim Bantuan Medis (TBM) dituntut tidak hanya memiliki kesehatan yang prima tapi juga memiliki kebugaran fisik yang optimal, mengingat Indonesia sebagai daerah

rawan bencana di mana bencana bisa terjadi kapan dan dimana saja. Penelitian dilakukan pada anggota TBM Fakultas Kedokteran dan Ilmu Kesehatan (FKIK) Warmadewa, bertujuan untuk mengetahui perbandingan metode step exercise (SE) terhadap denyut nadi istirahat dan denyut nadi pemulihan pada mahasiswa TBM. Penelitian di lakukan di Laboratorium Fisiologi FKIK Warmadewa, dengan etical clearance Nomor:323/Unwar/FKIK/EC-KEPK/IV/2023. Penelitian ini menggunakan 71 sampel mahasiswa TBM yang dibagi menjadi 3 kelompok dengan metode acak sederhana. Kelompk P1 melakukan SE dengan kecepatan 100 x/menit selama 216 detik, kelompok P2 melakukan SE dengan kecepatan 110 x/menit selama 196 detik, kelompok P3 melakukan SE dengan kecepatan 120 x/menit selama 180 detik, latihan dilakukan 3 kali per minggu, selama 4 minggu. Semua subjek dilakukan uji kebugaran jantung paru dengan Harvard Step Test dan dibandingakan hasil pre dan post latihan. Analisis data dilakukan menggunakan metode uji T paired untuk melihat perbandingan metode step exercise terhadap denyut nadi istirahat dan denyut nadi pasca pemulihan. Hasil penelitian menunjukan pada P1 dan P3 tidak terjadi penurunan nadi istirahat pre-post yang signifikan (p>0,05), sedangkan pada nadi pemulihan mengalami penurunan yang signifikan (p <0,05). Pada P2 terjadi penurunan nadi istirahat maupun nadi pemulihan yang signifikan (p <0,05). Kesimpulan dari penelitian tersebut hanya pada P2 terjadi perbaikan yang signifikan baik pada nadi istirahat maupun nadi pemulihan.

Kata kunci: *metode step exercise, denyut nadi istirahat, denyut nadi pemulihan*

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INTRODUCTION

At the time of the Covid-19 pandemic health became so meaningful, if in the past degenerative diseases such as hypertension, diabetes mellitus, hypercholesterolemia and obesity were relatively easy to control with drugs, even without changing lifestyles such as a balanced nutritional diet, regular exercise, adequate rest and good stress management. Unfortunately, during this pandemic, most of the above disease conditions (comorbid factors) became risk factors for the occurrence of Case Fatality Rate (CFR) from Covid-19, and even though these comorbid factors can be

controlled with drugs, they still experience CFR from Covid-19.[1]

One of the conditions for getting an optimal level of health is doing regular physical activity. Various studies have proven that physical inactivity is a major risk factor for various health problems today. Research proves that physical inactivity increases the risk of various diseases, especially coronary heart disease, stroke, type 2 diabetes, and cancer, consequently reducing life expectancy. This condition of physical inactivity also exacerbates and causes complications when infected with Covid-19, prolongs the healing process and causes a more frequent Long Covid effect.[1,2]

Medical students are future doctors who will be involved in society in the future, so they are not only required to be capable and competent in solving various health problems, of course it will be difficult for them to make society healthy if they themselves are not healthy. There is a renewal of the Hippocratic oath which is more than 2500 years old by Doctor Sam Hazledine from New Zealand, namely that doctors care about their own health just like their patients. Where one of the revisions of the Hippocratic oath reads "I will maintain health, well-being and personal abilities so that I can provide maximum health services".[3]

Indonesia is an archipelagic country flanked by two oceans and crossed by a series of volcanoes which makes Indonesia a country prone to natural disasters such as volcanic eruptions, earthquakes, landslides, floods, storms including tsunamis. In addition to natural disasters, Indonesia is also prone to man-made disasters, such as forest fires, environmental destruction and terrorism.[4]

Tim Bantuan Medis (TBM) is a medical faculty student activity that is engaged in the emergency and humanitarian fields. As members of TBM, students are required to have basic medical assistance competencies as well as excellent physical fitness considering that emergencies can occur anywhere and in terrain conditions that vary from mild to extreme severe. One of the physical fitness that TBM members must possess is cardiorespiratory fitness.[5] Unfortunately, the physical fitness condition of medical students, especially during the Covid-19 pandemic, was not very good. This can be seen from the research of Subrata et.al. in Fakultas Kedokteran dan Ilmu Kesehatan (FKIK)

Warmadewa students where it was found that 83.6% of their physical fitness was moderately low, while research conducted by Risma on students of the Faculty of Medicine Christian University of Indonesia showed that 72% had less physical activity and 41% had central obesity.[6,7]

The heart, lungs and blood vessels form a system, namely the cardiorespiratory system, where the heart plays a role in pumping blood and blood vessels to circulate blood throughout the body, while the lungs play a role in the process of respiration, namely taking in oxygen and releasing carbon dioxide.[8] Cardiorespiratory fitness is the ability of the heart, respiration and blood vessels to maintain the intake of nutrients and oxygen into the tissues. A person's cardiorespiratory fitness depends on various factors such as genetics, nutrition, exercise patterns and recovery abilities. The pattern of exercise is one of the important factors in optimizing cardiorespiratory fitness, where aerobic exercise/training is the main training pattern in optimizing cardiorespiratory fitness.[8,9]

The efficiency of the cardiorespiratory system will affect a person's ability to obtain and utilize oxygen to produce energy. Someone who can run all day long not only trains their slow twitch fiber to be efficient, but they also have to train their cardiorespiratory system to be efficient at getting and extracting oxygen while removing carbon dioxide and lactic acid. Until finally, one of the main signs and symptoms of heart and lung disease is easily exhausted and gasping for minimal activity.[9,10]

Aerobic exercise can improve the cardiorespiratory system, except in severe cases, where improvement is not possible without surgery or other medical intervention. These aerobic exercises range from the simplest, such as walking or climbing stairs, to the most strenuous, such as running a marathon. Aerobic exercise in general can be done indoors and outdoors, both individually and in groups. The duration of aerobic exercise varies widely from 30 minutes to hours, with a frequency between 2-3 times per week to 14 times per week.[9,10]

Various methods have been shown to be relevant in measuring cardiorespiratory fitness using sophisticated equipment such as measuring the maximum volume of oxygen (VO2Max), running tests using distance (1 mile runs test) and using time

(12-minute runs test), steps test such as the Harvard Step Test and YMCA Step Test which measure heart rate as a parameter of the test.[9]

Resting heart rate/pulse can be considered in the context of health markers, such as blood pressure, blood sugar levels and cholesterol levels, so it can help identify potential health problems as well as measure heart health. In certain cases, a lower resting heart rate can mean a better level of physical fitness, which has been linked to reduced rates of health problems such as heart attacks. Conversely, a high resting heart rate can be a sign of an increased risk of heart attack, because the more beats the heart has to perform, it ultimately reduces overall heart function.[11]

Heart rate recovery (HRR) is the difference between the heart rate/pulse during exercise (when the heart is working hardest) and the heart rate/pulse immediately after stopping training or what is called the recovery or recovery period. The faster the recovery period indicates the better the cardiorespiratory fitness, conversely the longer recovery is associated with the risk of morbidity and death.[12,13]

METODHS

This study used an experimental research design with pre-test and post-test group designs, which were divided into 3 treatment groups. The research will be carried out for 5 months, from January to May 2023 at FKIK Warmadewa. The study population was all members of TBM FKIK Warmadewa. The research sample was members of TBM FKIK Warmadewa who met the inclusion criteria, namely men and women aged 19-21 years and willing to participate in the study. Participants were selected by simple random sample selection method. From the results of calculating the sample size, the minimum number of samples required is 71. Ethical clearance was carried out at the Research and Development Unit of Warmadewa University, Denpasar, with ethical clearance Number: 323/Unwar/FKIK/EC-KEPK/IV/2023. The data obtained were analyzed descriptively and the results of data analysis were displayed in the form of frequencies, percentages and graphs. The statistical test used to see the correlation of the step exercise method on post-exercise pulse and resting heart rate in this study is the paired t test if the data is normally distributed or using the Wilcoxon test if the

data is not normally distributed. The P value <0.05 was declared significant.

Research procedure

1. Research subjects are collected to get directions and technical information on the implementation of data collection to be carried out
2. Research subjects then complete basic respondent data before measurement (as inclusion and exclusion criteria)
3. Cardiorespiratory fitness was measured using the Harvard step up test. All subjects measured resting heart rate/pulse and recovery heart rate/pulse, namely pulse measured after resting 1 minute after the test and measured for 30 seconds. The measurement results are then converted into a categorical assessment of cardiorespiratory fitness
4. Randomly grouping subjects into groups P1, P2 and control (P3), in which the three groups used a 20 cm ladder
5. Group P1 will do a step test exercise, with a speed of 100 beats per minute for 216 seconds or three minutes 36 seconds, with a frequency of 3 times per week, for 4 weeks
6. Group P2 will do a step test exercise, with a speed of 110 beats per minute for 196 seconds or three minutes and 16 seconds, with a frequency of 3 times per week, for 4 weeks
7. The control group (P3) will do a step test exercise, at a speed of 120 beats per minute for 180 seconds or three minutes, with a frequency of 3 times per week, for 4 weeks
8. After doing 4 weeks of exercise, the research subjects will again do the Harvard Step Test, and compare resting heart rate and post-recovery heart rate to the three groupsAfter all the subject data and measurement results have been collected, an analysis of the data is carried out.

RESULT

From the 3 groups, the normality test was carried out with the Shapiro-Wilk test and the results of the normality test showed that the sig p value was mostly p value> 0.05, so the data distribution was normal, so the next test was the paired sample t test.

In the pre-P1 group, the average resting pulse was 86.181 ± 10.78640 and in the post-P1 group, the average resting pulse

was 84.8182 ± 13.78279. In the pre-P1 group, the average recovery pulse was 66.4545 ± 9.39973 and post-P1 the average recovery pulse was 56.7273 ± 6.54058. From the comparison of pre and post P1 with paired T test shows the results:

- Resting pulse pre–post p value> 0.05 (0.67> 0.05) has no relationship or effect with the resting pulse variable (H1 is rejected H0 is accepted)
- Recovery pulse pre–post p value<0.05 (0.00<0.05) there is a relationship or effect of recovery pulse (H 1 accepted H0 rejected

Table 1. Resting Pulse P1, P2, P3

Resting Pulse	N	Mean ± SD Pre	Mean ± SD Post	Mean ± SD difference Pre-Post	95% CI of the difference		t	Sig. (2-tailed)
					Lower	Upper		
P1	22	86.181 ± 10.78640	84.8182 ± 13.78279	1.36364 ± 14.78270	-5.19064	7.91792	0.433	0.670
P2	25	88.8400 ± 10.15168	81.6800 ± 8.86341	7.16000 ± 10.37899	2.87577	11.44423	3.449	0.002
P3	19	87.6842 ± 9.04343	87.0000 ± 10.78064	0.68421 ± 5.88834	-2.15388	3.52230	0.506	0.619

In the pre-P2 group, the average resting pulse was 88.8400 ± 10.15168 and in the post-P2 group, the average resting pulse was 81.6800 ± 8.86341. In the pre-P2 group, the average recovery pulse was 67.4800 ± 9.52680, and post-P2 the average recovery pulse was 57.5600 ± 6.72731. From the comparison of pre and post P2 with paired t test shows the results:

1. Resting pulse pre – post p value <0.05 (0.002 <0.05) there is a relationship or influence with the resting pulse variable (H1 accepted H0 rejected)
2. Recovery pulse pre-post p value <0.05 (0.00 <0.05) there is a relationship or influence pulse recovery (H 1 accepted H0 rejected)

In the pre-P3 group, the average resting pulse was 87.6842 ± 9.04343 and in the post-P3 group, the average resting pulse was 87.0000 ± 10.78064. In the pre-P3

group, the average recovery pulse was 68.3158 ± 7.50594, and post-P3 the average recovery pulse was 62.0000 ± 4.87625. From the comparison of pre and post P3 with paired t test shows the results:

1. Resting pulse pre–post p value> 0.05 (0.619> 0.05) has no relationship or effect with the resting pulse variable (H1 is rejected H0 is accepted)
2. Recovery pulse pre-post p value <0.05 (0.005 <0.05) there is a relationship or influence pulse recovery (H 1 accepted H0 rejected)

Table 2. Recovery Pulse P1, P2, P3

Recovery Pulse	N	Mean ± SD Pre	Mean ± SD Post	Mean ± SD difference Pre-Post	95% CI of the difference		t	Sig. (2-tailed)
					Lower	Upper		
P1	22	66.4545 ± 9.39973	56.7273 ± 6.54058	9.72727 ± 8.43000	5.98962	13.46493	5.412	0.000
P2	25	67.4800 ± 9.52680	57.5600 ± 6.72731	9.92000 ± 11.88108	5.01573	14.82427	4.175	0.000
P3	19	68.3158 ± 7.50594	62.0000 ± 4.87625	6.31579 ± 8.6670	2.13843	10.49315	3.176	0.005

The following is a comparison diagram between resting pulse and recovery pulse P1, P2 and P3

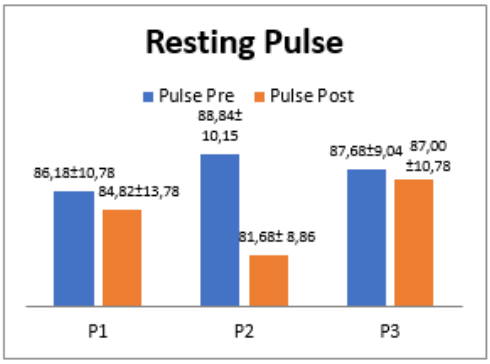

Diagram 1. Comparison diagram between resting pulse P1, P2, P3

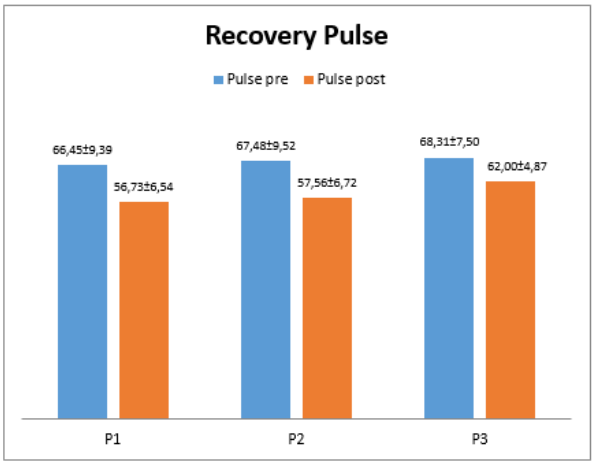

Diagram 2. Comparison diagram between recovery pulse P1, P2, P3

DISCUSSION

Previous studies have concluded that SE exercises are effective and efficient in improving cardiorespiratory fitness as walking and running exercises, but SE exercises can be done anywhere with simple equipment such as using a bench (steps), stairs that are easy to find, while walking exercises and running generally requires a large area or relatively expensive special equipment such as a treadmill.[14,15]

Biomechanically walking exercises involve the leg muscles such as the gastrocnemius, soleus, quadricep femoris, biceps femoris, gluteus and other supporting muscles in a relatively small range of motion (ROM) with low intensity; running workouts involve the same muscles but with greater ROM and higher intensity; whereas SE exercises involve the same muscles but with greater ROM than running, especially the gluteus, quadricep femoris, biceps femoris and gastrocnemius muscles with more varied intensity modifications than running exercises. The intensity of running can be modified by increasing speed and having an incline, then the intensity of SE can be done by increasing speed/cadence, step distance, step height, adding weight with dumbbells, and upper body movement activities.[16,17]

Scharff-Olson et. al. states the factors that affect SE, among others, the selected step height, training speed, forced step maneuvers, and the use of additional weights. In this study also showed that the ground reaction forces (GRF) experienced during walking at a lower step than running and are directly related to the height of the step and the type of exercise maneuver.[18] Scharff-Olson et. al. modified the SE method by testing the bench heights used for SE as 15.2 cm (6 inches, B-6), 20.3 cm (8 inches, B-8), 25.4 cm (10 inches, B-10), and 30.5 cm (12 inches, B-12), where in the study it was found that the higher the bench used, the better the VO2max response was measured.[19]

In this study, modifications to the intensity and duration of SE were carried out, where in P1 with lower intensity, longer duration (frequency of 100 beats per minute for 216 seconds); P2 with moderate intensity of moderate duration (frequency of 110 beats per minute for 196 seconds) and P3 with higher intensity of shorter duration (frequency of 120 beats per minute for 180 seconds (according to the frequency on the Harvard Step Test)). From the results

of the difference between pre and post averages, it was found that SE of medium intensity of moderate duration resulted in significantly better resting pulse and recovery pulse, while lower intensity longer duration SE and higher intensity shorter duration SE only resulted in significantly better recovery pulse.

McDermott et.al. comparing low-intensity walking with high-intensity walking in patients with Peripheral Artery Disease (PAD), the results found that low-intensity walking exercise was significantly less effective than high-intensity walking exercise and was not significantly different from controls who did not exercise to improve walking ability for 6 minutes.[20] Whereas the opposite results were found by Nambi et.al who examined the effectiveness of low-intensity versus high-intensity aerobic training combined with resistance training exercises in elderly men who had sarcopenia after Covid-19, the results of the study concluded that low-intensity aerobic exercise was more effective in increasing body size. clinical (muscle strength) and psychological (kinesiophobia and quality of life) over high-intensity aerobic exercise.[21] In another study conducted by Regnaux et. al. who compared physical activity or high-intensity versus low-intensity exercise in people with osteoarthritis of the hip or knee, concluded that there was no significant difference between high-intensity and low-intensity exercise, and suspected higher-intensity exercise programs can have more harmful effects than lower-intensity programs.[22]

CONCLUSION

Step exercise is proven to be effective and efficient in improving cardiorespiratory fitness as walking, running, cycling and other aerobic activities. Step exercise does not require special tools such as a treadmill, stationary bicycle or others aerobic equipment, SE also does not require a special place such as a jogging tract, bicycle path or other outdoor activities. The 20 cm step height makes it easy to practice because it is the standard height of the steps. Low, medium and high exercise intensities were proven to significantly reduce recovery pulse, whereas only moderate intensity was proven to significantly reduce resting and recovery pulse rates, where the pulse is an indication of cardiorespiratory fitness.

Step exercise using stairs (20 cm high) with moderate speed or intensity and moderate duration can be an effective and efficient aerobic exercise recommendation in improving cardiorespiratory fitness

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