Senam GEMU FAMIRE Training Can Increase Maximum Oxygen Volume (Vo_2Max) on College Students of Physiotherapy Study Program, Faculty of Health Sciences, Bali International University

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Abstract. This study aims to determine the Senam GEMU FAMIRE training can increase VO2 Max. This type of research is experimental with the randomized pretest-posttest control group design. The research sample of Physiotherapy Study Program on college students amounted to 24 people divided into 2 groups. Group 1 was given Senam GEMU FAMIRE training and Group 2 as a control group, with a sample test. Average VO_2Max in both groups before training with p value = 0.28 ($p > 0.05$) and after training with p value = 0.00 ($p < 0.05$). In Group 1, the average VO_2Max before training was 26.05 and after training was 39.08 with a difference of 13.03 and the percentage increase was 50%. Meanwhile in Group 2, the average VO_2Max before training was 25.21 and the average after training was 27.52 with a difference of 2.31 and the percentage increase was 9%. This shows that the treatment of group 1 and group 2 both gave a change effect. However, the improvement in group 1 was better than group 2. It was concluded that Senam GEMU FAMIRE training can increase VO_2Max.

Frequency of exercise 3 times a week for 6 weeks. VO_2Max is measured by Multistage Fitness Test. The results of the test were different from the t-paired test before and after the intra-group training. The results in Group 1 and Group 2 were significantly different with p value = 0.00 ($p < 0.05$). The results of the VO_2Max test between the two groups before and after the training were tested using the t-independent.

Keywords: Senam GEMU FAMIRE Training · VO_2Max · Multi Stage Fitness Test

1 Introduction

To achieve good immunity and physical fitness, the need for physical training or exercise plays a major role. Besides that, it is necessary to change a healthy lifestyle and be supported by a healthy and regular diet. Physical training has an important role to maintain and improve the degree of physical fitness. The better the degree of physical fitness of

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a person, the better the physiological abilities of the body. In addition, committed and consistent physical/physical training will be very beneficial so that the body does not experience excessive fatigue during strenuous physical activities, prevents obesity and improves health status [1].

Increased awareness of physical fitness in the midst of the Covid-19 pandemic as well as busyness encourages the community, in this case students, to maintain their health and improve their fitness. Through exercise will get the body's immunity as well as a healthy and fit body. With good immunity and physical fitness, a person will be able to carry out daily activities without significant fatigue and avoid being infected with the corona virus. Physical fitness is improved so that students are not only healthy at rest (static healthy) but also healthy in physical activity.

General endurance (cardiorespiratory endurance), this endurance is closely related to the maximum oxygen volume (VO_2Max) which is one of the parameters of physical fitness. According to Hairy (1989) VO_2Max, which means it shows the maximum volume of oxygen consumed by the body and is expressed in liters or milliliters per minute. The maximum ability of lung and heart organ function is an assessment to measure a person's maximum oxygen consumption ability. To increase VO_2Max, physical training programs must be carried out appropriately, carefully, systematically, regularly, and progressively following accurate training principles and methods in order to achieve the expected goals [2].

Physical fitness is a person's ability to carry out daily work activities or tasks without causing significant fatigue [3]. Physical fitness is determined by several components, but the most important and closely related to activity and health are the components of endurance, in addition to several other components such as strength, flexibility, and body composition. Physical fitness is very necessary for everyone to support their daily work activities. Physical fitness really needs to be maintained and given continuous training to stay optimal. This physical fitness really needs to be improved because it can prevent various health problems such as avoiding being infected with the corona virus (COVID-19) in general, preventing heart disease, not getting tired easily and increasing work efficiency and productivity in particular [4]. These considerations strengthen the researchers' decision to carry out aerobic exercise activities in the form of healthy gymnastics. The healthy exercise chosen to be carried out is "GEMU FAMIRE Gymnastics".

In addition, Gymnastics GEMU FAMIRE has elements of physical fitness such as general endurance, muscle strength, balance, flexibility, and coordination of movements. This will be very well applied to the wider community both for children, adolescents, and adults, especially for students to prevent being infected with the corona virus and break the chain of spreading this virus. This is because the period of students in both public and private universities is the right time to maintain and maintain physical health degrees because at the age of 18 until 25 years, entering a peak period in achievement in their respective fields in growth and development that is qualified to Boost immunity and prevent disease in the midst of the COVID-19 pandemic.

Students in the Physiotherapy Study Program, Faculty of Health Sciences, Bali International University are the ones who apply the health curriculum, community service and in physiotherapy health services, one of which is about aerobic exercise therapy lectures to patients or clients. If it is seen from the development of attendance in lecture journals,

there are still some students who are often absent during lectures due to illness and/or being in self-isolation. This causes the need for research to improve health status and find the best solution to increase body immunity and physical fitness during this pandemic. To solve this problem, the provision of healthy exercise before and after lectures and also looking for an empty schedule so that they can do healthy exercise together while staying within the health protocol in the Corona Virus (COVID-19) pandemic. The healthy gymnastics chosen in this study was GEMU FAMIRE Gymnastics and provided specific guidance on sustainable GEMU FAMIRE Gymnastics training. Therefore, research was conducted to improve physical fitness by participating in GEMU FAMIRE Gymnastics training together on campus with health protocols and online.

2 Research Method

This type of research is experimental research. In experimental research, the main problem of research is events / phenomena that will occur as a result of giving treatment or intervention to events that already exist in nature [5]. Treatment in this case, providing training programs, providing training models for Senam GEMU FAMIRE. The research design "The Randomized Pretest-Posttest Control Group Design" [6].

The place for conducting research in the ceremonial field of the International Bali University. This research was conducted on April 1 to June 28, 2022. The duration of the training provided in this study was for 6 weeks, with a training frequency of 3 times a week, namely Wednesday, Friday and Saturday. The training time is in the morning at 06.30–08.00 WITA and in the afternoon at 16.30–18.00 WITA and can be carried out offline/online.

The target population in this study were all male students of the Physiotherapy Study Program, Faculty of Health Sciences in the 2022 academic year who met the inclusion and exclusion criteria. The sample of this study used a total sampling method with a simple random sampling technique involving all male students of the Physiotherapy Study Program, Faculty of Health Sciences, Academic Year 2022, totaling 24 people who met the inclusion and exclusion criteria.

The sampling technique was carried out by simple random sampling with the aim of placing each research subject on the same opportunity by first calculating the number of respondents who would be selected as research samples. Then the researcher made a lottery with odd-even numbers to divide the sample into two groups. Where the odd number became group 1 (treatment) which was given the GEMU FAMIRE Gymnastics training, and vice versa even number as group 2 (control), namely as the control group.

GEMU FAMIRE gymnastics is a series of movements that aim to improve and maintain one's physical fitness. The series of physical fitness gymnastics movements of GEMU FAMIRE is an improvement and development of previous physical fitness exercises that have been introduced. With the successful compilation of a series of GEMU FAMIRE gymnastics movements, it is hoped that it can improve and provide various community alternatives to carry out gymnastics in order to improve their physical fitness. In the sense that a physical activity with a series of gymnastic movements arranged systematically is carried out with static, dynamic, and rhythmic movements as well as in aerobic activities with the aim of improving physical fitness.

Physical fitness is a person's ability to carry out daily work activities or tasks without causing significant fatigue. Physical fitness is measured by general endurance (cardiovascular-respiratory system), in terms of maximal oxygen volume (VO_2Max), which is one of the parameters of physical fitness. Maximum oxygen volume is a level of the body's ability to absorb, circulate, and use oxygen for activities and is processed by the human body during intensive activities as measured by the Bleeps test instrument Multistage Fitness Test.

Each study must reach the training zone (training zone), which is 70–80% (medium intensity) of the maximum pulse rate (DNM), because the research sample used is students who are not athletes, so it can be described a medium level training program with a duration of five exercises. Minutes, with the stages in providing GEMU FAMIRE gymnastics training.

Differences in training effects in this study were tested by Paired Sample T-Test and Independent Sample T-Test, which was preceded by tests of normality and homogeneity of data. Because data is normally and homogeneous, continue with analysis parametric test. Paired - Samples T Test (paired t-test) was used to analyze differences in the results of intra-group of agility before and after training in the two treatment groups. The limit of significance was $\alpha = 0.05$. Independent - Samples T-Test was used to analyze differences in the results of VO_2Max between treatment groups, both before and after treatment. The limit of significance was $\alpha = 0.05$.

3 Result Research

3.1 Descriptive Analysis of Research Sample Characteristics

The characteristics of the research sample data analyzed include; age, height, and weight, Table 1.

Table 1 shows that the characteristics of age, height, and weight of the two groups before training were not significantly different. So each group has the same physical characteristics and abilities.

3.2 Test for Normality and Homogeneity of Data

To determine the distribution of the data distribution in the research sample, the data normality test was carried out using the Saphiro Wilk Test and the homogeneity of the

Table 1. Research Sample Characteristics Data

Characteristics	n	Group 1	Group 2
		Average	Average
Age	24	20.25	19.50
Height	24	167.25	167.67
Weight	24	72.25	67.66

Table 2. Test Results for Normality and Homogeneity of Data Before and After Training

Variable	Training	(p) Normality Test (*Shapiro Wilk Test*)		(p) Homogeneity Test (*Levene Test*)
		Group 1	Group 2	
VO_2Max	Pre-test	0.67	0.73	0.34
	Post-test	0.95	0.22	0.09

Table 3. Average Difference Test Results Before and After Intra-Group Training

VO_2Max	n	Average	t	p
Group 1 Pre-test	12	26.05	-16.03	0.00
Post-test		39.08		
Group 2 Pre-test	12	25.21	-3.74	0.00
Post-test		27.52		

data using the Levene Test. Tests were conducted on the data obtained in both groups before and after the training. The variables tested were VO_2Max before and after training in each study group, Table 2.

Table 2 shows that data analysis using normality and homogeneity tests of VO_2Max results before and after training, it was found that both groups had a p value greater than 0.05 ($p > 0.05$), which means that the VO_2Max results data before and after training were normally distributed and the variation of the data is homogeneous so that further tests use parametric statistical analysis tests.

3.3 Results of the Differences in the Means of Intra-Group Research Results

The results of the different tests were used to determine and compare the average results of physical fitness (VO_2Max), before and after training between Group 1 and Group 2, namely between the GEMU FAMIRE exercise training and the control group. The results of the analysis of significance using paired t-test for intra-group, Table 3.

Table 3 shows that the mean VO_2Max results before and after training between the two groups had a p value of less than 0.05. This shows the mean VO_2Max results after training in each group there is a significant difference ($p < 0.05$). Thus the results of the difference in mean VO_2Max before training between Group 1 and Group 2 were comparable. The difference in VO_2Max after training was significantly different, meaning that the difference in final results was caused by different types of training given.

3.4 Test Results Improvement Before and After Between Groups

To determine the increase in VO_2Max between the two groups both before and after training. The results of the analysis of significance with independent t-test, Table 4.

Table 4. Improvement Test Results Before and After Inter-Group Training

Variable	Training	Average		t	p
		Group 1	Group 2		
VO_2Max	Pre-test	26.05	25.21	1.02	0.28
	Post-test	39.08	27.52	7.15	0.00

Table 5. Percentages in Each Group

VO_2Max	Group 1 (Senam GEMU FAMIRE)	Group 2 (Control)
Pre-test (T1)	26.05	25.21
Post-test (T2)	39.08	27.52
Increase Difference (T2–T1)	13.03	2.31
Percentage	50.01%	9.16%

Table 4 shows that the average VO_2Max before training between the two training groups had a p-value greater than 0.05 while after training had a p-value smaller than 0.05. This means that the mean VO_2Max data before training between the two groups was not significantly different ($p > 0.05$). Thus the mean VO_2Max before training is comparable. Meanwhile, the difference in VO_2Max after training was significantly different ($p < 0.05$) meaning the difference in final results was caused by differences in the type of training given.

3.5 Percentage Improvement in Both Groups

After training for 6 weeks, there was a difference in increase and percentage. The percentage increase VO_2Max in both groups, using the percentage formula [7]:

$$P = \frac{T_2 - T_1}{T} \times (100\%)$$

The percentage increase in VO_2Max in both groups during training is in Table 5 which shows that the increase in VO_2Max after training in Group 1 is greater than in Group 2. This shows that both treatment groups have an increasing effect after the research data is obtained. The percentage increase in VO_2Max in Group 1 training was higher than in Group 2 training.

4 Discussions

Physical fitness is a person's ability or ability to carry out activities or activities with high work power without experiencing significant or excessive fatigue. Physical fitness

is everyone's dream to be able to have high physical fitness which will later be able to affect the increase in work productivity, especially during the Covid-19 pandemic like now that is hitting the world globally.

The increase in physical fitness seen from the maximum oxygen volume in the treatment group was caused by the GEMU FAMIRE gymnastics training, this was because the training was carried out for six weeks with a frequency of three (3) times a week in accordance with the training dose carried out so as to allow a positive effect on increasing VO_2Max where there is an adaptation of the cardiorespiratory system in the body to the training load given during the training. Training given within a period of 4–6 weeks will obtain constant results, where the body has adapted to the training [3].

Sports training with an aerobic energy system is a form of physical training that gives a load to the organs being trained. This load will provide an opportunity to increase the ability of the cardiorespiratory system in delivering oxygen to all body tissues.

Physical training that is applied systematically, regularly and measurably with sufficient doses and time, will result in physiological changes that lead to the ability to produce greater energy and improve physical appearance. The right type of physical training will provide changes that include an increase in anaerobic and aerobic substrates such as ATP-PC, creatine and glycogen as well as an increase in the number and activity of enzymes in metabolic processes in the body [8].

In the GEMU FAMIRE gymnastics training using an aerobic energy system, where aerobic endurance is controlled by the capacity of the heart, lungs, and respiratory system to provide oxygen to the muscles. The GEMU FAMIRE gymnastics training method is given by adding the load gradually and progressively from the repetition of each exercise per week. As a form of training with an aerobic energy system, this method has a positive effect on increasing VO_2Max which is the dominant factor in showing a person's body ability and VO_2Max ability will provide an overview of the magnitude of motor ability (motor power) of a person's aerobic process [9].

According to Wiarto (2013) physical exercise can provide changes to all body system functions. Changes that occur during exercise are called responses. While the changes that occur as a result of continuous and programmed training in accordance with the principles of training are called adaptations. The fast heart rate during exercise is a response from the heart, but after a long time of training the heart rate slowly becomes stable because the strength of the heart muscle increases to pump blood, this is an adaptation of the heart to the physical exercise that is undertaken. The heavier the physical activity carried out while exercising, the greater the need for oxygen in the body, to compensate for this the heart and circulatory system must work more to meet the oxygen demand in the body's tissues [10].

In this GEMU FAMIRE exercise training uses an aerobic energy system, where aerobic endurance is controlled by the capacity of the heart, lungs, and respiratory system to provide oxygen to the muscles. This training method is given by adding the training load gradually and progressively each exercise per week. As a form of training with an aerobic energy system, this method has a positive effect on increasing VO_2Max. Maximum ability of heart and lung function is the best assessment of a person's body's ability to measure maximum oxygen consumption. VO_2Max has a large effect on a

person's physical endurance, namely in the use and transport of oxygen by muscles [11].

A person's level of oxygen consumption depends on the magnitude and level of a person's activity. There are several factors that determine VO_2Max including heart capacity, the ability of the cardiorespiratory system to function properly, heart function, blood volume, number of red blood cells, hemoglobin concentration must be normal and blood vessels able to drain blood from inactive tissue to active tissue, and tissues, especially muscle, must have a normal capacity to use oxygen or have a normal metabolism, as well as their mitochondrial function [2].

The results of this study are supported by research researched by Kamajaya (2013) entitled "The Effect of 2008 Physical Fitness Training on Maximum Oxygen Volume in terms of Initial Ability". Research from Prayogo (2013) entitled "The Influence of Scouting Exercises and Fitness Exercises on Physical Fitness Levels", and also research from Hasyim (2012) which examined the relationship between the intensity of physical fitness exercises and the level of physical fitness in students [12].

Types of aerobic exercise are low impact, (hi/low) impact aerobic exercise can be tailored to one's taste, special physical health needs and specific goals. The term Aerobic means "with Oxygen" aerobic exercise is a sport movement that is useful for aligning the upper body with the lower body simultaneously in a happy and excited atmosphere. The advantages of doing aerobic exercise according to Lynne Brick (2001) in Suroto (2004) are: (1) The heart, the heart muscles will be stronger in pumping blood to send oxygen throughout the body. (2) Muscle strength will increase, (3) Muscle endurance will increase (4) Flexibility around the joints will increase. (5) Body composition will be better and more ideal [13]. In this case, it is very suitable for the research sample to be given GEMU FAMIRE Gymnastics training to improve their physical fitness, especially in their VO_2Max ability.

5 Conclusion

Senam GEMU FAMIRE Training can increase Maximum Oxygen Volume (VO_2Max) on College Student of Physiotherapy Study Program, Faculty of Health Sciences, Bali International University Academic Year 2021/2022.

Acknowledgement. In improving physical fitness (maximum oxygen volume) it is recommended to use the GEMU FAMIRE gymnastics training method because it is effective in its implementation so that it can have a positive effect on physical fitness. For other research, the results of this work can be used as a guide or reference in conducting similar research. It is expected that in physical training using physical fitness training methods such as GEMU FAMIRE gymnastics so that research samples can be more effective in improving physical fitness, especially VO_2Max.

References

1. Sharkley, B. J. 2009. *Kebugaran dan Kesehatan*. Jakarta: Raja Grafindo Persada.

2. Hairy, J. 1989. *Fisiologi Olahraga Jilid I*. Jakarta: Proyek Pengembangan Lembaga Pendidikan Tinggi.
3. Nala, N. 2011. *Prinsip Pelatihan Fisik Olahraga.* Denpasar: Universitas Udayana Press.
4. Berkat, S. C. 2016. Senam Ayo Bangkit. Available at: https://www.citraberkat.sch.id/surabaya/news/senam-ayo-bangkit/.
5. Kanca, I. N. 2010. *Metode Penelitian Pengajaran Pendidikan Jasmani dan Olahraga.* Singaraja: Universitas Pendidikan Ganesha Press.
6. Pocock, S. J. 2008. *Clinical Trials A Practical Approach.* New York: A Willey Medical Publication.
7. Arikunto, S. 2004. *Dasar-Dasar Evaluasi Pendidikan (Edisi Revisi).* Jakarta: Bumi Aksara.
8. Hairy, J. 2009. Buku Materi Pokok Dasar-Dasar Kesehatan Olahraga. Jakarta: Depdikbud.
9. Sukarman, R. 2006. *Energi dan Sistem Energi Predominan Pada Olahraga.* Pusat Ilmu Olahraga Jakarta: KONI Pusat.
10. Wiarto, G. 2013. *Fisiologi dan Olahraga.* Yogyakarta: Graha Ilmu.
11. Ismaryati. 2008. *Tes dan Pengukuran Olahraga.* Surakarta: Lembaga Pengembangan Pendidikan (LPP) UNS dan UPT Penerbitan dan Pencetakan UNS (UNS Press).
12. Kamajaya, D. M. 2013. Pengaruh Pelatihan Senam Kesegaran Jasmani 2008 Terhadap Volume Oksigen Maksimal Ditinjau Dari Kemampuan Awal. (*Tesis*). Singaraja: Pascasarjana Universitas Pendidikan Ganesha.
13. Suroto. 2004. *Buku Pegangan Kuliah Peningkatan Kebugaran Melalui Kegiatan Senam Aerobik dan SKJ 2004.* Semarang: Unit Pelaksana Teknis – Mata Kuliah Umum Bidang Umum Bidang Olahraga Universitas Diponegoro.

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