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Comparison of the Effectiveness of Aerobic Gymnastics and Zumba on Increasing VO_2 Max of the Gymnastics Team Community at CPI Makassar City

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Abstract. Increasing cardiovascular capacity is an important aspect in maintaining public health, especially through community-based physical activity. This study aims to compare the effectiveness of aerobics and zumba on increasing VO_2 max in the gymnastics team community at CPI Makassar City. Using a quasi-experimental method with a Non-Equivalent Control Group design, 30 community members were divided into two treatment groups. Data collection was carried out through pre-test and post-test measurements using the Balke Test, and data analysis was carried out using paired t-test, independent t-test, and two-way ANOVA. The results of the independent t-test on the delta increase in VO_2 max showed that the zumba group experienced a statistically greater increase than the aerobic group, with a t value = -5.26 and $p = 1.35 \times 10^{-5}$ ($p < 0.05$). These findings reinforce that music-based activities and dynamic movements such as zumba are more effective in increasing the aerobic capacity of the general public. This study provides an important contribution to developing evidence-based community fitness programs and leads to the development of more effective interventions to improve cardiovascular health. Future studies are recommended to involve larger samples with full experimental designs.

Keywords: VO_2 max, aerobic exercise, zumba, cardiovascular fitness, sports community

1 Introduction

Aerobic exercise is a form of physical exercise that is done rhythmically and continuously with moderate to high intensity, which aims to increase the functional capacity of the heart, lungs and circulatory system. (Nurulita, Sukamto, Badaru, Hasyim, & others, 2024). Gymnastics involving a series of patterned or unpatterned movements arranged according to the rhythm of music that has certain rhythmic, continuity, and duration provisions is known as aerobic gymnastics or aerobics. Aerobic gymnastics movements are done quickly and require the use of proper oxygen (Arfanda, 2023). The importance of health and physical fitness is increasing, especially through various physical activities such as aerobics and zumba. Zumba is a dance-based fitness training program that combines various aerobic movements with Latin and international music rhythms. (Gunawan, Polii, & Pengemanan, 2015). This activity not

only serves as a means of recreation, but also as a method to increase cardiovascular capacity, one of the main indicators of which is an increase in VO_2 max. VO2 max is the maximum amount of oxygen a person can intake and the value does not change despite an increase in workload over time period (Buttar, Saboo, & Kacker, 2019).

Community-based sports trends such as aerobics and zumba are now growing in Indonesia. According to (Tim IPO, 2024) The increase in physical literacy will in turn increase the participation rate in sports and physical fitness of the community. The report states that the community participation index in sports in 2024 will increase by 0.009, from 0.254 in 2023 to 0.263 in 2024. Aerobics and zumba are the two most widely followed activities.

In Makassar itself, community-based programs such as those held in the Center Point of Indonesia (CPI) area have become part of the active lifestyle of urban communities. This area has its own appeal for Makassar City residents, one of which is the gymnastics team community which is one of the driving forces in promoting aerobic and zumba sports. This activity is not only popular among young people, but also by various productive ages, reflecting the inclusiveness of this gymnastics sport. However, despite the increasing popularity of zumba and aerobics, there is little research comparing the effectiveness of these two methods in increasing VO_2 max directly in the gymnastics team community at CPI Makassar City. The main problem behind this research is the gap in scientific information regarding which exercise method is more effective in increasing VO_2 max, especially in the context of non-professional gymnastics members.

Community exercise programs designed without considering specific physiological aspects such as increasing VO_2 max. This results in less than optimal training results for participants' cardiovascular health. In fact, higher VO_2 max ability is directly related to reduced risk of heart disease and improved overall quality of life (Abassi et al., 2019). This study aims to fill this gap by providing empirical evidence regarding the comparative effectiveness of aerobics and zumba on VO_2 max.

The urgency of this research is supported by the fact that the prevalence of cardiovascular disease in Indonesia continues to increase. (WHO, 2022) reported that heart disease remains the number one cause of death in Indonesia. One preventive measure that can be taken is to improve heart fitness through regular physical activity, where VO_2 max is an important indicator of success. Based on this background, this article aims to compare the effectiveness of aerobics and zumba in increasing VO_2 max in the gymnastics team community at CPI Makassar City. Through an experimental approach and quantitative data analysis, this study is expected to provide a clearer picture of the benefits of each method.

Theoretically, the results of this study can enrich the literature on the effectiveness of physical activity-based interventions on VO_2 max in community populations. While practically, these results are expected to help fitness trainers, health practitioners, and local policy makers in designing more effective and evidence-based community fitness programs.

2 Method

This study used a quasi-experimental design method with a Non-Equivalent Control Group Design. This method was chosen because it allows for comparing two groups (aerobic exercise group and zumba group) without full randomization. This study is quantitative, with

the aim of objectively measuring changes in VO_2 max before and after treatment in two groups that were not formed randomly (Rachmadi & Rusip, 2020)

The data source in this study came from members of the gymnastics team community at CPI Makassar City. A total of 30 community members became research samples using the total sampling technique, where the entire population that met the criteria was directly sampled. Total sampling, also known as saturation sampling, is a sampling technique in which all members of the population are used as research samples (Hennink & Kaiser, 2022). Inclusion criteria include: (1) age 20–40 years, (2) no history of heart or respiratory disease, (3) actively participating in community activities for at least the last 6 months, and (4) willing to participate in the full intervention program.

Data collection was conducted through Pre-test and Post-test experiments using a standard VO_2 max measurement test, namely the Balke Test adapted for young adult populations. Before treatment, all participants underwent an initial measurement (pre-test) to obtain baseline VO_2 max data. The Balke Test is a physical fitness test that involves running for 15 minutes to measure aerobic endurance or VO2Max. This test measures how far a person can run in 15 minutes and is used to assess the body's ability to use oxygen during physical activity (Muhyi, Rusdiana, Imanudin, & others, 2024). Then, each group received a sports intervention: one group did aerobics, while the other group did zumba, for 8 weeks with a frequency of 3 times per week.

In the data analysis process, the statistical techniques used were Paired t-test to determine the difference in VO_2 max before and after treatment in each group, and Independent t-test to compare the average change in VO_2 max between the aerobic and zumba groups. If it is necessary to compare the interaction between the type of sport and the measurement time (pre and post), then Two-way ANOVA can be used. This research approach is oriented towards controlled experiments, although not fully randomized, to maintain internal validity through standard intervention procedures and strict supervision of external factors. The validity and reliability of the data are strengthened through the use of standardized VO_2 max measuring instruments and uniform data collection procedures for all research participants (Saputri, Siswanto, & Sukamto, 2019).

Through this method, the study is expected to be able to provide valid and reliable results regarding the comparison of the effectiveness of aerobic and zumba gymnastics on increasing VO_2 max in the gymnastics team community at CPI Makassar City. The results of this study are not only useful for the development of community-based fitness programs but can also be a theoretical reference for similar research in the future.

3 Result

This study aims to compare the effectiveness of aerobics and zumba on increasing VO_2 max in the gymnastics team community at CPI Makassar City. A total of 30 community members were divided into two treatment groups, namely the aerobics group and the zumba group, each consisting of 15 people. Before treatment, a pre-test measurement of VO_2 max was carried out, and after 8 weeks of intervention, a post-test measurement of VO_2 max was carried out. The measurement results showed an increase in VO_2 max values in both groups. The following is a summary of the statistical test results in table form:

Table 1. Descriptive Statistics Results

Statistical Test	Mark t / F	p-value	Information
Paired t-test Aerobik	11,53	0,0000000156	Significant improvement
Paired t-test Zumba	20,96	0,000000000006	Significant improvement
Independent t-test Delta	-5,26	0,0000135	Delta VO_2 max significantly different
Two-way ANOVA (Waktu)	61,58	0,0000000001379	Time has a significant effect

Based on table 3.1, it is known that there was a significant increase in VO_2 max in both groups after being given treatment. In the aerobic group, the test results produced a t value = 11.53 and p-value = 0.0000000156 ($p < 0.05$), which means there was a statistically significant increase in VO_2 max. Likewise in the zumba group, the t value = 20.96 and p-value = 0.00000000000568 ($p < 0.05$), indicating a greater and very significant increase in VO_2 max. In addition, an Independent t-test was conducted to see the difference in increase (delta VO_2 max) between the two groups. The results of this test showed a t value = -5.26 with a p-value = 0.0000135 ($p < 0.05$). These results indicate that the increase in VO_2 max in the zumba group was significantly greater than the aerobic group. Thus, it can be concluded that zumba is more effective in increasing VO_2 max than aerobics in this community.

Table 2. Results of Paired t-test, Independent t-test, and Two-way ANOVA calculations

Number	Test Type	Statistical Value	p-value	Information
1	Paired t-test (Aerobik)	t = 11.53	1.56×10^{-8}	Significant
2	Paired t-test (Zumba)	t = 20.96	5.68×10^{-12}	Significant
3	Independent t-test (Delta VO_2 max)	t = -5.26	1.35×10^{-5}	Significant
4	Two-way ANOVA (Time)	F = 61.58	1.38×10^{-10}	Significant
5	Two-way ANOVA (Group)	F = 0.12	0.728	Not Significant
6	Two-way ANOVA (Interaction)	F = 3.36	0.072	Not Significant

Based on table 3.2, To strengthen the results, a Two-way ANOVA analysis was also conducted with Group (Aerobic and Zumba) and Time (Pre-test and Post-test) factors. The ANOVA results showed that the Time factor had a significant effect on VO_2 max ($F = 61.58$, $p = 0.0000000001379$). However, the interaction between Group and Time was not significant ($F = 3.36$, $p = 0.072$), which means that the difference in increase between aerobic and zumba did exist, but was not too strong for all samples. The results of the Paired t-test were that the increase in VO_2 max was significant in both the aerobic and zumba groups. The results of the Independent t-test showed that the increase in VO_2 max in the zumba group was significantly higher than aerobic. While the results of the Two-way ANOVA showed that the time factor (pre vs post) had a significant effect, the group factor and interaction (Group × Time) were not fully significant, although the trend direction was visible.

The important findings of this study answer the research question, namely that both aerobics and zumba are effective in increasing VO_2 max, but zumba provides statistically greater results. This is very relevant to the conditions of the gymnastics team community at CPI

Makassar City which does more zumba activities, so the results of this study support the implementation of a zumba-based fitness program to increase cardiorespiratory capacity.

4 Discussion

This study proves that both aerobics and zumba can significantly increase VO_2 max capacity. The results of the Paired t-test showed a significant increase in both groups, with the zumba group showing higher changes than aerobics. This is in line with the basic theory of exercise physiology which states that rhythmic activities with moderate to high intensity, such as zumba and aerobics, can increase the efficiency of the cardiovascular system and the body's oxygen transport capacity (Tanzila & Hafiz, 2019).

This finding strengthens the research results (Ayuni, Wijianto, & others, 2021) who found that Zumba exercise is more effective than aerobic exercise in improving aerobic fitness in women of productive age. The intensity of Zumba exercise is generally higher, involving dynamic movements of the whole body, as well as variations in music and fast rhythms are thought to be driving factors in increasing VO_2 max more significantly than traditional aerobics..

Independent t-test analysis in this study showed a significant difference in the increase in VO_2 max between the aerobic and zumba groups. The implications of these results emphasize that more varied and challenging types of exercise, such as zumba, can be a more attractive alternative for community-based fitness programs. Practically, communities such as joint gymnastics implemented at CPI in Makassar City can consider zumba as the main program to improve the cardiovascular fitness of its members..

Within the framework of training adaptation theory, increases in VO_2 max are caused by physiological adaptations such as increased cardiac stroke volume and muscle capillarization. (Erina, 2016). Zumba, which combines high-intensity aerobic movements with a variety of explosive movements, accelerates this adaptation process more effectively than conventional aerobics, which tends to move at a moderate intensity..

However, factors such as intrinsic motivation, baseline fitness level, and individual suitability for a particular activity type may influence outcomes. For example, individuals who enjoy music and dance more may demonstrate higher exercise commitment in zumba compared to aerobics, which may impact their VO_2 max results. Environmental factors of exercise, such as community atmosphere and social support, are also possible supportive aspects that may contribute to the success of this intervention.

The contribution of this research to the field of community fitness is quite significant, especially in the context of developing community programs based on physical activity. With scientific evidence that zumba is more effective in increasing VO_2 max, fitness instructors and community managers can optimize exercise programs to improve the cardiovascular fitness of the community at large. This is a concrete step in supporting the national program "Indonesia Bugar 2045".

5 Conclusion

This study shows that both aerobics and zumba can significantly increase VO_2 max in members of the gymnastics team community at CPI Makassar City. Through paired t-test

analysis, it was found that there was a significant increase in VO_2 max in both groups. However, the results of the independent t-test revealed that the increase in VO_2 max in the zumba group was significantly higher than the aerobics group. Two-way ANOVA analysis also confirmed that the time factor had a significant effect on increasing VO_2 max, although the interaction between type of exercise and time did not show a significant effect. The effectiveness of each exercise method on increasing cardiovascular capacity (VO_2 max) supports the main objective of this study: to compare the effectiveness of aerobics and zumba on increasing VO_2 max. This study emphasizes that zumba, with its intensity and variety of movements, is more effective in increasing cardiovascular capacity than traditional aerobics.

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