Теорія та методика фізичного виховання
Physical Education Theory and Methodology
Teorìâ ta Metodika Fìzičnogo Vihovannâ

ISSN 1993-7989 (print)
ISSN 1993-7997 (online)
ISSN-L 1993-7989

ORIGINAL SCIENTIFIC ARTICLE

COMPARISON OF THE EFFECT OF HIGH IMPACT AEROBIC DANCE EXERCISE VERSUS ZUMBA ON INCREASING MAXIMUM OXYGEN VOLUME IN ADOLESCENT WOMEN

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Accepted for Publication: April 8, 2022
Published: June 25, 2022

DOI: 10.17309/tmfv.2022.2.03

Abstract

The study purpose was to compare high impact aerobic dance exercise versus Zumba to increase Maximum Oxygen Volume (VO_2max) in adolescent women.

Materials and methods. This research is quasi-experimental with a two-group pretest-posttest design research design. A total of 30 adolescent women from the Student Activity Unit (UKM) aerobic gymnastics at Universitas Nusantara PGRI Kediri, aged 18-24 years, body mass index (BMI) 18.5-24.9 kg/m^2, normal blood pressure participated in the study. Respondents were randomly divided into two groups, namely ZADE (n = 15, Zumba aerobic dance exercise) and HADE (n = 15, High impact aerobic dance exercise). HADE and ZADE were conducted for 30 minutes/session, with an intensity of ≥ 85% HRmax, as often as 3 times/week, and both types of training were performed for 8 weeks. Measurements of VO_2max, oxygen saturation (SpO_2), and heart rate at rest (HRrest) were pre-test and 1×24 hours post-test after 8 weeks of training intervention. Statistical analysis used Paired Sample t-Test with a significance level of 5%.

Results. Paired Sample T-Test results showed significant differences in average VO_2max, SpO_2, HRrest between pretest vs. posttest in both groups ($p \leq 0.001$).

Conclusions. Based on the study results, we have concluded that both HADE and ZADE increase VO_2max, SpO_2, and decrease HRrest. But HADE is more effective in increasing VO_2max, SpO_2, and lowering HRrest than ZADE in adolescent women.

Keywords: aerobic dance, exercise, high impact, maximum oxygen volume, zumba.

Introduction

A person who experiences fatigue while carrying out daily activities can be caused by a lack of physical activity, resulting in a decrease in fitness levels. Physical activity has benefits in health development and positively impacts challenging things, such as exploration, skills building, and social integration (Barber & Weichold, 2007). Aerobic fitness is the maximum capacity when inhaling, channeling, and using oxygen. Aerobic capacity is a major component of the element of success in sporting achievement. Maximum oxygen volume (VO_2max) is the best indicator of an athlete's physical capacity (Rankovic et al., 2010). VO_2max is the maximum amount of oxygen that can be consumed during intense physical activity until fatigue occurs. Physical freshness is a person's ability to perform physical activities that require strength, endurance, and flexibility. The element

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that affects physical health is cardiorespiratory endurance (Kusnanik et al., 2019). During exercise there is an increase in motor units, increased strength, and frequency of muscle contractions, this is important because it shows changes in muscle function during development towards exercise with intensity approaching VO_2max (Robergs, 2001).

Endurance is needed for daily activities, with good endurance then daily activities will not experience fatigue that is so heavy. Endurance is strongly related to breathing, heart, and circulatory (Irwandi & Aprizalmi, 2016). Physical freshness is an interpretation of the heart's endurance ability to maintain maximum body performance without fatigue for a while. Parameters as a marker of a person's physical fitness can be assessed from high VO_2max levels (Widodo et al., 2021). VO_2max is the maximum amount of oxygen that can be consumed during intense physical activity until fatigue occurs. A person with a good level of VO_2max means having good physical fitness as well. Physical fitness gives a person the ability to do productive daily work without excessive fatigue. Low cardiorespiratory fitness can increase the risk of death from heart disease and hypertension (Irianto & Hasnah, 2018).

Aerobic gymnastics is very popular in various parts of the world (Schroeder, 2017). Aerobic exercise can be done anywhere and anytime. Aerobic gymnastics in addition to being able to train endurance is also able to increase motivation so that individuals who do it are more excited. Aerobic exercise can also help break away from the routine (Wang & Wu, 2016). Aerobic exercise performed 30-45 minutes, 3x/week for 10 weeks significantly increases physical work capacity and cardiovascular function (Dowdy et al., 2015). Aerobic gymnastics is one of the most common adult fitness activities performed (Aleksandra et al., 2016). Based on its intensity, aerobic gymnastics is divided into three types low impact, high impact, and mixed impact. High impact aerobic gymnastics has benefits to help boost the immune system, heart, and blood circulation. High impact aerobic exercise is an aerobic exercise with foot movements that do not touch the floor (Suminar et al., 2018). In addition to aerobic dance, doing zumba dance activities is also able to increase flexibility, respiratory endurance, cardiovascular endurance, and abdominal strength. Zumba is also a rhythmic aerobic fitness program. Zumba involves dance and all the aerobic components (Bandopadhyay, 2018). Zumba is a new type of dance practice, inspired by Latin American music and Latin American dance. This exercise combines the basics of merengue dance, salsa, samba, cumbia, reggaeton, and other Latin American dances, using basic aerobic steps, but also has the advantages of other dance variations such as hip hop, belly dance, India, African dance, etc (Perez, 2009).

High blood pressure is one of the riskiest factors for cardiovascular disease and is one of eight causes of death worldwide (Punia et al., 2016). Hypertension is a multifactorial chronic disease that affects more than one billion adults worldwide (Mills, 2016). This is considered an important cardiovascular risk factor, as it is closely related to the occurrence of cardiovascular disease (Rapsomaniki et al., 2014) and the risk of premature death (Pan, 2020). In addition to treatment, lifestyle changes are very important in the treatment of hypertension, in addition to regular physical exercise also includes the prevention of hypertension (Whelton et al., 2020). Variable variations of exercise can be an important strategy in maintaining health (de Barcelos et al., 2022). One way to assess a person's cardiorespiratory endurance is to measure VO_2max values to measure the capacity of the heart, lungs, and blood to hold oxygen to working muscles and measure muscle oxygen use (Nugraheni et al., 2017). The most common measurement for VO_2max prediction is the Multi-Stage 20-m Shuttle Run Fitness Test. This test is widely used by sports scientists, teachers, trainers, and fitness advisors because it requires limited equipment, is relatively easy to perform, and is suitable for the assessment of a large number of subjects. As is the case with all tests and measurements used to assess the physical fitness component, critical questions must be asked regarding the repetition and validity of MFT (Cooper et al., 2005). Maximal oxygen absorption is assessed by establishing an oxygen recovery curve based on the Multi-Stage 20-m Shuttle Run Fitness Test (Paradisis et al., 2014).

The goal of the study was to compare high-impact aerobic dance exercise versus Zumba aerobic dance exercise against the increase in VO_2max in adolescent girls. Increased VO_2max can be useful in health, such as the diagnosis of potential heart disease in the elderly to measuring peak performance in elite athletes (Snarr et al., 2018).

Materials and Methods

Study participants

This research is Quasi-Experimental with a two-group pretest-posttest design. A total of 30 adolescent women from the Student Activity Unit (UKM) aerobic gymnastics at Universitas Nusantara PGRI Kediri, aged 18-24 years, body mass index (BMI) 18.5-24.9 kg/m^2, normal blood pressure participated in the study. Randomly respondents were divided into two groups, namely ZADE (n = 15, Zumba aerobic dance exercise), HADE (n = 15, High impact aerobic dance exercise). Before participating in the research, all respondents obtain information both orally and in writing about the research to be carried out. All respondents expressed willingness to participate in the research by signing informed consent. All procedures carried out in our research have complied with the Helsinki World Medical Association Declaration on the ethical conduct of research involving human subjects.

Study organization

The high-impact aerobic dance exercise and Zumba program are applied and supervised by professional officers from the Faculty of Health and Science, Universitas Nusantara PGRI Kediri. High impact aerobic dance exercise and Zumba for 30 minutes/training session with intensity ≥ 85% HRmax with a frequency of 3x/week for 8 weeks. Monitoring heart rate during high impact aerobic dance exercise and Zumba using polar heart rate monitor (Polar H7 Bluetooth Heart Rate Sensor & Fitness Tracker, Inc., USA).

Data collection for body height (BH) measurement using a Stadiometer (Portable Seca® Stadiometer, North America). Body weight (BW) is measured using digital scales (OMRON HN-246, Osaka, JAPAN). BMI is calculated using BW (kg) divided by BH (m^2). Blood pressure measurement using digital meter tension (OMRON Model Deluxe HEM-8712 BASIC, JAPAN) on the non-dominant arm 3 times in a

row with a break interval of 2 minutes between the two measurements then take the average value of the three measurements. Measurements of heart rate rest (HR-rest) and oxygen saturation (SpO_2) using the Beurer Pulse Oximeter PO-30. Measurement of maximum oxygen volume (VO_2max) using Multi-Stage 20-m Shuttle Run Fitness Test (Paradisis et al., 2014). VO_2max, SpO_2, and HR-rest measurements were pretest and 1×24 hours post-test during 8 weeks of high-impact aerobic dance exercise and Zumba interventions.

Statistical analysis

The technique of data analysis used the Statistical Package for Social Science (SPSS) version 21 software. The Shapiro-Wilk test was used for normality test analysis with a significant level ($p \geq 0.05$). Paired Sample t-Test was used to compare the mean VO_2max, SpO_2, and HR-rest between pretest vs. posttest, while the Independent Samples t-Test was used to compare the mean VO_2max, SpO_2, and HR-rest between ZADE vs. HADE at the pretest, posttest, and delta observation points. All statistical analyzes used a significant level ($p \leq 0.05$).

Results

Preliminary measurement results of the characteristic parameters of study respondents which include age, body height, body weight, body mass index, blood pressure are shown in Table 1 below.

Based on Table 1, the results of the Independent Samples t-Test analysis showed that there was no significant difference in the average parameter characteristics of study respondents between ZADE vs. HADE ($p \geq 0.05$). The results of the analysis of the average maximum oxygen volume (VO_2max), oxygen saturation (SpO_2), heart rate rest (HR-rest) between pretest vs. posttest on ZADE and HADE can be seen in Figure 1.

Based on Figure 1 it is seen that there is an average change in VO_2max, SpO_2, HR-rest between pretest vs. posttest on ZADE and HADE. Paired Sample T-Test results showed significant differences in average VO_2max, SpO_2, HR-rest between pretest vs. posttest in both groups ($p \leq 0.001$). The results of the analysis of the average VO_2max, SpO_2, HR-rest between ZADE vs. HADE at the pretest, posttest, delta observation points can be seen in Table 2.

Table 1. Initial measurement results of characteristic parameters of study respondents

No	Parameter	ZADE (n = 15)	HADE (n = 15)	p-value
1	Age (years)	20.73±1.58	20.60±1.59	0.820
2	Body height (m)	1.55±0.04	1.54±0.06	0.662
3	Bodyweight (kg)	55.40±4.75	54.33±8.52	0.675
4	Body mass index (kg/m^2)	23.11±2.15	22.78±2.60	0.710
5	Systolic blood pressure (mmHg)	117.87±3.02	116.60±2.56	0.225
6	Diastolic blood pressure (mmHg)	78.87±3.76	77.40±3.78	0.295

Description: ZADE: Zumba aerobic dance exercise, HADE: High impact aerobic dance exercise. p-value is obtained using the Independent Samples t-Test. Data presented with Mean ± SD.

Table 2. Average analysis results VO_2max, SpO_2, HR-rest between ZADE vs. HADE

No	Observation Point	ZADE (n = 15)	HADE (n = 15)	p-value
1	VO_2max (mL/kg/min)			
	Pretest	26.37±2.72	26.23±3.57	0.905
	Posttest	30.49±2.31	32.91±3.31*	0.029
	Delta (Post – Pre)	4.12±2.02	6.67±1.25**	0.000
2	SpO_2 (%)			
	Pretest	96.60±0.91	96.80±0.77	0.522
	Posttest	98.00±0.93	98.87±0.92*	0.015
	Delta (Post – Pre)	1.40±0.74	2.07±0.88*	0.033
3	HR-rest (bpm)			
	Pretest	79.07±4.13	79.60±3.64	0.710
	Posttest	76.40±4.07	73.07±2.81*	0.014
	Delta (Post – Pre)	–2.67±1.05	–6.53±2.67**	0.000

Description: ZADE: Zumba aerobic dance exercise, HADE: High impact aerobic dance exercise. *Significant vs. ZADE ($p \leq 0.05$). **Significant vs. ZADE ($p \leq 0.001$). p-value is obtained using the Independent Samples t-Test. Data presented with Mean ± SD.

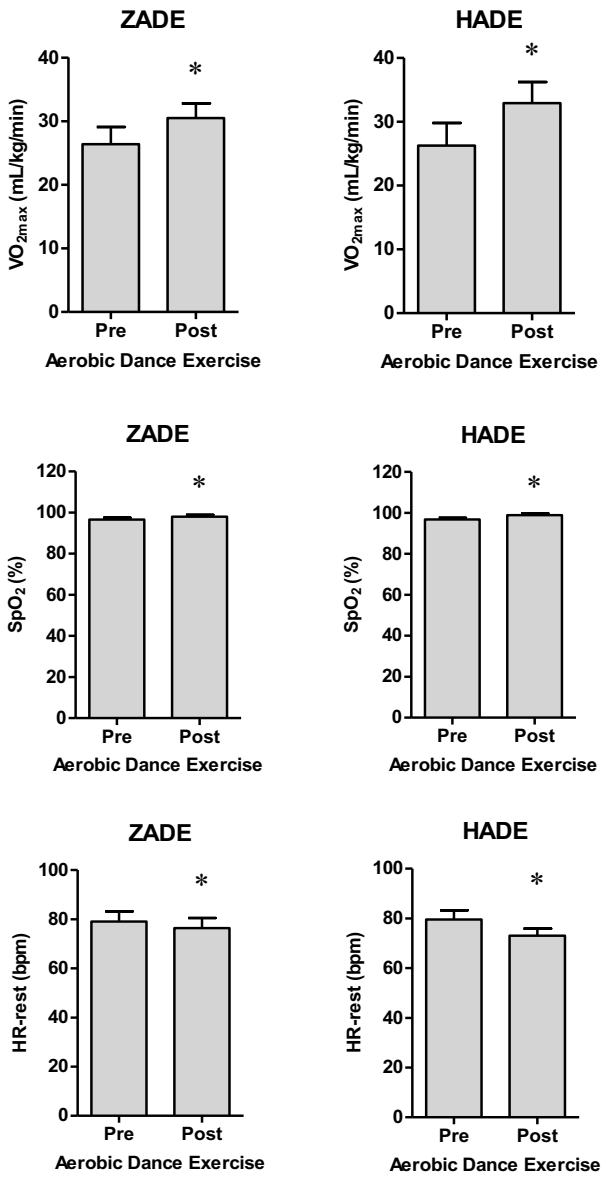

Figure 1. Average VO_2max, SpO_2, HR-rest between pretest vs. posttest on ZADE and HADE
Description: ZADE: Zumba aerobic dance exercise, HADE: High impact aerobic dance exercise. *Significant vs. Pretest ($p \leq 0.001$). p-value is obtained using the Paired Sample t-Test. Data presented with Mean±SD

Independent Samples t-Test analysis showed no significant difference in average VO_2max, SpO_2, HR-rest between ZADE vs. HADE at the pretest observation point ($p \geq 0.05$), while at the posttest and delta observation points there was a significant difference in average VO_2max, SpO_2, HR-rest between ZADE vs. HADE ($p \leq 0.05$).

Disscusion

Aerobic dance exercise is one form of physical activity that can improve health and please many people around the world (Vijayalakshmi et al., 2021). Currently, aerobic dance exercise has become a lifestyle, this is because aerobic dance exercise can improve heart health (Donath et al., 2014), overall muscle strength, balance, and coordination, and reduce depression (Santos-Silva et al., 2021). Our research aims to gain insight into the comparison of the effects of high-impact aerobic dance exercise (HADE) and Zumba aerobic dance exercise (ZADE) to maximal oxygen volume (VO_2max), heart rate rest (HR-rest), oxygen saturation (SpO_2). Based on the results of the study showed that there was a significant difference in the average increase in VO_2max and SpO_2 between pre-test vs. post-test on (HADE and ZADE). While the average HR-rest between pretest vs. posttest on HADE and ZADE decreased significantly (Figure 1). These results are in line with the results of research conducted by Suminar et al. (2018) reported that high-impact aerobics exercise, and Zumba fitness increase VO_2max and decrease heart rate recovery. Research of Nandhini (2013) also reported an increase in VO_2max after aerobic dance training. Samba dance performed with moderate to heavy intensity improves cardiorespiratory fitness (Santos-Silva et al., 2021). Likewise, Zumba training (group fitness based on salsa and aerobics) improves aerobic fitness (Donath et al., 2014). The 8-week Low Impact Aerobic Dance Program significantly improved VO_2max (Olufemi & Adaeze, 2012). The increase in VO_2max is likely due to high-impact aerobic dance exercise increasing Fast-twitch muscle fibers, thus causing an increase in muscle contractions faster than Zumba aerobic dance exercise. Muscle fibers are designed to produce powerful explosive power with the use of more energy sources. Fast-twitch muscle fibers require more energy than slow-twitch muscle fibers, so the recovery process after aerobic dance exercise is more effective (Mallesh et al., 2017).

Heart rate is one of the foundations in determining the dose of physical activity. Heart rate can describe a person's intensity in doing a physical activity so that it can show how hard the heart works. A person who has a normal pulse and tends to be low can have good VO_2max and will not easily experience fatigue while doing aerobic exercise. This is supported by our results which showed an increase in VO_2max and a decrease in HR-rest after 8 weeks of high-impact aerobic dance exercise and Zumba. High levels of VO_2max affect the body's ability to recover optimally. Maximum oxygen volume (VO_2max) can provide important information about an individual's capacity in the long-term energy system and maximum oxygen consumption can be increased with long-term aerobic exercise (Bandopaddhyay, 2018). Aerobic exercise has been shown to lower the risk of cardiovascular disease in women with sedentary lifestyles characterized by improvements in systolic and diastolic blood pressure as well as increasing high-density lipoprotein (HDL) and lowering total cholesterol (TC), low-density lipoprotein (LDL), and triglyceride (TG) (İmamoğlu et al., 2017).

Endurance is needed for daily activities, with good endurance then daily activities will not experience fatigue that is so heavy. Endurance is strongly related to breathing, heart, and circulatory (Irwandi & Aprizalmi, 2016). Physical freshness is an interpretation of the heart's endurance ability to maintain maximum body performance without experiencing fatigue for a period of time. The parameter that can be used as a marker of a person's physical fitness level is VO_2max (Widodo et al., 2021). VO_2max is the maximum amount of oxygen that can be consumed during intense physical activity until fatigue occurs. A person with

a good level of VO_2max means also having a good level of physical fitness. Physical fitness gives a person the ability to do productive daily work without excessive fatigue. A person with a low level of physical fitness can increase the risk of death from heart disease and hypertension (Irianto & Hasnah, 2018). Based on the results showed that Zumba aerobic dance exercise and high impact aerobic dance exercise conducted 30 minutes/training sessions with a frequency of 3x/week for 8 weeks increase VO_2max, but high impact aerobic dance exercise is more effective in increasing VO_2max than Zumba aerobic dance exercise (Table 2). Therefore, high-impact aerobic dance exercise can be used as a method in improving physical fitness, to reduce the risk of heart disease and hypertension.

Conclusion

Based on the results of the study concluded that Zumba aerobic dance exercise and high impact aerobic dance exercise conducted 30 minutes/training session with a frequency of 3x/week for 8 weeks increase VO_2max, SpO_2 and decrease HR-rest. But high impact aerobic dance exercise is more effective in increasing VO_2max, SpO_2, and lowering HR rest than Zumba aerobic dance exercise in adolescent women.

Acknowlegdement

We thank the Rector of Surabaya State University Prof. Dr. Nurhasan, M.Kes, Rector of Universitas Nusantara PGRI Kediri Dr. Zaenal Afandi, M.Pd, Dean of the Faculty of Health and Sciences, Universitas Nusantara PGRI Kediri Dr. Sulistiono, M.Si, Chairperson of the Physical Education Study Program of Universitas Nusantara PGRI Kediri Dr. Slamet Junaidi, M.Pd, who has provided support in the implementation of this research. We would also like to thank all the respondents who participated in this study.

Conflict of interest

All authors declare no conflict of interest.

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ПОРІВНЯННЯ ВПЛИВУ ВПРАВ ІЗ ВИСОКОУДАРНОЇ ТАНЦЮВАЛЬНОЇ АЕРОБІКИ ТА ЗУМБИ НА ПІДВИЩЕННЯ ПОКАЗНИКА МАКСИМАЛЬНОГО СПОЖИВАННЯ КИСНЮ В ЮНИХ ЖІНОК

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 2 табл., 1 рис., 32 джерела.

Метою дослідження було порівняння вправ із високоударної танцювальної аеробіки та зумби за їхнім впливом на підвищення показника максимального споживання кисню (VO_2max) у юних жінок.

Матеріали та методи. Це дослідження є квазіекспериментальним, при цьому план проведення дослідження включає попереднє та заключне дослідження в рамках двох експериментальних груп. У дослідженні брали участь загалом 30 юних жінок із секції студентської діяльності зі спортивної аеробіки, які навчаються в університеті Нусантара Асоціації вчителів Індонезії в місті Кедірі (Індонезія), віком 18-24 роки, індекс маси тіла (IMT) 18,5–24,9 кг/м^2, нормальний кров'яний тиск. Учасниць випадково розподілили на дві групи, а саме: ZADE (n = 15, вправа з танцювальної аеробіки зумби) та HADE (n = 15, вправа з високоударної танцювальної аеробіки). Вправи HADE та ZADE виконувалися протягом 30 хв/заняття з інтенсивністю ≥ 85% максимальної ЧСС (HRmax), із частотою 3 рази/тиждень, і обидва типи тренувань проводилися протягом 8 тижнів. Вимірювання показників максимального споживання кисню (VO_2max), насиченості крові киснем (SpO_2) і частоти серцевих скорочень у стані спокою (HRrest) проводили до початку та 1×24 години після завершення експериментальної частини після 8 тижнів тренувального втручання. Статистичний аналіз даних було проведено з використанням t-критерію Стьюдента для парних вибірок із рівнем значущості 5%.

Результати. Результати аналізу даних із використанням t-критерію Стьюдента для парних вибірок показали значні відмінності в середніх значеннях показників максимального споживання кисню (VO_2max), насиченості крові киснем (SpO_2) і ЧСС у стані спокою (HRrest) між даними до та після експериментальної частини в обох групах ($p \leq 0,001$).

Висновки. На підставі одержаних результатів дослідження ми дійшли висновку про те, що і вправи з високоударної танцювальної аеробіки (HADE), і вправи з танцювальної аеробіки зумби (ZADE) підвищують показники максимального споживання кисню (VO_2max), насиченості крові киснем (SpO_2) та знижують показник ЧСС у стані спокою (HRrest). Проте вправи з HADE ефективніші за вправи ZADE для підвищення показників VO_2max, SpO_2 та зниження показника HRrest у юних жінок.

Ключові слова: танцювальна аеробіка, вправа, високоударний, максимальне споживання кисню, зумба.

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Cite this article as: Puspodari, P., Setijono, H., Wiriawan, O., Arfanda, P.E., Raharjo, S., Muharram, N.A., Himawanto, W., Allsabah, M.A.H., & Koestanto, S.H. (2022). Comparison of the Effect of High Impact Aerobic Dance Exercise Versus Zumba on Increasing Maximum Oxygen Volume in Adolescent Women. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 22*(2), 166-172. https://doi.org/10.17309/tmfv.2022.2.03

Received: 14.03.2022. Accepted: 8.04.2022. Published: 25.06.2022