The Effect of Skipping Exercise on Endurance Level among Adolescents aged 15-18 years in Gribin Volleyball Community Surabaya

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ABSTRACT

Background: The most frequently encountered problem of individuals who are in transition period from childhood to adulthood is deteriorated cardiorespiratory endurance due to low physical activity. Adolescents had low physical activity because of their sedentary lifestyle. The exercise that could boost their cardiorespiratory endurance is long duration exercise with moderate intensity, such as skipping exercise. **Objectives:** This study aimed to evaluate the effect of skipping exercise on the endurance level of adolescents age 15-18 years in Gribin Volleyball Community, Surabaya. **Methods:** This study utilized an experimental analytics method with pre-test and post-test with control group design. The sample consisted of members Gribin Volleyball Community Surabaya aged 15-18 years. The endurance level was evaluated using PACER test, then the data was analyzed using Shapiro-Wilk test for normality prior to the next analysis. Then, in order to compare the data in-between and between groups, Paired T-test, Wilcoxon Signed Rank test, and Mann-Whitney U test were performed. **Results:** The mean of post-test VO_2Max in the control group was 20.80 ± 0.94 ml/kg/min, while the mean of post-test VO_2Max in the intervention group was 23.64 ± 1.85 ml/kg/min. The Mann-Whitney U test results showed a significant different of the post-test VO_2Max between group with p-value of 0.000 (P<0.05). **Conclusion:** The skipping exercise had a significant effect on improving endurance level among adolescents age 15-18 years in Gribin Volleyball Community, Surabaya.

Keywords: adolescent, endurance, skipping exercise, PACER test

BACKGROUND

According World Health Organization (WHO), adolescents includes individuals who are aged 10-19 years.(1) Adolescence is a transitional peridod between childhood and adulthood, (2) where a significant changes occur in body composition which then subsequently affecting the body's response towards physical activity and exercise.(3) The increasing trend of sedentary lifestyle among adolescents would decreases their tolerance to physical activities which mainly caused by the declining cardiorespiratory endurance. (4)

Endurance is the ability to perform repetitive activities over a certain period of time. The endurance level is determined by how well the cardiorespiratory system perform in increasing the cardiac output, to ensure that the blood flow in each cell can meet its needs. Endurance level can be improved through moderate intensity exercise with a long duration.(4) One of the exercie is skipping exercise. (5)

Skipping exercise is an exercise that utilized rope which performed by holding both ends of the rope and swinging it over the head and legs while jumping over it.(6) Skipping exercise is known as a physical activity with many benefits for cardiorespiratory endurance which is simple and safe to perform. The benefits include improving muscle strength, muscle flexibility, coordination and balance. Skipping exercise with a proper dosage could help to significantly improve the endurance of adolescents through increaed VO_2Max and physical capability. (7)

Based on the justifications as described above, this study aims to evaluate the effect of skipping exercise on the endurance level among adolescents age 15-18 years in Gribin Volleyball Community, Surabaya.

METHODS

Ethical Consideration

This study has been approved by Ethical Committee of Faculty of Dental Medicine, Universitas Airlangga Surabaya with reference number 0400/HRECC.FODM/IV/2024.

Study Design

This analytic experimental study utilised pre-test and post-test with control group design. Thus, the study is performed by categorized the sample into two groups, which are treatment group and control group. The subjects in the treatment group received the thrice a week skipping exercise program for four weeks, meanwhile those in control group only performed their usual exercise routines. The skipping exercise is performed 12 times in a month with the exercise duration in the first two week of intervention is 30 minutes and 40 minutes skipping exercise for the last two weeks of the intervention.

Study Site

This study was conducted on April-May 2024 in the field of Gribin Volleyball Community, Surabaya, Jawa Timur, Indonesia.

Population and Sample

The target population of this study was the member of Gribin Volleyball Community Surabaya. The total of 30 community members met the inclusion criteria and involved in this study, with 15 adolescents in each groups.

The inclusion criteria include: 1) member of Gribin Volleyball Community and agreed to signed the informed consent form; 2) adolescents aged 15-18 years; 3) physically and mentally healthy; 4) good general health which indicated by normal vital signs. Meanwhile, subjects with declined general health in the last month, subject with history of cardiovascular diseases (i.e. coronary heart disorder, arrythmia, deep vein thrombus, etc.), and subject who experiences dyspnea due to pulmonary diseases (i.e. asthma, chronic obstructive pulmonary diseases, and pneumonia), were excluded from this study.

Additionally, the data of subjects who withdraw from the study and subject whose health condition continously declined during the program will also be excluded from the analysis process.

Study Instruments

Progressive Aerobic Cardiovascular Endurance Run test (PACER test) is a test performed to evaluate the cardiovascular endurance. This assessment, which is a modification of bleep test, is conducted by running back and forth with an increasing pace every minute following a predetermined rhythm for 20 meter. The scoring was done when the subject failed to increase the speed by matching the specified rhythm twice.[8]

The test begins by asking the subject to run for 20 meter right after the cue ”on your mark, get ready, start!”. The subject was told to maintain their running speed according to the predetermined rhythm. The subject must run from the starting line until one of the foot touches the finish line before the sound cue ”TING” and must run back toward the end of the other finish line upon hearing the sound ”TING”. The subjects have to continue running back and forth from the starting line to the finish line, and the test was only stopped once they completed the 20 meter distance or when they failed to pass the finish line twice. The normal scores of PACER test according to the Ministry of Youth and Sports of Republic of Indonesia (KEMENPORA RI) is outlined in Table 1.

This test was conducted before and after the skipping exercise, to evaluate the endurance level which represented by VO_2Max. The normal values of VO_2Max in female and male aged 13-19 years old as adapted from Hadiono (2019) is presented in Table 2.

Table 1. PACER test normal score [9]

PACER TEST						
Age	**Gender**	**Very low**	**Low**	**Moderate**	**Good**	**Very good**
15yo	**M**	≤ 51	52-69	70-86	87-93	≥ 94
	F	≤ 32	33-39	40-45	46-50	≥ 51
16yo	**M**	≤ 61	62-72	73-87	88-93	≥ 94
	F	≤ 32	33-42	43-50	51-60	≥ 61
17yo	**M**	≤ 61	62-77	78-92	93-105	≥ 106
	F	≤ 32	33-42	43-50	51-60	≥ 61
17+ yo	**M**	≤ 72	73-84	85-95	96-105	≥ 106
	F	≤ 41	42-52	53-62	63-71	≥ 72

Table 2. Normal values of VO_2Max in male and female aged 13-19 years old [10]

Age	**Very low**	**Low**	**Moderate**	**Good**	**Very good**	**Excellent**
13-19 yo	< 25.0	25.0–30.9	31.0–34.9	35.0–38.9	39.0–41.9	> 41.9
13-19 yo	< 35.0	35.0–38.3	38.4–45.1	45.2–50.9	51.0–55.9	>55.9

Data Analysis

Data that obtained from this study was analysed using IBM SPSS Statistics 23. Shapiro-Wilk test for normality was utilised to evaluate the data distribution because the sample size was less than 50. Next, the data analysis that conducted were: 1) Wilcoxon Signed-Rank test to examine the differences between VO_2Max of pre-test and post-test in the control group; 2) Paired t-test to examine the differences between VO_2Max of pre-test and post-test in the treatment group; and 3) Mann-Whitney U test to examine the post-test VO_2Max difference between both groups.

RESULTS

Subjects Characteristics

The subjects consisted of male and female adolescents aged 15-18 years who are the member of Gribin Volleyball Community in Surabaya. There were 30 subjects who met the inclusion criteria, which then randomly classified into two groups with 15 subjects for each group. The characteristics of the subjects in treatment group were outlined in Table 3, whilst the characteristics of subjects in control group were presented in Table 4.

Table 3. Characteristics of subjects in treatment group

	Age	**Weight (kg)**	**Height (cm)**	**Body Mass Index (kg/m^2)**
N	15	15	15	15
Min	15	45	155	18,37
Max	18	70	170	27,34
Mean ± SD	16.33 ± 1.05	54.73 ± 6.76	163.07 ± 5.02	20.56 ± 2.23

Table 4. Characteristics of subjects in control group

	Age	Weight (kg)	Height (cm)	Body Mass Index (kg/m^2)
N	15	15	15	15
Min	15	46	155	18,43
Max	18	58	167	21,56
Mean ± SD	16.27 ± 1.10	51.13 ± 4.50	160.47 ± 3.94	19.82 ± 0.89

Table 3 showed that subjects in treatments group consisted of four females and 11 males with average age of 16.33 ± 1.05 years old. Moreover, the average Body Mass Index (BMI) in the treatment group was 20.56 ± 2.23 kg/m^2. Meanwhile, Table 4 showed that there were eight females and seven males in control group with the average age of 16.27 ± 1.10 years old and average BMI slightly lower than those in treatment group, which was 19.82 ± 0.89 kg/m^2.

The PACER Test Scores

The endurance level of both groups in this study before and after the skipping exercise program as assessed using PACER test, which represented in VO_2Max, is outlined in Table 5.

Table 5. PACER test scores in VO_2Max

	VO_2Max in Control Group (ml/kg/min)		VO_2Max in Treatment Group (ml/kg/min)	
	Pre-Test	**Post-Test**	**Pre-Test**	**Post-Test**
N	15	15	15	15
Min	19.4	19.4	19.8	20.1
Max	22.1	23	25.3	26.2
Mean ± SD	20.47 ± 0.71	20.80 ± 0.94	22.74 ± 1.67	23.64 ± 1.85
VO_2Max Classification	Very Low	Very Low	Very Low	Very Low
Mean difference pretest - posttest	1,61%		3,95%	

The mean of pre-test VO_2Max in control group was 20.47 ml/kg/min, while the post-test VO_2Max in the same group was 20.80 ml/kg/min. Moreover, in treatment group, the VO_2Max mean were 22.74 ml/kg/min for pre-test and 23.64 ml/kg/min for post-test. These results indicated that the PACER test scores of both pre-test and post-test in treatment group were higher than those in control group. Furthermore, according to the VO_2Max classification, the pre-test VO_2Max in both groups demonstrated a very low endurance level. In the other hands, the post-test score in control and treatment groups also indicated a very low endurance level.

The Effects of Skipping Exercise on Endurance Level

The Shapiro-Wilk test for normality showed that the pre-test data of both groups, also the post-test data of the treatment group were normally distributed. Meanwhile, the post-test data of the control group is not normally distributed. Hence, Wilcoxon Signed-Rank test was used to compare pre-test and post-test data of the control group. Additionally, Paired T-test was conducted to compare pre- and post-test data of the treatment group. Moreover, to compare the post-test data of both groups, Mann-Whitney U test was utilized. The results of the statistical analysis were presented in Table 6, Table 7, and Table 8.

1) Comparison between pre- and post- PACER test score in Treatment Group

Table 6. PACER test score of Treatment Group in VO_2Max

	N	Mean ± SD VO_2Max (ml/kg/min)	p-value
Pre-Test	15	22.74 ± 1.67	0.000
Post-Test	15	23.64 ± 1.85	

The Paired T-test results indicated that there was a significant VO_2Max difference between the pre- and post- PACER test with p = 0.000. Thus, it can be concluded that skipping exercise have a significant effect on the endurance level in adolescents in treatment group with VO_2Max difference of 3.95%

2) Comparison between pre- and post- PACER test score in Control Group

Table 7. PACER test score of Control Group in VO_2Max

	N	Mean ± SD VO_2Max (ml/kg/min)	p-value
Pre-Test	15	20.47 ± 0.71	0.011
Post-Test	15	20.80 ± 0.94	

Comparison test using Wilcoxon Signed Rank Test showed that there was a significant VO_2Max difference between pre- and post- PACER test in the control group with p-value = 0.011. Hence, it can be concluded that skipping exercise have a significant effect on the endurance level in adolescents in the control group with VO_2Max difference of 1.61%

3) Comparison between Treatment Group and Control Group

Table 8. PACER test score in VO_2Max

	N	Mean ± SD VO_2Max (ml/kg/min)	p-value
Post-Test Control Group	15	20.80 ± 0.94	0.000
Post-Test Treatment Group	15	23.64 ± 1.85	

Mann-Whitney U Test showed that there was a significant VO_2Max difference between post- PACER test in treatment and control group with p-value = 0.000. Therefore, skipping exercise has a significant effect on the endurance level among adolescents aged 15-18 years old in Gribin Volleyball Community, Surabaya.

DISCUSSION

The subjects of this study consisted of adolescents aged 15-18 years who were known to have a sedentary lifestyle due to lack of physical activity. WHO (2016) stated that there were 26% of men and 35% of women who have a low physical activity in high-income countries, while there were 12% of men and 24% of women with lack of physical activity in low-income countries. This lack of physical activity could affect the cardiorespiratory endurance level which subsequently cause a decline in their productivity and achievements.[11]

According to the Wilcoxon Signed Rank Test as outlined in Table 7, a total of 15 subjects in the control group showed significant VO_2Max differences between the pre-test (VO_2Max = 20.47 ± 0.71 ml/kg/min) and post-test (VO_2Max = 20.80 ± 0.94 ml/kg/min), with a p-value of 0.000. The increase in VO_2Max of 1.61% in this control group was attributed to the subjects continuing their regular training activities, which included physical exercise such as running two laps on the field, passing, and playing volleyball, all of which can enhance their endurance

level. In contrast, the Paired T Test in Table 6 indicated that subjects in the treatment group, who not only participated in regular training but also received additional training in the form of skipping exercises, demonstrated a significant difference with an increase in VO_2Max of 3.95%.

These results align with the research conducted by Nasrulloh et al (2021) regarding the effects of skipping exercise on significant VO_2Max improvements among adolescents aged 17-21 years. This study was conducted without a control group. Skipping exercise was performed with a frequency of three times per week for 30 minutes over a period of eight weeks. Endurance levels were evaluated using the Multistage Fitness Test (MFT), also known as the PACER test. The findings of this study indicate a significant increase in VO_2Max with p-value of 0.000, where the average pre-test score was 34.92 and the post-test score improved to 40.05.[5]

Another study conducted by Maryani (2023) on the Raja Karate Team karate athletes also indicates a significant effect of skipping exercise on the athletes' endurance levels. This research was carried out on karate athletes that were divided into a treatment group and a control group. The treatment group received skipping exercise with a frequency of three times per week for a total of sixteen sessions. Endurance levels were evaluated using the bleep test, which is a measurement tool similar to the PACER test. The results of this study demonstrate a significant increase in VO_2Max with p-value of 0.000.[12]

Furthermore, the comparison test using the Mann-Whitney U Test indicated that the post-test results in both the control group and the treatment group showed a significant difference with p-value of 0.000. This result indicates that skipping exercise had a significant effect on the endurance levels among adolescents aged 15-18 in the Gribin Volleyball Community, Surabaya.

The same results were obtained in a study conducted by Jubaisyah (2020) which indicated that skipping exercise has a significant effect on the increase of VO_2Max in the Badminton Student Activity Unit. This study involved 20 subjects who performed skipping exercise for a duration of 15-30 minutes three times a week over four weeks. The measurement tool used to evaluate endurance levels in this study was the Queen's College Step Test (QCST). The control group subjects in Jubaisyah's (2020) study also experienced a significant improvement in endurance levels as they continued to engage in regular physical activities during the study period.[13]

A significant increase in VO_2Max in both groups occurred due to physical activity that elevates oxygen demand in the body. As the demand for oxygen rises, the muscles work harder to enhance oxygen absorption. The higher the VO_2Max, the longer the muscles can work without experiencing fatigue. In order to improve VO_2Max, it is essential to consider a training program with intensity and frequency that suitable with the needs. The intensity and frequency of exercise greatly influence lung capacity; the greater the physical activity, the larger the lungs will become, enabling them to absorb more oxygen into the muscle cells that are required to work harder.[14]

Some strengths of this study include the homogeneity of the subjects, as this research specifically targets adolescents aged 15-18 years in the Gribin Volleyball Community. This allows the researcher to specifically observe the effects of skipping exercise on endurance levels among subjects with relatively similar physical activity levels. Furthermore, the study employs a pre-test and post-test design with a control group, which facilitates the observation of changes after the administration of skipping exercise. The presence of a control group also enables the researcher to compare results with a group that does not receive the intervention, thereby enhancing the validity of the measurement outcomes. Another strength of this study is the use of the PACER test, which demonstrates high validity ($r = 0.62 – 0.83$) and reliability (Intraclass Correlation Coefficient = 0.77 – 0.93).[15]

The limitations of this study include the presence of confounding factors that may affecting the results, such as physical activities outside the program (i.e. intense or light exercise), genetic variations, initial health conditions, and differing lifestyle habits of the subjects such as sleeping patterns, stress, dietary habits, and lifestyle, as well as the body's responses to physical training. Therefore, future research should establish more specific

inclusion criteria. This is to prevent any additional activities undertaken by subjects outside the exercise program. Furthermore, future studies could also focus on one gender exclusively, as males and females have different VO_2Max classifications.[10]

CONCLUSION

The research findings indicate that there is a significant increase in VO_2Max in both research groups with p-value of 0.000 (treatment group = 23.64 ± 1.85; control group = 20.80 ± 0.94). Additionally, the implementation of skipping exercises has been shown to have a significant effect on the endurance levels among adolescents aged 15-18 years in the Gribin Volleyball Community, Surabaya. Skipping exercise that was given with proper dosage could boost the oxygen demand by enhancing the muscle works, which subsequently improve the cardiorespiratory endurance.

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