The Effect of Moderate Intensity Continuous Training on V02 Max Overweight Adolescents

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ABSTRACT
This study aimed to determine the effect of moderate-intensity continuous training (MICT) on V02 Max in overweight adolescents. This study used an experimental method with pre and post-test designs on 20 overweight adolescents according to the inclusion and exclusion criteria. Samples were randomly divided into two groups, the control group and the MICT group. The control group did not do the exercise. The MICT group exercised by running for 30 minutes (64-76% of maximal heart rate), three times per week for four weeks. VO2 Max capacity was measured using a multi-stage fitness test by running back and forth with a 20-meter track. The results showed that there was a significant increase in VO2 Max in the MICT group (p=0.00). In the control group, there was a decrease in VO2 Max, but there was no significant difference (p=0.869). There was a significant difference in VO2 Max between the MICT group and the control group (p=0.005). In conclusion, MICT over four weeks can increase the VO2 Max in overweight adolescents.

Keywords: Moderate-Intensity; Continuous Training, VO2 Max, Overweight, Adolescents.

INTRODUCTION
Overweight in adolescence is one of the main problems in global health (Nicolucci & Maffeis, 2022). Being overweight has negative short-term and long-term impacts. In the short term, adolescents who are overweight and obese are more likely to suffer from psychological co-morbidities such as depression, anxiety, low self-esteem, a range of emotional and behavioural disorders, asthma, systemic diseases, inflammation, liver complications, and musculoskeletal problems, especially in the lower extremities. Overweight and obese adolescence also have more metabolic and cardiovascular risk factors, such as high blood pressure, dyslipidemia, type 2 diabetes and other cardiovascular system disorders. In the long term, being overweight and obese in adolescence increases
the risk of cardiovascular disease, diabetes, several types of cancer, and musculoskeletal disorders in adulthood, which can cause disability and premature death (Todd, Street, Ziviani, & Byrne, 2015).

According to World Health Organization (WHO) data in 2016, more than 1.9 billion adults aged >18 years were overweight, and 600 million were obese (39%). The total population is 38% male, and 40% female. Based on data from the Global Nutrition Report, 10% of the adult population in Indonesia are overweight, and 2% are obese (WHO, 2016). Ministry of Health Basic Health Research (Riskesdas) data for 2018 showed that the prevalence of adults over 18 years in Indonesia who are overweight is 13.6%, and 21.8% are obese. Furthermore, based on the 2018 Riskesdas of the Ministry of Health of the Republic of Indonesia regarding the incidence of overweight, there was a significant increase in the number of proportions in 2007 (8.6%), 2013 (11.5%), and 2018 (13.6%) (Kemenkes RI, 2018).

Being overweight is largely caused by high energy intake, including disproportionate amounts of refined carbohydrates or processed foods (increased insulin release and fat storage), as well as decreased physical activity (Cesare et al., 2020). The developing 'obesogenic' environment increases the tendency for children to consume foods and drinks that are high in calories, energy-dense, or low in nutrients (Osei-assibey et al., 2012), sedentary lifestyle (Raj, 2020) and lack of mobility or active movement in daily life were the factors that contribute to changes in energy balance and causes obesity (Lin & Li, 2021). Body composition affects oxygen consumption, a body that has a high-fat percentage will have a lower maximum oxygen consumption (Mondal & Mishra, 2017).

Maximum oxygen consumption (V02 Max) is the maximum capacity of the lung, heart and muscle systems to absorb oxygen (Bruno, Smirmaul, Bertucci, & Inaian, 2013). V02 Max is affected by body mass index (BMI), an increase in BMI will be followed by the effect of body fat on cardiorespiratory function. Excessive amounts of body fat place an unfavourable burden on oxygen uptake by working muscles (Laxmi, Udaya, & Vinutha Shankar, 2014). Previous research also explained that there was a correlation between maximal oxygen volume and body mass index which showed that an increase in BMI was followed by a decrease in V02 Max which resulted in a decrease in the level of cardiorespiratory fitness (Shah, Ranga, Jadhav, Rukadikar, & Singh, 2022). Maximum oxygen consumption (V02 Max) is the main indicator to evaluate cardiorespiratory fitness. V02 Max is directly related to cardiovascular health and increasing it is associated with a reduced risk of mortality from cardiovascular disease.
The World Health Organization (WHO) recommends a minimum of 150-300 minutes of moderate-intensity physical activity (40%-60% VO2 Max) or 75-150 minutes of high-intensity physical activity (60%-80%) per week to maintain or improve cardiorespiratory fitness in healthy adults (Yang, 2019). In the general population, regular physical exercise is known to have beneficial effects on physical fitness, such as increased aerobic capacity and increased muscle strength, which are important for the ability to lead a physically active life and for health (Ruegsegger & Booth, 2018).

Moderate-intensity continuous training (MICT) is moderate-intensity aerobic exercise. The continuous running exercise method is a continuous running exercise without any rest. In general, MICT consists of 30–60 minutes of aerobic exercise at 64–76% HRmax (Williams et al., 2019). This method is often used by trainers to train VO2 Max. Exercises that are carried out in a programmed and continuous manner can increase the work efficiency of the cardiovascular system (Kurniawan, 2020).

This study aimed to determine the effect of moderate-intensity continuous training (MICT) on VO2 Max in overweight adolescents.

**METHOD**

The research was quasi-experimental with a pretest – a posttest group design. This study compared the VO2 Max of overweight adolescents who received the MICT intervention and controls for four weeks. Anthropometric measurements, VO2 max, and exercise interventions were carried out at the Physiotherapy Laboratory, Abdurrab University from February to May 2022. These parameter measurements were carried out before and after the intervention.

The population used in this study were DIII Physiotherapy students at Abdurrab University who were active in the 2021/2022 academic year. The inclusion criteria of this study were age 18-24 years and having BMI ≥25 kg/m2. Exclusion criteria were students who did strenuous exercise twice per week for ≥30 minutes and students who reported heart, liver, kidney disease, inflammation, immune disorders, asthma, and experienced trauma, and injuries.

Subjects were randomly assigned to two groups, the control and MICT group. The control group did not do any exercise sessions. MICT intervention is carried out by running for 30 minutes continuously without pause (64-76% HRmax). MICT was performed three times per week.
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days per week for four weeks.

A heart rate monitor is used to measure heart rate. Anthropometric measurements are used to measure the Boddy Mass Index (BMI), the ratio between body weight (BB) and the square of height (H). The equipment used for the aerobic fitness test includes multistage running tracks, whistles, speakers, multistage software rhythms, writing tools and Multi-Stage Fitness Test forms, ropes, distance markers or cones, and a meter to determine the 20-meter distance.

Each subject started the exercise with a five-minute warm-up by running at 50-55% HRmax, the maximum heart rate predicted according to age as determined by the following equation, HRmax = 220-A(age). After warming up, the MICT group did exercises for 30 minutes (64-76% HRmax). The MICT workout ends with a five-minute cool down at 50-55% HRmax. Before and after the exercise, the subjects were required to stretch according to the researcher's instructions to avoid injury.

Statistical analysis using IBM SPSS Statistics Program version 24, IBM, US. Shapiro–Wilk test is used to verify data normality. To analyze the V02 Max score, paired sample t-tests and independent t-tests were performed. P value < 0.05 was used as the criterion for statistical significance.

RESULTS AND DISCUSSION

The average V02 Max value before treatment in the control group was 17.25 ± 2.04, and the MICT group was 17.15 ± 2.07 ml/kg/minute. The V02 Max scores of both groups according to David and Samuel's (2015) classification are in the poor category for the fitness of adolescents aged 18-24 years (≤33 ml/kg/minute).

<table>
<thead>
<tr>
<th>V02 Max</th>
<th>Group</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ml/kg/mnt</td>
<td>Control</td>
<td>MICT</td>
</tr>
<tr>
<td>Pre-Test</td>
<td>17.25±2.04</td>
<td>17.15±2.07</td>
</tr>
<tr>
<td>Post-Test</td>
<td>17.08±3.77</td>
<td>21.78±2.63</td>
</tr>
<tr>
<td>p</td>
<td>.869</td>
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</tr>
</tbody>
</table>

Based on table 1, the results showed that the V02 Max score in the pre-test of the MICT group is lower than the control group. However, the results of the statistical test using the independent T-test showed no significant difference (p = 0.92). Meanwhile, the results of the V02 Max score in the post-test of the MICT group were higher than the
control group. Independent T-test results showed a significant difference (p=0.005)

![Image 1. V02 Max score in the Control and MICT Groups]

Image 1 shows a comparison of the V02 Max values between the control group and the MICT group. The results showed that the V02 Max value in the pre-test of the MICT group was 17.15 ± 2.07 and in the post-test of the MICT group was 21.78 ± 2.63 [Table 1]. Based on statistical tests, there was a significant difference in the V02 Max score between the pretest and posttest in the MICT group (P = 0.00). V02 Max in the pre-test of the control group was 17.25 ± 2.04 and in the post-test of the control group 17.08 ± 3.77. There was a decrease in the V02 Max score in the control group, but this decrease was not significant (p = 0.869).

The Effect of MICT on V02 Max score

V02 Max can be described as the maximal oxygen volume capacity of each pulmonary, cardiovascular and muscle system in absorbing and utilizing oxygen during intense activity. This can be seen when a person is easily tired when doing light activities. Because someone who is overweight usually when doing activities such as climbing stairs, and running will feel short of breath after these activities because the V02 Max value is low (Scribbans, trisha d. Vecsey, Hankinson, Foster, & Gurd, 2016).

Based on Laxmi's research (2014) V02 Max is affected by body mass index (BMI), and an increase in BMI will be followed by the effect of body fat on cardiorespiratory function. Excessive amounts of body fat create an unfavourable burden on oxygen
absorption by working muscles. Previous research also explained that there was a
correlation between maximal oxygen volume and body mass index which showed that an
increase in BMI was followed by a decrease in V02 Max which resulted in a decrease in
cardiorespiratory fitness (Laxmi et al., 2014).

One way to increase V02 Max capacity in overweight adolescents is by
implementing continuous training exercises. According to research, continuous training
exercise programs are very effective in supporting and maintaining muscle and
cardiovascular endurance in early childhood and adolescents (Koubaa et al., 2013).

Research shows that giving continuous running which is carried out three times a
week for four weeks will produce constant results, where the body can adapt to training
and will produce significant improvements. Physical exercise that is carried out
systematically, regularly and continuously will be able to increase the ability to consume
oxygen properly. The increase in amount of blood pumped by the heart at each beat will
increase, this is due to the exercise given which has the effect of getting stronger and the
size of the heart muscle (Hottenrott, Ludyga, & Schulze, 2012). The results of the study
also revealed that there was a significant effect of continuous running exercise on
increasing cardiovascular endurance. Physical exercise can be seen as a repetitive physical
activity aimed at increasing individual functional capacities (Nalcakan, 2014)

CONCLUSIONS AND SUGGESTIONS

Based on the results of the research above, it can be concluded that the moderate-
intensity continuous training (MICT) method has a great influence on the process of
increasing V02 Max. Exercise with the MICT method three times per week can be used as
a way to increase V02 Max capacity in overweight adolescents.

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