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# Acute Moderate Intensity Exercise Decreases Oxygen Saturation In Obese Women

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## ABSTRACT
Obesity can lead to dysfunction of the pulmonary respiratory system by decreasing oxygen saturation. This is due to obese people experiencing impaired ventilation-perfusion mechanisms and disruption of gas exchange which results a decrease in oxygen saturation. This study aims to analyze acute moderate intensity exercise decreases oxygen saturation in obese women. This study is a true experiment with a randomized control group design posttest-only design using 14 obese women aged 19-24 years, body mass index (BMI) 27-33 kg/m2, percentage body fat (PBF) above 30 % and fasting blood glucose (FBG) below 100 mg/dL, normal hemoglobin (Hb), normal systolic and diastolic blood pressure, normal resting heart rate and randomly divided into two groups, namely CON (n=7, control without intervention) and MIE (n=7, moderate intensity exercise). Moderate intensity exercise intervention is carried out at 08.00-10.00 a.m. Moderate intensity exercise interventions carried out for 40 minutes using a treadmill. Blood sampling is done 10 minutes after the intervention. Measurement of oxygen saturation using a Pulse Oximeter. Data analysis techniques used the Independent-Samples T Test with the Statistical Package for Social Science (SPSS). The results obtained mean oxygen saturation at CON (98.43±0.53) % and MIE (96.57±0.97) % (p=0.001). Based on the results of the study concluded that moderate moderate intensity acute exercise reduces oxygen saturation in obese women. It is recommended to do further research by providing intensity exercise interventions that are carried out chronically (chronic exercise) in obese women.

**Keywords:** Cortisol Levels, Moderate Intensity Exercise, Obese Women, Oxygen Saturation,

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**BACKGROUND**

Weight and height, are indicators of overweight and obesity, and are factors used to describe the health of a population. Over the past few decades, the prevalence of overweight and obesity has increased worldwide and has reached significant public health prelevance (Schienkiewitz, 2017). Obesity is an increasing global public health problem (Fruh *et al*., 2017) in developing countries including Indonesia (Harbuwono *et al*., 2018). This case, supported by the statement of the Consultant of World Health Organization (WHO) related to obesity has warned that an increase in the prevalence of obesity in developing countries (Prentice, 2006). In Indonesia, obesity has become a major health problem since the "double burden of disease" has affected Indonesia's population (Mihardja and Soetrisno, 2012). The prevalence of obesity needs to be done the right action in dealing with it.

The previous World Health Organization (WHO) report on diet, nutrition, and prevention of chronic diseases states that obesity is a major risk factor for all non-communicable diseases (Prentice, 2006). This increase in morbidity and mortality associated with obesity is associated with obesity playing a role in a variety of chronic medical conditions, including cardiovascular and metabolic diseases, hyper-coagulable states, low back pain, osteoarthritis, and cancer. Obesity is also strongly associated with respiratory symptoms and diseases, including dyspnea activity, obstructive sleep apnea syndrome (OSAS), obese hypoventilation syndrome (OHS), chronic obstructive pulmonary disease (COPD), asthma, pulmonary embolism, and aspiration pneumonia. Besides the health risks associated with obesity can affect respiratory function (Mukhlis and Bakhtiar, 2015) can affect the decrease in oxygen saturation (SpO2) (Herdiyanti *et al*., 2018).

Health risks associated with obesity, including its effects on respiratory function. Respiratory muscle strength can experience weakness in obesity, where there is a decrease in maximal inspiratory pressure in obese subjects compared to control subjects for normal body weight. Respiratory muscle weakness in obesity has been linked to muscle weakness as a result of decreased compliance of the chest wall or reduced lung volume or can occur both (Mukhlis and Bakhtiar, 2015). This is because obesity has a disturbance in ventilation-perfusion mechanism and gas exchange disruption which results in a decrease in oxygen saturation (Herdiyanti *et al*., 2018). Oxygen saturation shows the adequacy of oxygenation or tissue perfusion, while decreasing oxygen saturation causes failure in oxygen transport (Andriyani and Hartono, 2013). Oxygen is substantially carried in blood bound to hemoglobin. A small portion in dissolved form. The amount of oxygen transported bound to hemoglobin is known as oxygen saturation ($SpO_2$) (Eroglu *et al*., 2018). Exercise will cause several changes in the body, one of which is the oxygen level in the blood. Under normal circumstances in the blood there is a reserve of oxygen. However, when doing exercise the body requires oxygen in large quantities to meet the need for energy. If the level of oxygen in the blood decreases beyond the normal limit will be very dangerous for the body (Simanjuntak *et al*., 2016). Research conducted by Eroglu *et al*. (2018) acute aerobic exercise reduces oxygen saturation. According to Simanjuntak *et al*. (2016) that acute physical exercise in basketball players has an increase in oxygen saturation. Besides Herdiyanti *et al*., (2018) explained that obesity has decreased oxygen saturation. Research conducted by Neto *et al*. (2014) concluded that acute exercise decreases oxygen saturation. Based on the above background, further research is needed regarding acute exercise of moderate intensity to changes in oxygen saturation in obesity.

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## METHODS

This study was a true experiment with a randomized control group posttest-only design study using 14 obese women aged 19-24 years, body mass index (BMI) 27-33 kg/m$^2$, percentage body fat (PBF) above 30% and fasting blood glucose (FBG) < 100 mg/dL, normal Hemoglobin (Hb), blood pressure systole and diastole are normal, resting heart rate is normal and randomly divided into two groups, namely CON (n=7, control without intervention) and MIE (n=7, moderate intensity exercise). All of these research procedures were approved by the Health Research Ethics Commission of the Faculty of Medicine, Airlangga University, Surabaya number 309/EC/KEPK/FKUA/2019.

MIE intervention is done by running on a treadmill with a moderate intensity of 60-70% $HR_{max}$ for 40 minutes (Dias *et al*., 2017; Wewege *et al*., 2017; Rahimi and Tayebi, 2013). The intervention was carried out at 08.00-10.00 a.m using a treadmill (Richter Treadmill Semi-Commercial Evolution (4.0 hp DC)). MIE intervention is done once (acute exercise).

Height measurements used a stadiometer (SECA, Chino, CA). Measurement of body weight, BMI and PBF, fat mass (FM), free fat mass (FFM) used TANITA (Body Composition Analyzer DC3607601 (2) -1604 FA, TANITA Corporation of America, Inc. USA). Measurement of blood pressure used a digital blood pressure meter (OMRON Model HEM-7130 L, Omron Co. JAPAN). Oxygen saturation ($SpO_2$) was measured using a Pulse Oximeter (PO 30 Pulse Oximeter, Beurer North America LP, 900 N Federal Highway, Suite 300, Hallandale Beach, FL 33009). FBG measurements using ACCU-CHEK (ACCU-CHEK® Performa, Mannheim, Germany) with a unit of concentration of mg/dL. Hb measurement used Easy Touch (Easy Touch GCHb, Taiwan) with a unit of concentration g/dL.

Statistical analysis used statistical software packages for social science (SPSS). The normality test uses the Shapiro-Wilk test. Data that were normally distributed were tested using the Independent-Samples T Test with a significant level ($p<0.05$). All data are displayed with mean±SD.

## RESULT

The results of descriptive analysis of the research subjects' characteristics in each group can be seen in table 1.

**Table 1. Research subjects characteristics**

| Variabel | n | CON | MIE | *p*-value |
|---|---|---|---|---|
| | | Mean±SD | Mean±SD | |
| Weight (kg) | 7 | 75.21±6.15 | 73.13±7.29 | 0.573 |
| Height (m) | 7 | 1.58±0.04 | 1.57±0.05 | 0.793 |
| Body Mass Index Tubuh (kg/m$^2$) | 7 | 29.94±1.48 | 29.28±1.15 | 0.372 |
| Fasting Blood Glucose (mg/dL) | 7 | 92.71±4.99 | 88.14±6.79 | 0.177 |
| Hemoglobin (g/dL) | 7 | 15.60±1.97 | 14.41±1.06 | 0.186 |
| Systolic Blood Pressure (mmHg) | 7 | 114.28±5.34 | 111.43±3.78 | 0.271 |
| Diastolic Blood Pressure (mmHg) | 7 | 77.14±4.88 | 75.71±5.34 | 0.611 |
| Resting Heartbeat (bpm) | 7 | 78.14±11.35 | 80.00±7.66 | 0.726 |
| Percentage Body Fat (%) | 7 | 46.34±3.70 | 44.56±2.41 | 0.306 |
| Fat Mass (kg) | 7 | 36.01±6.14 | 32.73±4.63 | 0.280 |
| Free Fat Mass (kg) | 7 | 41.37±4.06 | 40.46±3.08 | 0.644 |

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Based on Table 1, the Independent-Samples T Test shows that there are no significant differences in the mean data characteristics of research subjects in all groups. The result of oxygen saturation analysis of each group can be seen in table 2.

**Table 2. The Result of Statistic Analysis of Oxygen Saturation**

| Variable | Time | n | CON | MIE | *p*-value |
|---|---|---|---|---|---|
| | | | Mean±SD | Mean±SD | |
| Oxygen Saturation (%) | Pre-exercise | 7 | 98.57±0.53 | 98.14±0.89 | 0.305 |
| | Post-exercise | 7 | 98.43±0.53 | 96.57±0.97 | 0.001* |

Based on Table 2, the Independent-Samples T Test shows that there is significant difference in the mean oxygen saturation ($p<0.05$).

## DISCUSSION

Based on the results of the study Table 2 shows that oxygen saturation in the MIE group was lower than the CON group. Based on the Independent-Samples T Test, it shows that there is a significant difference in the average oxygen saturation. These results are in line with the results of research conducted by Eroglu *et al*. (2018) concluded that aerobic exercise performed acutely can reduce oxygen saturation. Likewise the results of research conducted by Neto *et al*. (2014) concluded that acute exercise decreases oxygen saturation. The decrease in oxygen saturation in the MIE group is likely due to an intervention factor. This is due to when there is an increase in oxygen demand in the blood. Oxygen is substantially carried in blood bound to hemoglobin (Eroglu *et al*., 2018). Oxygen is bound to hemoglobin in red blood cells as it moves through the lungs, then it is distributed throughout the body through arteries. Hemoglobin that binds oxygen is called oxyhemoglobin ($HbO_2$), while hemoglobin that does not bind oxygen is called deoxihemoglobin (Hb). Oxygen saturation level in arterial blood ($SaO_2$ oxygen saturation) shows the percentage of the amount of HbO2 to the amount of hemoglobin in the blood (Konica Minolta Sensing, Inc., 2006). Oxygen saturation is the ability of hemoglobin to bind oxygen. Intended as the degree of saturation or saturation ($SpO_2$) (Rupii, 2005). Decreased oxygen saturation in the MIE group due to muscle activity due to MIE can increase the temperature. Muscles that are working will release carbon dioxide, carbon dioxide acid released by the muscles that are working will increase the concentration of hydrogen ions (decreased pH) in muscle capillaries. In addition, muscle temperature often rises from 2-30C which can increase $PO_2$ to release $O_2$ into the muscles, thereby decreasing the attractiveness of hemoglobin in oxygen thereby reducing oxygen saturation (Guyton and Hall, 2016). Any increase in body temperature can cause hemoglobin bonds and decreased oxygen levels. Body temperature is one of the factors that influence the speed of metabolism, because if body temperature rises there will be an acceleration of metabolic processes and metabolism will rise. The main factor of speed of metabolism is muscle activity (Ganong, 2009). According to Widiyanto and Yamim (2014) added that the factors that influence oxygen saturation include the amount of oxygen entering the lungs (ventilation), the speed of diffusion, and the capacity of hemoglobin to carry oxygen.

Decreased-oxygen saturation in the MIE group was also caused by obesity. Obesity occurs excessive accumulation of adipose tissue around the chest wall and abdomen. This

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will cause changes in respiratory mechanics that can cause interference with the ventilation-perfusion mechanism and interference with $O_2$ and $CO_2$ exchange which results in a decrease in $PO_2$. A decrease in $PO_2$ will cause a decrease in the amount of oxygen that is bound to each heme group on the hemoglobin molecule (% saturation) (Rabec *et al*., 2011; Littleton, 2011). Changes to oxygen saturation stimulate peripheral chemoreceptors. Peripheral chemoreceptors will forward impulses to the respiratory control center to increase or decrease the frequency of breathing in response to changes in oxygen saturation (Coztanzo, 2014).

Respiratory muscle weakness in obesity has been linked to muscle weakness as a result of decreased compliance of the chest wall or reduced lung volume or can occur both (Mukhlis and Bakhtiar, 2015). This is because obesity has a disturbance in ventilation-perfusion mechanism and gas exchange disruption which results in a decrease in oxygen saturation (Herdiyanti *et al*., 2018). Oxygen saturation shows the adequacy of oxygenation or tissue perfusion, while decreasing oxygen saturation causes failure in oxygen transport (Andriyani and Hartono, 2013). Oxygen is substantially carried in blood bound to hemoglobin. A small portion in dissolved form. The amount of oxygen transported bound to hemoglobin is known as oxygen saturation (SpO2) (Eroglu *et al*., 2018). Exercise will cause several changes in the body, one of which is the decreased oxygen level in the blood (Niko *et al*., 2018). Under normal circumstances there is a reserve of oxygen in the blood. However, when doing exercise the body requires large amounts of oxygen to meet the energy needs for muscle contraction, thus causing oxygen stores in the body. The decrease in oxygen storage causes a decrease in oxygen saturation, so that in the exercise group moderate intensity tends to have lower oxygen saturation compared to the control group.

## CONCLUSION

Acute moderate intensity exercise performed for 40 minutes causes a decrease in oxygen saturation in obese women. Based on the results of the study it is recommended to do further research by comparing several training methods such as ergocycle training, resistance training to decrease oxygen saturation in obese women. Further research is carried out by comparing treadmill exercises conducted chronically with several kinds of exercise intensity, such as low intensity, moderate intensity and high intensity to changes in oxygen saturation.

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