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## **MAT PILATES EXERCISE INCREASE PEAK EXPIRATORY FLOW RATE IN YOUNG ADULTS WITH OBESITY**

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### **ABSTRACT**

**Background:** Obesity is one of the main problems that keep growing globally including in Indonesia. Obesity can cause various health problems, one of which is respiratory problems and decreased pulmonary function parameters in the form of peak expiratory flow rate (PEFR). One of the methods that can be used to increase the pulmonary function parameters of the peak expiratory flow is the Mat Pilates exercise. Mat Pilates exercise works by strengthening the core area between the pelvis, abdomen and back, which aims to increase the strength, flexibility and endurance of the respiratory muscles, thus Mat Pilate exercise help increase peak expiratory flow. However, there have not been any studies that discuss the effect of Mat Pilates exercise on the peak expiratory flow rate in obese young adults. **Aim:** To prove that Mat Pilates exercise can increase the peak expiratory flow rate of young adults with obesity. **Methods:** This study used quasi-experimental pretest and posttest design and was done from August until October 2020. The subjects were 33 females aged 18-23 years with BMI>27, divided into 2 groups. The experimental group (n=15) was instructed to do 8 weeks of Mat Pilates exercise (3 times a week) and the control group (n=18) was instructed not to do any exercise. Peak expiratory flow rate was measured with a peak flow meter. Data's significance was analyzed with Paired t-test and Independent t-test. **Result :** Peak expiratory flow rate increase significantly ( $P<0,001$ ) after Mat Pilates Exercise. There was no significant differences ( $P=0,841$ ) of peak expiratory flow rate at the pretest between the 2 group. The posttest peak expiratory flow rate of Mat Pilates exercise group ( $339,44 \pm 53,71$ ) was significantly higher ( $P=0,027$ ) than the control group ( $294,26 \pm 56,97$ ). The increase of PERF on Mat Pilates exercise group ( $45,00 \pm 37,27$ ) was higher significantly ( $P=<0,001$ ) than the increase in the control group. ( $4,07 \pm 14,98$ ). **Conclusion:** Mat Pilates exercise can increase peak expiratory flow rate in a young adult with obesity.

**Keywords:** *Mat pilates exercise, Obesity, Peak expiratory flow rate, Peak flow meter, Young adult.*

### **INTRODUCTION**

Obesity is a problem that keeps growing around the world. According to World Health Organization (WHO), in 2016, more than 1.9 billion adults, 18 years and older, were overweight and around 650 million people were obese.<sup>1</sup> Based on these data, it can be estimated that by 2030, 57.8% of adults worldwide will have obesity. This makes obesity can be considered as the world's epidemic case now.<sup>2</sup>

Indonesia Basic Health Research (Riskesmas) data from 2007 to 2018 showed that the number of obesity sufferers over 18 years old had risen significantly from 10.5% in 2007, 14.8% in 2013, and 21.8% in 2018.<sup>1,3</sup> Obesity is a condition in which fat accumulates excessively within the body. Body Mass Index (BMI) as the indicator reaching 25 kg/m<sup>2</sup> or more according to Asia Pacific standards, 27 kg/m<sup>2</sup> or more according to the standards of the

Indonesian Ministry of Health, 30 kg/m<sup>2</sup> or more according to WHO.<sup>3,4</sup>

Obesity is a condition that must be treated as best as possible because it can be a risk factor for various diseases. These diseases can affect someone's life quality, even resulting in death.<sup>5</sup> Moreover, for young adults who should be able to do their activities optimally and productively, obesity can be a big problem.

One of the problems that could arise is respiratory disorders.<sup>6</sup> The accumulation of the body's fat can affect the organs' functions and breathing physiological processes resulting in abnormalities of various lung function parameters.<sup>7</sup> One parameter that can measure lung function is the Peak Expiratory Flow Rate (PEFR), which describes the maximum flow that can be achieved during lapse subsequent to taking a deep breath.<sup>8</sup> Several studies have shown a relationship between BMI and PEFR values, that is,



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an increase in BMI is associated with a decrease in PEFr. So it is necessary to increase PEFr in obese people to show optimal lung function.<sup>9-12</sup>

Regular physical activity or exercise can be one solution to improve lung function, while doing exercises, the two main organs will work to meet oxygen needs, one of which plays a vital role is the lungs. In addition, physical activity or proper exercise can also train the respiratory muscles to support lung function.<sup>13</sup> One physical exercise routine that can be done easily and affordably is Mat Pilates.

Mat Pilates exercise is a strengthening exercise in the core area between the pelvic, abdomen and back which expects to improve muscle's strength, flexibility and endurance.<sup>14</sup> Along with the strengthening, flexibility and endurance of the respiratory muscles, it is hoped that Mat Pilates exercise can improve respiratory capacity, rated by the peak expiratory flow. As far as the researchers' knowledge, research on the effect of Mat Pilates exercise on peak expiration flow rate is limited to young women, and specific studies on obese young adults have not been found.<sup>15,16</sup> Based on the description above, the researcher wanted to know the effect of Mat Pilates exercise on the peak expiratory flow rate in obese young adults.

## **MATERIALS AND METHODS**

This research uses experimental research with quasi-experimental pre-test and post-test design. The research was conducted in Semarang and carried out remote home exercises for each research subject using an online meeting application guided by a coach. This study was conducted from August to October for 8 weeks. Samples were taken by purposive sampling method based on predetermined criteria and divided into two groups, namely the treatment group and the control group using subject matching ordinal pairing techniques.

The samples for this research are students residing in Semarang who fulfill the criteria. This research's inclusion criteria are women aged 18-23 years, BMI > 27 kg/m<sup>2</sup>, not participating in other sports that affect the body's respiratory function (Yoga, Tai chi, etc.) except sports activities required by campus. While the exclusion criteria was having a history or complaints of suffering from respiratory problems,

for instance, shortness of breath, having history, clinical signs and symptoms of cardiovascular disorders, having anatomical structural deformities of the body that cause obstacles in exercising.

The sample size for each group was 18 people and the total sample size of this study was 36 people. The independent variable in this study is The Mat Pilates exercise. Meanwhile, PEFr is the dependent variable. The type of data used in this research is primary data. The data collection process started from all research subjects following the pre-test of measuring the PEFr value using a peak flow meter. The control group was instructed not to do any exercise for 8 weeks.

The treatment group was instructed to do Mat Pilates exercises. The procedure to do the Mat Pilates exercise is 60 minutes including 5 minutes of warm-up, core movements consisting of 16 movements, and 5 minutes of cooling. Each movement is repeated 3-5 times. Because the research was conducted in the pandemic era, the Mat Pilates exercise intervention was carried out online while monitored through video calls with the online meeting application. After 3 times a week for 8 weeks of intervention, all research subjects' PEFr was measured again using a peak flow meter. The PEFr measurement before and after the intervention was done by meeting directly with research subjects using the door-to-door method to avoid crowds and still follow the health protocol.

The data is then processed, coded, and entered into a computer for descriptive analysis and hypothesis testing. The data normality test on the dependent variable was analyzed using the Saphiro-Wilk test. Hypothesis test regarding the difference in PEFr before and after Mat Pilates exercise was analyzed using paired t-test. Hypothesis test regarding PEFr differences between the control group and the treatment group was analyzed using unpaired t-test.

Before the execution, all research procedures have received ethical clearance from the Ethics Committees of Medical Research (KEPK) of the Faculty of Medicine, Diponegoro University Semarang. The Ethical Clearance number is 157/EC/KEPK/FK-UNDIP/VII/2020.



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## RESULTS

This research was conducted from August to October 2020 with 36 research subjects in Semarang who have met the research criteria and were willing to take part in the research. There were 36 research subjects selected based on inclusion and exclusion criteria. Subjects were divided into 2 groups, each group consisting of 18 people. After being observed until the end of the study, the entire control group could carry out the research until it was finished, while in the treatment group three subjects could not be followed up because the subjects did not respond to the researchers' message. Therefore, the total number of research subjects are 33 people.

There were 33 research subjects with average age  $\pm$  SD,  $21.11 \pm 0.96$  from the control group and  $20.53 \pm 0.83$  from the treatment group. The age ranges in both groups were 20-23 years old (min-max) for the control group and 18-21 years old (min-max) in the treatment group. While the average BMI  $\pm$  SD (min-max) of the control group was  $30.99 \pm 2.57$  (27.93 - 36.20) and the treatment group was  $29.37 \pm 2.57$  (27.24 - 35.76). In addition, on the characteristics of physical activity, 15 subjects (100%) in the treatment group & 15 subjects (83.3%) in the control group were included in the temporary category while 3 subjects (16.7%) in the control group were included in the non-sedentary category. The difference in physical activity was not significant with  $P=0.150$  (C).

Measurement of the PEFR was executed using a peak flow meter 2 times, once before starting the treatment group (pre-test) and then after 8 weeks of treatment in the form of Mat Pilates exercise. The memory score is obtained from the ability to breathe out as much as possible after a deep breath, the higher the APE value obtained, the better the lung function. The following is the data obtained on measuring the APE value with a peak flow meter. (Table 1).

Based on table 1, it is found that the PEFR at pre-test in the treatment group was higher than the control group. However, the statistical test results the unpaired t-test showed that the difference was not significant ( $P = 0.841$ ). Meanwhile, the results of the PEFR at post-test in the treatment group were higher than the control group. The unpaired t-test results showed a significant difference ( $P = 0.027$ ).

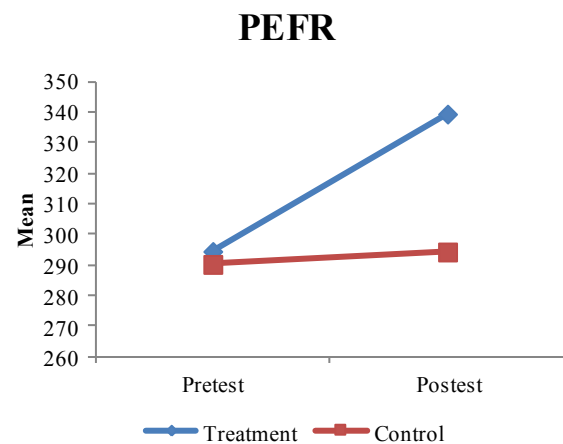
**Table 1.** Peak Expiratory Flow Rate

PEFR (liter/minute)	Group		$p^{\ddagger}$
	Treatment (Mean $\pm$ SD)	Control (Mean $\pm$ SD)	
Pretest	294,44 $\pm$ 60,95	290,19 $\pm$ 59,27	0,841 <sup>§</sup>
Posttest	339,44 $\pm$ 53,71	294,26 $\pm$ 56,97	0,027 <sup>§*</sup>
P	<0,001 <sup>¶*</sup>	0,264 <sup>¶</sup>	
Deviation	45,00 $\pm$ 37,27	4,07 $\pm$ 14,98	<0,001 <sup>‡*</sup>

\*Significant ( $P < 0,05$ );

<sup>§</sup> Independent t; <sup>‡</sup> Mann whitney; <sup>¶</sup> Paired t

Based on table 1, it is also found that in the treatment group there was a significant increase in the PEFR ( $p < 0.001$ ; paired t-test). In the control group there was also an increase in the PEFR, but it was not significant ( $p = 0.264$ ; paired t-test).



**Fig 1.** PEFR diagram from pre-test and post-test in treatment group (n=15) and control group (n=18)

Based on figure 1, it can also be seen that PEFR in the treatment and control groups increased. However, the increase in the control group was not as big as in the treatment group. In the treatment group there was a significant increase in the PEFR ( $P < 0.001$ ; paired t-test), while in the control group there was not any significant increase in the PEFR ( $P = 0.264$ ; paired t-test). The comparison of the difference between the pre-test and post-test PEFR for both groups is shown in figure 2.



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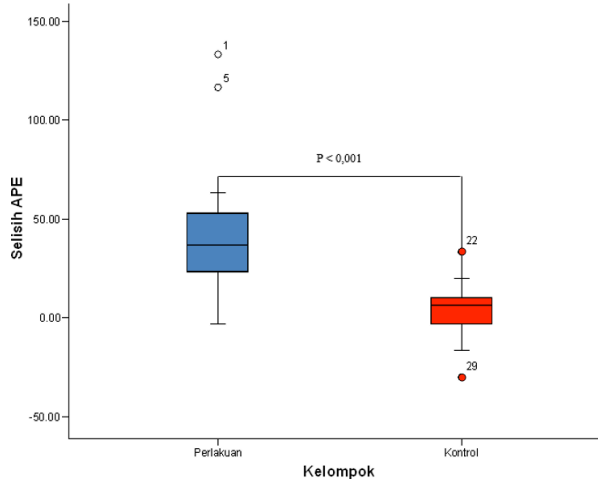


Fig 2. Boxplot graph of the difference between the pre-test and post-test PEFR in the control and treatment groups

In figure 2, it can be seen that the difference between the pre-test and post-test PEFR in the treatment group was significantly bigger than the control group ( $P < 0.001$ ; Mann Whitney test).

## DISCUSSION

Based on the statistical test in the group that was given the treatment of Mat Pilates exercise for 8 weeks, there had been difference and a significant increase in the PEFR, while the control group that was not given the Mat Pilates exercise had not showed any significant difference in PEFR. This research indicated a higher increase of PEFR in the treatment group than in the control group after the Mat Pilates exercise intervention. These results are in accordance with the research which states that there is an effect of Mat Pilates exercise on the PEFR for obese young adults.

The results of a synergistic research conducted by Saetikho, *et al.*, who examined the differences in peak expiratory flow before and after Pilates exercise in young women, found a significant difference in the PEFR after Pilates exercise.<sup>15</sup> The results were similar to the study conducted by Kheirandish, *et al.*, which examined the effect of Pilates Exercise on respiratory parameters in obese women who had temporarily shown that Pilates could significantly increase PEFR.<sup>16</sup> The results also synergistic to the study conducted by Wicaksono, *et al.* who examined the differences in peak expiratory flow rate before and after Circuit Training exercise in obese children

shown a significant difference after exercise and Bora, *et al.*, who examined the impact of exercise training on peak expiratory flow rate in relation to body mass index found 19% increase on PERF.<sup>17,18</sup>

A decrease in the peak expiratory flow rate can occur in obesity. Obesity is a condition in which a person has accumulated excess fat in the body which can be measured using BMI based on height and weight. The accumulation of excess fat in the body can overload the work of the respiratory muscles, reduce lung capacity, reduce lung growth, and increase airway resistance.<sup>16</sup> In addition obesity also has weakness in the respiratory muscles leading to decreased PEFR.<sup>9,10</sup>

Mat Pilates exercise with resistance training method paired low impact exercise method. Mat Pilates exercise has the primary function of strengthening the core area between the pelvic, abdomen and back which aims to increase muscle strength, flexibility and endurance. Mat Pilates can support lungs function by strengthening the abdominal muscles which function as muscles that help the inspiratory and expiratory processes, and are responsible for stabilizing respiratory control. Mat Pilates can also increase the activation and recruitment of respiratory muscles.<sup>16</sup> Respiratory muscles involved and trained with Mat Pilates exercises include *musculus transversus abdominis*, *musculus rectus abdominis*, dan *musculus obliquus abdominis externus*<sup>19</sup>. This process caused Mat Pilates exercises to significantly affect the increase of PEFR measured by the peak flow meter.

## CONCLUSION AND SUGGESTION

### Conclusion

Mat Pilates exercise can improve the PEFR indicated by a significant increase in it before and after Mat Pilates exercise, and the PEFR in the group given Mat Pilates exercise is significantly higher than the group that was not given exercise.

### Suggestion

Further research will be needed on the effect of Mat Pilates exercise on other lung function parameters such as Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), and  $VO_2$  max. It is necessary to do further research on the effect of Mat Pilates exercise on lung function



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parameters by measuring and considering the distribution of fat in research subjects.

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