**Mat Pilates Excercise Increaase Peak Expiratory Flow Rate in Young Adults with Obesity**

**Nugrahani Wiraningrum1\*, Erna Setiawati2, Tanti Ajoe Kesoema3, Yuswo Supatmo4**

*1 Faculty of Medicine, Diponegoro University, Semarang, Indonesia*

*2,3 Department of Physical Medicine & Rehabilitation, Diponegoro University, Semarang, Indonesia*

*4 Department of Physiology, Faculty of Medicine, Diponegoro University, Semarang, Indonesia*

*\*) Corresponding author: Nugrahani Wiraningrum. Email : nugrahaniwiraningrum@gmail.com*

***Abstract***

**Background:** Obesity is one of the main problems that keep growing in the world including in Indonesia. Obesity can cause various health problems, one of which is respiratory problems and decreased of 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 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, by that Mat Pilate exercise can increase the 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 increasae peak expiratory flow rate of young adults with obesity.

**Methods:** This study used quasi experimental pretest and posttest design and was done in August until October 2020. The subjects were 33 female aged 18-23 years with BMI>27, divided in 2 groups. Experimental group (n=15) was instructed to do 8 weeks of Mat Pilates exercise (3 times a week) and control group (n=18) was instructed to not do any exercise. Peak expiratory flow rate was measured with peak flow meter. Data’s significance was analyzed with Paired T Test and Independent T Test.

**Results :** A significant increase (p<0,001) in peak expiratory flow rate before and after Mat Pilates Exercise. The peak expiratory flow rate at the pretest between the 2 groups was no significant differences (p=0,841). The posttest peak expiratory flow rate of Mat Pilates exercise group (339,44 ± 53,71) was significant (p=0,027) higher than the control group (294,26 ± 56,97). The increase of PERF on Mat Pilates exercise group (45,00 ± 37,27) is higher significantly (p=<0,001) than the increase on control group (4,07 ± 14,98).

**Conclusion:** Mat Pilates exercise can increase peak expiratory flow rate in 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 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.1 Based on these data, it can be estimated that by 2030 57.8% of adults around the world will have obesity. This makes obesity can be considered as world’s epidemic case now.2

Indonesia Basic Health Research (Riskesdas) data from 2007 to 2018 showed that the number of obesity sufferers over 18 years old has risen significantly from 10.5% in 2007, 14.8% in 2013, and 21.8% in 2018.1,3 Obesity is a condition in which fat accumulates excessively within the body Body Mass Index (BMI) as the indicator reaching 25 kg / m2 or more according to Asia Pacific standards, 27 kg / m2 or more according to the standards of the Indonesian Ministry of Health, 30 kg / m2 or more according to WHO.3,4

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 resulted in death.5 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.6 The accumulation of the body’s fat can affect the organs’ functions and breathing physiological processes that will result in abnormalities of various lung function parameters.7 One parameter that can be used to 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 profound breath.8 Several studies have shown a relationship between BMI and PEFR values, that is, 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. 9-12

Regular physical activity or exercise can be one solution to improve lung function, whilst 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 so that they can support lungs function. 13 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.14 Along with the strengthening, flexibility and endurance of the respiratory muscles, it is hoped that Mat Pilates exercise can improve respiratory capacity, which is 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.15,16 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 fulfil the criteria. This research’s inclusion criteria are women aged 18-23 years, BMI> 27 kg / m2, 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 is 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 Mat Pilates exercise. Meanwhile, the dependent variable is The Peak Expiratory Flow Rate (PEFR). The type of data used in this research is primary data. The data collection process was carried out starting 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 type of 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 implementation of the Mat Pilates exercise intervention was carried out online whilts monitored through video calls with the online meeting application. After 8 weeks of intervention, all research subjects’ PEFR were measured again using a peak flow meter. The PEFR measurement for before and after the intervention was done by meeting directly with research subjects using the door-to-door method to avoid crowds and still following the health protocol.

The data is then being 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.

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

**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 there were 3 subjects who could not be followed up because the subjects did not respond to the researchers' message. Therefore, the total research subjects are 33 people.

There were 33 research subjects with average age ± SD, 21.11 ± 0.96 from the control group and 20.53 ± 0.83 from the treatment group. The age ranges in both groups were 20-23 (min-max) for control group and 18-21 (min-max) in the treatment group. While the average BMI ± SD (min-max) of the control group was 30.99 ± 2.57 (27.93 - 36.20) and the treatment group was 29.37 ± 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 (Chi square test).

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).

**Table 1.** Peak Expiratory Flow Rate

|  |  |  |  |
| --- | --- | --- | --- |
| **PEFR** | **Group** | | ***p*¶** |
| **Treatment** | **Control** |
| **(Mean±SD)** | **(Mean±SD)** |
| *Pretest* | 294,44 ± 60,95 | 290,19 ± 59,27 | 0,841§ |
| *Posttest* | 339,44 ± 53,71 | 294,26 ± 56,97 | 0,027§\* |
| P | <0,001¶\* | 0,264¶ |  |
| Deviation | 45,00 ± 37,27 | 4,07 ± 14,98 | <0,001‡\* |

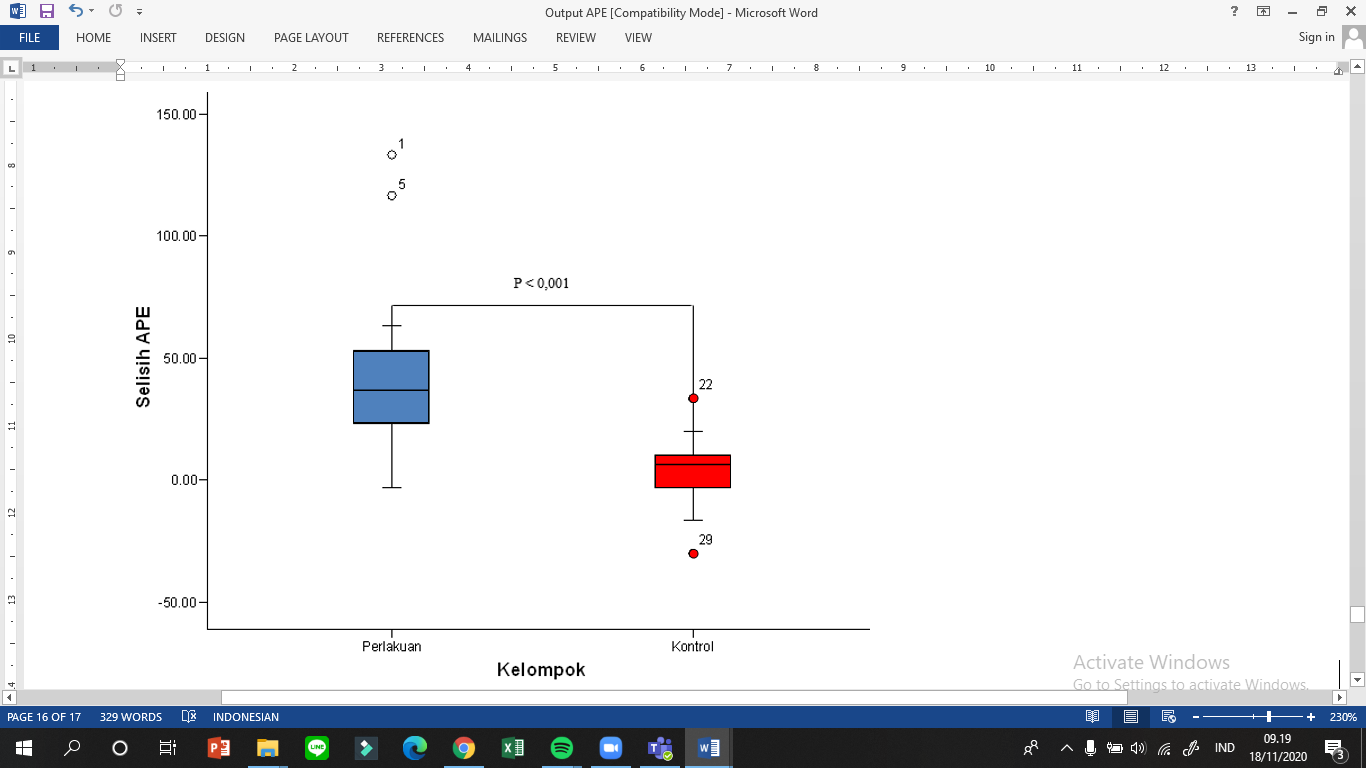
\* Significant (p < 0,05); *§ Independent t*; ‡ *Mann whitney; ¶ Paired t*

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 using 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).

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 increasein 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.



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

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

**DISCUSSION**

The Mat Pilates research was conducted from August to October 2020 for 8 weeks with 36 research subjects with 18 people in the control group and 18 people in the treatment group. In the execution of the research, there were 3 subjects from the treatment group who dropped out that at the end of the research there were 33 subjects. There was no significant difference in physical activity in the two groups and it was considered not to affect the research.

The Mat Pilates exercises intervention was brought out online through Zoom application in each subject’s house due to large-scale social restrictions because COVID-19 pandemic which made Mat Pilates exercise cannot be done face-to-face. Research subjects were asked to fill in daily physical activity records online via google form every week as a form of controlling physical activity confounding variables on the PEFR. The measurements with a peak flow meter were carried out twice, once before the Mat Pilates exercise (pre-test) and then after the implementation (post-test).

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. The results of this research indicate that there is 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 F15, who examined the differences in peak expiratory flow before and after Pilates exercise in young women, found that there was a significant difference in the PEFR after Pilates exercise. The results were similar to the study conducted by Kheirandish R16, which examined the effect of Pilates Exercise on respiratory parameters in obese women who had temporarily shown that Pilates could significantly increase PEFR.

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.16 In addition obesity also has weakness in the respiratory muscles which can lead to decreased PEFR. 9,10

Mat Pilates exercise with resistance training method paired low impact excercise method. Mat Pilates exercise has the main 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.16 Respiratory muscles involved and trained with Mat Pilates exercises include *musculus transversus abdominis, musculus rectus abdominis, dan musculus obliquus abdominis externus*17. This process caused Mat Pilates exercises to have a significant effect on 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 VO2 max. It is necessary to do further research on the effect of Mat Pilates exercise on the parameters of lung function by measuring and considering the distribution of fat in research subjects.

**Acknowledgements**

Researchers would like to thank those involved in this research, especially those from the Faculty of Medicine, Diponegoro University, Semarang and to all parties who helped, either directly or indirectly, so that this research can be finished well.

**REFERENCES**

1. Kementrian Kesehatan Republik Indonesia. Ayo Gerak, Lawan Obesitas [Internet]. 2019 [cited 2020 February 7].
2. Du Z, Xing L, Lin M, Tian Y, Jing L, Yan H et al. Prevalence of first-degree atrioventricular block and the associated risk factors: a cross-sectional study in rural Northeast China. BMC Cardiovascular Disorders [Internet]. 2019 [cited 8 February 2020]; 19(1):1-9.
3. Hasil Utama RISKESDAS 2018 [Internet]. Jakarta : Kementrian Kesehatan Republik Indonesia; 2018 [cited 10 February 2020].
4. Lim J, Lee J, Kim J, Hwang Y, Kim T, Lim S, et al. Comparison of World Health Organization and Asia-Pacific body mass index classifications in COPD patients. Int J COPD [Internet]. 2017 [cited 10 February 2020]; 12:2465-2475.
5. Australian Institute of Health and Welfare. Impact of overweight and obesity as a risk factor for chronic conditions [Internet]. 2017 [cited 11 February 2020].
6. Kinlen D, Cody D, O’Shea D. Complications of obesity. QJM [Internet]. 2018 [cited 11 February 2020];111(7):437–43.
7. Mafort T, Rufino R, Costa C, Lopes A. Obesity: systemic and pulmonary complications, biochemical abnormalities, and impairment of lung function. Multidisciplinary Respiratory Medicine [Internet]. 2016 [cited 11 February 2020];11(1).
8. DeVrieze B, Modi P. Peak Flow Rate Measurement. India: StatPearls; 2018.
9. Shekharappa K, Johney S, Vedawathi K. Impact of obesity on peak expiratory flow rate in different age groups. Indian J Clin Anat Physiol [Internet]. 2016 [cited 11 February 2020];3(3):339.
10. Jena S, Mirdha M, Meher P, Misra A. Relation of peak expiratory flow rate to body mass index in young adults. Muller J Med Sci Res [Internet]. 2017 [cited 11 February 2020];8(1):19.
11. Saraswathi S. Correlation of Obesity Indices with Peak Expiratory Flow Rate in Males and Females. IOSR J Pharm [Internet]. 2014 [cited 11 February 2020];04(02):21-27.
12. Das R. A Study of Correlation of Peak Expiratory Flow Rate with Body Mass Index in Healthy School Going Children. J Med Sci Clin Res [Internet]. 2017 [cited 11 February 2020];5(8):26192–5.
13. Your lungs and exercise. Breathe [Internet]. 2016 [cited 11 February 2020];12(1):97-100.
14. Trisnowiyanto B. Pengaruh Mat Pilates Exercise terhadap Fleksibilitas Tubuh. J Kesehat [Internet]. 2016 [cited 11 February 2020];9(2):40-52.
15. Saetikho F, Ambarwati E. Perbedaan Arus Puncak Ekspirasi Sebelum Dan Sesudah Senam Pilates Pada Wanita Usia Muda. J Kedokt Diponegoro [Internet]. 2017 [cited 11 February 2020];6(1):73–8.
16. Kheirandish R, Ranjbar H. The effect of selected Pilates exercises on some respiratory parameters of obese sedentary women [Internet]. 2018 [cited 11 February 2020];22(2):153–61.
17. Isacowitz R. Pilates Anatomy. United States: Human Kinetics; 2011