International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 2, No. 05; 2019

THE EFFECTS OF MODIFIED LOW IMPACT AEROBIC EXERCISES TO RESPIRATORY EFFICIENCY IN SMOKEHOUSE WORKERS IN BONANG, DEMAK REGENCY, CENTRAL JAVA

Vicky Dwi Arista, Ari Suwondo and Yuliani Setyaningsih
Faculty of Public Health,Magister Health Promotion, Universitas Diponegoro, Semarang

ABSTRACT

Fish smoking is one of fish preservation methods. Fish smoking process use corn cobs as fuel. Continuous smoke exposure and inhalation can cause a decrease in lung function in workers. One of the activities that can be done to improve respiratory efficiency is practicing modified low impact aerobic exercise. The aim of the study was to analyze the effect of the implementation of modified low impact aerobic exercise. The research was a quantitative research with quasi-experimental method using two-factor completely randomized design. The experiment was conducted by categorizing the sample into four groups: group I was treated by 1-week modified low impact aerobic exercises, group II acted as the control for group I, group III was treated by 2-week modified low impact aerobic exercises, and group IV acted as the control for group III. Each group consisted of 24 samples. The levels of respiratory efficiency were measured before and after 1-week treatment for Group I and II and 2-week treatment for Group III and IV. The result shows that the measurement of Vital Capacity FEV 1 for group 1 that conducted 1-week low impact aerobic exercises showed an increase of 9.63% and group 2 that conducted 2-week low impact aerobic exercises showed an increase of 9.25%. While the measurement of Vital Capacity FEV1/FVC for group 1 that conducted 1-week low impact aerobic exercises showed an increase of 5.75% and group 2 that conducted 2-week low impact aerobic exercises showed an increase of 17.5%. The result of General Linear Model shows that there is a correlation between the exercise using modified low impact aerobics to the levels of respiratory efficiency with p-value 0,003 ($\alpha<0,05$).

KEYWORDS: modified low impact aerobic exercises, respiratory efficiency, smokehouse workers

INTRODUCTION

Fish smoking is one fish preservation methods which is quite popular in Indonesia. Fumigation can delay the process of deteriorating quality of fish, although for shorter period compared to other preservation methods like salted fish or dried fish. The purposes of fish smoking are to prepare fish for direct consumption, to give a distinctive taste, and to provide durability through heating, drying and chemical reactions of smoke and fish flesh during the fuming process.[1]

Wonosari Village in Bonang District is one of the villages in Demak Regency that is famous for its product, smoked fish. Fish smoking businesses in Bonang have a total production of 8-9 tons of smoked fish. Fish smoking process is centered in RT 4 RW 4, which consists of 76 households, and fish smoking business is one of household-based economic activities in Wonosari Village. Fish

ISSN 2581-5148

Vol. 2, No. 05; 2019

smoking process in Wonosari Village, Bonang District, Demak Regency are divided into several stages, namely chopping fish heads, sharpening knives, cleaning fish, cutting fish bodies, stabbing fish with bamboo, lifting fish baskets, putting fish on furnace, and smoking fish

Fish smoking process uses corn cobs as its fuel. Chemical components in corn cobs have the potentials as high-value product ingredients. Corn cobs (Zea Mays L) can be used as a source of smoke because corn cobs contain several chemical components, such as: 6.04% ash, 15.70% lignin, 36.81% and 27.01% hemicellulose. Smoke from corncobs is used for a variety of food productions, such as preserving and adding flavor to food, yet fresh corn cobs produce high CO emissions due to volatile substances in corn cobs. 2 The daily activities at fish smokehouses start from 08.00 am until the fish run out, usually around 04.00 pm. From the duration of fish smoking process, the smokehouse workers are always exposed to smoke and prone to health problems.

The smoking process produces compounds that are dangerous for health. Some carcinogenic compounds such as benzo (a) pyrene present in smoke products. Fish smoking process is a household-scale industrial process that can cause air pollution due to its production of smoke. Persistent exposure to smoke can cause a decrease in lung function, resulting in damage to respiratory organs. The accumulation of secretes and damage of respiratory organs might cause reduced flow of oxygen to the body.[3]

Bluish symptoms on the skin and mucous membranes due to lack of oxygen in the blood is known as cyanosis. Cyanosis is characterized by decreased levels of oxygen saturation in the body. Oxygen saturation is the amount of hemoglobin that binds to oxygen in arteries. Normal oxygen saturation levels in the blood are between 95-100%.[4]

Exercising is one of the methods to improve respiratory efficiency. Exercising can be done by performing modified low impact aerobics. Modification of low impact aerobic exercise consists of 5 easy movements that can be practiced independently by workers. Modified low impact aerobics cause hypertrophy in muscles. Muscles that have hypertrophy, have increased muscle fibers and the number of capillaries so that oxygen-rich blood will be pumped to the muscle fibers that are active during exercise. The quality of hypertrophy caused by the contraction strength of the deep breathing muscles will stabilize the breastbone, thoracic wall and enlarge the development of the chest cavity
Based on the description, the researcher was interested in conducting research for the effect of modified low impact aerobics interventions to increase fitness and respiratory efficiency of fish smokehouse workers in Bonang, Demak Regency.

RESEARCH METHODOLOGY

The study was a quasi-experiment research using two-factor completely randomized design.[5] The samples of the research were categorized into 4 groups, namely group 1 – group 4. Group 1 is the group having 1-week treatment and Group 2 is the control group for Group 1. Group 3 is the group

having 2-week treatment and Group 4 is the control group for Group 3. Each group consists of 24 samples. The vital capacity was measured using spirometry and the oxygen saturation was measured using oximeter. The measurements to Groups 1, 2, 3 and 4 were conducted before the treatment. After the intervention of modified low impact aerobics for 1 week (post-test), Group 1 and Group 2 were measured for their vital capacity and oxygen saturation. Group 3 and Group 4 were measured for their vital capacity and oxygen saturation after 2 weeks of treatment (post-test). The samples of the study were 96 workers of fish smokehouse in Bonang, Demak Regency. The data of the study were analyzed using univariate and bivariate analysis. The bivariate analysis was conducted using General Linear Model (GLM).

RESULT

1. Characteristics of Respondents

The respondents were mostly 36-45 years old, recorded as 55% of the respondents. The respondents were mostly recorded as IMT Overweight, recorded as 90.6% of the respondents All respondents (100%) had >5 years of service, having at least 6 years of employment. Respondents with history of illness were 72.9% and all respondents (100%) did not wear Personal Protective Equipment (PPE) during working hours

2. The increase of Vital Capacity based on the characteristics of the respondents

The increase of vital capacity based on the age were recorded as follows. The group of workers aged 36-45 years old increased the vital capacity of the lungs at 5.07%. The group of workers aged >45.1 years old increased the vital capacity of the lungs at 6.91%. Based on the variable of IMT, the increase of vital capacity at the group having IMT >23 kgs (overweight) was recorded at 5.4%, while at the group having normal IMT (18.5-22.9 kgs) was recorded at 4.55%. In the group with length of employment >5 years, the increase of vital capacity was 5.32%. The increase of vital capacity in group having Medical History of Lung Disease was 5.9% while in group without Medical History of Lung Disease was 3.77%. In group of workers without PPE, the increase of vital capacity was 7.56%

Table 1 Distribution of Vital Capacity of Lungs based on Characteristics of Smokehouse workers in Bonang, Demak Regency

Variables		N	Average Vital Capacity (FEV1/FVC)				Difference
			Pre-test	SD	Post-tes	SD	
Age	25-35	29	63,62	10,507	68,76	8,830	5,14
	36-45	55	63,78	12,070	68,85	11,583	5,07
	>45,1	12	56,92	14,267	63,83	12,995	6,91
IMT	18,5 – 22,9 Normal	9	67,56	14,001	72,11	11,984	4,55
	>23 Overweight	87	62,39	11,763	67,79	10,915	5,4

Length of Employment	>5 years	96	62,88	12,002	68,20	11,025	5,32
Medical History of Lung Disease	Yes	70	63,00	11,871	68,90	10,871	5,9
	N/A	26	62,54	12,580	66,31	11,429	3,77
PPE	Not Implemented	96	62,88	12,002	70,44	11,343	7,56

3. Effect of modification of low impact aerobic exercise on vital capacity

Table 2 Comparison of Vital Capacity of Lungs recorded before and after treatment in Smokehouse workers in Bonang Demak Regency

Duration	Group	N	Average Vital Capacity (FEV1/FVC)				Difference
			Pre-test	SD	Post-test	SD	
1 week	Treatment	24	60,67	12,303	66,42	9,895	5,75
	Control	24	63,63	7,210	67,21	6,241	3,58
	Treatment	24	62,08	14,527	79,58	11,041	17,05
2 weeks	Control	24	65,13	12,999	68,54	12,406	3,41

Table 3 Effect of modification of low impact aerobic exercise on vital capacity (FEV1/FVC) in Smokehouse workers in Bonang Demak Regency

Duration	Group	Mean	S.D	N	Sig
1 week	Treatment	66,42	9,895	24	
	Control	67,21	6,241	24	0,005
2 weeks	Treatment	79,58	11,041	24	
	Control	68,54	12,406	24	

The average vital capacity of the lungs before the modification of low impact aerobics in 1-week treatment group was 60.67% and after the modification of low impact aerobics, the average increased to 66.42% or there was an increase of the vital capacity of the lungs in 1-week treatment group at 5.75%

The average vital capacity of the lungs before the modification of low impact aerobics in 2-week treatment group was 62.08% and after the modification of low impact aerobics, the average increased to 79.58% or there was an increase of the vital capacity of the lungs in 2-week treatment group at 17.5%

The control group for 1-week treatment group showed an increase of vital capacity at 3.58% while the control group for 2-week treatment group increased the vital capacity for 3.41%. The result of GLM test shows that there is a correlation between the application of spinal cord corset to lactic acid levels, based on the p- value 0,005 (p<0,05).

4. Effect of modification of low impact aerobic exercise on oxygen saturation

Tabel 4 Effect of modification of low impact aerobic exercise on oxygen saturation in Smokehouse workers in Bonang Demak Regency

Duration	Group	Mean	SD	N	*p-value*
1 week	Treatment	95,13	1,752	24	
	Control	95,17	2,014	24	0,023
2 weeks	Treatment	97,13	1,650	24	
	Control	95,54	1,444	24	

The average oxygen saturation of the group having 1-week treatment of modified low impact aerobics was 95.13%, while the average oxygen saturation of the control group for the group having 1-week treatment of modified low impact aerobics was 95.17%. The average oxygen saturation of the group having 2-week treatment of modified low impact aerobics was 97.13%, while the average oxygen saturation of the control group for the group having 2-week treatment of modified low impact aerobics was 95.54%.

The result of GLM test shows that there is a correlation of the application of spinal cord corset to low back pain complaints based on the p-value=0,023 or p<0,05.

DISCUSSION

Characteristics of Respondents

The results of research conducted on 96 respondents shows that most respondents are 36-45 years old with a percentage of 55% while the age group>

45.1 years has the percentage of 12%. In the age group of 36-45 years, there was an increase in vital capacity of lungs (FEV1 / FVC) by 5.07% while in the age group>

45.1 years there was an increase in vital capacity of lungs by 6.91%.

Increase of age is mainly accompanied by bad environmental conditions and the possibility of infected by a disease, so the possibility of a decline in lung function occurred is greater.6,7 The older one's age, the greater the possibility of lung function to decline. Increase of age causes in a decrease in the maximum amount of oxygen that can be delivered from the lungs to the muscles or VO2max, which is caused by a decrease in maximum heart rate and maximum reserve volume. Energy needs continue to increase until finally decreased after the age of 40 years. Decrease of energy requirements is due to decreasing of physical strength. Under normal circumstances, age also affects the frequency of breathing and lung capacity. The respiratory rate in adults is between 16-18 times

ISSN 2581-5148

Vol. 2, No. 05; 2019

per minute, in children about 24 times per minute while in infants is around 30 times per minute. Although breathing in respiratory frequency is smaller in adults compared to children and infants, KVP in adults is greater than in children and infants. Under certain conditions this will change for example due to an illness, breathing can get faster and vice versa.6

Nutritional status in this study was measured using a body mass index that is body weight divided by height squared. Based on the results of the analysis showed that most respondents had BMI> 23 kg or Overweight of 90.6%. In the group, BMI>23 kg of overweight experienced an increase in vital capacity of lungs (FEV1 / FVC) of 5.4%.

Overweight or Obesity causes various diseases of respiratory function in the form of changes in respiratory mechanism, decreasing of strength of respiratory muscles, decreasing of gas exchange in the lungs, low regulation of breathing and restrictions on lung function. Changes in lung function are due to accumulation of adipose tissue in the abdominal cavity and also above the chest wall, it causes a decrease in diaphragm movement, decreased adjustment of the lungs and chest wall, increased elasticity back and decreased lung volume.7

In obesity, mechanical breathing undergoes significant changes during exercise. Compared to people of normal weight, obese people breathe with low lung volume, experience increased breathing pressure, breathing work, and shortness of breath and have expansive flow expiration and hyperinflation of lungs at the peak of exercise. Research conducted by Jones et al stated that an increase in one BMI unit will cause a 0.5% reduction in vital capacity. The same thing was also expressed by El-Baz. et al that vital capacity has a negative correlation with BMI.8,9

Based on the results of the analysis showed that the average length of working period of respondents is 11.03 years with a standard deviation of 3.692 while a minimum working period of 6 years and a maximum working period of 19 years. All respondents had a working period of> 5 years by 100%. In the group of working period > 5 years there was an increase in the vital capacity of lungs (FEV1 / FVC) by 5.32%. The longer a worker is at work, the more workers will be exposed to the dangers caused by the work environment. Working period can affect the workers both positively and negatively. It will have a positive influence on workers if the length of time a person works, the worker will be more experienced in doing the job. While the negative effect for a worker is the longer exposure to hazards caused by the workplace, it can affect health, especially the respiratory tract. If the lung condition is exposed to various pollutant components, the physiological function of the lung as the main respiratory organ will experience several disorders as a result of continuous exposure of various pollutant components. [10]

Based on the results of the analysis showed that the percentage of characteristics of respondents based on those who have a history of disease are the majority who have a history of disease by 72.9% while the respondents who do not have disease by 27.1%. In the group which has a history of

disease, there was an increase in vital capacity of lungs (FEV1 / FVC) by 5.9% and in the group without a history of disease there was an increase in vital capacity of lungs (FEV1 / FVC) by 3.77% History of lung disease is a factor that is considered as a result of respiratory problems, because the disease suffered by a person will affect health conditions in the work environment. If someone has or has a temporary respiratory system disease, it will increase the risk of respiratory system disease if exposed to dust, chemicals or others. Basically, someone who has had lung disease tends to reduce perfusion ventilation so that the alveoli will experience too little air exchange. The result will reduce the oxygen levels in the blood.[11]

Based on the results of the analysis showed that the percentage of respondents' characteristics based on the use of PPE is that all respondents did not use PPE by 100%. In the group of respondents not using PPE there was an increase in the Vital Capacity of Lungs (FEV1 / FVC) by 7.56%. The use of PPE is simply a set of tools used by workers to protect part or all of their bodies from potential hazards or work accidents. PPE does not perfectly protect the body, but can reduce the severity that might occur. The lack of maximum use of PPE is caused by errors in choosing the type of PPE, for example: the appropriate mask, the wrong way to use PPE, using a damaged PPE, do not replace a mask that has been damaged. In addition to the fact that the use of PPE is less than optimal, in the Bonang fish smokehouse center itself there is also no strict sanctions if workers do not use PPE, so workers are free not to use PPE. [12]

Effect of modification of low impact aerobic exercise on vital capacity in smokehouse workers
The results showed that the average vital capacity of lungs before modification of low impact aerobic exercise in 1-week treatment group was 60.67% with a standard deviation of 12.303. The average vital capacity of lungs after modification of low impact aerobic exercise for 1 week was 66, 42 with a standard deviation of 9.895 resulting in an increase in the vital capacity of lungs by 5.75%. Meanwhile, the average vital capacity of lungs before modification of low impact aerobic exercise in the 2-week treatment group was 62.08% with a standard deviation of 14.527. The average vital capacity lungs after modification of low impact aerobic exercise for 2 weeks was 79.58 % with a standard deviation of 11.041 resulting in an increase in the vital capacity of lungs by 17.05%.
This study is in line with research conducted by Fatima, et al. stated that there was a difference in the increase of FEV1 in asthma patients who were given exercises intervention for 2 weeks compared to before exercise, with p value <0.005.13

Pulmonary physiology and exercise have a reciprocal relationship, impaired pulmonary physiology can affect exercises ability. Conversely, regular physical exercise or sports can improve pulmonary physiology. Someone who is active in exercise will have greater aerobic capacity and better fitness also increased capacity of lungs. The vital capacity of lungs can be influenced by one's habit of doing sports. Sports can increase blood flow through the lungs so that oxygen can diffuse into the lung capillaries with a greater or maximum volume. [14]

Based on the results of research analysis showed that the p-value = 0.005 Because the p value <0.05 then there is the effect of modification of low impact aerobic exercise on increasing the vital capacity of lungs in each group. This study is in line with research conducted by Arwa Rawashdesh which stated that intense aerobic exercise can improve pulmonary function with p value <0.05.15
Increase of vital capacity of lungs during modification of low impact aerobic exercise occurs when increasing in air ventilation and venous reverse flow due to the activity of all large muscles in the body and thoracic pumps. Increase of ventilation is along with increasing of oxygen consumption. When muscles contract, the compression of the blood vessels inside them emerges, so that increasing the blood flow to the heart. Increase of venous reverse flow causes contraction from the atrium

which causes an increase in ventricular filling, so that the volume of the stroke is increased.[16] Increasing the volume of the stroke is also accompanied by an increase in heart rate. If the heart's contents increase, the cardiac output increases so that the supply of nutrients to the body's cells increases. If the sports activities are continuously added but not be followed again by the addition of heart rate frequency and frequency of the constant heart rate, the heart becomes stronger and pumps more blood with diminishing pulse. The lungs process more air with less effort so that the blood supply distributed throughout the body's tissues that will increase and the blood volume increases overall.[17]

The effect of exercise is exercising the respiratory muscles, increasing muscle strength and efficiency. Vital capacity of a sport player will be greater than people who never exercise. Exercise habits will increase lung capacity by 30-40%. When doing physical activity, muscles need a smooth and stable supply of energy, so oxygen is needed as a fuel for adequate energy formation. The way to fulfill oxygen demand is by increasing the frequency of respiration so that someone who is active will have ventilation efficiency which causes the vital capacity of lungs to increase so that it can be concluded that the vital capacity of lungs has a direct relationship with physical exercise or sports. People who are trained with physical exercise, when doing activities, could breathe more air and in a longer period, are also able to exhale the remnants of burning more, because the muscles around their lungs have been trained to do work more. Besides being determined by the respiratory, cardiovascular, oxygen and biochemical transportation systems, vital capacity of lungs is also influenced by the frequency of exercise. The frequency of exercise is closely related to the intensity of the exercise and the length of the exercise. In doing exercises, it is better to exercise frequently at least three times a week, both for health sports and for performance sports. To improve fitness you need to exercise 3- 5 times per week.

Effect of modification of low impact aerobic exercise on oxygen saturation in smokehouse workers
Oxygen saturation is the ratio of oxygen that is actively bound by Hb to oxygen that can be bound by all Hb in units of %. The amount of oxygen present in the blood is determined by the active oxygen that is bound by Hb and the oxygen dissolved in the plasma which is determined by the amount of oxygen in the air.

Oxygen saturation is an indicator of the percentage of hemoglobin that binds to oxygen when doing measurement.[18]

The results showed that the average oxygen saturation before modification of low impact aerobics exercise in the 1-week treatment group was 90.2% with a standard deviation of 4.242, the average oxygen saturation after modification of low impact aerobic exercise for 1 week was 97.17 % with a standard deviation of 1.890 resulting in an increase in oxygen saturation of 6.25%. Meanwhile, the average oxygen saturation before modification of low impact aerobics exercise in the 2-weeks treatment group was 91.38% with a standard deviation of 3.843, the average oxygen saturation after modification of low impact aerobic exercise for 2 weeks was 97.50% with standard deviation of 1.719 so that there is an increase in oxygen saturation by 6.12%.

Modification of low impact aerobic exercise is beneficial for the cardiovascular system, regardless of its effect on other risk factors. A person who has modified low impact aerobics will be able to do more efficient muscle work than before training. The work can be done with a less amount of heart rate at lower blood pressure and with less use of oxygen by the heart muscle than an untrained person. Also, the capacity for oxygen use increases so that one can work better at the level of submaximal activity. Modification of low impact aerobics exercise regularly will reduce fear and depression because the ischemic changes in the S-T segment on the electrocardiogram will improve.[19]

Based on the results of the analysis showed that the p-value = 0.023 because the p value <0.05 then there is the effect of modification of low impact aerobic exercise on increasing oxygen saturation in each group.

Modification of low impact aerobics exercise can improve the need and use of oxygen by the heart. The determining factor in oxygen consumption by the heart muscle is the pressure in the heart during systolic contraction. When the pressure rises, the oxygen consumption also rises. Intramyocardial pressure or ventricular wall pressure is equally high to systolic blood pressure multiplied by the radius of the heart or in other words as high as blood pressure multiplied by the size of the heart. The maximum heart rate and shortening of myocardial fibers affects the need for oxygen. The consumption of oxygen by the heart muscle depends on the interaction of the factors mentioned above. The heart works hard depending on cardiac output and blood pressure in the arteries. When the pressure in the arteries increases, the heart must work harder to achieve the same cardiac output. Therefore the need for oxygen also increases so that modification of low impact aerobics exercise is one way to increase oxygen saturation.[4]

CONCLUSION

From the study, the conclusions are:

1. The characteristics of respondents based on age shows that most of the respondents are >36-45 years old, categorized as IMT Overweight, length of employment >5 years, have medical records, and not wearing PPE during working hours.
2. There is a correlation between the exercise using modified low impact aerobics to respiratory efficiency in fish smokehouse workers, showed by p-value 0,003 (p<0,05). Based on the result of vital capacity FEV1/FVC measurement, the 1- week treatment group increased its vital capacity at 5.75% while the 2-week treatment group increased its vital capacity at 17.5%.
3. There is a correlation between the exercise using modified low impacts aerobics to the increase of oxygen saturation in fish smokehouse workers, showed by p- value=0,023 (p<0,05). After the measurement of vital capacity, the 1-week treatment group increased its oxygen saturation at 5.75% while the 2-week treatment group increased its oxygen saturation at 6.12%.

RECOMMENDATION

1. For smokehouse workers

Practice modified low impact aerobic exercises at least 2 times a week as an effort to increase the vital capacity of the lungs

2. For Community Health Center

Applying modified low impact aerobic exercises to increase the vital capacity of the lungs in smokehouse workers in the working area of the Community Health Center.

3. For smokehouse employers

Implement a program for the employees to practice modified low impact aerobic exercises at least 2 times in a week to increase vital lung capacity

4. For other researchers

Implement a strict control regarding the measurement of heat pressure in the workplace, food consumption and physical activity of the employees

CONFLICT OF INTEREST

There is no conflict of interest

ACKNOWLEDGMENT

The author would like to extend a gratitude to the adviser, examiner, family, friends in college as well as smokehouse workers in Wonosari, Demak Regency for the support.

ETHICAL CLEARANCE

Ethical Clearance number XXX /EC/FKM/2019 by the ethics committee on health research at Faculty Public Health, Diponegoro University.