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The impact of using surgical masks and non-masks when exercising on heart rate, calories and VO2max during the Covid-19 pandemic

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Abstract

The use of surgical masks during exercise is still a matter of controversy. Thus the aim of this study was to see the effect of using surgical masks and non masks on heart rate, VO2max and calories during exercise. This study used a quasi-experimental method with a posttest-only crossover design approach. The instrument used in this study was the VO2max test using the Cooper Test (running as far as 2.4 km). The total subjects were 12 healthy men with a mean age of 19.87 ± 1.24 years; height, 166.81 ± 6.31 cm; and weight, 56.30 ± 3.79 kg; BMI, 20.06 ± 0.95 kg / m-2. The results showed that the use of masks during aerobic endurance exercise had no effect on heart rate and VO2max, a significant difference occurred in energy expenditure which included the number of calories while using surgical masks (p = 0.001). Aerobic exercise using a surgical mask and without the use of a mask is safe and possible. Despite the fact that wearing a mask when exercising is a little uncomfortable, the use of a surgical mask has only a small effect on physiological parameters during exercise

Keywords: *Surgical mask, Covid-19, Aerobic endurance.*

INTRODUCTION

COVID-19 is a type of infectious disease caused by a newly discovered coronavirus, namely SARS-Cov-2 (Shaw et al., 2020). This virus is suspected to be able to attack the respiratory tract and is spread through small droplets that come out of the mouth or nose of people who has been infected by the COVID-19 virus. Symptoms found from the spread of this virus were fever, dry cough, and difficulty of breathing (Epstein et al., 2020). So that requires everyone to be able to protect themselves and keep a distance from each other so that the spread of the virus is not massive.

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Efforts made to reduce the spread of the COVID-19 virus, the government enforces the rules contained in the decree of the Minister of Health of the Republic of Indonesia number HK.01.07/MENKES/ 382/2020 regarding health protocols for the community in public places and facilities in the context of preventing and controlling coronavirus disease 2019 (COVID-19) (Kementerian Kesehatan Republik Indonesia, 2020). The regulation requires the public to follow health protocols or rules that limit the movement of people in public facilities such as using masks in doing all activities outside the home, providing hand sanitizers, using masks, hand sanitizers, maintaining distance, and reducing physical contact. These rules form a new lifestyle in society, one of which is the use of surgical masks when exercising (Chen et al., 2020; Timpka, 2020).

The use of surgical masks is considered very effective to prevent the spread of influenza and severe acute respiratory syndrome (SARS) (Chen et al., 2020; Cowling, 2009; Lau et al., 2004; Leung et al., 2020). However, on the other hand, the use of masks when exercising can have an impact on the respiratory system so that it will make people who exercise doing inhale and exhale frequently. This can have an impact that more CO2 produced can be inhaled in return (Chu et al., 2020). Thus, hemoglobin binds more CO2 than O2 which in turn will harm one's cardiorespiratory (Azuma et al., 2018).

The results showed that the heart rate produced by people who used masks while exercising was faster than those who did not use masks while exercising (Chen et al., 2020). Besides, the side effect that can be felt is a slight headache. However, using a mask when exercising during the Covid-19 pandemic is still highly recommended because it can greatly limit the circulation of the spread of Covid-19 (Chandrasekaran & Fernandes, 2020). In addition, several studies explain that exercising using a mask does not have an impact on the physiology of the human body, however, the use of a mask during exercise can cause an uncomfortable sensation while exercising (Porcari et al., 2016).

This problem presents an interesting challenge to examine the effects of using surgical masks when exercising more deeply. By the making of this article, researchers have not found any literature that discusses how much influence the use of surgical masks compared to those who do not use masks when exercising on heart rate, calories spent, and VO_{2max}. Thus, this study aimed to see the effect of using surgical masks compared to non-masks when exercising on the heart rate, calorie and VO_{2max} during a pandemic so that the results of this study can be used as a reference for people to use masks when exercising.

METHOD

This study used a quasi-experimental method with posttest-only crossover design approach. Where each group will be given different treatment with one week gap separated as a washout from the first treatment. The first treatment is that all subjects were required to wear a surgical mask when exercising, after a 7 day pauses, the participants did sports without wearing a surgical mask.

The population of this study was several bicycle communities from Yogyakarta. The criteria to participate in this study were, included not smoking, having no history of disease, and spending at least 1 week for 150 minutes exercising. The total subjects were 12 healthy adult males with a mean age of 19.87 ± 1.24 years; high, 166.81 ± 6.31 cm; and weight, 56.30 ± 3.79 kg; BMI, 20.06 ± 0.95 kg / m^{-2}. All subjects had completed the informed consent before the study was conducted.

The procedure in this study was at the athlete's demographic or anthropometric data collection stage, which was collected based on the results of a questionnaire that had been filled out independently, including; height, weight and BMI. For BMI calculations were carried out by the researcher, so that the subjects only filled the column for their height and weight. Whereas for the VO_{2max} test, researchers used the 2.4 KM cooper test method which was converted to the $VOtable_{2max}$, then in collecting the calorie and heart rate data , the researchers used MI BAND 4 as reference

for the data which would later be processed manually. Calorie and data were *heart rate* that were taken after the subject completed the VO_{2max} test where the average heart rate when doing the VO_{2max} test is taken to see the maximum ability of each subject. The study was conducted in compliance with strict health protocols, and all subjects were prohibited from engaging in strenuous activities for 24 hours before starting the test.

At the time of taking the VO_{2max} data was tested with the cooper test, it was divided into 2 sessions, where the first session only allowed 6 people to be tested and 6 more people after completing the test from the first group. This was done so that the subjects could maintain a distance between other runners during the test.

Data Analysis

The data results were presented in the form of mean and standard deviation. And the significant analysis per group using *one way* ANOVA or one way test where all statistical analysis tests used SPSS version 22 with a significance level ($p < 0.01$ or $p < 0.05$).

RESULTS

The results of the subject's anthropometric data showed that the mean (± SD) age, height, body weight, BMI, there was no significant difference in the standard deviation (see table 1).

Table 1. Anthropometric Data

Variables	Experimental(N = 12)		
	Mean (SD)	Min	Max
Age	23 ± 1.41	20	25
Height (cm)	169.16 ± 2.24	165	173
Body Weight (kg)	59.56 ± 2.30	56	63
BMI (kg / m^{-2})	20.70 ± 0.86	22	19.3

BMI = Body Mass Index

Table 2. Physiological Characteristics of

Variable	Mask Surgical	Non-Masks	*P* Value
Heart rate (bpm)	185.1 ± 8.20	180.07 ± 7.26	0.123
Calories (kcal)	174.58 ± 14.2	143.91 ± 16.5	0.001 **
VO_{2max}	52.76 ± 1.70	52.82 ± 2.49	0.947

* significance *p* <0.05
** significance *p* <0.001

The results in table 2 show that the mean of heart rate and VO_{2max} in the two groups did not show any significant difference (HR, *p*= 0.123, VO_{2max}, *p*= 0.947). Significant differences occurred in the calorie variable (*p*= 0.001) where the surgical mask group spent more calories during the cooper test compared to the non-mask group.

DISCUSSION

This trial was very important to do considering that many people are afraid to exercise because they are afraid of being exposed to Covid-19 and are afraid that using a mask while exercising can affect their health level. Our findings suggest that aerobic endurance exercise, measured during the Cooper Test, can be performed safely by healthy young volunteers in both surgical and non-masked masks. The results showed that exercising using a mask did not have a significant difference in HR (*heart rate*) and VO_{2max} compared to exercising without using a mask (HR *p*= 0.123, VO_{2max} *p*= 0.947). However, exercising using a mask can be associated with increase in a mild partial pressure of carbon dioxide (CO_2), so that it can affect the increase in the heart rate of individuals who use masks when exercising (Epstein et al., 2020; Rasmussen, 2020).

The difference in heart rate between groups in this study is in accordance with what has been found by (Pifarré et al., 2020), which revealed that the weakness of using masks during exercise, especially aerobic exercise in Catalonia, causes hypoxic and hypercapnic breathing, so the use of masks while exercising has a negative impact by interfering

with breathing during these sports activities. Meanwhile, according to (Shaw et al., 2020), using a face mask when doing strenuous exercise does not affect performance. Because the study states that the use of masks during exercise is relative to exercise performance. So that sports activities using masks and not using masks do not have a significant difference. The opinion of (Shaw et al., 2020) is also different from the opinion (Epstein et al., 2020) which states that there are no significant differences in using masks, not using masks, and using N95 respirators. Because systolic blood pressure during fatigue also does not vary. Systolic pressure when not wearing a mask is 143 ± 14 mmHg, systolic pressure when using a surgical mask is 143 ± 16 mm Hg and when using a N95 respirator, systolic pressure is 147 ± 16 mm Hg. This figure explains that although there is a difference that is not too significant when the heart pumps blood throughout the body as a human respiratory activity, the use of masks during exercise (either surgical masks or using N95 respirators) has a greater systolic pressure than when not wearing a mask. However, there was no negative impact caused by this difference in pressure figures.

The high energy expenditure as indicated by the calories variable in the surgical mask group was associated with an increase in heart rate when exercising. The results showed that heart rate and energy expenditure were highly correlated (r = 0.98) and linear regardless of age or gender (Schrack et al., 2014). Awareness of physical activity is a core component in maintaining a healthy lifestyle, especially during the Covid-19 pandemic. The results of other studies indicated that the effect of using a surgical mask or N95 during a short walk (5-6 minutes) was associated with increase in the effort of muscle respiratory but no differences was found in the heart rate parameter (Long et al., 2020; Person et al., 2018; Roberge et al., 2010). Thus, our findings extend to previous findings to show that exercising using a surgical mask does not affect body physiology, but the HR factor in the surgical mask group shows that HR increases in line with the *energy* expended on the cooper test. This should

be noted that subjects with pulmonary comorbidities may be much more affected by the use of surgical masks while exercising (Kyung et al., 2020; Lee & Wang, 2011).

Our study has several additional limitations. First, the effect of surgical masks was not tested on a large number of subjects and the influence of factors such as fitness, gender (only men were included in this trial). Second, different mask models and designs may have different effects on different physiological parameters. Third, physiological effects can vary based on different levels of physical activity. Fourth, the effect of wearing a surgical mask during prolonged strenuous exercise was not discussed in our study and should be evaluated separately.

CONCLUSIONS

The findings in this study provide evidence that aerobic exercise using a surgical mask and without using a mask is safe and possible. Although basically wearing a mask when exercising is a little uncomfortable, the use of a surgical mask has only a small effect on physiological parameters during exercise. Subjects with obstructive pulmonary disease such as asthma or COPD and heart disease should undergo careful evaluation before attempting physical activity with masks.

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