

# Physiological impact of wearing a surgical face mask during walking in the COVID-19 pandemic

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## Abstract

**Background and Study Aim** Common use of surgical face masks is recommended for social and individual health due to the COVID-19 pandemic. However, there is no systematic report for responses of organism to wearing a surgical face mask during different exercises. In this context the purpose of this study was to examine the impacts of wearing a surgical face mask during a one-hour brisk walking.

**Material and Methods** A total of thirty male (n=16) and female (n=14) volunteers (mean age and BMI of 32±1.07 years and 25.1±0.68 kg/m<sup>2</sup>, respectively) completed the protocol. This was a multiple cross-over trial for healthy volunteers. All participants took a one-hour brisk walking with and without a surgical face mask. Specific physiological measurements (HR - heart rate; BP - blood pressure, SaO<sub>2</sub> - arterial oxygen content) were compared before and immediately after two brisk walking. Each subject served their own control.

**Results** The evaluation found that there was no statistically significant difference between the mean HR and blood pressure values during the brisk walking with and without a surgical face mask, while there was a statistically significant difference in the SaO<sub>2</sub> values on behalf of no-mask-walking (p<0.05).

**Conclusions:** The use of surgical face masks in healthy volunteers causes a decrease in SaO<sub>2</sub> during brisk walking. However, it does not affect the mean pulse rate and blood pressure. Although there was a statistically significant decrease in the SaO<sub>2</sub> parameter during mask-walking, it is possible to state that brisk walking with a surgical face mask does not have a physiologically negative impact, because this decrease is in ranges that are accepted to be normal.

**Keywords:** brisk walking, Covid-19, surgical face mask, oxygen saturation

## Introduction

The Covid-19 pandemic has greatly affected not only all areas of life [1] but also the exercise routine of people [2]. Yet still participating in some kind of physical activity or doing exercise regularly in a safe environment is an important means for a healthy life in this pandemic period [3]. Moreover since face masks are a clinically accepted method in reducing the transmission of virus; international, national and local administrations insistently recommend the use of face masks [4]. The public and sports clubs consider wearing a mask an inseparable part of physical activity to prevent contagiousness in daily life [5]. In addition this measure can be even more important during aerobic activities like running or bicycling, because some preliminary studies show that smaller droplets can be transmitted up to five meters while walking at 4 km/h speed and up to ten meters while running at 14.4 km/h speed [1].

It is thought that the mask obligation and other restrictions imposed by the Covid-19 pandemic, will also cause the increase of disorders like obesity, cardiovascular morbidity and depression by reducing physical activity [2]. Furthermore mask obligation and restrictions have caused professional and recreational sporters and sports

club owners to face specific difficulties during this crisis [6, 7].

Despite all this information, people have not been able to obtain clear information on whether wearing a mask during exercise may pose a health risk or not. The World Health Organization has recommended social distancing instead of masks, because masks may decrease the ability of breathing freely and a mask which gets wet with sweat during exercise may obstruct breathing and encourage microorganisms to grow [8]. Also some experts have asserted that face masks obstruct breathing, a part of the carbone dioxide inhaled previously is inhaled in every respiratory cycle and these two phenomenon increase the frequency and depth of breathing [9]. They have stated that it is hard to do physical activity with a mask, because lungs need more oxygen to let the same amount of air in [10, 11]. In contradistinction to these, another study reported that it is safe to wear a mask during exercise and especially moderate and intense exercises do not affect respiration frequency, blood pressure, O<sub>2</sub> level and exercise burnout times [1].

In this context the study aimed to at least seek an answer to the question in the minds of people regarding whether the walking activity, which has proven to be useful for health and physical convenience, should be performed with or without a mask in order to protect the

physical and mental health of people in this process.

**Material and Methods**

*Participants.*

A total of 30 women (n=14) and men (n=16) who had similar exercise routines (doing aerobic exercise 75-150 minutes a week), did not smoke, had no chronic illness and did not take medication regularly, took part in the study voluntarily.

*Research Design.*

Demographic data was collected via the Inbody 270 body analysis measuring device. Height (cm) and weight (kg) were measured for each subject and body mass index (BMI) was calculated. This was a multiple cross-over trial for healthy volunteers. All participants took a one-hour brisk walking on a cinder path first without a mask and then with a Type 1 surgical face mask in EN 14683 standards every two days. During the no-mask-walking, it was tried to fix the maximal heart rate which is determined based on the intensity of exercise and age factor, on 50-55% range. The distance they walked was recorded and then in the mask-walking the participants were asked to walk the distance they had walked during the no-mask-walking, once again in an hour. Each subject served their own control. Before and immediately after the brisk walking taken with and without a surgical face mask, their systolic and diastolic blood pressure (mm/Hg) was measured via a digital sphygmomanometer branded OMRON-M2. During the brisk walking their oxygen saturation, SaO<sub>2</sub> (%) and pulse rate were measured via a pulse oximeter device (Choicemed MD300C12, South Korea). In order to determine the saturation accurately, the walking was taken on hours when the sunshine was weaker [12, 13] and the finger in which the probe was placed was kept dry and clean [14]. The participants were all asked not to change their nutrition order before the measurement day, not to participate in any intense physical activities 24 hours before, not to use alcohol 12 hours before and not to eat two hours before every test.

*Statistical analysis*

For the analysis of the data the SPSS 23.0 package program was used. In order to determine whether the numeric variables were normally distributed or not,

the Shapiro-Wilk test was used. In order to determine whether there was a difference between the groups or not, the “Paired Samples T test” was used. All analyses were processed at the significance level of 0.05.

**Results**

Thirty volunteers successfully completed the study protocol (all the two brisk walking sessions). The mean age of the participants was 32±1.07 years. The mean height, weight and BMI were 171.9±1.5 cm, 75.7±2.72 kg and 25.1±0.68 kg/m<sup>2</sup>, respectively. Two brisk walking were performed after a minimally required rest of 24 hours and the mean time between the walking was 48 hours.

Environmental factors like temperature, moisture, elevation and noise and women’s cycle may affect the intensity of responses which develop in basic physiological systems. Thus being unable to standardize these factors for all participants might have been the reason why there was no statistically significant difference between the mean systolic and diastolic blood pressures (p>0.05). In addition the fact that the participants had had similar ranges of blood pressure before the exercise, might have contributed to this outcome. Although not statistically significant, the 3-5% decrease which was observed in the systolic blood pressure parameters after the two exercises may be associated with a temperature increase occurring during exercise, an increase in the CO<sub>2</sub> amount caused by a decrease in the O<sub>2</sub> saturation and a decline arising from vasodilatation due to all these reasons. Table 1 shows the blood pressure values of the participants.

According to our findings it is possible to state that wearing a surgical face mask during brisk walking has no negative impact on healthy adults. Table 2 shows findings supporting this view.

There was no significant difference between the mask-walking and no-mask-walking groups in terms of the mean heart rate parameter (fig. 1, fig. 2). Although there was a statistically significant decrease in the SaO<sub>2</sub> parameter in the mask-brisk-walking group, it is possible to state that mask-walking does not create a physiological difference in general, because an oxygen saturation (SaO<sub>2</sub>) value above 95% is accepted to be normal [15].

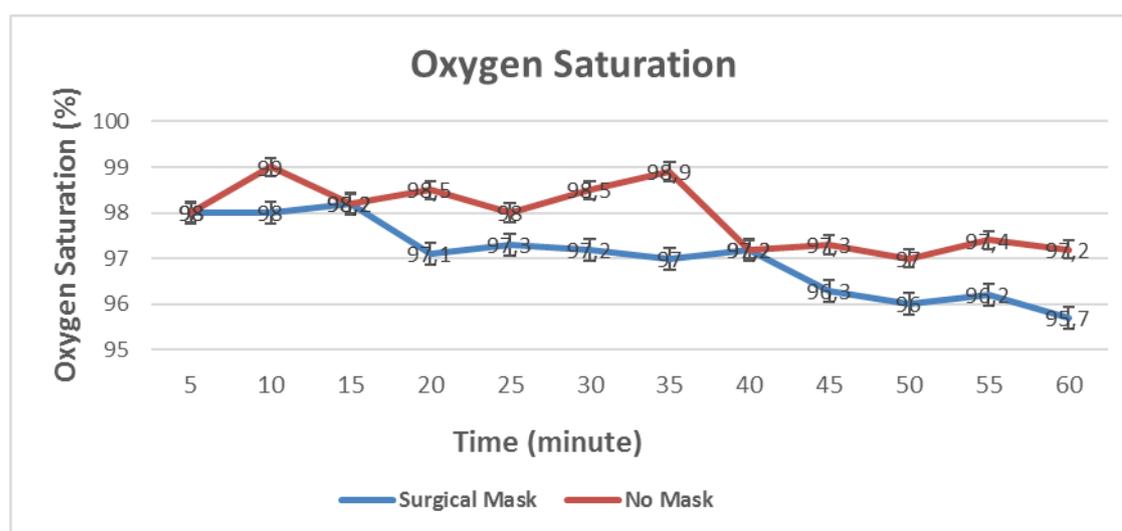
**Table 1.** The mean blood pressure values of all participants before and immediately after the walking

Group	Before Walking		After Walking	
	Mean±sd		Mean±sd	
	Systolic (mm/Hg)	Diastolic (mm/Hg)	Systolic (mm/Hg)	Diastolic (mm/Hg)
Mask-Walking Group (n:30)	123.4±2.03	76.6±1.49	117.1±1.68	77.1±1.22
No-Mask-Walking Group (n:30)	122.1±1.98	78.4±1.79	118.9±1.79	76.2±1.71

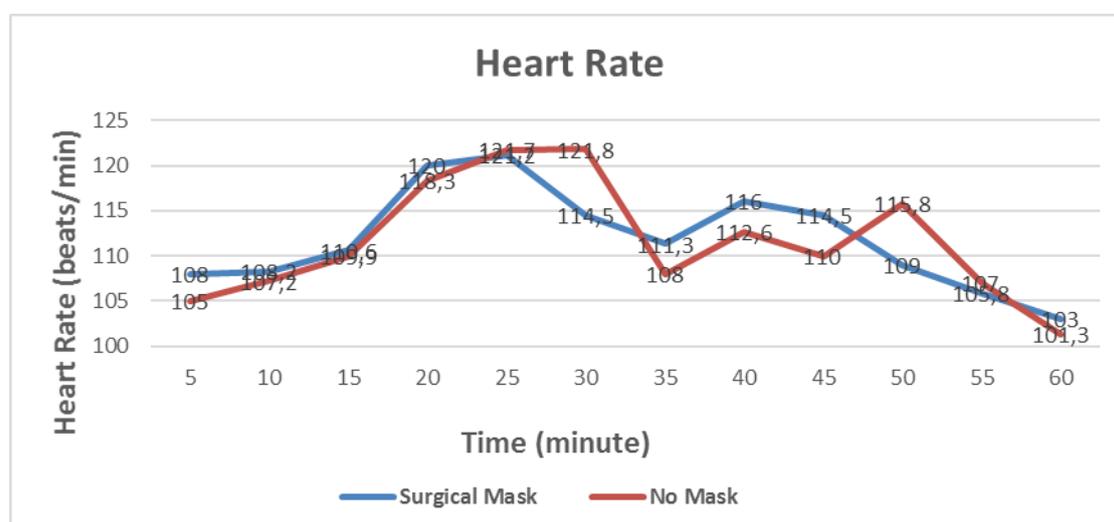
**Table 2.** Comparing the mean HR and SaO<sub>2</sub> values of the mask-walking and no-mask-walking group

Parameters	Group	Mean±sd	t	p
Mean HR (rate)	Mask-Walking Group (n:30)	111.8±1.18	0.31	0.76
	No-Mask-Walking Group (n:30)	111.6±1.35		
SaO <sub>2</sub> (%)	Mask-Walking Group (n:30)	97.02±0.09	-8.79	0.00*
	No-Mask-Walking Group (n:30)	97.93±0.1		

\*p<0.05



**Figure 1.** Mean changes in the oxygen saturation (%) values during the one-hour walking exercise performed by 30 subjects with and without a surgical face mask



**Figure 2.** Mean changes in the HR (rate/min) values during the one-hour walking exercise performed by 30 subjects with and without a surgical face mask

### Discussions

Examining similar studies in the literature; there is no clear information about whether wearing a mask during exercise is bad for health or not. However, one of the studies conducted specific to wearing a mask outside exercise, examined the impact of wearing a mask on respiration and physiological parameters and found that

wearing an N95 mask four hours during hemodialysis significantly decreases the PaO<sub>2</sub> (arterial oxygen partial pressure) and has negative impacts on respiration in people with final-stage renal disease. Considering that the study was performed with renal patients and considering the technical properties of N95 mask; this result can be accepted to be normal [16]. Another study reported that

N95 masks obstructs breathing and gas exchange in healthcare professionals and places additional workload to the metabolic system, which is in agreement with these findings [17]. Another study which was conducted specific to surgical face masks reported that there was an increase in the pulse rate and a decrease in the SaO<sub>2</sub> values of 53 surgeons one hour after wearing surgical face masks during surgeries [18]. It is thought that these findings can also be associated with psychological factors created by surgical procedures conducted with masks. A study conducted by Fernando et al. with eight people measured the pulse rate, oxygen saturation and carbone dioxide values during a mask-exercise performed at 6-8 MET intensity and consequently found that there was a decrease in the O<sub>2</sub> intake and an increase in the CO<sub>2</sub> production. Furthermore the O<sub>2</sub> saturation value which was 97.6% ± 1.5 in the beginning of the exercise, dropped to 92.1% ± 4.12 after the exercise (p<0.002). It is thought that this dramatic decline may create a risk for health and can be associated with exercise intensity. Also the study reported that the oxygen level decreased 3.2% and the CO<sub>2</sub> level increased 20% [19].

A study conducted with 60 healthy males evaluated the physiological impacts of wearing a surgical face mask or an N95 mask during short-time tiring exercise and found that the masks were safe and practicable and they only had minor and insignificant impacts on physiological parameters during exercise, which is in agreement with our study findings [1]. Another study investigating the impact of wearing a mask during exercise from a different point of view reported that doing exercise with a mask causes physiological developments in the person. Person et al. and Chen reported that wearing a mask (surgical or N95) during short walking (5-6 minutes) will contribute to the development of respiratory muscles [20, 21, 22]. Other studies conducted from the same point of view reported that doing exercise with a mask decreases the performance in the beginning; however, there will be an adaptation in the course of time. In addition using a mask for weeks or months increases the power of lung muscles and thus, the performance may increase if the mask is

taken off because the lungs will receive more oxygen [23]. What is stressed here is the training applications under hypoxic conditions, which have proven to be useful in the resiliency development for many years. Indeed our study also found that the saturation value decreased, which makes us ask whether it may contribute to the resiliency performance when applied for a long time.

Examining contrary studies; Fikenzer et al. indicated that medical face masks (especially N95) are tiring masks that significantly ruin physical and occupational activities, have a distinct negative impact on the cardiopulmonary capacity and they also significantly ruin the quality of life [24]. Porcari and Jaim stated that masks cause psychological disorders, slightly decrease the performance and require an adaptation period. Also they stressed that a wet mask increases the resistance against air flow to the lungs and there is a need for more effort for respiratory muscles. Yet still the masks are safe to use in all conditions and should be promoted in the COVID-19 period because they serve as a barrier against virus particles [25, 26].

### Conclusion

In the light of all this information, according to the results of the literature and our study; surgical face masks have no negative impact on the pulse rate and blood pressure during aerobic exercises performed at moderate and lower intensity in healthy people and although the oxygen saturation significantly decreases during these exercises, this decrease has no negative impact on health. In addition since wearing a mask has scientifically proven to prevent the virus transmission, it is thought that exercises which are performed at moderate and lower intensity especially in crowded places should be performed with masks. Further studies can seek an answer to the question “Can wearing a mask have long-term useful impacts on resiliency by creating hypoxic conditions, outside health perspective?”.

### Conflicts of Interest

The authors declare no conflicts of interest.

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