Exercising with a Surgical Mask is Safe but Decreases Performance in Both Athletic and Non-Athletic Individuals

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ABSTRACT

Introduction: Upper respiratory tract infections (URTI) are common medical problems in athletes. Many athletes with URTI continue to train at high-levels and even compete. Using a mask as an additional measure may be beneficial to prevent the spreading of infection among teammates. However, there are many concerns about the effects of mask use on exercise safety and performance. Although some studies have investigated the effects of masks on performance in healthy individuals, studies in athletes are even more limited. Thus, we aimed to evaluate the impact of surgical masks on performance and safety during a cardiorespiratory exercise test (CPET) test applied to both athletes and non-athletes.

Patients and Methods: A cross-over, non-randomized study was designed. The study was conducted in two phases. In phase 1, the CPET was performed without using a surgical mask. In phase 2, CPET was performed with a surgical mask in addition to the spiro mask 48 hours after the first test. Thirty participants aged 18-35 were included in the study. They were further divided as athletes (n= 17) and non-athletes (n= 13) subgroups.

Results: Significant decreases were observed in some parameters of submaximal exercise [VEan, BFan, VE/VO_2, VE/VCO_2 ($p< 0.001$)] and in maximal exercise [VEmax, BFmax, TVmax, VE/VO_2, VE/VCO_2 ($p< 0.001$)]. There were also significant decreases in VO_2 levels (VO_2an, VO_2max) when compared with and without a surgical mask in both submaximal and maximal exercise ($p< 0.001$). Additionally, $PETO_2$ decreased, and $PETCO_2$ increased in maximum exercise ($p< 0.001$), whereas no significant changes were detected at the submaximal level. In subgroup analysis, VEan, VEmax, VO_2an, VO_2max parameters were decreased in athletes compared to non-athletes in surgical masked tests.

Conclusion: Surgical masks for athletes and non-athletes decrease performance but have no detrimental effect on cardiorespiratory parameters. Athletes should be aware of this negative effect when high-level performance is demanded.

Key Words: Mask; oxygen consumption; exercise; athlete

Sporcu ve Sporcu Olmayan Bireylerde Maske ile Egzersiz Yapmak Güvenlidir Ancak Performansı Düşürür

ÖZET

Giriş: Üst solunum yolu enfeksiyonları (ÜSYE) sporcularda çok yaygın görülen tıbbi problemler arasında yer alır. ÜSYE geçirmekte olan sporcuların birçoğu yüksek seviyelerde antrenman yapmaya ve hatta yarışmaya devam etmektedir. Hijyen prosedürlerine ek bir önlem olarak maske kullanılması, enfeksiyonun takım içinde yayılmasını önlemek için faydalı olabilir. Ancak maske kullanımının egzersiz güvenliği ve performansı üzerindeki sonuçları hakkında çeşitli tartışmalar vardır. Her ne kadar maske kullanımının sağlıklı bireylerin egzersiz performans üzerine etkileri ile ilgili çalışmalar olsa da sporcularda yapılan çalışmalar kısıtlıdır. Bu nedenle bu çalışmada hem sporcu hem de sporcu olmayan bireylere uygulanan kardiyorespiratuvar egzersiz testi (KPET) sırasında, cerrahi maskelerin performans ve güvenlik üzerindeki etkisini değerlendirmeyi amaçladık.

Hastalar ve Yöntem: Çapraz, kontrollü bir çalışma tasarlandı. Çalışma iki fazda gerçekleştirildi. Faz 1'de KPET (kardiyopulmoner egzersiz testi) katılımcılara cerrahi maske kullanılmadan yapıldı. Faz 2'de katılımcılara ilk testten 48 saat sonra spiro maskesine cerrahi maske takılmak suretiyle KPET yapıldı. Çalışmaya 18-35 yaş arası 30 katılımcı dahil edildi. Katılımcılar sporcu (n= 17) ve sporcu olmayan (n= 13) şeklinde iki alt gruba ayrıldı.

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Bulgular: Submaksimal egzersizin bazı parametrelerinde [VEan, BFan, VE/VO_2, VE/VCO_2 ($p< 0.001$)] ve maksimal egzersiz parametrelerinde [VEmax, BFmax, TVmax, VE/VO_2, VE/VCO_2 anlamlı düşüş gözlendi ($p< 0.001$)]. Hem submaksimal hem de maksimal egzersizde cerrahi maskeli ve maskesiz değerler karşılaştırıldığında VO_2 seviyelerinde de (VO_2an, VO_2max) anlamlı düşüş görüldü ($p< 0.001$). Ayrıca maksimum egzersizde $PETO_2$ azalıp $PETCO_2$ artarken ($p< 0.001$), submaksimal düzeyde anlamlı bir değişiklik saptanmadı. Alt grup analizinde VEan, VEmax, VO_2an, VO_2max parametreleri maskeli testlerde sporcu olmayanlara göre sporcularda azalmıştı.

Sonuç: Sporcular ve sporcu olmayanlar için cerrahi maske performansı düşürür ancak kardiyorespiratuvar parametreler üzerinde zararlı bir etkisi yoktur. Sporcular ve antrenörler, üst düzey performans talep edildiğinde bu olumsuz etkinin farkında olmalıdır.

Anahtar Kelimeler: Maske; oksijen tüketimi; egzersiz; sporcu

INTRODUCTION

Upper respiratory tract infections (URTI) are very common medical problems in athletes and cause the highest illness burden among professional football players[1,2]. It was also shown that intense exercise required for competitive sports is linked to a threefold increase in upper respiratory tract infections[3]. Illnesses not only affect the health of athletes but also impair their ability to train and compete. Prevention strategies for illnesses, in addition to injuries in sports, are critical for reducing athletes' absence from training and competitions. In the context of upper respiratory tract infections, in addition to measures like regular handwashing and maintaining distance between athletes and the team, it is crucial to control droplets when speaking, coughing, and sneezing. Obviously, preventing the spread of any upper respiratory tract infection within the team is the key factor in reducing the absence time for all athletes. However, maintaining distance between an athlete with URTI and their teammates in a team environment can be challenging due to the contact nature of some sports, travel requirements, and the natural tendency of young athletes to socialize with their teammates[4]. On the other hand, given that many athletes with URTIs continue to train at high levels and even compete, using masks could be a significant measure to prevent the transmission of the infection to teammates. A mask blocks the spread of aerosols and protects healthy athletes when speaking, sneezing, or coughing[5,6].

However, many hypotheses about the effects of using a mask during exercise have been put forward. One of these hypotheses is that respiratory air trapping and rebreathing of carbon dioxide may lead to hypercapnic hypoxia, especially during high-intensity exercise. Another is that the mask will increase the respiratory workload by creating resistance during breathing[7]. How the use of masks affects exercise performance is another question, especially in the minds of athletes. Because athletes have expressed worries about their physiologic performance while wearing a face mask, as anything that covers the mouth and/or nose can theoretically increase the resistive work of breathing[8].

To date, some studies have investigated the effects of masks on physiological and physical performance in healthy individuals. Studies in the athlete population are even more limited.

Therefore, our study aimed to examine the impact of surgical masks on maximal and submaximal exercise using the cardiopulmonary exercise test (CPET) applied to both athletic and non-athletic individuals. In this context, we primarily evaluated the following parameters: maximum oxygen consumption (VO_2max), exercise test duration, maximum heart rate (HRmax), maximum minute ventilation (VEmax), and end-tidal carbon dioxide pressure ($pETCO_2$).

PATIENTS and METHODS

General Design

A non-randomized, cross-over study was conducted in two phases. In phase 1, the CPET was performed without using a surgical mask. In phase 2, CPET was performed with a surgical mask in addition to the spiro mask 48 hours after the first test. The participants were asked not to consume caffeine and alcohol, to avoid strenuous physical activity, and to have at least 6-8 hours of night sleep before the tests.

Participants

The study included 30 participants, aged 18-35, without any health problems related to cardiopulmonary, orthopedic, or neurological systems**.** They were further divided into athletic (n= 17) and non-athletic physically active (n= 13) subgroups, according to their sport activity level. All participants underwent a detailed physical examination before enrolment in the study. The demographics of the participants were recorded.

Ethical Approval

Participants provided written informed consent prior to the study. The study was registered at ClinicalTrials.gov (NCT05282472,15.03.22).

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of İstanbul University, İstanbul Faculty of Medicine (File no: 2021/659).

Figure 1. Fitting of mask.

Cardiopulmonary Exercise Test (CPET)

Surgical Mask and CPET Mask Compatibility

The metabolic test device was first put on the mask (Rudolph Mask 2 way 7910) during the test. Participants were instructed to exhale forcefully, and the presence of an air leak was subsequently assessed. Following this, a 3-layer surgical mask (UNL mask, Türkiye) was applied over the original mask and secured using a CPET turbine (Figure 1).

CPET Test Protocol

The resting arterial blood pressure, heart rate, oxygen saturation (SpO_2) (EDAN Vital Sings Monitor M3A, Edan Instruments, China), and electrocardiography (ECG) measurements were performed. CPETs were carried out using the Q 5000 (Quinton 5000, USA) stress test system and the ergospirometric test system (Metalyzer 3B system, Metasoft 2.7 software, Cortex, Germany) on the Quinton 65 treadmill. O_2 and CO_2 gases were analyzed with the breath by breath method during the test, and O_2 consumption (VO_2) and CO_2 production (VCO_2) values were determined.

Bruce protocol was used and blood pressure, SpO_2 and ECG were monitored throughout the test. The test was terminated when the participants reached the maximum exercise level.

The criteria for reaching the maximum included:

1) A respiratory exchange ratio (RER) value above 1.10,

2) The age-related target heart rate reaching ± 10 beats per minute, or

3) A plateau in VO_2. Participants who met two of these three criteria were considered to have reached their maximum[9]. Active recovery was performed with a three-minute walk after the test was terminated. The highest VO_2 value analyzed within the 15-second period in the maximum phase of CPET was considered VO_2max.

Descriptive and Outcome Data

The values for heart rate (HR), target heart rate percent (HRpred%), systolic blood pressure (SBP)-diastolic blood pressure (DBP), oxygen consumption (VO_2), RER value, minute ventilation (VE), ventilation/carbon dioxide curve (VE/VCO_2 slope), ventilation/oxygen curve (VE/VO_2 slope), oxygen pulse (VO_2/HR), respiratory frequency (BF), tidal volume (TV), end-tidal oxygen pressure ($pETO_2$) and end-tidal carbon dioxide pressure ($pETCO_2$) for anaerobic threshold and maximum level were recorded during the CPET. The anaerobic threshold was calculated using the V-slope method (slope of the linear relationship between VCO_2 and VO_2)[10].

Data Analysis

Data were analyzed using SPSS 26 package software. The mean and standard deviation were calculated for the numerical data; nominal and original data were expressed as numbers and percentage distributions. The distribution of normality was tested using the Kolmogorov-Smirnov test. According to the result, the analysis of dependent groups before and after was performed with the paired sample t-test. p-value of <0.05 was considered significant. The differences between the subgroups of physically active individuals and athletes were revealed by the Linear Model Anova review.

RESULTS

A total of 30 people were included in the study. 50% (n= 15) of the participants were women, 56.7% (n= 17) were athletes. The mean ± Std age of all participants was 23.1 ± 3.5, height 174.5 ± 8.68 cm, weight 68.4 ± 10.2 kg, and BMI 22.46 ± 2.72. The demographics of the participants are given in Table 1.

There were no significant differences in the following CPET parameters; HRrest (p= 0.64), HRan (p= 0.69), HRmax (p= 0.95), HRmax/HRpred% (p= 0.84), HRrec (p= 0.96), SBPrest (p= 0.27), SBPmax (p= 0.45), SBPrec (p= 0.92), DBPrest (p= 0.10), DBPmax (p= 0.54) and DBPrec (p= 0.21), when comparing the tests with and without surgical masks in the study group (Table 2).

Table 1. Demographic features of participants

Demographic Information		n (%)	Demographic Information	Mean ± Std
Gender	Female	15 (50%)	**Age**	23.1 ± 3.5
	Male	15 (50%)	**Height**	174.5 ± 8.7
Sports Participation	Athlete	17 (56.7%)	**Weight**	68.4 ± 10.2
	Non-Athlete	13 (43.3%)	**BMI**	22.5 ± 2.7

AUC: Ara under the curve, CI: Confidence interval, IL: Interleukin.

Table 2. Results of the cardiopulmonary exercise test of volunteers with and without surgical masks

Measure	Without Mask (Mean ± Std)	With Mask (Mean ± Std)	Difference (95% CI)	Effect Size	p
VEan (L/min)	54.41 ± 18.86	46.71 ± 14.26	4.08-11.32	2.86	**<0.001**
VEmax (L/min)	101.41 ± 29.84	83.27 ± 19.93	11.90-24.38	3.37	**<0.001**
BFan (/min)	31.39 ± 8.44	28.36 ± 7.47	1.08-5.00	3.48	**<0.001**
BFmax (/min)	44.47 ± 8.66	40.78 ± 7.39	2.41-4.98	4.94	**<0.001**
TVan (L/min)	1.76 ± 0.54	1.72 ± 0.49	-0.08-0.17	0.33	0.48
TVmax (Lmin)	2.30 ± 0.58	2.07 ± 0.43	0.12-0.35	0.85	**<0.001**
VO_2an (ml/kg/min)	29.50 ± 6.55	26.27 ± 4.92	1.33-5.13	4.31	**<0.001**
VO_2max (ml/kg/min)	42.07 ± 8.84	38.03 ± 6.68	2.20-5.86	4.72	**<0.001**
RERmax	1.22 ± 0.11	1.22 ± 0.11	-0.06-0.04	-0.55	0.72
VE/VO_2an	25.25 ± 2.93	24.12 ± 2.82	0.25-2.01	7.61	**0.01**
VE/VO_2max	33.88 ± 4.89	30.98 ± 4.46	1.56-4.24	6.14	**<0.001**
VE/VCO_2an	25.76 ± 3.01	24.72 ± 2.88	0.22-1.86	7.66	**0.01**
VE/VCO_2max	27.83 ± 3.09	25.27 ± 2.79	1.83-3.29	7.31	**<0.001**
$pETO_2$an (mmHg)	105.90 ± 6.32	104.89 ± 4.71	-0.45-2.47	18.49	0.17
$pETO_2$max (mmHg)	115.55 ± 4.92	112.96 ± 5.54	1.18-4.00	20.50	**<0.001**
$pETCO_2$an (mmHg)	42.58 ± 5.48	43.35 ± 4.44	-1.94-0.39	8.39	0.18
$pETCO_2$max (mmHg)	39.07 ± 4.60	42.31 ± 5.15	-4.33-2.14	7.88	<0.001
CPET duration (sec)	863.23 ± 156.87	879.43 ± 167.98	-36.46-4.06	5.39	0.11
HRrest (BPM)	82.53 ± 12.97	83.57 ± 13.55	-5.48-3.41	6.20	0.64
HRan (BPM)	157.03 ± 10.31	157.53 ± 11.40	-3.00-2.00	14.45	0.69
HRmax (BPM)	191.40 ± 13.76	191.27 ± 9.19	-3.97-4.24	16.35	0.95
HRmax/HRpredic %	97.33 ± 6.83	97.13 ± 4.97	-1.85-2.25	16.07	0.84
HRrec (BPM)	127.67 ± 16.35	127.57 ± 17.81	-4.16-4.36	7.44	0.96
SBPrest (mm/Hg)	122.93 ± 13.03	120.53 ± 16.21	-2.00-6.80	7.44	0.27
SBPmax (mm/Hg)	169.43 ± 20.63	166.53 ± 18.33	-4.88-10.68	5.71	0.45
SBPrec (mm/Hg)	144.50 ± 20.97	144.83 ± 20.18	-7.49-6.82	6.08	0.92
DBPrest (mm/Hg)	68.77 ± 8.34	71.77 ± 10.10	-6.60-0.60	8.19	0.10
DBPmax (mm/Hg)	64.60 ± 10.60	66.27 ± 11.93	-7.14-3.81	8.56	0.54
DBPrec (mm/Hg)	59.37 ± 8.14	62.23 ± 11.19	-7.48-1.74	7.02	0.21

an: Anaerobic threshold, max: Maximum, VE: Minute ventilation, BF: Breath frequency, TV: Tidal volume, VO_2: Oxygen consumption, VCO_2: Carbon dioxide production, RER: Respiratory exchange ratio, pET: End tidal pressure, CPET: Cardiopulmonary exercise test, Sec: Second, HR: Heart rate, pred: Predicted, rec: Recovery, BPM: Beat per minute, SBP: Systolic blood pressure, DBP: Diastolic blood pressure.

When the ventilation parameters were evaluated; significant decreases were observed in Vean ($p< 0.001$), Vemax ($p< 0.001$), Bfan ($p< 0.001$), Bfmax ($p< 0.001$) and TVmax ($p<0.001$) parameters during CPET tests performed with surgical masks compared to CPET tests performed without a surgical mask (Table 2). There was no significant difference in the TVan ($p= 0.48$) parameter (Table 2).

The VO_2 values at both the anaerobic threshold and the maximum exercise level during the CPET tests with a surgical mask were significantly lower than those obtained during the CPET tests without a surgical mask ($p< 0.001$ and $p< 0.001$, respectively). However, no significant change was identified in the CPET duration ($p= 0.11$) (Table 2).

When the VE/VCO_2 slope and VE/VO_2 slope results obtained from the CPET tests with surgical masks were compared to CPET tests without surgical masks, significant decreases were detected in both the anaerobic threshold level ($p= 0.01$ and $p= 0.01$, respectively) and the maximum exercise level ($p< 0.001$ and $p< 0.001$, respectively) (Table 2).

Considering the gas pressure parameters, there was a significant decrease in $pETO_2$ at the maximum level ($p< 0.001$), but no significant difference was observed at the anaerobic threshold of the CPET tests ($p= 0.17$) when comparing tests conducted with surgical masks to those without (Table 2). The $pETCO_2$ did not show a significant change in the anaerobic threshold level ($p= 0.18$), in the same way as $pETO_2$. However, the $pETCO_2$ value increased significantly at the maximum exercise level ($p< 0.001$), unlike $pETO_2$ (Table 2).

When the subgroups were analyzed using Linear Model Anova, it was revealed that VEan ($p= 0.005$), VEmax ($p= 0.002$), VO_2an ($p= 0.001$), VO_2max ($p= 0.001$) (Figure 2) parameters were decreased significantly after the use of surgical masks in athletes compared to physically active non-athletes. Also, it was observed that the alterations in the maximal $pETCO_2$ values in the CPET tests with and without masks were not significant between the subgroups ($p= 0.282$).

DISCUSSION

From a physiological standpoint, the level of oxygen consumption (VO_2) results from the pulmonary, cardiovascular, and hematological systems and the aerobic ATP production capacity of the muscles. VO_2max stands as the most prominent indicator of aerobic capacity.

VO_2max measurement is accepted as the gold standard in the evaluation of the aerobic capacity of individuals, especially athletes, and these measurements are performed with CPET. These tests can be carried out for clinical purposes, not only for healthy individuals such as athletes but also for those with pathologies of respiratory and circulatory systems. In one phase of our study, a 3-layer surgical mask was used during CPET. This way, the effect of the mask on the aerobic capacity and anaerobic threshold levels of individuals was determined. In addition, other cardiopulmonary parameters monitored during the test were also evaluated.

Alterations in Maximum Exercise Level

Our results showed that surgical masks used during CPET significantly decreased VO_2max, and VEmax values, while significantly increasing $pETCO_2$max, similar to some studies in the literature (Table 2)[7]. Alkan et al. reported a decrease in VO_2max as a performance output when a surgical mask is used during maximal exercise in both young and older adult

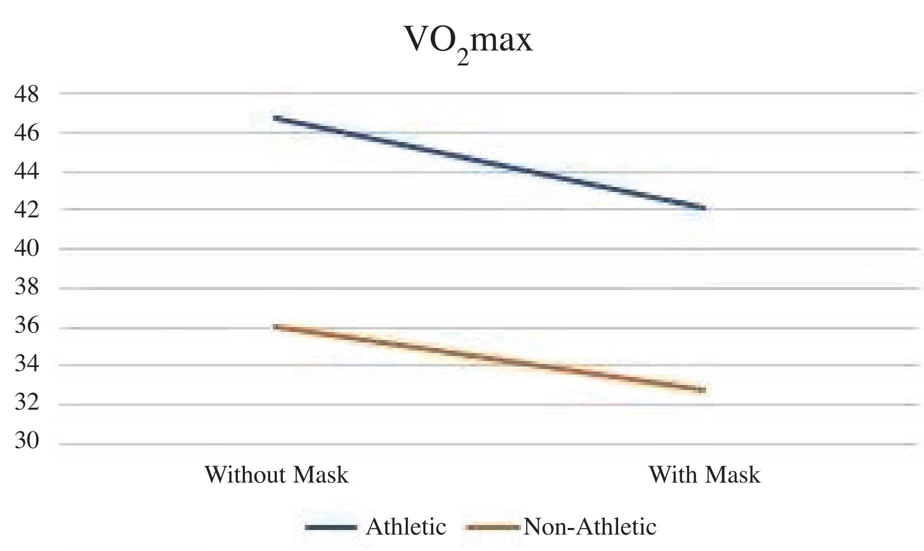

Figure 2. Maximum O_2 consumed per kg per minute (VO_2 max/kg) results of comparison of athletic and physically active non-athletic individuals; *$p= 0.001$.

groups[11]. Similar results were obtained in later studies, and two hypotheses were proposed. The first is the increase in airway resistance and, accordingly, the ventilatory workload due to the structure of the surgical mask. The other is that it traps a certain level of the exhaled air on the face area covered by the surgical mask, and CO_2 can be re-inspired, causing hypercapnic hypoxia[7,9]. Another study by Driver et al. reported that using cloth masks decreased VO_2max, VEmax as well as exercise duration and HRmax. Even though no direct association with the cardiovascular system has been reported in this study, due to the decrease in pulmonary function and mask discomfort, the exercise had to be terminated early[12].

Shaw et al. claimed that the spirometer mask placed separately on the surgical mask causes the surgical mask to stick to the face and eventually impairs its external permeability. They claimed that this situation might cause discomfort. Although they did not perform any ergospirometric evaluation or gas analysis, the same researchers reported that the use of surgical masks and cloth masks did not cause any significant changes in parameters such as exercise time, HRmax, SpO_2, and peak power[13].

On the other hand, Epstein et al. did not detect a significant difference in tissue oxygenation parameters, but they found a slight increase in $pETCO_2$ value. Despite this increase, they stated that the use of surgical masks during exercise remains safe[14].

In our study, unlike the previous ones, we applied a 3-layer surgical mask on the spirometer and fixed it with a CPET turbine[13,14]. We believe that this method provides the opportunity to evaluate gas exchange in conditions similar to surgical masks in daily life.

In our findings,

1) There was no statistically significant difference between CPET durations with and without a surgical mask,

2) None of the participants wished to terminate the test due to ventilation-related difficulties,

3) In terms of cardiovascular parameters, our results were in line with the studies conducted by Epstein and Shaw, which did not involve the use of a spirometry mask (Table 2).

However, the detection of a decrease in VO_2max during CPET performed with a surgical mask in our study suggests that masking individuals during maximal exercise may cause a reduction in their exercise capacity and performance. This finding distinguishes our study from the two studies above that did not directly assess aerobic capacity[13,14].

Alterations in Submaximal Exercise (Anaerobic Threshold) Level

The anaerobic threshold level is a frequently used marker for exercise prescribing, especially in endurance sports. Determination of the anaerobic threshold provides the opportunity to evaluate the metabolic response to exercise directly. It reveals the intensity of an exercise to be planned more reliably and more personalized than the calculations made on the VO_2max and HRmax percentages[15].

An exercise performed at the anaerobic threshold level is known as submaximal exercise. In a typical aerobic exercise session, activity is mostly performed at submaximal intensity. For this reason, it is crucial to know whether using a surgical mask during this type of exercise affects the anaerobic threshold level and cardiopulmonary parameters during exercise.

Many studies in the literature evaluate the effects of the mask during submaximal exercise. Lässing et al. stated that using a surgical mask during submaximal exercise, similar to maximal exercise, causes an increase in airway resistance and a decrease in maximum oxygen consumption, but no difference in endurance performance and perceived stress was observed[16]. On the other hand, Bar-on et al. stated that brisk walking with a mask for five minutes causes a significant increase in $pETCO_2$ and a slight decrease in oxygen saturation and that the situation may have clinical significance in the elderly and comorbid populations during longer exercise periods[17].

Studies evaluating the effect of surgical mask use on the anaerobic threshold and parameters during the anaerobic threshold are limited. Egger et al., by using a bicycle ergometer in their study, found that with well-trained athletes, the use of surgical masks did not change the anaerobic threshold and exercise parameters during the anaerobic threshold[18].

In our study, although changes were observed in ventilation parameters at the maximum exercise level, no significant change was found in $pETCO_2$ at the anaerobic threshold level. In line with these findings, we can say that possible re-inspiration of exhaled CO_2 during a submaximal exercise with a mask may not cause additional metabolic load.

In light of these findings, we think that submaximal exercise can be performed safely with a mask in crowded open areas such as parks and in closed areas such as gyms where the risk of URTI transmission is higher. In the medical literature thus far, we have not come across any study that reports the $pETCO_2$ value at the anaerobic threshold level during exercise with a surgical mask.

Differences Between the Sub-Groups

The results of both subgroups showed similar alterations in the evaluated parameters, but these changes were statistically significant in the athlete group.

Most of the studies we encountered in the literature were conducted with healthy and physically active volunteers(12-14). Egger et al. suggested that the exercise test can be terminated early without complete physical exhaustion due to leg fatigue, lack of motivation, and pain intolerance in poorly trained individuals. They stated that the mask used by individuals in this population might be less deformed(18,19).

They also observed that as the duration of exercise increases in well-trained individuals, there is an increase in sweating and mouth breathing. Furthermore, individuals can achieve higher minute ventilation, which results in more water vapor retention in the surgical mask, leading to deformation of the mask. This effect may adversely affect the maximum exercise performance by causing an increase in respiratory resistance.

Based on these findings and our study results, we believe that a surgical mask has a comparable impact during exercise in individuals with varying physical activity levels, but it appears to have a more pronounced effect on the performance of athletes.

CONCLUSION

Our data has revealed that surgical masks have a detrimental impact on CPET parameters at the maximum exercise level for both athletes and physically active healthy individuals, but they can still be considered safe. In this regard, athletes and coaches should be mindful of this detrimental effect, especially in situations where peak performance is crucial, such as competitive sports and competitions. In accordance with the findings, we believe that using surgical masks during submaximal exercise does not impose an additional metabolic burden and can be considered safe. We believe that wearing masks while exercising in locations where there is a risk of transmission will have no negative consequences for physically active healthy people. In our opinion, using a surgical mask may also be safe for individuals who have chronic diseases such as diabetes, obesity, and hypertension and who exercise regularly while performing a submaximal exercise. However, further studies with relevant populations are needed to reveal the effects of surgical mask use during exercise in individuals with chronic diseases.

Ethics Committee Approval: This study was approved by the İstanbul University Faculty of Medicine Ethics Committee (Decision no: E-29624016-050.99-196051, Date: 03.05.2021).

Informed Consent: This is retrospective study, we could not obtain written informed consent from the participants.

Peer-review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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