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Research Article / Araştırma Makalesi

Impact of using surgical face masks on exercise test parameters in professional athletes

Profesyonel sporcularda cerrahi yüz maskesi kullanımının egzersiz testi parametrelerine etkisi

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ABSTRACT

Background: The use of face masks is common worldwide due to the COVID-19 pandemic. However, the debate on the advantages and disadvantages of face masks continues. While face masks have been recommended to protect from COVID-19, their potential risks on cardiorespiratory systems in various populations are being investigated. This study aims to examine the impact of face masks on exercise test parameters in professional athletes.

Materials and Methods: 25 professional athletes (mean age: 19.6±2.4 years; F/M: 11/14; BMI: 20.2±1.6 kg/m^2) were included in the study. They performed an exercise test two times, with and without face masks, 48 hours apart. A comparison of exercise test parameters with and without face masks was made to determine cardiorespiratoryresponses in professional athletes.

Results: The participants with and without face masks were statistically similar for the test parameters, excluding final oxygen saturation, test duration (min), and peak heart rate. The participants with face masks had significantly lower scores of final oxygen saturation (p<0.001), test duration (p<0.001), and peak heart rate (p=0.004) compared with the participants without face masks.

Conclusion: Our results revealed that the use of face masks during the exercise test is associated with lower scores of oxygen saturation, test duration, and peak heart rate.

Keywords: *Exercise test, cross over, masks, COVID-19, heart rate*

ÖZ

Amaç: COVID-19 pandemisi nedeniyle yüz maskesi tüm dünyada yaygın olarak kullanılmaktadır. Ancak yüz maskelerinin avantajları ve dezavantajları konusundaki tartışmalar devam etmektedir. Yüz maskeleri COVID-19'dan korunmak için önerilse de, çeşitli popülasyonlarda kardiyorespiratuar sistemler üzerindeki potansiyel riskleri araştırılmaktadır. Bu çalışma, profesyonel sporcularda yüz maskelerinin egzersiz testi parametreleri üzerindeki etkisini incelemeyi amaçlamaktadır.

Gereç ve Yöntemler: Çalışmaya toplam 25 profesyonel sporcu (ortalama yaş: 19,6±2,4 yıl; K/E: 11/14; VKİ: 20,2±1,6 kg/m2) dahil edildi. Bu sporcular, 48 saat arayla yüz maskesi takarak ve takmayarak iki kez egzersiz testi yaptılar. Profesyonel sporcularda kardiyorespiratuar yanıtları belirlemek için, yüz maskeli ve yüz maskesiz yapılan egzersiz testi parametrelerinin karşılaştırılması yapıldı.

Bulgular: Yüz maskesi takan ve takmayan katılımcıların nihai oksijen doygunluğu, test süresi (dk) ve en yüksek kalp hızı dışındaki test parametreleri istatistiksel olarak benzerdi. Yüz maskesi takan katılımcılar, yüz maskesi takmayan katılımcılarla karşılaştırıldığında, anlamlı olarak daha düşük nihai oksijen satürasyonu (p<0.001), test süresi (p<0.001) ve tepe kalp hızı (p=0.004) skorlarına sahiptiler.

Sonuç: Çalışmamızın sonuçları, egzersiz testi sırasında yüz maskesi kullanımının daha düşük oksijen satürasyonu skorları, test süresi ve tepe kalp hızı ile ilişkili olduğunu ortaya koymuştur.

Anahtar Sözcükler: *Egzersiz testi, maske, COVID-19, kalp atım hızı*

INTRODUCTION

Currently, the use of face masks is common worldwide due to the COVID-19 pandemic. However, the debate on the advantages and disadvantages of face masks continues, although their preventive effect against the spread of COVID-19 has been proven (1). Furthermore, while face masks have been recommended to protect from COVID-19, their potential negative impacts on cardiorespiratory systems in various populations have been demonstrated during physical exercises (2,3). On the other hand, a recent systematic review and meta-analysis reported that face masks could be used during exercise with no negative effects on performance (4).

There is a concern that face masks may cause inadequate oxygenation, but studies reveal that gas exchange during physical activity is not critically impaired (5). However, po–

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tential negative effects of face masks may be related to various factors such as comorbidity, activity level, and type of face mask (6-8).

Exercise testing is widely used to evaluate the cardiorespiratory systems, exercise performance, and functional capacity. The Bruce treadmill test, in which exercise is performed on a standard treadmill, is one of the most common protocol used in exercise testing. The difficulty level of exercise test is progressively increased every 3 min by increasing the speed and incline of the treadmill according to the original Bruce protocol. The test is stopped when the person cannot continue due to any medical problem or fatigue (9,10).

This study aims to examine the impacts of face masks on parameters of exercise test using the Bruce protocol in professional athletes.

MATERIAL and METHODS

Our study was a prospective cross-over study in which the effects of wearing a surgical face mask (Evony®, Turkey; disposable, 3 layers, surgical face mask with elastic ear loops, adult mask) on exercise test parameters in professional athletes (short, middle and long distance runners) were evaluated. The Bruce treadmill test (the original Bruce protocol) was used on a standard treadmill (Cardiosoft v6.73 & T2100-ST2, GE) and to determine perceived physical activity intensity during the treadmill test, the Borg Rating of Perceived Exertion (RPE) was used. The Bruce Protocol is composed of 7 stages, with increasing inclination and speed at each stage. The stages last 3 minutes, except for the last one, which continues with the same parameters until the participant reaches a state of exhaustion. Borg's rating of perceived exertion (RPE) is a widely used psycho-physical tool to assess subjective perception of effort during exercise. It is based on a six to twenty rating scale, and there is a relationship between its scores and exercise intensity and the actual heart rate during the exercise test. Borg's RPE is a valid and inexpensive tool for monitoring exercise intensity for primary and secondary disease prevention (11,12).

Following the medical history, physical examination and a resting electrocardiogram, each subject performed two incremental exertion tests; one was with surgical mask, the second without. The order of the tests was randomly assigned using the GraphPad Quickcalcs online randomization tool.

Exercise tests were performed at the same time of day with a minimum of 48 h of interval. During the tests the following parameters were recorded: heart rate (initial and final), systolic and diastolic blood pressures (initial and final), oxygen saturation (initial and final), test duration (min), perceived exertion (at last stage), peak heart rate, and peak systolic and diastolic blood pressures. The participants were instructed that the speed and incline would increase 10 seconds before the beginning of each stage and to perform their maximal possible effort until reaching the maximal predicted heart rate. The termination criteria of the tests before the predicted maximal heart rate achievement were as follows: chest pain developed during the test, abnormal ECG findings indicating restriction of heart muscle oxygenation, rise of blood pressure to dangerous levels, exhaustion or leg pain.

A pulse oximetry device (Siemens MicrO2 Portable Pulse Oximeter Patient Monitoring) was used to assess the blood oxygen level. Heart rate, systolic and diastolic arterial pressures were monitored (GE-Cardiosoft, GE Healthcare GmbH, Solingen, Germany). The initial (pre-test, baseline) and final (at rest, 3 min after the end of the test) scores and peak systolic-diastolic arterial pressures and pulses of all subjects were measured.

The participants were blinded with regard to their respective test results to avoid influence by an anticipation bias. Statistical analysis was performed by an independent and fully blinded scientist who was not involved in the conduction of the tests.

The study was conducted at the Department of Yüzüncü Yıl University Hospital, between October 2020 and December 2020. The Yüzüncü Yıl University Hospital Ethical Review Board approved the study protocol (Decision No: 04; Date: September 30, 2020), and the participants' informed consents were obtained. The study was conducted in accordance with the principles of the Declaration of Helsinki. Participants aged <18 years or who had a smoking history were excluded.

Statistical analysis

Power analysis was performed by using an internet-based electronic computing tool (https://clincalc.com/stats/samplesize.aspx).

Data was analysed by using IBM SPSS 20.0 software program. Considering the results of the Kolmogorov-Smirnov normality test that applied to the data, parametric or non-parametric tests (Student t test or Mann-Whitney U test) were used to compare the data between the two groups. The data were expressed in mean±standard deviation (min.-max.) (median) when used the Mann-Whitney U test. $P<0.05$ was considered as statistically significant.

RESULTS

Table 1 presents the demographic features of the participants (professional athletes; n=25; mean age: 19.6±2.4 years; F/M: 11/14; BMI: 20.2±1.6 kg/m^2)

Table 2 shows the comparison of the participants with and without face masks in terms of the exercise test parameters.

The participants with and without face masks were statistically similar for the test parameters, excluding final oxygen saturation, test duration (min), and peak heart rate. The participants with face masks had significantly lower scores of final oxygen saturation (p<0.001), test duration (p<0.001), and peak heart rate (p=0.004) compared with the participants without face masks.

Table 1. Demographic characteristics of the participants (professional athletes).

	N=25 Mean±SD (min.-max.)
Age (year)	19.7±2.2 (18-27)
Gender, (F/M, n)	11/14
Height (cm)	169.5±8.2 (155-187)
Weight (kg)	58.1±7.3 (45-72)
BMI (kg/m^2)	20.2±1.6 (17.8-24.2)
Sports training intensity (hour/week)	12.4±4.3 (3-21)
Sports year	5.6±3.4 (1-12)

SD: standard deviation, F/M: female/male; BMI:body mass index

Table 2. Comparisons of exercise test parameters between the groups.

	Group 1 (With face mask) N=25	Group 2 (Without face mask) N=25	P
Heart rate (initial)	82.8±13.3 (55-105)	76.2±14.9 (50-105)	0.102
Heart rate (final)	89.2±15.4 (59-124)	87.9±15.8 (64-122)	0.766
Systolic pressure (initial)	108.4±8.9 (100-133)	106.9±8.8 (100-131)	0.199*
Systolic pressure (final)	118.9±20.8 (80-160)	114.3±21.8 (80-170)	0.544
Diastolic pressure (initial	66.4±9.9 (50-90)	59.2±7.6 (50-80)	0.006*
Diastolic pressure (final)	65.2±10.8 (50-90)	62.8±15.7 (30-80)	0.526
Oxygen saturation (initial)	96.5±1.2 (94-98)	97.0±1.0 (94-99)	0.110
Oxygen saturation (final)	92.9±2.6 (84-97)	97.5±1.4 (94-99)	<0.001*
Test duration (min.)	16.2±1.6 (13-19)	18.0±0.8 (17-19)	<0.001
Perceived exertion (6-20)	12.6±1.9 (10-15)	11.6±1.5 (10-14)	0.060*
Peak heart rate	167.6±18.1 (102-190)	177.8±18.3 (132-191)	0.004*
Peak systolic pressure	132.2±20.0 (100-175)	135.6±23.0 (103-186)	0.584
Peak diastolic pressure	68.0±12.6 (55-105)	74.4±12.2 (58-106)	0.074

Based on the normality test results, the Student test or the Mann-Whitney U test were used to compare the data between the two groups. The data were expressed in mean±standard deviation (min.-max.). *: Mann-Whitney U test.

DISCUSSION

Although the face masks are used globally based on the expert recommendations due to the current pandemic, there is a debate on their advantages and disadvantages. The preventive effect of face masks against the spread of COVID-19 has been proven (1). On the other hand, their potential negative impacts on the cardiorespiratory system in various populations have been demonstrated during physical exercises (2,3). Fortunately, considering exercise performance, it has been reported in a recent systematic review and meta-analysis that face masks can be used during exercise with no negative effects on performance (4). However, our results revealed that using face masks is associated with reduced capacity to continue exercise. Epstein et al. (5) have stated that short-term moderate-to-vigorous, aerobic physical activity is safe and feasible in healthy people with face masks.

Correlation between perceived exertion and exercise intensity and the actual heart rate during the exercise test has been reported (11,12). Poon et al. (13) have stated that when as exercise intensity exceeded the limits, perceived exertion increased. We found no significant difference for perceived exertion scores between participants with and without face masks, although the participants without face masks had longer test durations. There was no significant difference in terms of initial and final heart rate scores between participants with and without face masks regarding the perceived exertion scores. On the other hand, the participants without face masks had higher scores of peak heart rate, as they had longer test duration.

There are studies showing that face masks do not critically impair gas exchange during physical activity (6). However, the potential negative effects of face masks may be related to various factors. For example, Kyung et al. (7) have shown that N95 face masks can increase pulmonary airflow resistance and dead space in patients with chronic obstructive pulmonary disease. On the other hand, Georgi et al. (8) have concluded that surgical masks are not related with health risks in healthy people. Driver et al. (14) have demonstrated a 29% decrease in maximum oxygen level with cloth face mask-wearing during a graded treadmill running exercise test. Exercise testing on treadmill is shown to lead more decrease in oxygenation than on ergometer cycling (15). Many factors such as comorbidity, activity level, type of face mask, and exercise test seem to be related with the obtained results.

The main limitation of the current study is that the study group consisted of young and healthy professional athletes, so the results may not be valid for the elderly, patients and individuals from different professions.

CONCLUSION

Using face masks negatively affects some exercise test parameters. It is associated with lower scores of final oxygen saturation, test duration, and peak heart rate.

Ethics Committee Approval / Etik Komite Onayı

The approval for this study was obtained from Yüzüncü Yıl University, Clinical Research Ethics Committee, Van, Türkiye (Decision no: 04 Date: September 30, 2020).

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

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Author Contributions / Yazar Katkıları

Concept – ŞK; Design - VŞ; Supervision – NA; Materials – RD; Data Collection and/or Processing – ZÖ; Analysis and Interpretation – CA; Literature Review – ŞK; Writing Manuscript - VŞ; Critical Reviews - VŞ,ŞK

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