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The effect of surgical mask use on recovery heart rate during gradually increasing walking*

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Abstract

The World Health Organization (WHO) and the Ministry of Health recommend distance, hygiene, and the use of masks in the fight against epidemics. Therefore, everyone from children to the elderly, from healthy people to all individuals with chronic diseases must wear a mask while performing their daily activities. After the activities they perform at a slow or fast rhythm, they rest in a mask. Therefore, the study aimed to examine the effect of surgical mask use on recovery heart rate during gradually increasing walking. Nine healthy university students without chronic diseases and orthopedic disorders participated in the study voluntarily. Participants performed a gradually increasing walking protocol on a treadmill with and without surgical masks on two different days at least 48 hours apart, and then recovered in a sitting position for 10 minutes, again with and without masks. Data on body temperature, blood pressure (BP), blood lactate level (LA), heart rate (HR), total quality of recovery (TQR), and borg-breathlessness (B-B) were collected. The paired sample t-test was used for normally distributed data, and the Wilcoxon signed-rank test was used when the distribution was not normal. The significance level was set as p<0.0 5. No statistically significant differences were found between unmasked and masked body temperature, lactate level, systolic and diastolic blood pressure, mean recovery HR, end-of-recovery HR, and total heart rate. On the other hand, breathlessness was felt more in masked recovery compared to unmasked recovery and total quality of recovery was felt lower. As a result; it can be said that the use of surgical masks during gradually increasing walking affects the participants psychologically, although it does not affect them physiologically in recovery.

Keywords: Surgical mask, recovery, breathlessness, heart rate, lactate level.

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Kademeli Artan Yürüyüş Sırasında Cerrahi Maske Kullanımının Toparlanma Kalp Atım Hızına Etkisi

Özet

Dünya Sağlık Örgütü (WHO) ve T.C. Sağlık Bakanlığı, salgın hastalıklarla mücadelede mesafe, hijyen ve maske kullanımını önermektedirler. Dolayısıyla çocuğundan yaşlısına, sağlıklısından kronik hastalığı olan tüm bireylere kadar herkes günlük aktivitelerini gerçekleştirirken maske takmak zorundadır. Yavaş veya hızlı ritimde gerçekleştirdikleri aktivitelerin ardından maskeli şekilde dinlenmelerini gerçekleştirmektedirler. Bu nedenle çalışmanın amacı; kademeli artan yürüyüş sırasında cerrahi maske kullanımının toparlanma kalp atım hızına etkisini incelemektir. Çalışmaya gönüllü olarak üniversitede öğrenim gören kronik hastalığı ve herhangi bir ortopedik rahatsızlığı olmayan sağlıklı 9 öğrenci katılmıştır. Katılımcılar en az 48 saat arayla iki farklı günde cerrahi maskeli ve maskesiz olarak koşu bandında kademeli artan yürüyüş protokolü ve sonrası yine maskeli ve maskesiz olarak 10 dakika oturur pozisyonda toparlanma gerçekleştirmişlerdir. Katılımcıların; vücut ısısı, kan basıncı, kan laktat düzeyi, kalp atım hızı (KAH), algılanan toparlanma derecesi ve dispne şiddetine ilişkin verileri toplanmıştır. Normal dağılım gösteren veriler için eşleştirilmiş örneklem t testi, dağılım normal olmadığında ise Wilcoxon işaretli sıralar testi kullanılmıştır. Anlamlılık seviyesi $p<0.05$ olarak belirlenmiştir. Katılımcıların maskesiz ve maskeli vücut ısısı, laktat düzeyi, sistolik ve diastolik kan basıncı, toparlanma ortalama KAH, toparlanma sonu KAH ve toplam kalp atım sayısı değerleri arasında istatistiksel olarak anlamlı farklar bulunmamıştır. Buna karşın maskeli toparlanmada dispne şiddeti maskesiz toparlanmaya göre daha fazla hissedilmiş, algılanan toparlanma da daha düşük hissedilmiştir. Sonuç olarak; kademeli artan yürüyüş sırasında cerrahi maske kullanımının toparlanmada fizyolojik olarak katılımcıları etkilemese de psikolojik olarak etkilediği söylenebilir.

Anahtar Kelimeler: Cerrahi maske, toparlanma, nefes darlığı, kalp atım hızı, laktat düzeyi.

INTRODUCTION

The World Health Organization (WHO) declared the novel coronavirus (COVID-19) pandemic a global pandemic in March 2020. Following the outbreak of the pandemic, international, national, and local authorities have taken some measures to reduce human-to-human transmission. People were advised to reduce social contact, avoid traveling, stay at home, pay attention to personal hygiene and wear surgical masks (12). Experts have stated that the primary route of transmission of COVID-19 and similar diseases is likely to be small droplets excreted by carriers during conversation, breathing, coughing, or sneezing. It has also been stated that the main source of transmission of the virus is the young population, which is mostly asymptomatic (11).

COVID-19 and similar diseases affecting the world and our country have caused some new habits to enter our lives. One of these is the obligation to wear a surgical mask. Many health authorities recommend, and some even require the use of surgical masks in public places (8). Research shows that surgical masks reduce respiratory virus infections and the risk of human-to-human transmission. It is recommended that all individuals, from children to the elderly, from the healthy to the chronically ill, wear masks while performing their daily activities (9).

After any exercise, metabolic events in the body continue for a while. The reason for this is the removal of metabolic wastes (CO_2, lactic acid, etc.) in the body due to the exercise performed, replacing the energy spent, that is, recovery. Recovery is a process in which the muscles and the whole organism return to their pre-exercise state. It is especially important in terms of preparing for the next activity and load (14). Post-exercise heart rate recovery is the difference between the heart rate at the end of exercise and the heart rate at the end of the first minute of the recovery period (3). Recovery continues until heart rate, blood pressure, and ECG return to baseline (16), which takes approximately 9 minutes. In normal asymptomatic individuals and athletes, a rapid decline in heart rate is observed in the first 30 seconds after exercise, followed by a slower decline. This early rapid decline is prevented by atropine, indicating that this rapid decline is caused by vagal influence (17). The factors determining the recovery process are the heart rate, the time for respiration to return to normal, and the return of the lactic acid level to normal levels. During recovery, the VO_2 consumed increases to help return to pre-exercise conditions. A so-called oxygen debt occurs (27). In a healthy heart, beats are not regular like clockwork. There are autonomic tone-related changes in heart rate in coordination with respiration. This condition, called heart rate variability, can be used as an indicator of sympathetic-parasympathetic balance, that is, whether the autonomic nervous system is functioning properly. In people in whom the sympathetic system is dominant and the parasympathetic system is not activated, the heart works faster than normal and changes coordinated with respiration are not seen (7).

There are many studies in the relevant literature showing the effects of the masks used during exercise (2,4,18,26). In addition, there is only one study examining the physiological effects of surgical mask use during walking (1). Especially considering that people are in a rush for several reasons in daily life and can take fast walks in a hurry to get from one place to another, no study has been found to examine the effects of mask use during recovery after these and similar situations. Therefore, this study is important in terms of contributing to the literature in terms of the widespread increase in mask use knowing the effects of this situation on recovery heart rate in healthy individuals and being a source for other studies. Based on this information, our study aimed to examine the effect of surgical mask use on recovery heart rate during gradually increasing walking.

METHOD

Research Model and Participants

The experimental model was used in the study. In addition, a randomized crossover design method was utilized. Nine healthy university students (21,89 ± 1,69 ages and 169,78 ± 10,18 height) without any chronic disease or orthopedic disorder participated in the study. The participants were selected based on volunteerism among the students studying at Hatay Mustafa Kemal University School of Physical Education and Sports. Participants were informed about the study in detail. They were also asked to sign a consent form indicating that they were volunteers. Before starting the study, approval was obtained from Hatay Mustafa Kemal University Clinical Research Ethics Committee for all stages of the study.

Research Procedure

In the study, participants performed gradually increasing walking on a treadmill with and without standard surgical masks on two different days 48 hours apart. After gradually increasing walking performance in the speed ranges from walking to running, they recovered in a sitting position for 10 minutes, again with and without masks. Data such as body temperature (BT), blood pressure (BP), blood lactate level, heart rate (HR), total quality of recovery (TQR), and borg-breathlessness (B-B) were collected.

Data Collection

The body temperature of the participants was measured with a Saubern BNT9603 non-contact infrared thermometer on the forehead according to the instructions (Saubern, China). BP was measured in the arm using an Omron M3 (Healthcare; Kyoto, Japan) digital sphygmomanometer. During the measurement, it was ensured that the participant was not talking, leaning back, sitting on a chair, with feet touching the floor, and the arm supported at the level of the heart. Blood lactate level was determined by taking blood samples from the earlobe with a Lactate Plus portable blood lactate analyzer (Nova Biomedical, Waltham, MA, USA). Heart rate (HR) was recorded with Polar RS800CX (Polar Electro Ov, Kempele, Finland) telemetric device in RR (beat-to-beat) intervals. Data on heart rate (HR mean, HR standard deviation, 10-min HR, and total heart rate) were obtained through Polar Pro Trainer 5 software. The TQR during recovery was determined using a modified Borg scale. In this scale, the participants expressed the total quality of recovery they felt in a range between 0 and 20 (5). The Modified Borg Dyspnea Scale was used to determine the breathlessness during recovery. In this scale, the participants expressed the breathlessness they felt in a range between 0 and 10 points (the higher the score, the more breathlessness) (6,15).

Statistical Analysis

Mean, standard deviation and rank mean were used to describe the data. The normality of the data was evaluated statistically (Shapiro Wilk, skewness, kurtosis) and graphically (Histogram, Q-Q plot). For the comparison of masked and unmasked protocols, the paired sample t-test was used for normally distributed data, and the Wilcoxon signed-rank test, the nonparametric equivalent of the t-test, was used when the distribution was not normal. The data were analyzed in SPSS 23.0 (SPSS Inc., Chicago, IL, USA) and the significance level was set as $p<0.05$.

Ethical approval and institutional permission

The research procedure was carried out in adherence to the principles outlined in the Declaration of Helsinki and after the approval of the Hatay Mustafa Kemal University Clinical Research Ethics Committee (Decision Number: 24).

FINDINGS

The comparison of body temperature, blood lactate, systolic, and diastolic blood pressure values of the participants during recovery is shown in Table 1.

Table 1. Comparison of body temperature, lactate level and blood pressure variables

Variables	Group	Mean	Std. Dev.	z / t	p
BT (°C)	No Mask	36.63	0,05	z= -0,71	0,48
	Mask	36,31	0,12		
LA (mmol/l)	No Mask	2,49	0,93	t= 0,40	0,70
	Mask	2,34	1,24		
SBP (mmHg)	No Mask	105,44	10,73	z= -0,35	0,73
	Mask	104,56	8,76		
DBP (mmHg)	No Mask	74.33	7,65	t= 0,69	0,51
	Mask	74.89	6,49		

BT: Body temperature, LA: Lactate level, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

There were no statistically significant differences between unmasked and masked body temperature (p=0.48), blood lactate level (p=0.70), systolic blood pressure (p=0.73), and diastolic blood pressure (p=0.51) values (Table 1).

The comparison of heart rate (HR) values is shown in Table 2.

Table 2. Comparison of heart rate variables

Variables	Group	Mean	Std. Dev.	z / t	p
HRmean (beats/min)	No Mask	96,56	18,53	z= -0,12	0,91
	Mask	97,00	14,71		
SD (msec)	No Mask	19,07	12,93	t= 1,05	0,32
	Mask	15,26	8,95		
HR10.min (beats/min)	No Mask	80,67	16,84	z= -1,44	0,19
	Mask	84,67	15,39		
THR (beats)	No Mask	965,56	185,80	z= -0,24	0,81
	Mask	971,67	147,40		

HR: Heart rate; SD: Heart rate standard deviation, HR10.min: 10. Heart rate at 10 minutes, THR: Total heart rate

There were no statistically significant differences between the mean HR (p=0.91), SD (p=0.32), HR at 10 minutes (p=0.19), and total heart rate (p=0.81) values of the participants without and with masks (Table 2).

The comparison of the TQR and B-B is shown in Table 3.

Table 3. Comparison of total quality of recovery and borg-breathlessness

Variables	Group	Mean	Std. Dev.	z	p
TQR	No mask	16,78	2,99	z= -1,40	0,16
	Mask	15,00	2,06		
B-B	No Mask	0,83	0,50	z= -2,39	0,02*
	Mask	2,17	1,62		

TQR: Total quality of recovery, B-B: Borg-breathlessness, *: p<0.05.

Although there was no statistically significant difference between unmasked and masked TQR (p=0.16), participants stated that they recovered less with masks than without masks. However, B-B (p=0.02) values were found to be statistically significantly higher in the masked protocol ($p<0.05$) (Table 3). The graph of the rate of perceived recovery is shown in Figure 1.

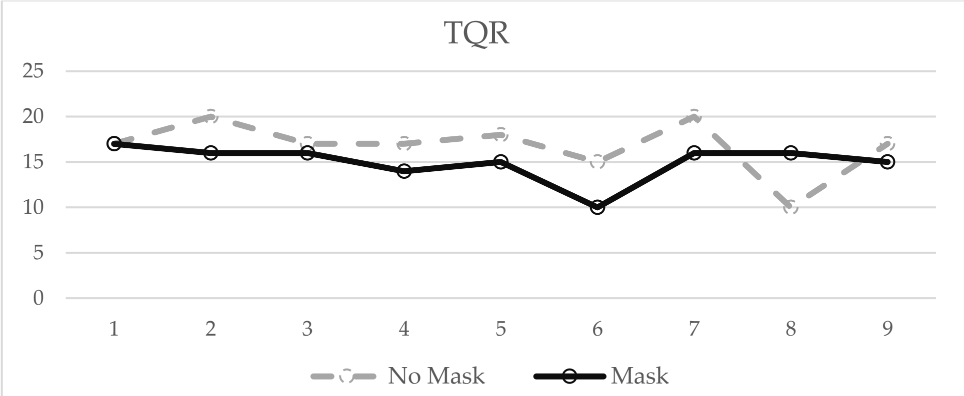

Figure 1. Total Quality of Recovery

Except for one participant, all unmasked participants felt a higher rate of recovery than masked participants (Figure 1). The B-B graph of the participants is shown in Figure 2.

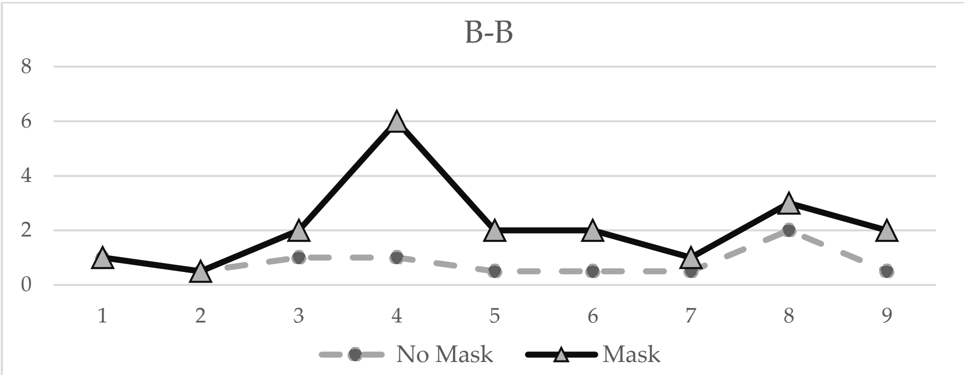

Figure 2. Borg-Breathlessness

Except for two participants, all unmasked participants had lower breathlessness values than masked participants (Figure 2).

DISCUSSION AND CONCLUSION

Our study was conducted to examine the effects of surgical mask use during gradually increasing walking on heart rate, total quality of recovery, and breathlessness during recovery. The main finding of the study was that the use of a surgical mask can have a significant negative effect on breathlessness during recovery. On the other hand, the use of surgical masks during gradually increasing walking did not significantly affect the participants in terms of recovery body temperature, blood pressure, blood lactate level, heart rate, and total quality of recovery. However, it is noteworthy that the values in unmasked recovery were lower than in masked recovery.

In the relevant literature, all of the studies on a surgical mask and exercise focused on the effects of surgical mask use on various parameters during exercise (1,2,4,10,11,12,18,20,21,22,25,26). Only two studies investigated the physiological effects of the mask during the recovery period after exercise. In a study examining the physiological effects of surgical mask use during as well as immediately after walking exercise, it was found that using a surgical mask did not show any difference for HR and BP immediately after brisk walking and similar values of HR and BP were determined with and without surgical mask after brisk walking in the recovery period (1). In the other study, Kwon and Kim (2023) investigated the effects of mask use on recovery HR and LA during a gradually increasing running test and in the recovery period. As a result of the study, no statistically significant differences were found for both variables with and without masks (19). In our study, no differences were found between the groups in terms of HR, BP, and LA during the recovery process after gradually increasing walking exercise. Therefore, there is a similarity between the results of these two studies and the results of our study in terms of the variables mentioned.

Although studies have shown that the use of surgical masks during different types of exercises has effects on various physiological parameters, it can be said that the use of surgical masks in the recovery period after walking or running exercises does not show any physiological differences and brings similar physiological loads to the person. In addition, the fact that the lactic acid level in the blood did not decrease significantly in the recovery period after the test with the mask may be due to the high activation of anaerobic lactic acid metabolism. However, further studies are needed to better understand the physiological effects of mask use during and after exercise on the recovery period and the underlying reasons for this.

Although the number of studies examining the effects of surgical mask use on feeling-based parameters such as total quality of recovery and breathlessness other than physiological parameters is quite small in the literature, all of these studies focused on feelings during exercise (13,21,23,24,26,28). There is no other study in the literature that examined the effects of surgical mask use during exercise on total quality of recovery and breathlessness in recovery similar to the protocol of our study. Therefore, our study is unique in this respect.

There were no statistically significant differences between unmasked and masked body temperature, lactate level, systolic and diastolic blood pressure, recovery mean HR, recovery end HR, and total HR. However, breathlessness was felt more in masked recovery than in unmasked recovery and the total quality of recovery was felt lower. The results of this study suggest that wearing a surgical mask during recovery from gradually increasing walking does not place additional physiologic demands on the person, although it may require slightly more respiratory effort and psychologically affect them.

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