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RESEARCH ARTICLE

DOES MASK USE DURING ACTIVITY AFFECT THE HEMODYNAMIC RESPONSE?

Gülşah Karabiyik[1], Selen Öztürk[1], Fulya Senem Karaahmetoğlu[2], Filiz Yağcı[3], Baris Demirkol[4], Halit Çınarka[5], Esra Pehlivan[1]

[1] University of Health Sciences, Hamidiye Faculty of Health Sciences, Department of Physical Therapy and Rehabilitation, Istanbul, Turkey
[2] University of Health Sciences, Hamidiye Institute of Health Sciences, Department of Physical Therapy and Rehabilitation, Istanbul, Turkey
[3] Uludağ University, Department of Mathematics, Istanbul, Turkey
[4] University of Health Sciences Başakşehir Çam and Sakura City Hospital, Department of Pulmonology, Istanbul, Turkey
[5] Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital, Department of Pulmonology, Istanbul, Turkey

ORCID: G.K. 0000-0003-1082-580X; S.O. 0000-0003-4222-5972; F.S.K. 0000-0002-4397-9322, F.Y. 0000-0001-5574-9922, B.D. 0000-0001-5585-3842, H.C. 0000-0002-4910-149X, E.P. 0000-0002-1791-5392

Corresponding author: Esra Pehlivan, **E-mail:** fztesrakambur@yahoo.com
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ABSTRACT

Purpose: The use of face masks during physical activity is increasingly attracting interest regarding their potential impact on cardiovascular and respiratory responses. This growing interest reflects the need to clarify how face masks might influence physiological responses during exercise. This study aimed to investigate the impact of mask use on hemodynamic responses during exercise.
Material and Methods: This cross-over clinical study included healthy young individuals aged 18–25 years. Participants were randomly assigned to either a Mask Group, who wore masks during treadmill exercise at 60% of their maximum heart rate, or a Non-mask Group, who exercised without masks. Following the first exercise session, a wash-out period was provided before participants crossed over to the alternate group. Blood pressure, oxygen saturation, heart rate, and perceived breathlessness (measured using the Modified Borg Scale) were recorded before and after each exercise session.
Results: A total of 52 participants completed the study. Statistically significant changes in hemodynamic parameters were observed from pre- to post-exercise within both groups ($p<0.05$). However, no significant differences were found between the Mask Group and the Non-mask Group ($p>0.05$).
Conclusion: In healthy young individuals, physical exercise led to increases in heart rate, blood pressure, dyspnea, and fatigue, as well as a decrease in oxygen saturation. Notably, wearing a mask during exercise did not result in significant differences in hemodynamic responses compared to exercising without a mask. Further studies are warranted to validate these findings in similar populations.

Keywords: dyspnea, exercise, hemodynamic, mask.

INTRODUCTION

The use of face masks is recognized as an effective measure to reduce the spread of respiratory infections, and increasing interest has focused on how mask use may influence hemodynamic responses during physical activity (1). The hemodynamic response refers to the response of the cardiovascular system to various stimuli such as

physical activity, exercise or stress. This response is measured by changes in parameters such as heart rate (HR), blood pressure (BP) and oxygen saturation (SpO_2) and reflects the body's oxygen-carrying capacity and the status of cardiovascular functions. One of the main problems with the use of masks during exercise is that they prevent comfortable breathing and create resistance to airflow due to humidity (2). There is insufficient information in the literature on how surgical masks affect cardiopulmonary capacity in healthy individuals (3). It is assumed that exercising with a face mask may cause carbon dioxide (CO_2) accumulation. In the case of hypercapnic hypoxia, heart rate (HR) and blood pressure may increase exponentially even at low activity levels due to decreased oxygen (O_2) and increased CO_2 (4).

On the other hand, there are studies reporting that surgical masks have no significant effect on physiological parameters (5), while N95 masks cause slight changes in minute ventilation (VE), tidal volume (VT), oxygen saturation, carbon dioxide levels and exercise performance, but these changes are generally within normal limits. In addition, there are findings showing that no significant change was detected in heart rate, stroke volume, cardiac output, blood pressure and respiratory rate with mask use (1). Therefore, the main purpose of this study is to investigate the possible effects of mask use during exercise on hemodynamic parameters. By examining this relationship, we aim to provide valuable information about the physiological effects that may occur during mask use and exercise. The main research question of our study is to determine whether mask use during exercise affects hemodynamic parameters such as oxygen saturation, heart rate, perceived shortness of breath and blood pressure.

METHODS

This is a prospective, single-center, randomized, crossover controlled study. The study subjects were randomly separated into two groups: masked onset group and unmasked onset group. This study included voluntary participants between the ages of 18 and 25 years, who are in good general health and recreationally active adults. They were asked whether they had any disease diagnosis and healthy individuals were included in the study. Exclusion criteria were encompass individuals with unstable angina pectoris, rapid ventricular-atrial arrhythmia, uncontrolled asthma, Partial Arterial Carbon Dioxide Pressure (PaCO2)> 50 mmHg, Partial Arterial Oxygen Pressure (PaO2)<70 mmHg, valvular disease, tachycardia, bradycardia, systolic blood pressure> 200 mmHg at rest, smokers, and those with clinical conditions (e.g., nasal deviation) that could potentially influence the measurements. By adhering to these criteria, the study aims to investigate the impact of mask use on hemodynamic responses during physical activity in a controlled and homogenous participant cohort.

Data Collection Tools

Blood pressure (BP), heart rate (HR), oxygen saturation (SpO2), perceived fatigue and dyspnea were recorded just before and just after exercise.

The Modified Borg Scale (MBS) is a 10-item scale which evaluates the severity of dyspnea. The MBS has been reported to be a valid and reliable scale for determining the severity of resting and exertional dyspnea (6). The dyspnea and fatigue values of the study participants were evaluated according to the MBS, which is the most commonly used scale in the literature.

The blood pressure values of the participants were recorded with a manual sphygmomanometer (Comfort Plus). The first number on the instrument panel indicates systolic blood pressure (SBP), and the last number, diastolic blood pressure (DBP). Normal blood pressure values are 120-80 mmHg in adults.

The heart rate and SpO2 values of all the subjects were recorded with a hand-held pulse oximeter device (Seamed). This finger type pulse oximeter takes measurements directly from the finger to show heart rate per minute and oxygen level in the blood. Normal heart rate is accepted as 60 - 100 beats per minute, and normal blood oxygen level as 75 -100 mmHg.

Demographic information was collected from all participants included in the study, and a signed Informed Consent form was obtained from each individual. Prior to each test, participants were instructed not to engage in vigorous exercise within the 24-hour period. Participants had no dietary restrictions. The study comprised two groups: the first group performed exercises without masks, while the second group performed exercises with masks. The type of mask used in the study was a surgical mask. Following an adequate washout period, the groups were crossed over, and the same exercise regimen

was applied. During this second set of exercises, the first group exercised while wearing masks, and the second group exercised without masks. The washout period was based on the findings of a study that evaluated the physiological effects of participants with and without a gas mask during exercise (7) Hemodynamic parameters, including blood pressure, heart rate, SpO2, perceived fatigue, and dyspnea levels, were recorded for each subject just before and after the exercise sets. After a 3-minute warm-up period at 20% of maximum heart rate, treadmill exercise was performed at 60% of maximum heart rate, and was completed with a cool-down period at 20% of maximum heart rate The level of fatigue experienced by the subjects was evaluated using the MBS, and they were instructed to rest until they reported a score of 0-0.5 on the MBS. A crossover protocol was applied. After the rest period, the test was conducted in the same manner as the first set of exercises, but this time, Group 1 subjects were unmasked, and Group 2 subjects were masked. At the conclusion of the test, hemodynamic values of the individuals were measured. Exercise was performed at room temperature of 20-25ºC and humidity of approximately 50%.

Ethics committee approval was given by the Clinical Research Ethics Committee of Istanbul Yedikule Chest Diseases and Chest Surgery Training and Research Hospital (Protocol Number: 2022-248, Date: 26.05.2022). The study was registered on the ClinicalTrial.gov website (Registration Number: NCT05401331). All procedures were performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all study participants.

Statistical Analysis

Sample size was determined using the G-power program with type-1 error of 0.05, and test power of 0.80. To determine a significant difference between the two groups, it was calculated to be necessary to include a total of 52 subjects, as 26 in each group (8). Data obtained in the study were analyzed statistically using SPSS for Windows, version 22.0 software (IBM Corp., Armonk, NY, USA). According to the data distribution, the Independent t-test and Anova analysis were applied to parametric data, and the Mann Whitney U-test. Relationships between variables were examined with Pearson and Spearman correlation analyses. A value of $p<0.05$ was accepted as statistically significant.

Table 1. Descriptive Statistics of Quantitative Variables

	Mean (Min Max)*
Demographic features	
Age (years)	21.75 (19-26)
BMI, kg/m^2	21.90(16.41-
Gender, n(%)	34.64)
Male	20(38)
Female	32(62)
Smoking, n(%)	
Yes	0 (0)
No	52(100)
Baseline hemodynamic parameters	
HR	80.60 (60-100)
SBP	117.21 (90-140)
DBP	75.29 (60-90)
SPO_2	98.13 (95-99)
Dyspnea Borg Score (0-10)	.663 (.0-4.0)
Fatigue, Borg Score (0-10)	1.18 (0-5)
Regular exercise, n(%)	
Yes	12(23)
No	40(77)
Type of exercise, n(%)	
Aerobic	3(5,8)
Resistance exercise	5(9,6)
Flexibility exercise	3(5,8)
Other	1(1,9)
None	40(76,9)

*Abbreviations: BMI: Body Mass Index, DBP: Diastolic Blood Pressure, HR: Heart Rate, SBP: Systolic Blood Pressure, SpO_2: O_2 Saturation. *Data are reported as median (minimum-maximum) values.*

In masked individuals, a moderate negative significant correlation was found between heart rate and oxygen saturation ($r = -0.601$, $p > .001$), and in unmasked individuals, a similar moderate negative significant correlation was observed ($r = -0.607$, $p > .001$). There was no significant difference in oxygen saturation values between individuals wearing masks and those not wearing masks ($t = 0.223$, $p < .05$).

No significant difference was found in perceived exertion values between individuals wearing masks and those not wearing masks ($t = 0.277$, $p < .05$). There was no significant difference in dyspnea scores between individuals wearing masks and those not wearing masks ($U = 1214.500$, $p < .05$). Similarly, no significant difference in heart rate values was observed between masked and unmasked individuals ($U = 1297.000$, $p < .05$).

RESULTS

The study group consisted of 52 subjects, with 20 (38%) males and 32 (62%) females, having a mean age of 21.75 years and BMI of 21.90 kg/m^2.

Table 2. Descriptive statistics of quantitative variables

	Mask Group (n=52)				Non-mask Group (n=52)				Differences between groups
	Before Exercise Median (min-max)	**After Exercise** Median (min-max)	**In-group change (Δ)** Median (min-max)	***p*****	**Before Exercise** Median (min-max)	**After Exercise** Median (min-max)	**In-group change (Δ)** Median (min-max)	***p*****	***p******
HR	84.50 (68-110)	148.00 (82-188)	54.50 (0-78)	.000	84.50 (60-110)	144.50 (82-186)	52.00 (9-11)	.000	,897
Blood pressure									
SBP	120.00 (90-140)	130.00 (100-155)	15.00 (20-33)	.000	120.00 (90-140)	130.00 (100-150)	10.00 (20-40)	.000	.093
DBP	75.00 (60-90)	85.00 (40-100)	10.00 (25-32)	.000	75.00 (60-100)	80.00 (60-110)	6.00 (20-30)	.001	.300
SPO_2	98.00 (91-99)	96.50 (87-99)	1.00(4-12)	.000	98.00 (95-99)	97.00 (83-99)	2.00(2-12)	.000	.475
Dyspnea, (0-10)*	1.00 (0-3)	5.00 (2-10)	4.00 (0-9)	.000	1.00 (0-4)	4.00 (0-8)	3.00 (0-8)	.000	.067
Fatigue, (0-10)*	1.00 (0-5)	5.00 (1-10)	3.00 (0-7)	.000	1.00 (0-6)	4.00 (0-8)	2.00 (2-8)	.000	.169

Abbreviations: HR: Heart Rate, DBP: Diastolic Blood Pressure, SBP: Systolic Blood Pressure, SPO_2: O2 Saturation
**Borg score used, **Wilcoxon rank test, ***Mann Whitney U test, significance level p<0.05.*

Table 3 Cohen's d effect sizes

Variable	Cohen's d	Effect Size
Heart Rate	0.059	Very small
Saturation	-0.244	Small (reverse)
Dyspnea	0.116	Very small
Fatigue	0.192	Small
Systolic Blood Pressure	0.340	Small-Medium
Diastolic Blood Pressure	0.431	Near Medium

Cohen's d interpretation: - 0.2= Small, - 0.5= Medium, - 0.8 = Large effect

None of the participants were smokers, and their heart rate, blood pressure, and oxygen saturation values were found to be within the normal range.

Upon analyzing the changes in hemodynamic parameters, dyspnea, and fatigue scores following exercise, a statistically significant difference was observed between the mask and non-mask groups from pre-exercise to post-exercise. Specifically, heart rate, blood pressure, dyspnea, and fatigue scores increased, while oxygen saturation decreased ($p<0.05$, Table 2). Further examination of the intergroup difference in delta values for hemodynamic parameters revealed that the changes observed in the masked and non-mask groups were found to be similar ($p>0.05$, Table 2).

DISCUSSION

The results of this study showed that exercise causes an increase in heart rate (HR), blood pressure (BP), dyspnea and fatigue levels and a decrease in SpO_2 values in healthy young adults; also, wearing a mask has no significant effect on the change in hemodynamic parameters. The findings suggest that the effect sizes of the variables evaluated between the masked and unmasked groups were generally quite low, thus suggesting that there was no clinically significant difference.

Conflicting results have been reported in the literature between mask use and SpO_2 change. Some studies

have shown that mask use increases SpO_2 levels (9,10), but other studies have reported that SpO_2 decreases during exercise. In the current study, a decrease in SpO_2 values was found in the masked group compared to the non-mask group.

Similar inconsistencies are seen in studies on mask use and HR variability. Some studies have reported that masks have no effect on HR (10), but others have reported that masks increase HR (11). In the current study, HR was found to increase in the group using surgical masks.

In terms of BP change, some studies reported that masks had no effect on BP (12), while others reported that systolic blood pressure (SBP) increased (9) or decreased, while diastolic blood pressure (DBP) increased (11). Differences in these results may be attributed to variables such as the exercise protocols applied, the age range of the participants, and the type of masks used.

A randomized controlled trial conducted on a treadmill reported that respiratory distress and perceived exertion levels increased at maximum exercise capacity in masked individuals (13). Similarly, a decrease in SpO_2 levels and an increase in dyspnea and perceived exertion levels were observed in the current study, suggesting that the mask may cause changes in hemodynamic responses.

Systematic reviews and meta-analyses have shown that the use of masks during exercise in healthy young individuals increased discomfort, shortness of breath, and perceived exertion; however, these effects did not cause a serious loss in exercise performance (14,15). However, elderly individuals and those with chronic diseases were excluded from both studies.

Studies on mask tolerance in elderly individuals have yielded different results. According to a systematic review, elderly individuals were generally able to tolerate the mask during exercise, and no adverse events such as severe respiratory distress or hypoxemia were reported (16). However, mild subjective discomfort such as a feeling of warmth and difficulty breathing were reported. Similarly, a study conducted on elderly individuals reported that the use of a mask during 30 minutes of exercise had no significant effect on oxygen saturation and HR, but perceived exertion and shortness of breath increased, especially with N95 masks (17). Another study found that perceived exertion increased in elderly individuals using a mask after a 6-minute walking test, but oxygen saturation was not affected (18). In contrast, it has been reported that masks have a negative effect on all physiological parameters in elderly patients with chronic heart failure and that mask use should be avoided during exercise in this group (19). These findings suggest that the inclusion of only young and healthy individuals in our study may limit the generalizability of the results and that there may be different tolerance profiles in elderly individuals or individuals with cardiopulmonary disease. In our study, moderate-intensity exercise (60% of maximum heart rate) was applied to standardize hemodynamic responses and ensure participant safety. However, it is stated in the literature that the physiological effects of surgical mask use may differ depending on the exercise intensity. Poon et al. (12) showed that surgical masks did not cause any adverse effects during light-moderate exercise; however, perceived exertion increased significantly when exercise intensity increased above 75% VO_2max. Similarly, a systematic review stated that surgical masks were well tolerated during light-moderate exercise, but may not be suitable for high-intensity exercise in the elderly and patients (16). Therefore, although our findings show that moderate-intensity exercise with a surgical mask is safe and tolerable in healthy young adults, caution should be exercised when generalizing to high-intensity exercises or different patient groups. Further studies are needed to clarify the physiological effects of mask use during intense exercise (12,16).

It has been reported that the use of surgical masks during high-intensity exercise may have negative effects on cardiopulmonary function (9). However, in both this study and the current study, it was found that although exercise caused changes in SpO_2 levels and fatigue perception, these changes were not statistically significant between the groups.

Another study examined the effects of using cloth masks and surgical masks on exercise performance and reported that mask use did not affect performance, and there was no significant difference in SpO_2, tissue oxygenation index, perceived exertion degree and HR values (10).

Although only surgical masks were used in our study, existing systematic reviews have indicated that surgical masks, N95 respirators and fabric masks show similar physiological trends during exercise, but there may be differences depending on the exercise intensity (16). While surgical masks do not significantly affect oxygen saturation or oxygen

uptake in light-moderate exercise, they may cause a slight decrease in maximum exercise capacity. N95 masks, on the other hand, were associated with a more pronounced increase in exertion and a decrease in oxygen uptake at high intensity. Fabric masks, on the other hand, show similar physiological effects to surgical masks. A study evaluating the effects of cloth masks found a decrease in VO_2max, an increase in minute ventilation and maximum HR, a decrease in SBP, and an increase in DBP (11).

Limitations

This study had several limitations. All the subjects included in the study were young healthy individuals, and therefore the results as measured by mask use during exercise cannot reflect the cardiopulmonary function of middle-aged/elderly persons or individuals with cardiopulmonary disease. The relatively low number of study participants, the limited range of assessment scales used, and the absence of multivariate analyses according to physical activity level also limit the generalization of these results. Although a surgical mask was used for the purposes of this study, it can be considered that different mask types may result in differences in exercise responses. More research is needed to more clearly determine the possible effects of using various types of face masks while exercising.

CONCLUSION

Considering the COVID-19 pandemic and the widespread use of masks, it is crucial to be aware of the potential physiological effects on the cardiorespiratory systems of individuals, particularly those with underlying health conditions. Individuals with cardiopulmonary diseases should be carefully evaluated by healthcare professionals when wearing masks during exertion, and proper guidance and education on mask use should be provided to ensure their safety.

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REFERENCES

1. Farah W, Abusalih MF, Hasan B, Lees EH, Fleti F, Elkhatib WY, et al. Safety implications of mask use: a systematic review and evidence map. BMJ Evid Based Med 2025;30(2):91–103.
2. Santos-Silva PR, Greve JMD, Pedrinelli A. During the coronavirus (Covid-19) pandemic, does wearing a mask improve or worsen physical performance? Revista Brasileira de Medicina do Esporte 2020;26(4):281-284.
3. Fikenzer S, Uhe T, Lavall D, Rudolph U, Falz R, Busse M, et al. Effects of surgical and FFP2/N95 face masks on cardiopulmonary exercise capacity. Clin Res Cardiol 2020;109(12):1522-1530.
4. Chandrasekaran B, Fernandes S. “Exercise with facemask; Are we handling a devil’s sword?” – A physiological hypothesis. Med Hypotheses. 2020;144:110002.
5. Alkan B, Özalevli S, Sert ÖA. Wearing a surgical mask: Effects on gas exchange and hemodynamic responses during maximal exercise. Clin Physiol Funct Imaging 2022;42(4).
6. Grant S, Aitchison T, Henderson E, Christie J, Zare S, McMurray J, et al. A comparison of the reproducibility and the sensitivity to change of visual analogue scales, Borg scales, and likert scales in normal subjects during submaximal exercise. Chest 1999;116(5):1208-1217.
7. Bourassa S, Bouchard PA, Lellouche F. Impact of gas masks on work of breathing, breathing patterns, and gas exchange in healthy subjects. Respir Care. 2018;63(11):1350–9.
8. Alkan B, Ozalevli S, Akkoyun Sert O. Maximal exercise outcomes with a face mask: the effects of gender and age differences on cardiorespiratory responses. Ir J Med Sci. 2022;191(5): 2231-2237.
9. Zhang G, Li M, Zheng M, Cai X, Yang J, Zhang S, et al. Effect of Surgical Masks on Cardiopulmonary Function in Healthy Young Subjects: A Crossover Study. Front Physiol. 2021;12:710573.
10. Shaw K, Butcher S, Ko J, Zello GA, Chilibeck PD. Wearing of cloth or disposable surgical face masks has no effect on vigorous exercise

performance in healthy individuals. Int J Environ Res Public Health. 2020;17(21):8110.
11. Driver S, Reynolds M, Brown K, Vingren JL, Hill DW, Bennett M, et al. Effects of wearing a cloth face mask on performance, physiological and perceptual responses during a graded treadmill running exercise test. Br J Sports Med. 2022;56(2): 107-113.
12. Poon ETC, Zheng C, Wong SHS. Effect of Wearing Surgical Face Masks During Exercise: Does Intensity Matter? Front Physiol. 2021;12: 775750.
13. Hopkins SR, Dominelli PB, Davis CK, Guenette JA, Luks AM, Molgat-Seon Y, et al. Face Masks and the Cardiorespiratory Response to Physical Activity in Health and Disease. Annals of the American Thoracic Society 2021; 18(3):399-407.
14. Glänzel MH, Barbosa IM, Machado E, Prusch SK, Barbosa AR, Lemos LFC, et al. Facial mask acute effects on affective/psychological and exercise performance responses during exercise: A meta-analytical review. Vol. 13, Frontiers in Physiology 2022;13:994454.
15. Zheng C, Poon ETC, Wan K, Dai Z, Wong SHS. Effects of Wearing a Mask During Exercise on Physiological and Psychological Outcomes in Healthy Individuals: A Systematic Review and Meta-Analysis Sports Medicine 2023;53(1):125-150.
16. Odey AF, Arikpo II, Meremikwu J, Otonkue MA, Chukwu NN, Ita-Lincoln F. Tolerability of facemask during physical exercises during COVID-19 pandemic: A systematic review. J Public Health Afr 2025;16(2);610.
17. Vogt G, Radtke K, Jagim A, Peckumn D, Lee T, Mikat R, et al. Effect of Face Masks on Physiological and Perceptual Responses during 30 Minutes of Self-Paced Exercise in Older Community Dwelling Adults. Int J Environ Res Public Health 2022;19(19):12877.
18. Amput P, Wongphon S. Effects of Wearing Face Masks on Cardiorespiratory Parameters at Rest and after Performing the Six-Minute Walk Test in Older Adults. Geriatrics 2022;7(3):62.
19. Salles-Rojas A, Guzmán-Valderrábano C, Madrid WA, González-Molina A, Silva-Cerón M, Rodríguez-Hernández C, et al. Masking the 6-minute walking test in the covid-19 era. Annals of the American Thoracic Society 2021;18(6):1070-1074.