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Carolina Fernandes Souza, Iuri Henrique da Silva Monteiro,
Larissa Caroline Alves Resende Costa and Larissa Soares Lopes
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SUMMARY

CHAPTER 4

Acute effects of mask use during resistance exercise

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ABSTRACT
Rationale: The use of face masks during physical exercise (PE) is considered a safe way to prevent the contagion and spread of the disease, however, can it impair the practice of physical exercise?
Objective: To analyze the hemodynamic changes with the use of face masks during resistance exercise.
Methods: Cross-sectional, crossed study, carried out with 20 volunteers, age ranging from 18 to 32 years. Two acute exercise sessions were performed, with and without the use of mask, performing three series of 12 repetitions, with an interval of 3 days between sessions, in the intensity of the exercise session of 70% of 1RM. Cardiovascular parameters were evaluated. After testing for normality, data were presented as mean ± variance, using ANOVA for repeated measures with Tukey post-test.
Results: Systolic blood pressure with mask use resulted in a significant increase after exercise ($p<0.05$) with difference: SBP = 11.2±7.9 vs 7.3±10.1 with mask use and without mask use, SBP = 7.6±10.6 vs 4.8±9.1. And DBP= - 4.5±6.0 vs -2.0±9.4 4.8±9.1 with the use of mask and DBP= -3.3±3.8 vs -6±9.0 without the use of mask, showing no significant difference ($p>0.05$), causing hypotensive effect in their results.
Conclusion: The use or not of a mask during physical exercise influences the increase in heart rate and systolic blood pressure, causing hypotensive effect on diastolic blood pressure in both genders.

Keywords: pandemic, mask use, resistance exercise.

1 INTRODUCTION

In December 2019, severe pneumonia caused by a new type of coronavirus emerged in China1 . The disease was named coronavirus disease 2019 (COVID-19). 2 A virus in which transmission happens through close contact, either through droplets of saliva or by touching contaminated surfaces. On March 11, 2020, the World Health Organization declared that the outbreak of COVID-19 has evolved into a pandemic, spreading to numerous regions across the planet with continuous transmission.3

In this perspective, because it is an emerging infectious-contagious disease, the adoption of COVID-19 prevention measures are the best option for controlling the spread of the virus. 4 Quarantine and/or social isolation are two measures that have been taken to prevent or minimize the impact of the spread of the disease. In public health, quarantine refers to the separation of people or communities that have been exposed to the disease. Isolation applies to people who are known to be infected. 5

Other measures include hand hygiene and the use of protective masks, due to the large number of asymptomatic people detected. 6, 7 Although physical activity is essential in improving quality of life, the measures imposed in the current pandemic scenario have restricted practices by people of all ages. In most countries, indoor and outdoor activities have been restricted, followed by the closing of gyms, parks, playgrounds, and schools.8

As a health measure, the use of face masks during physical exercise (PE) is considered a safe way to prevent the contagion and spread of the disease. But their use has generated much controversy regarding the most appropriate type (N95, FFP2, FFP3, surgical or tissue) in which circumstances to use them and about their effects. 9, 10, 11 Thus, it is necessary to analyze the hemodynamic changes with the use of face masks during resistance exercise, observing the effects before and after an acute session of resistance exercise with and without the use of a mask on heart rate, systolic and diastolic blood pressure.

2 METHODS

The present study is characterized as a cross-sectional, crossover study, carried out with healthy people practicing resistance exercise for at least 3 months and aged between 18 and 45 years, of both genders, who were recruited through outreach at the Maranhão State University and social media.

The participants who agreed to participate in the study were selected according to the inclusion criteria, which are: non-smokers, without comorbidities that could compromise participation in the study, such as locomotor system disorders or limiting cardiovascular disease. Those who use drugs that act on the central nervous system and cardiovascular system, pregnancy, and mental dysfunction did not participate.

After the volunteers were selected, they received an informative material containing the explanation of the procedures used, the recommendations for the days of the tests, as well as the Informed Consent Form - ICF. This term explained the objectives and justifications for the study, the risks and benefits to which the volunteers would be exposed, and other items described in the Guidelines of the National Health Council, in accordance with the resolution on research with human beings 466/2012.

After reading the material, all doubts were explained and then the volunteers signed two copies of the term. One copy remained with the volunteer and the other with the researcher. The volunteer was allowed to refuse to participate in the study at any time, without any harm to him/her. The present study was approved by the Research Ethics Committee, according to opinion 4.938.897.

The study was carried out with a sample of healthy people (N=20), ten males and ten females, in which body composition (lean mass and fat mass) was obtained by assessing skinfolds with a Sanny caliper, following the Pollock, Schmidt, and Jackson (1980) protocol12 for adult men.

Before the study protocol was carried out, the volunteers received masks made and standardized in fabric (cotton).

source: own elaboration (2022)

To perform the protocol, the maximum load test of one repetition maximum (1RM) was used, where each individual performed a maximum of five attempts at each exercise, with a 3-5 minute interval between attempts. The maximum weight that each volunteer lifted in a single repetition was identified as the maximum load.

The volunteers performed two acute PE sessions, one with the use of the mask (SEF-EXP) and one without the use of the mask (SEF-CTL), performing three sets of 12 repetitions, with a minimum interval of 3 days between sessions. The intensity of the exercise session was 70% of 1RM. The exercises that comprised the acute PE session were: straight supine, extension chair, front raise, and triceps pulley. The execution speed used was 2:2 and the recovery interval was 60 seconds between sets and two minutes between exercises. All tests and sessions were performed in the morning.

To meet the objectives proposed in the research, a professional arm blood pressure monitor model HBP-1100 (OMRON, USA) was used to measure blood pressure and heart rate by the oscillometric method. All cardiovascular parameters were evaluated at rest and immediately after the end of the PE session. Recovery was assessed in the sitting position with the feet uncrossed and supported on the floor and the arm supported at heart level according to the VII Brazilian Guideline of Hypertension.13

After testing for normality, data were presented as mean ± standard deviation. ANOVA for repeated measures with Tukey's post-test and Pearson's correlation test were used. With the significance level of $p<0.05$.

3 RESULTS

Anthropometric variabilities

Twenty volunteers were evaluated, of which 10 (50%) were female and 10 (50%) were male, with a mean age of 22.3±0.04, ranging from 18 to 32 years. BMI was 23.9±2 for males and 20.8±2.4 for females.

Table 1. Descriptive analysis of age and anthropometric data of the study volunteers.

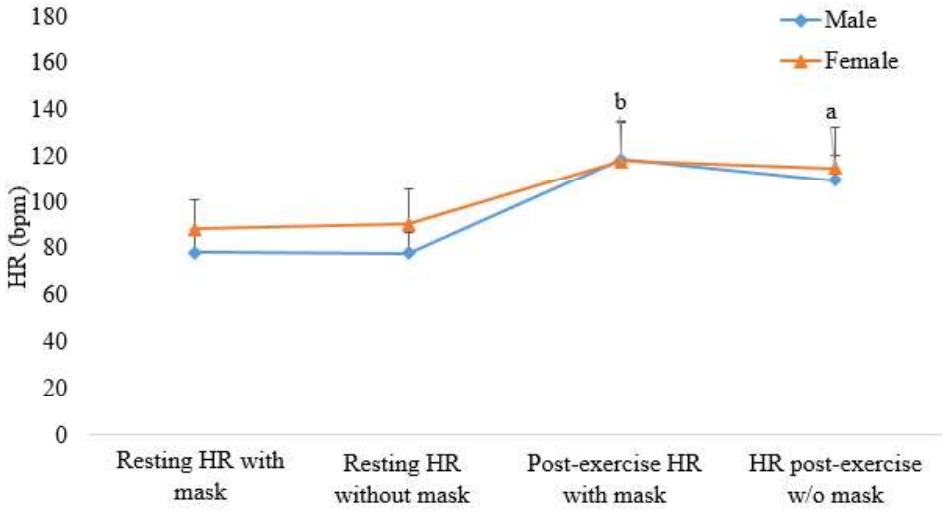
Variables	Average (M)	Mean (F)
Age (years)	24±4,1	21±4,1
Weight (kg)	71,3±7,0	53,9±5,3
Height (m)	1,7±0,1	1,6±0,1
BMI (kg/m²)	23,9±2,0	20,8±2,4
CG (%)	5,3±3,1	17,8±3,8
Fat mass (kg)	67,5±7,3	44,3±6,5
Lean mass (kg)	3,77±2,4	9,59±2,2

Kg = kilogram; m = meters; CG = body fat; M = male; F = female; Data presented as mean ± standard deviation.

Heart Rate Variability

The volunteers performed two acute exercise sessions with 70% of the maximum load, one session with the use of a mask and the other without. Heart rate (HR) and blood pressure (BP) data were collected at rest and immediately after the exercise session. Figure 1 shows the HR results at rest and after exercise with and without the use of a mask.

Figure 1. Heart rate in beats per minute (bpm), with and without the use of masks. Repeated measures ANOVA with Tukey post-test. a = P<0.05 vs resting HR without mask (significant in both groups); b = P<0.05 vs resting HR with mask (significant in both groups).



According to figure 1, the data showed that without the use of mask the HR (bpm) of the volunteers, according to age, were within normal range when at rest, with the female HR resulting higher compared to the male. After the exercise session there was an increase in both genders, with a difference in HR of 31.7±11.2 for males and 24.4±12.4 for females.

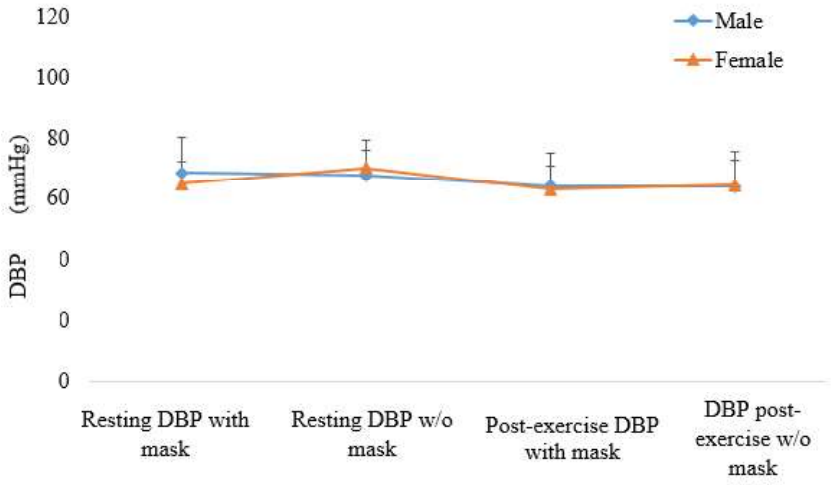
With the use of the mask, the HR at rest is also within normal range, with the female HR higher with an average of 88.5 ± 12.3, compared to 78.5 ± 9.5 for males. Regarding HR after exercise, we can see that there was also an increase in both genders with a difference of 38.4±11.3 for males and 29.6±8.1 for females.

In comparison with the data obtained through the exercise session both HR without the use of mask and with the use of mask had significant difference in both groups ($p < 0.05$).

Variability Blood Pressure (BP)

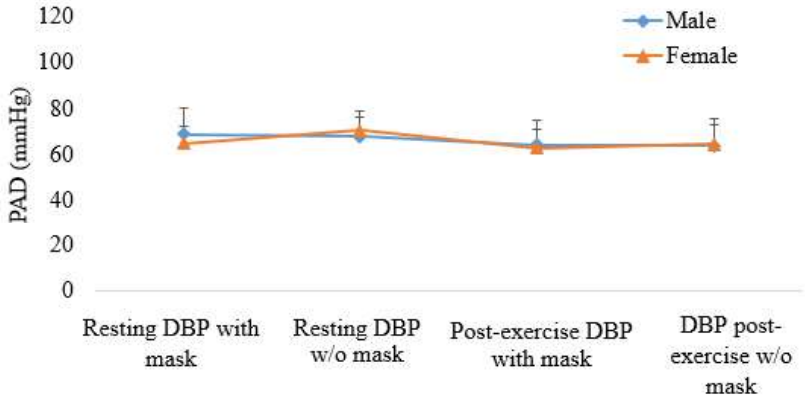
SBP (mmHg) was also within normal range (SBP < 120) when at rest. But after exercise it had a greater change with the use of mask, as shown in figure 2. With a difference of 11.2±7.9 and 7.3±10.1 for male and female, respectively, with the use of mask. And 7.6±10.6 and 4.8±9.1, without the use of mask.

Figure 2. Systolic Blood Pressure (SBP) mmHg, with and without the use of masks. Repeated measures ANOVA with Tukey's post-test. c = P<0.05 SBP post exercise with male mask vs SBP post exercise with female mask.



Studies have shown that after only one session of resistance exercise (RE), BP may be elevated, reduced or unaltered when compared to the pre-exercise measurement. According to the results of the present study, SBP was elevated after the resistance exercise session, thus agreeing with a study by HILL, et. al. (1989). 14

Figure 3. Diastolic Blood Pressure (DBP) mmHg, with and without the use of masks. Repeated measures ANOVA with Tukey post-test. P>0,05.



According to figure 3, the DBP at rest is within normal range. After the exercise session it changes with a difference of -4.7± 6.0 (male) and -2.0±9.4 (female), respectively.

4 DISCUSSION

Physical exercise (PE) and heart rate parameters

In dynamic exercises, occurring a greater volumetric load on the left ventricle, the hemodynamic responses are proportional to the intensity and muscle mass involved in the activity. The maximum values of HR normally occur during the last repetitions of a series, thus confirming that, during resistance exercises, HR measurement should be done at the end of the series, as happened in the present study.14

Without a doubt, one of the main difficulties caused by wearing a mask during exercise is discomfort in breathing. There is a need for a period of adaptation. The pace will be slower and fatigue will appear more quickly, associated with the unpleasant sensation of mask humidification as the activity progresses. Compared to normal breathing, wearing any kind of protective mask decreases the flow of air into the lungs. Less oxygen in the lungs means less oxygen in the blood and muscles, which makes training more difficult. 15

Cloth masks can also be used as it seems less restrictive.16 However, more research is needed to compare the effects of different types of face mask in RE and different exercise intensities and whether the performance impairment observed acutely can occur in a chronic setting. 16

SBP volume oscillation during PE

In continuous activities of progressive intensity, SBP increases in direct proportion to the intensity of the exercise, due to the increase in cardiac output. In maximal exercise, it may exceed 200 mmHg. 17 BP during strength exercises and continuous activities indicated that the blood pressure elevation curves, as a whole, tend to exhibit larger angular coefficients in resistance exercises. The pressure tends to increase more slowly in continuous activities with less force requirement. 17

Studies show that after only one session of resistance exercise (RE), BP may be elevated, reduced, or unchanged when compared to the pre-exercise measurement. 18 According to the results of the present study, SBP was high after the resistance exercise session, in agreement with the data evidenced in previous studies.

Volume oscillation of DBP during PE

During resistance exercise, DBP tends to rise, causing a significant increase in mean arterial pressure, even if for a short period of time; in the present study, DBP did not increase. 18

The hypotensive effect related to resistance training programs was verified by Hill et al. (1989)13 , who investigated the blood pressure responses after strength training program. The results showed a significant reduction in diastolic blood pressure 1 h after the end of the exercises, but no hypotensive effect was found in systolic blood pressure, similar to the results of the present study.

The hemodynamic responses vary according to the intensity of the effort. In exercises performed with light loads there is an increase in heart rate (HR) and systolic blood pressure (SBP), while when high loads are used there is also an increase in diastolic blood pressure.19 According to data from figures 1 and 2, we can notice that during resistance exercise there is an increase in both HR and BP, since they caused significant physiological effects on systolic blood pressure ($P<0.05$) and heart rate in the individuals who participated in the study.

It is known that during the pandemic there was a great incentive to social isolation, with formerly active people being restricted to their homes. With the flexibilization many of them are returning to the gyms. It is important for exercising professionals to remember that, to minimize transmission risks inside gyms, special care must be taken, such as cleaning hands, constantly sterilizing equipment, and the mandatory use of a mask, which is one of the precautions that has left people in doubt about whether or not to use it during resistance exercise. 20,21

First, despite being carried out in a context where the use of the mask is mandatory, some volunteers did not agree to participate, because they reported not practicing resistance exercise with the use of the mask. Secondly, when performing the exercises with the use of the mask, the volunteers showed a lot of discomfort regarding breathing, with three volunteers feeling discomfort and four not being able to perform all the repetitions. And finally, although the use of mask during the practice of resistance exercises caused hemodynamic changes, the n (=20) is small and the study should be repeated in a larger number. Nevertheless, the results obtained show pertinent significance regarding the use of face masks during an exercise session.

5 FINAL CONSIDERATIONS

The findings of this study demonstrate that the use or not of mask during the practice of resistance exercise promotes hemodynamic alterations in both cases, with this, the increase in heart rate and systolic arterial pressure is evident, as seen in other studies before the pandemic of the new coronavirus, causing a hypotensive effect on diastolic arterial pressure. Being that, heart rate and systolic blood pressure have an increase both with the use of mask and without the use of post-exercise mask.

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