57 - VO2MAX IN RUNNERS: WITH/WITHOUT THE USE OF DISPOSABLE MASKS

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doi:10.16887/92.a1.57

INTRODUCTION:

The street running, accompanied by a physical education professional, can be a strong ally in disease prevention, health promotion and the better quality of life (Souza et al., 2020).

However, in the year 2020, people were faced with a new disease, caused by the New Coronavirus (SARS-CoV-2). COVID-19 is a highly transmissible disease that has caused a worldwide pandemic (Wiersinga et al., 2020).

However, in the year 2020, people were faced with a new disease, caused by the New Coronavirus (SARS-CoV-2). COVID-19 is a highly transmissible disease that has caused a worldwide pandemic (Wiersinga et al., 2020).

To contain it, governments and authorities established measures to control the virus, such as quarantine and social distancing. These measures, along with the recommendations of the World Health Organization (WHO), have completely changed the scenario of physical activity (PA) around the globe, mainly affecting athletes and practitioners of modalities that are performed in public and/or open environments (Epstein et al., 2021). The new measures that have been established to ensure the safety of practitioners include the distance of at least 2 meters between the athletes, the regular disinfection of the equipment and the use of face masks (Epstein et al., 2021).

Even though physical exercise being something organized and planned, also helping the human body's immune response, this practice does not immunize people against COVID-19 (Raiol, 2020). Therefore, all practitioners must follow the protocols and recommendations established by the competent authorities, so that there is greater control over the disease, and it does not proliferate through physical practices.

However, the adaptations of the street running practice, such as the use of a mask, caused some changes in behavior and opportunities during the pandemic, including in relation to the results and its multiple objectives (Raiol et al., 2020). The establishment of social isolation (quarantine), social distancing and the mandatory use of masks in public environments are some of these adjustments that partially or totally modified the practice of street running, that is, in outdoor environments.

The use of masks is often identified as a negative influence on practitioners' performance. According to reports from PA practitioners, one of the main problems arising from the use of the mask is that it makes breathing difficult, as it gradually becomes wet, further increasing the resistance to air intake (Santos-Silva et al., 2020).

In the study by Hopkins et al. (2020), it is possible to observe that it is not recommended that individuals with comorbidities, chronic or pulmonary diseases perform physical activities of light-moderate intensity with the use of face masks, due to the resistance offered by these, since the greater effort needed to maintain constant airflow could cause or aggravate dyspnea.

As the respiratory rate increases, the mask begins to offer greater resistance to breathing, causing some discomfort, in addition to the need for greater effort to maintain the inflow and outflow of air from the lungs. These discomforts could be interpreted as a result of changes in the maximum oxygen volume (VO2max).

However, there is controversy and doubts as to whether the use of face masks during exercise affects PA performance (Shaw et al., 2020). Given this context, this study had as objective to measure the maximum oxygen volume (VO2Max) of street runners, with and without the use of personal protective masks.

METHODOLOGY:

The study is characterized as cross-sectional with a descriptive and quantitative approach. Twenty-one runners, aged between 18 and 54 years, of both genders, who have been practicing the sport for at least one month, participated in this study.

Participants were screened by invitation, through social networks: WhatsApp© and Instagram©, through a flyer for dissemination, and in some cases the invitation was personal, turning some choices intentional and thus constituting a convenience sample.

Runners who accepted were allocated in order of arrival in waiting chairs, which were distributed throughout the room, with a minimum distance of 2 meters between each chair. The number of waiting participants, researchers and runners did not exceed the limit of people capacity established by the Univille biosafety protocol. The responsible researcher and assistants also performed the procedures with mask and hand hygienization, with 70% alcohol, throughout the entire period of research and collection.

One day before the research, a training was organized with the assistants, so that all procedures were carried out correctly and properly. On the day of collection, everyone involved had their responsibilities and roles well defined, which favored the optimal performance and execution.

Before starting the procedures for the application of the instruments, a conversation was held with the runners, where they were informed about the objective and what is expected with the research results. Upon consent, a Free and Informed Consent Form (FICF) was delivered to sign, and to be aware of all the risks and benefits.

Soon after signing the consent form, a questionnaire with questions regarding the characterization of the sample was delivered. Then, the total weight (kg) and height (m) were collected to calculate the Body Mass Index - BMI (kg/m²), together with the collection of skinfold measurements (triciptal, subscapular, supra iliac and calf), with the purpose of determining the percentage of body fat - %F, using the protocols of Petroski (1995) for body density, and Siri (1961). For classification, the pattern of Lohman (1992, p. 80) were used.

Total body weight was measured using a digital scale, brand Tanita, with 100g precision; Height using a Cescorf measuring two-meter-long stadiometer; Skinfolds collected using a Cescorf scientific plicometer.

After the anthropometric collections, the runners were sent to perform the McArdle Bench test, which aims to evaluate the individual's cardiorespiratory fitness, in a simple and economical way. A practical demonstration was performed by the professional on how to proceed with the test, and, soon after the detailed explanation, the individual performed three movements for the first contact with the device. The test was performed for a period of three minutes, with three heart rate collections being made, before and after the test.

The bench used in the test has a height of 40.3 cm. The movements of getting up and down on the bench are performed to the rhythm (cadence) of a metronome by the Cifra Club application (via the LG K62+ cell phone), using a speaker (JBL) so that the runner could easily hear the beats. The beat frequency for men was 96 bpm, while for women it was 88 bpm.

To perform the cardiorespiratory assessment calculations, the heart rate (HR) was collected. The HR measurement was performed manually and from these measurements, VO2max was obtained, through the calculation of Mcardle, Katch & Katch (2007).

These collections correspond to: HRB (heart rate at rest, before the test), measured before the test; HRT (heart rate after the test), measured 5 seconds after the end of the test; and HRR (heart rate after rest), which was measured one minute after the end of the test. All HR collections were performed manually, through the pulsation of the external carotid artery.

The test was performed twice, as follows: maximal oxygen volume test using a mask (VCM test), and maximal oxygen volume test without using a mask (VSM test).

The VSM test was performed 15 minutes after the VCM test. This period between tests was used as recovery and rest time for the runners. The masks used in the test (Protect Me) were provided by the researchers at the time the test was carried out. All participants performed the VSM test with due social distance, and at this time, all researchers and other runners were wearing personal protective masks. Soon after the execution of the VSM test, the participants were asked to put their mask back on.

After performing the bench tests, the runners were directed to a multi-sport gym, with a length of 36 meters between the bottom demarcation lines (goal line), where they ran for 30 minutes, in order to measure the distance covered by them, in the period of time determined.

As a criterion for the study, practitioners of the modality of street running for at least one month were included; were aged between 18 and 54 years; healthy, without injuries; and who signed the FICF. Those who: had not practiced street running for at least a month; were not in the age group; who had chronic diseases that offered risks during the tests; and those who did not agree and signed the FICF were excluded.

The data obtained (anthropometry, McArdle's bench test and running) were manually collected and recorded on sulfite sheets (A4), and later analyzed by descriptive statistics through measures of central tendency (mean, median and standard deviation) and frequency (percentage), with tab and plot in Microsoft Excel® for Windows®10.

The statistical treatment were performed using the Statistical Package for Social Sciences - IBM SPSS®, version 16.0. For statistical analysis, the Shapiro-Wilk normality test was initially used, which proved that there was no normality in the data and, therefore, non-parametric tests were used for significance and correlation tests. To determine whether the VO2Max showed any change, the Wilcoxon test for dependent variables was used and the Spearman correlation test was used for the correlation. In both tests, a significance level of $p<0.05$ was adopted.

This study had the favorable opinion for its execution by the Ethics and Research Committee of the University of the Region of Joinville/SC - UNIVILLE-CEP, according to the Resolution of the National Health Council for research with human beings, under number 2.653.092

RESULTS:

Twenty-one runners participated in the study, 12 (57%) women and 9 (43%) men with a mean age of 39.33±11.95 years. Table 1 shows the other characteristics of the runners, such as height, weight, BMI, %F, running time, distance in kilometers that the runner performs and the days that he practices PA during the week.

Table 1. Sample characterization

Variables	Ẋ	SD	Med.	Min.	Max.
Age (years old)	39,33	11,95	40	18	54
Stature (m)	1,63	0,08	1,61	1,46	1,82
Weight (kg)	66,15	9,97	64,9	50,9	91,1
IMC (kg/m²)	24,78	3,4	25,11	17,5	30,64
%BF (women)	28,94	4,65	29,48	17,9	35,36
%BF (men)	20,69	4,8	20,93	11,52	26,89
Running time (months)	36	28,35	24	1	120
Training distance (km)	7,93	4,27	7	2	20
Weekly physical activity (days)	4,21	1,4	4	2	7

Ẋ - Mean, SD - Standard deviation, Med. - Average, Min. - Minimum, Max. - Maximum.
kg - kilograms, km - kilometers, m - meters.

In addition to descriptive statistics, it is possible to analyze, in Frame 1, other characteristics of the participants, through the absolute number and percentage.

Frame 1. Answers regardin sample characteristics.

COVID-19 contamination	%	n
Yes	9,50%	2
No	90,50%	19
Disconfort wearing a mask*	**%**	**n**
Yes	70,00%	14
No	30,00%	6
Participates in competitions	**%**	**n**
Yes	62,00%	13
No	38,00%	8
Practices another modality	**%**	**n**
Yes	86,00%	18
No	14,00%	3
Modalities*	**%**	**n**
Weight training	29,00%	5
Functional training	6,00%	1
Dancing	6,00%	1
Cyclism	23,50%	4
Practices two or more modalities	35,50%	6
IMC	**%**	**n**
Below the normal	4,76%	1
Normal	33,33%	7
Overweight	57,14%	12
Level 1 obesity	4,76%	1
%BF	**Male**	**Female**
Below the Average	1 (11,5%)	1 (8,3%)
Average	0	2 (8,3%)
Above the Average	6 (66%)	7 (58,4%)
Very High	2 (22,5%)	3 (25%)

*one participant did not report the answer.
n (%) - absolute number (percentage).

In Table 2 its is possible to analyze the VO2Max of males and females, through descriptive statistics.

Table 2. VO2Max analysis between genders.

Male (9)	Ẋ	SD	Med.	Min.	Max.
VCM test	52,34	12,72	47,49	37,41	76,05
VSM test	55,52	8,84	52,53	47,49	74,37
Female (12)	**Ẋ**	**SD**	**Med.**	**Min.**	**Max.**
VCM test	37,86	3,1	37,36	32,56	44,38
VSM test	37	2,97	37,36	32,56	41,43

Statistically, no significance was found between the variables, however, a strong correlation was found between the VCM test and the VSM test (0.74); the classification of %F with the BMI values (0.79); and a moderate and strong correlation for %F with the VSM and VCM tests (0.60 and 0.76, respectively).

Frame 2 shows the VO2Max for analysis through the absolute number and percentage, between genders and their respective classification.

Frame 2. VO2Max classification by gender.

VCM test	Male	Female
Regular	0	1 (8%)
Good	4 (45%)	9 (75%)
Excelent	5 (55%)	2 (17%)
VSM test	**Male**	**Female**
Regular	0	2 (17%)
Good	2 (22%)	8 (66%)
Excelent	7 (78%)	2 (17%)

n (%) - absolute number (percentage).

Of the male runners, two had a raise large enough to change their rating from "good" to "excellent."

With women, three (25%) had classification changes between the VCM test and the VSM test, that being: "good" to "excellent" (1), "excellent" to "good" (1) and "good " to “regular” (1).

DISCUSSION:

The central axis of the present study was to measure the VO2Max of street runners, with and without the use of personal protective masks, since, estimatedly, the use of disposable masks during running could cause physiological changes that affect the runner's performance, such as an increase in HR or a drop in VO2Max.

Comparing the results obtained with and without the use of the mask, it was obtained an average of 52.34 and 37.86 mL/kg/min of VO2Max for men and women, respectively. The sample was classified as "good" in the VCM test, for both genders. As for the VSM test, for both men and women, there was an average of 55.52 and 37 mL/kg/min of VO2Max, respectively, classifying it as “excellent” for men, but remaining "good " for women. In this sense, according to Gomes et al. (2017), the VO2Max of women is significantly lower than that of men.

The correlation between the VCM test and the VSM test was given by the values without significance, thus, it is understood that the disposable masks do not influence the VO2Max of the runners. In view of this, the literature points out that, despite the discomfort and difficulty in breathing, the physiological changes resulting from the use of masks are minimal (Epstein et al., 2020).

Shaw et al. (2021) reveals that although the practice of PA with the use of a mask has increased HR, masks can be used without negative impacts on physiological variables and performance of the practitioner. According to Epstein et al. (2020), the use of a mask during PA, when practiced by healthy individuals and at moderate intensity, does not present major physiological changes.

In the study by Shaw et al. (2020) evaluated the effects of using a surgical mask, cloth mask or no mask in 14 participants (7 men and 7 women, aged 28.2±8.7 years) during a cycle ergometry test until exhaustion. The use of face masks had no noticeable detrimental effect on exercise performance in young, healthy participants.

Of the 14 runners in the present study who reported feeling discomfort while using the mask in the VCM test, seven (50%) had a loss in VO2Max in relation to the VCM test, when they performed the VSM test. Six (42.86%) of these had a higher VO2Max without the use of a mask,

and one (7.14%) had no change in values. In most cases, empirical perceptions of exertion did not reflect real physiological changes, and 50% of runners who reported discomfort while using the mask even had better results with the use of the mask. However, none of these changes in VO2Max proved to be significant enough to influence runners' performance.

Wong et al. (2020) revealed that the HR of athletes who use a face mask was higher than that of those who did not use a face mask, significantly increasing the perceived exertion. Corroborating the study by Fikenzer et al. (2020), which evaluated 12 healthy men (38.1±6.2 years). The results show that ventilation and comfort are reduced by disposable masks, where participants reported consistent and accentuated discomfort with the use of the masks.

Overall, although dyspnea can increase or alter the respiratory effort imposed by face masks during physical activity, the changes are often too small to detect, even during very heavy exercise (Hopkins et al., 2021). Thus, it was evident that the intrinsic perception of runners regarding discomfort is not always related to real losses or physiological changes of great significance.

The VSM and VCM tests were correlated with %F, allowing us to assume that the results of body composition should be smaller to consolidate with the runners' VO2Max. Manguci et al. (2021), demonstrated that in addition to men having more VO2max in relation to women, this measure is directly related to body composition, with positive correlations being found on lean body mass.

Therefore, in relation to the %F, it is suggested that runners seek help from a qualified health professional to reach their ideal weight, as there was a correlation between the %F ratings (above average) with the BMI, showing that overweight is related to a high percentage of fat mass, and offering a risk to the runner's health, and affecting performance. Reinforcing with the sample by Rosado et al. (2020), composed of 44 adult male runners (36.5±7.2 years). Body composition revealed significant differences (higher body density and lower fat mass), reinforcing the existence of weight control programs to regulate body composition. In contrast, a study by Gomes et al. (2017) evaluated 177 street runners, of both genders, where the %F and BMI were collected, which were found to be adequate, with significant differences for these variables.

The present study had limitations, such as the very low sample size and the collection carried out only with runners from a certain region. Thus, the data obtained only portray the study sample. In order to be able to identify the possible physiological variations mentioned throughout this article, further studies should be carried out, ideally with larger samples, and at professional levels, so that the results obtained are incontestable and reliably demonstrate the reality.

CONCLUSIONS:

Although the present study did not obtain significant results, not using the mask showed an improvement for men, generating an excellent VO2Max, according to the classification. For women, there were no considerable changes in classification. In this sense, for the participants of this study, the use of a disposable mask during exercise practice, although showing variations, did not cause physiological changes that could affect their performance in any way.

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ABSTRACT:
Objective: To measure the maximum oxygen volume (VO2Max) of street runners, with and without the utilization of personal protective masks. **Methodology**: The research took place with the participation of 21 street runners, aged between 18 and 54 years, of both genders, who have been practicing the modality for at least one month. The skin folds were measured in order to determine the percentage of body fat %BF, and to measure the VO2Max, the McArdle bench test was performed. This test was performed twice, as follows: maximum oxygen volume test with the mask utilization (VCM test), and maximum oxygen volume test without the mask utilization (VSM test). The statistical treatment was realized using the *SPSS*® program*,* version 25.0. **Results:** The VCM test results were classified as “good” for both genders. The VSM test was classified as “excellent” for men, remaining “good” for women. There was no significance found for the tests, however, there was a strong correlation between the VCM test and the VSM test (0.74), and a correlation between the %BF with the VSM test (0.76). **Conclusion:** The use of disposable masks during exercise, although showing some variations, did not cause physiological changes that could affect the runners performance in any way.
Keywords: Runners; Face mask; Maximum oxygen volume.

VO2MAX EN CORREDORES: CON/SIN USO DE MASCARILLAS DESECHABLES

RESUMEN:
Objetivo: Medir el volumen máximo de oxígeno (VO2Max) de los corredores, con y sin el uso de mascarilla de protección personal. **Metodología:** La investigación se realizó con la participación de 21 corredores callejeros, con edades comprendidas entre 18 y 54 años, de ambos sexos, que llevan practicando el deporte al menos un mes. Se midieron los pliegues cutáneos para determinar el porcentaje de grasa corporal -% GC, y para medir el VO2Max se realizó la prueba del banco de McArdle. La prueba se realizó dos veces, de la siguiente manera: prueba de

volumen máximo de oxígeno con una mascarilla (prueba VCM) y prueba de volumen máximo de oxígeno sin la mascarilla (prueba VSM). El tratamiento estadístico se realizó mediante el programa SPSS®, versión 25.0. **Resultados:** La prueba VCM se clasificó como "buena" para ambos sexos. La prueba VSM se clasificó como "excelente" para los hombres, permaneciendo "buena" para las mujeres. No hubo significación para las pruebas, sin embargo, hubo una fuerte correlación entre la prueba VCM y la prueba VSM (0,74) y una correlación entre el % GC con la prueba VSM (0,76). **Conclusión:** El uso de una mascarilla desechable durante el ejercicio, aunque mostró variaciones, no provocó cambios fisiológicos que pudieran afectar el rendimiento de alguna manera.
Palabras clave: Corredores, Mascarilla, Volumen máximo de oxígeno.

VO2MAX CHEZ LES COUREURS: AVEC/SANS UTILISATION DE MASQUES JETABLES

RÉSUMÉ:
Objectif : Mesurer le volume maximal d'oxygène (VO2max) des coureurs de rue, avec et sans l'utilisation de masques de protection individuels. **Méthodologie :** La recherche a eu lieu avec la participation de 21 coureurs de rue, âgés de 18 à 54 ans, des deux sexes, qui pratiquent la modalité pendant au moins un mois. Les plis cutanés ont été mesurés afin de déterminer le pourcentage de graisse corporelle - %GC, et pour mesurer la VO2max, le test du banc de McArdle a été effectué. Le test a été effectué deux fois, à savoir : le test du volume maximal d'oxygène avec utilisation d'un masque (test VAM), et le test du volume maximal d'oxygène sans utilisation d'un masque (test VSM). Le traitement statistique a été réalisé à l'aide du programme SPSS®, version 25.0. **Résultats :** Le test VCM a été jugé "bon", pour les deux sexes. Le test VSM, jugé "excellent" pour les hommes, reste "bon" pour les femmes. Aucune signification n'a été trouvée pour les tests, cependant, il y avait une forte corrélation entre le test VCM et le test VSM (0,74) et une corrélation entre le %GC et le test VSM (0,76). **Conclusion :** L'utilisation du masque jetable pendant l'exercice, bien que présentant des variations, n'a pas provoqué de changements physiologiques pouvant affecter les performances de quelque manière que ce soit.
Mots clés : Coureurs, Masque, Volume maximal d'oxygène.

VO2MÁX EM CORREDORES: COM/SEM UTILIZAÇÃO DE MÁSCARAS DESCARTÁVEIS

RESUMO:
Objetivo: Mensurar o volume máximo de oxigênio (VO2Máx) de corredores de rua, com e sem o uso de máscaras de proteção individual. **Metodologia:** A pesquisa ocorreu com a participação de 21 corredores de rua, com a idade entre 18 e 54 anos, de ambos os gêneros, que praticam a modalidade há pelo menos um mês. As dobras cutâneas foram medidas a fim de determinar o percentual de gordura corporal - %G, e para mensurar o VO2Máx, realizou-se o teste do Banco de McArdle. O teste foi realizado duas vezes, sendo: teste de volume máximo de oxigênio com utilização de máscara (teste VCM), e teste de volume máximo de oxigênio sem utilização de máscara (teste VSM). O tratamento estatístico foi realizado por intermédio do programa *SPSS®,* versão 25.0. **Resultados:** O teste de VCM classificou-se como "boa", para ambos os gêneros. O teste de VSM, classificou-se em “excelente” para os homens, permanecendo “boa” para mulheres. Não encontrou-se significância para os teste, porém, houve correlação forte entre o teste VCM com o teste VSM (0,74) e uma correlação entre o %G com o teste VSM (0,76). **Conclusão:** A utilização da máscara descartável durante a prática do exercício, ainda que apresentando variações, não ocasionou mudanças fisiológicas que poderiam afetar seu desempenho de alguma maneira.
Palavras-chave: Corredores; Máscara; Volume máximo de oxigênio.