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Strength and stress training during the COVID-19 pandemic

Entrenamiento de fuerza y estrés durante la pandemia de COVID-19

Treino de força e estresse durante a pandemia do COVID-19

ABSTRACT

Objective: To evaluate the effect of a strength training session on men's cortisol levels and correlate to the stress score during the COVID-19 pandemic. Ten physically active volunteers aged 18 to 31 years participated in the study. After a 48-hour rest, an anamnesis, body composition assessment, hemodynamics at rest, assessment of heart rate variability, blood collection was applied. A reduction in cortisol levels was observed one day after the strength training session. A strong correlation was observed between the stress score and cortisol levels and between cortisol and the LFms index at rest, and between the SD1 / SD2 ratio and lean weight. A single session of high-intensity strength training effectively reduced cortisol in adult men who had high levels of perceived stress during the COVID-19 pandemic.

DESCRIPTORS: Cortisol; Heart Rate Variability; Lean Mass.

RESUMEN

Objetivo evaluar el efecto de una sesión de entrenamiento de fuerza sobre los niveles de cortisol en hombres y correlacionarlo con la puntuación de estrés durante la pandemia de COVID-19. Participaron en el estudio diez voluntarios físicamente activos de entre 18 y 31 años. Después de un descanso de 48 horas, se aplicó una anamnesis, valoración de la composición corporal, hemodinámica en reposo, valoración de la variabilidad de la frecuencia cardíaca, extracción de sangre. Se observó una reducción en los niveles de cortisol un día después de la sesión de entrenamiento de fuerza. Se observó una fuerte correlación entre la puntuación de estrés y los niveles de cortisol, así como entre el cortisol y el índice LFms en reposo y entre la relación SD1 / SD2 y el peso magro. Una sola sesión de entrenamiento de fuerza de alta intensidad fue efectiva para reducir el cortisol en hombres adultos que tenían altos niveles de estrés percibido durante la pandemia de COVID-19.

DESCRIPTORES: Cortisol; Variabilidad del ritmo cardíaco; Masa magra.

RESUMO

Objetivo avaliar o efeito de uma sessão de treino de força nos níveis de cortisol em homens e correlacionar ao score de estresse durante a pandemia do COVID-19. Participaram do estudo 10 voluntários fisicamente ativos com idade de 18 a 31 anos. Após repouso de 48 horas foi aplicado uma anamnese, avaliação da composição corporal, hemodinâmica em repouso, avaliação da variabilidade da frequência cardíaca, coleta de sangue. Foi observada redução nos níveis de cortisol um dia após a sessão de treino de força. Uma forte correlação foi observada entre o score de estresse e os níveis de cortisol bem como entre o cortisol e o índice LFms em repouso e entre a razão SD1/SD2 e o peso magro. Uma única sessão de treino de força com alta intensidade se mostrou eficaz na redução do cortisol em homens adultos que apresentaram níveis elevados de estresse percebido durante a pandemia do COVID-19.

DESCRITORES: Cortisol; Variabilidade da Frequência da Cardíaca; Massa Magra.

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INTRODUCTION

The coronavirus (COVID) had its first reported case of human infection in Wuhan, China on December 1st, 2019. It refers to a viral group already known in the scientific community since the 1960s. [1, 2] COVID-19 is a highly contagious disease that can lead the patient to develop Severe Acute Respiratory Syndrome (SARS). By the beginning of January 2021, COVID-19 had already killed more than 1.930.265 people and infected 89.048.345 worldwide. The magnitude of the spread in practically all countries of the world, elevated in record time the status of COVID-19 as the greatest pandemic of the 21st century. [2] In an attempt to prevent the collapse in the health system, several countries have adopted the social detachment policy recommended by the World Health Organization. [3, 4] Such a measure is extremely necessary to contain the devastating advance of the disease. Still the fear of infection, the loss of relatives and friends, the economic impacts, among others, caused a high level of stress in the population, triggering several cases of panic syndrome, anxiety. [5-7] Sedentary lifestyle also grew considerably due to restrictions and the closure of public and private spaces for the practice of physical activities. This fact caused an increase in body fat leaving the population more predisposed to the development of chronic and metabolic diseases, further evidencing the deleterious effects of the COVID-19 pandemic on the emotional and physical health of the world population. [8, 9] For example: studies have shown that overweight and obese individuals are at greater risk of severe respiratory infection when infected with COVID-19. [10]

Since physical exercise is widely recognized as an important non-medication strategy in the prevention and combat of chronic and metabolic diseases, in the control of body mass, it is of fundamental importance in the immune system. It is suggested that the practice of physical exercises should be present in the population's routine in a safe manner and respecting due social distance during the pandemic. [11] However, the effects of strength training in alleviating the stress caused by the pandemic have not yet been investigated.

Thus, the present study aimed to assess the effect of a day of strength training on cortisol levels in adults and to correlate with the perceived stress score during the COVID-19 pandemic period.

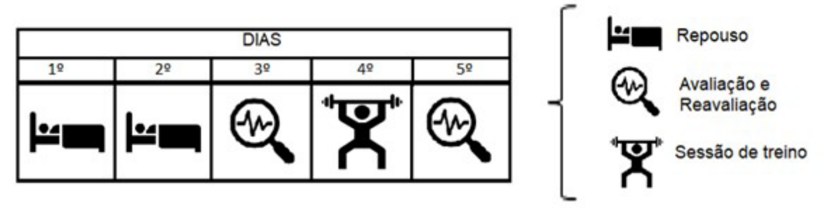
METHOD

This is an experimental exploratory field study, which is characterized by the search for the verification of a little-investigated phenomenon about the survey of a previous hypothesis. [12] The study consisted of 10 healthy and physically active male volunteers aged 18 to 31 years living in the city of Triunfo, Pernambuco. The survey was conducted in September 2020 and as of the collection date, no study participant had been diagnosed with COVID-19. In order to participate in the study, the following inclusion criteria were established: Not presenting any chronic metabolic diseases or emotional disorders diagnosed, not using any type of medication or supplementation, and being familiar with strength training. The volunteers signed the Informed Consent Form in accordance with the Declaration of Helsinki. The project was approved by the Human Research Ethics Committee of the Catholic University of Brasília, under protocol number CAAE: 08754219.3.0000.0029.

The volunteers at rest for 48 hours underwent an anamnesis, assessment of body composition, measurement of blood pressure and heart rate at rest for 15 minutes, assessment of heart rate variability, collection of venous blood for further analysis of cortisol concentration. These procedures were performed before and one day after the strength training.

The anamnesis contained questions about personal health history, physical activity level and perceived stress level using the translated Perceived Stress Scale (PSS). The questionnaire was applied in the form of an interview by the main evaluator. The PSS is a 14-question questionnaire with an answer option from zero to four (zero = never; one =

Figure 1. Study Design. Local authorship 2020.



almost never; two = sometimes; three = almost always and four = always). Positive questions (4, 5, 6, 7, 9, 10 and 13) should have their scores added upside down. The others add up directly. The score is the sum of the scores for each question, ranging from zero to fifty-six. The higher the score, the greater the perceived stress. [13]

The height of the volunteers was obtained using a wall stadiometer, with those assessed with the feet, buttocks, scapulae and the posterior portion of the skull touching the wall and the reading performed at the time of a deep breath. To obtain body mass, a Filizola® mechanical scale with an accuracy of 100 grams was used. The body mass index (BMI) was obtained using the equation: weight/(height). [2] Circumference measurements (waist and hip) were performed using a flexible non-elastic measuring tape with a scale in centimeters. Waist Hip Ratio (WHR) was extracted by dividing waist circumference by hip in centimeters. The percentage of body fat was obtained using the 3 skinfold protocol 14 with the aid of a Cescof® scientific adipometer. After determining body density by the equation DC = 1,10938-0,0008267x (sum of folds) + 0,0000016x (sum of folds x sum of folds) -0,0002574x (age) 15 fat body mass (FBM) was estimated by the following equation: FBM = total mass x (percentage of fat/100) and lean body mass (LBM) by the equation: LBM = total mass - fat mass. The body fat percentage in turn was estimated by the Siri equation, Fat Percentage = 495/DC) - 450. [14]

Blood pressure and heart rate were obtained after 15 minutes of rest with the use of a Microlife® electronic device and a cardio frequency meter. Heart rate variability was recorded for 15 minutes using a Polar RS800CX cardio frequency meter. The volunteers were instructed not to drink coffee or any other stimulant during the 24 hours prior to the assessment. Subsequently, the data was transferred to Polar's Software. To remove the artifacts, the medium filter was applied. [16] The data was then analyzed later using the Kubios Software where the data in the time and frequency domains were extracted.

CEach participant was placed comfortably seated with a tourniquet tied around his arm and a collection of 5 ml of blood was performed in the medial cubic vein after asepsis of the site, using sterile needles in serum tubes. None of the participants performed any type of physical exercise in the 48 hours prior to blood collection. Blood samples were collected at both times (pre and post) between 7:30 and 8:30 in the morning. After collection, the blood sample was kept at an ambient temperature of 20–25° C for 45 minutes and centrifuged for 10 minutes at 1,500 rpm (Megafuge 1.0R, Heraeus, Langenselbold, Germany). The serum was then removed and kept at 25 ° C for further analysis.

Serum cortisol concentrations were determined using radioimmunoassay kits (Cortisol Coat-Count-RIA; DPC Medlab, Los Angeles, CA, USA). All tests were performed according to the manufacturers' instructions by licensed and certified laboratory technicians.

Twenty-four hours after the first assessment, participants performed a circuit strength training session (10 exercises) that consisted of a single series of 12 repetitions (each exercise) with intensity 17-18 on the 20-point Borg scale. Before the beginning of the strength training, the volunteers performed a warm-up and treadmill with an intensity of 15 on the Borg scale. The strength training circuit consisted of the following exercises: bench press with barbell, seated row, biceps curl, cross triceps, squat on the guided bar, peck deck, front pull on the high pulley, scott curl, triceps on the machine and 45º leg press . The transition between each exercise was 15 to 20 seconds. Twenty-four hours after the training session, all procedures and collections performed in the first evaluation were repeated strictly following the same standards.

After tabulation, the data were analyzed statistically. Data were presented as means and standard deviations. To test normality, the Shapiro-Wilk test was applied. To investigate changes in cortisol level and HRV measurements before and after the training session, the two-way ANOVA with Bonferroni pos hoc was used. Pearson's correlation (r) was applied between the variables cortisol, stress score and HRV indices. The level of significance adopted was 5%. The sample power analysis was performed post hoc using the G * Power 3.1 software with a 0.05 alpha. The data were analyzed using the IBM SPSS 21.0 statistical package and GraphPad Prisma.

Table 1. Characterization of the sample (n=10).

	AVERAGE	STANDARD DEVIATION (±)
Age	27,10	4,55
Weight (kg)	80,66	9,93
Height (m)	1,74	0,06
BMI[1]	26,65	3,32
WHR[2]	0,86	0,04
Body Fat (%)[3]	18,59	8,95
Lean Body mass (kg)[4]	67,31	6,46
SBP (mmHg)[5]	124,50	10,94
DBP (mmHg)[6]	73,35	9,64
Stress[7]	21,70	6,81

[1]Body mass Index (Índice de Massa Corporal); [2]Waist to Hip Ratio (Relação Cintura Quadril); [3]Body Fat Percentage; [4]Lean body mass in kilograms; [5]Systolic Blood Pressure (Pressão Arterial Sistólica); [6]Diastolic Blood Pressure (Pressão Arterial Diastólica); 7Score of the Perceived Stress Scale Local authorship 2020.

Table 2. HRV indexes before and after strength training (n=10).

HRV	REST AVERAGE ± SD	POST-WORKOUT AVERAGE ± SD	P
SDNN (ms)	71,23 ± 26,38	65,69 ± 19,31	0,97
RMSSD (ms)	47,70 ± 26,60	43,65 ± 20,13	0,36
pNN50 (%)	24,28 ± 21,87	21,37 ± 18,68	0,42
HF (ms)	1047,86 ±1126,62	811,29 ± 554,36	0,64
LF (ms)	1384,27 ± 854,37	1191,67 ± 579,65	0,16
HF (nu)	37,73 ±16,65	37,82 ± 11,46	0,97
LF (nu)	62,20 ± 16,65	62,12 ± 11,46	0,97
LF/HF (ms)	2,12 ± 1,27	1,90 ± 0,97	0,22
SD1 (ms)	33,74 ± 18,82	30,87 ± 14,24	0,36
SD2 (ms)	94,38 ± 33,79	87,33 ± 24,39	0,24
SD1/SD2 (ms)	0,45 ± 0,42	0,38 ± 0,10	0,52

HRV: Heart Rate Variability; SD: Standard Deviation (Desvio Padrão); SDNN: Standard deviation of all normal RR intervals over a period of time; RMSSD: the square root of the mean squared difference of successive R-R intervals; pNN50: Percentage of adjacent RR intervals with a difference in duration greater than 50 milliseconds; HF: Variation that corresponds to respiratory modulation; LF: Variation due to the joint performance of the sympathetic and parasympathetic components; LF/HF: absolute and relative change between the sympathetic and parasympathetic components. SD1: instantaneous index of the variation between beats; SD2: Represents HRV in a long-term record; SD1/SD2: Ratio between the short and long variations of the RR intervals. Local authorship 2020.

Figure 2. Cortisol levels before and after strength training. Local authorship 2020.

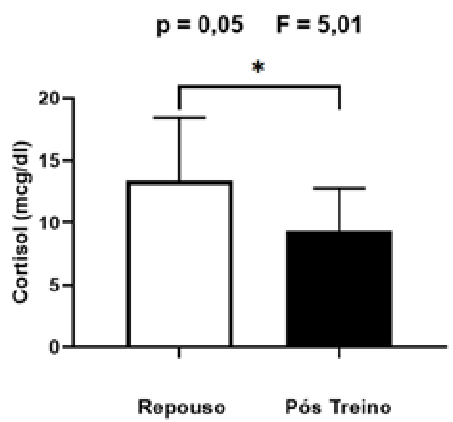
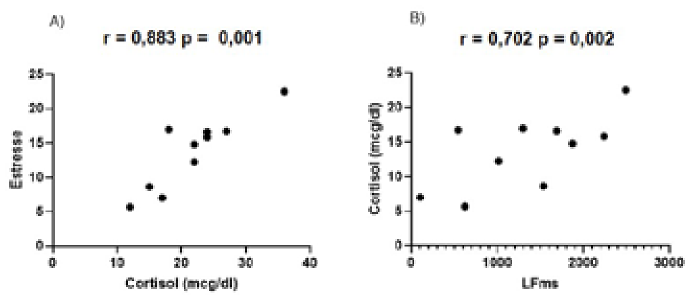


Figure 3. Correlations: A) Stress score and cortisol level; B) Cortisol and LFms index. Local authorship 2020.



RESULT

Table 1 shows the sample characterization data. For cortisol, the post hoc statistical power was 1.00. The average score of volunteers in the PSS was 21,36 ± 6,56. Significant reduction was observed in cortisol levels one day after the strength training session (figure 2).

There was no statistically significant change (p> 0,05) in HRV indices in the time and frequency domain (Table 2). SBP and DBP also did not show statistically significant changes (p> 0,05) after one day of strength training.

DISCUSSION

This study aimed to investigate the response of a single strength training session to cortisol levels and correlate with perceived stress in adult men during the COVID-19 pandemic. As far as we know, this is the first study to investigate the effect of strength training on stress during a pandemic. The main findings of this study demonstrate that there was a reduction in cortisol levels one day after a single session of strength training performed with intensity between 17-18 on the Borg Scale. In addition, a strong correlation was observed between the level of cortisol at rest with the perceived stress score and the LFms component, a strong correlation was also observed between lean mass and the SD1/SD2 ratio at rest.

Cortisol is a corticosteroid hormone in the steroid family. Production occurs in the upper cortex of the adrenal gland. Its function is to stimulate the breakdown of proteins, fats and the synthesis of glucose in the liver. It has a high relationship with stress, as it activates physiological responses in an emergency situation, such as increasing blood pressure and glucose availability, which is used as an energy source for muscle contraction. [17] In our study, cortisol showed a strong positive correlation (r = 0,883, p = 0,001) with the stress score. Although cortisol triggers these important changes, it simultaneously implies the paralysis of all recovery and anabolism functions. This fact makes cortisol play an influential role in muscle catabolism. [18, 19] Chronic stress can cause a constant increase in cortisol levels and influence the reduction of muscle mass due to catabolism. The decrease in muscle mass has a strong influence on metabolism, impacting the reduction of basal caloric expenditure, burning fat and reducing the use of glucose, which can lead to the development of chronic metabolic diseases. [20] In our study, a single strength training session with intensity 17 on the Borg scale proved to be efficient in significantly reducing blood cortisol levels one day after training. Studies show that cortisol is more likely to increase its levels after exercise with higher training volumes. [21, 22] The high intensity, but with lower volumes, does not seem to have much influence on the increase in cortisol levels. In the study by Geisler and his collaborators [23] a reduction in cortisol was observed after 45 minutes of strength training performed at 75% of 1RM. Strength training with combined sets also showed reductions in cortisol levels. [24] The findings of Rosa and collaborators [25,26] they also show a significant reduction in cortisol after a combined training session (aerobic and strength). In our study, strength training performed with only a single series in circuit, caused a reduction in cortisol levels, corroborating these studies. There was a strong correlation between cortisol levels and the LFms index at rest. This component is related to sympathetic activity. Increasing the values of the LFms index reduces HRV. Studies have observed a reduction in HRV and cortisol levels after a meditation session [27] and anticipation in a stressful situation is the cortisol response. [28] Our study showed a positive association between cortisol and LFms at rest, inferring greater sympathetic activity at rest. There was no statistically significant change in HRV indexes after strength training in our study. In the study by Figueiredo et al. [29] a greater magnitude was observed in the sympathetic tone after strength training (5 series of 8-10 repetitions) performed with an intensity of 70% of 1RM when compared to the group that performed only 1 series of exercise. Thus, HRV can be more sensitive to the training volume, increasing the sympathetic activity after exercise. Since our protocol was characterized as low volume and high intensity training, this may have been the reason why there were no statistically significant changes in HRV parameters. However, the lean mass in our study correlated strongly with the SD1/SD2 ratio, which represents the variation (short and long) of the RR intervals. Individuals with higher values of lean mass have a higher HRV. [30] Furthermore, an association between increased body adiposity and autonomic imbalance has been observed. [31] Also, the sympathetic-vagal imbalance is closely related to sarcopenia, proving the importance of maintaining muscle mass in autonomic health. [32, 33] These findings corroborate our study and emphasize the importance of reducing cortisol and, as a consequence, its catabolic effects, especially in this pandemic period.

CONCLUSION

A single session of high intensity strength training (Borg 17) proved to be effective in reducing cortisol in adult men who had high levels of perceived stress during the COVID-19 pandemic. When the goal is to alleviate emotional stress, short strength training seems to be a quick and viable strategy.

We recommend further research with different training volumes and intensity, in addition to other age groups and genders that will allow these results to be extrapolated to other population groups in the future. ■

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