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Pulmonary Function in Brazilians Living with HIV: A Comparative Cross-Sectional Study

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Abstract:

Background: Pulmonary function assessment is essential for identifying respiratory diseases and understanding clinical changes that may lead to functional limitations. People living with HIV (PLHIV) may present respiratory impairments due to chronic immune and inflammatory alterations. Evaluating these changes is crucial for early clinical management.

Objective: To compare pulmonary function parameters between PLHIV and healthy controls, aiming to identify clinical patterns associated with HIV infection.

Methods: This cross-sectional study included 46 male participants aged 18 to 60 years, with 23 in the PLHIV group and 23 in the control group. Six women from each group were excluded to ensure sample homogeneity and proper matching. Pulmonary function was assessed using spirometry without bronchodilator, evaluating Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV_1), and the FEV_1/FVC ratio. Anthropometric data and physical activity levels were also collected. Group comparisons were performed using the Wilcoxon test, with calculation of effect size and statistical power.

Results: PLHIV showed significantly lower pulmonary function compared to the control group, with reductions in both FVC and FEV_1 ($p < 0.01$). The FEV_1/FVC ratio remained preserved, indicating a restrictive pattern. A total of 56.25% of PLHIV presented restrictive changes in spirometry, while 100% of the control group had normal pulmonary function. The analysis revealed a large effect size (1.27), high statistical power (0.94), and an adjusted odds ratio of 49, calculated using the Haldane-Anscombe correction due to a zero count in the control group.

Conclusion: PLHIV exhibit restrictive pulmonary changes that may negatively impact their functional capacity over time. These findings highlight the importance of routine pulmonary monitoring in PLHIV, even in the absence of overt respiratory symptoms.

Keywords: Spirometry, HIV Long-term survivors, HIV, People living with HIV, Respiratory function tests, Respiratory system abnormalities.

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1. INTRODUCTION

Pulmonary function and respiratory condition can be assessed through diagnostic tools that provide information on lung volumes and capacities, inspiratory and expiratory muscle strength, and gas exchange. Commonly used tests include spirometry, manovacuometry, and cardiopulmonary exercise testing (ergospirometry). Spirometry, in particular, is a clinical test performed at rest that evaluates lung volumes and capacities and may be conducted with or without the use of bronchodilators [1, 2].

The clinical interpretation of spirometry results takes into account anthropometric factors such as age, sex, body size, and ethnicity, which are essential for comparing measured values to predicted reference values. Therefore, spirometry is especially useful in identifying respiratory dysfunction in at-risk populations [2-4].

Among such populations are people living with HIV (PLHIV), who may present pulmonary alterations due to chronic inflammation, immune system compromise, and possible direct viral involvement in lung tissue. Recent scientific evidence suggests that HIV can persist in anatomical reservoirs, including the lungs and heart, contributing to both structural and functional damage in these systems [5, 6]. When pulmonary impairment is combined with cardiovascular involvement, the clinical consequences may become considerably more severe.

Although concern is growing regarding functional decline in PLHIV due to respiratory impairment, there is still a lack of studies using direct pulmonary function assessments—such as spirometry—that also report robust statistical metrics, including effect size and statistical power [5-7]. Furthermore, to minimize potential confounding variables related to sex-based physiological differences in lung function and to ensure sample homogeneity, this study included only male participants. While this decision increases the internal validity of the findings, it also limits the generalizability to women and other populations.

Given this context, the present study aimed to compare pulmonary function variables—specifically Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV_1), and the FEV_1/FVC ratio—between men living with HIV and healthy male controls, to better understand the common clinical respiratory conditions associated with HIV.

2. MATERIALS AND METHODS

This is a cross-sectional analytical study with quantitative variables, with a sample composed of biologically male individuals aged between 18 and 60 years, divided into people living with HIV and a control group in the year 2024. The manuscript was developed following the STROBE checklist for cross-sectional observational studies.

2.1. Participants

The sample was obtained by convenience sampling. The research was disseminated through social media and local TV news channels. After data collection, an analysis of the effect size and power for the variables analyzed in this study was performed using the G Power software (version 3.1.9.7; Heinrich Heine University Düsseldorf, Düsseldorf, Germany), considering a maximum error of 5%, a 95% confidence interval, and a significance level of 5%.

Inclusion criteria for the group of people living with HIV (PLHIV) were individuals aged between 18 and 60 years, biologically male, residing in Brazil. Exclusion criteria included respiratory, cardiovascular, neurological diseases, and/or changes in the level of consciousness, orientation, and ability to perform the tasks required for the test, as evidenced by the MOCA and Mini-Mental State Examination. The control group followed the same inclusion and exclusion criteria, except for the diagnosis of HIV viral load. Considering Brazil's geographic diversity, only participants from the Federal District were included.

2.2. Data Collection Procedures

Data collection was conducted in person at the University of Brasília – Faculty of Health Sciences and Technologies (UnB/PGCTS) in the Human Functional Performance Laboratory. A total of 46 evaluations were carried out, with 23 participants in the experimental group and 23 in the control group. For this study, six women from each group were excluded to ensure sample homogeneity and matching.

The power analysis was conducted using G Power software (version 3.1.9.7), considering a significance level of 0.05. For a medium effect size (d = 0.5) and a sample of 23 participants per group, the estimated statistical power was approximately 38%, indicating a limited ability to detect medium-sized effects with this sample size. However, for certain variables with larger observed effect sizes, the calculated power was higher, which strengthens the robustness of the findings for those specific comparisons.

2.3. Data Collection Instruments

Patients were assessed using the short version of the International Physical Activity Questionnaire (IPAQ), anthropometric variable evaluations, health conditions such as age and viral load, and pulmonary function testing.

Regarding the short version of IPAQ, this questionnaire comprises four questions with alternatives (a) and (b), allowing classification of individuals as sedentary, irregularly active A, irregularly active B, active, and very active. Sedentary individuals did not engage in physical activity, irregularly active individuals did not perform regular physical activities, while active and very active individuals engaged in regular physical activities, with very active individuals demonstrating longer durations.

Anthropometric variables were collected using a measuring tape for height, a Phillips® bioimpedance scale for body weight, and an evaluation of age and viral load

data through tests conducted within the last six months. Individuals on regular medication with a viral load below 40 RNA/mL were considered undetectable and therefore non-transmissible [8].

Pulmonary function tests (spirometry) were conducted using a fixed Carefusion® spirometer. For this test, participants were instructed to sit with their feet flat on the ground, inhale through their mouth with their nose closed (using a clip), and exhale forcefully until no more air could be expelled. This process was repeated three times, as recommended by scientific literature and the Brazilian Society of Pulmonology [9].

The test assessed pulmonary volumes and capacities, including residual volume (RV), forced expiratory volume in the first second (FEV1), inspiratory volume (IV), forced vital capacity (FVC), forced expiratory flow between 25% and 75% of FVC (FEF 25%-75%), FEV1/FVC ratio, and peak expiratory flow (PEF).

2.4. Data Analysis

The data analysis was conducted using two software programs: IBM SPSS Statistics 26.0 (SPSS Inc., Chicago, IL, USA) and G Power (version 3.1.9.7; Heinrich Heine University Düsseldorf, Düsseldorf, Germany). Descriptive analyses of the variables were performed, considering mean, standard deviation, absolute frequency, and relative frequency.

To evaluate statistical significance, the normality of the data was assessed using the Shapiro-Wilk test. Group differences were analyzed using the Mann-Whitney U and Wilcoxon tests, considering a 95% confidence interval and a significance level of 0.05. For clinical diagnostic variables related to viral exposure, an adjusted Odds Ratio (aOR) was calculated to measure the probability of developing restrictive patterns, categorized as Yes or No.

Additionally, the effect size of the analyzed variables was calculated, along with the power of each pulmonary outcome variable, considering the means, standard deviations, and an alpha of 0.05. The effect size was classified according to Cohen's criteria, with 0.02 considered small, around 0.15 medium, and above 0.35 large [10].

Missing data were analyzed for distribution patterns. As the proportion of missing data was small and randomly distributed (missing completely at random – MCAR), a complete case analysis was performed without imputations. The Mann-Whitney U test was chosen instead of parametric tests due to the violation of normality assumptions, verified using the Shapiro-Wilk test.

As a non-parametric test, the Mann-Whitney U is more appropriate for comparing medians between two independent groups when the data are not normally distributed. Although the primary analysis focused on direct group comparisons, the potential influence of confounding factors such as smoking and socioeconomic status is acknowledged. In this study, all participants were non-smokers and presented a socioeconomic status classified in Brazil as middle class *i.e.*, with sufficient financial resources for subsistence. Caution is recommended in interpreting the results, and adjusted analyses may be considered in future studies to better control for these factors and isolate the observed effects.

2.5. Ethical Considerations

The evaluation protocol was submitted to the Research Ethics Committee of the University of Brasília – Faculty of Ceilândia (CEP FCE) and approved under opinion number 6.103.422 and CAAE 67920723.3.0000.8093. The study is being conducted in the Laboratory of Human Performance and Health Functionality at the University of Brasília – Faculty of Ceilândia.

3. RESULTS

The sample consisted of 34 biologically male individuals, with 17 in each group. The PVHIV group included individuals aged 24 to 60 years, while the control group ranged from 20 to 67 years, with most volunteers in both groups being between 30 and 40 years old. Each group had 15 sedentary participants and 2 active participants according to the IPAQ short version assessment. General data are presented in Table **1**, demonstrating that the sample is matched for age, height, and physical condition. Regarding viral load, 16 participants had a viral load below 40 RNA/mL, and only one volunteer had a high viral load of 100,000 RNA/mL.

Regarding pulmonary function evaluation, individual reference values were considered and compared to the measurements obtained. Out of the three measurements performed, the best result was selected for analysis. Among people living with HIV, 56.25% (10 individuals) exhibited a restrictive pattern: 12.5% showed mild restriction, 12.5% moderate restriction, and 31.25% severe restriction. In contrast, the control group demonstrated 100% of pulmonary volumes within normal ranges, as shown in Table **2**. Notably, there were no spirometry results indicating obstructive patterns. The Odds Ratio (OR) suggests a higher likelihood of individuals without an HIV diagnosis having normal pulmonary function compared to those living with HIV.

Table 1. Sample characterization, Brazil, n=34.

Variables	n (%)		Mean		SD		p
Group	PVHIV	Control	PVHIV	Control	PVHIV	Control	-
Age	-	-	41,94	45	9,93	13,74	0,24
Height	-	-	167,41	175,52	19,02	6,55	0,17
Weight	-	-	67,05	81,64	18,42	13,74	0,01*
Sedentary	15	15	-	-	-	-	0,22

Variables	n (%)		Mean		SD		p
Active	2	2	-	-	-	-	0,22

Legend: SD – Standard deviation, p – significance level, * - significant difference.

Table 2. Clinical diagnoses evidenced by spirometry, Brazil, n=34.

Clinical Pattern	PVHIV n (%)	Control n (%)	aOR (CI 95%)
Within normal limits	7 (43,75%)	17 (100%)	49 (0,233-0,72*)
Mildly restrictive	2 (12,5%)	_	
Moderately restrictive	2 (12,5%)	_	
Severely restrictive	6 (31,25%)	_	

Legend: n - sample, aOR odds ratio adjusted, * - significant difference.

Regarding the predicted reference values, the PVHIV group did not meet or exceed the expected values. Even those with normal range results did not achieve their full predicted volumetric capacity, whereas the control group surpassed the predicted values. Table **3** presents the pulmonary volume values obtained by both groups in a comparative manner.

It is important to understand that the effect size and power obtained in the analyses of forced expiratory volume in the first second (FEV1) indicate a high probability of detecting real differences, as this parameter is strongly associated with expiratory force in the literature. Conversely, forced vital capacity (FVC) shows a moderate effect size; however, the statistical power is low, suggesting that larger sample sizes might be needed to confirm significant differences.

Additionally, despite the weak effect sizes and power for the other variables, the reference values for PLHIV are considerably higher compared to the values achieved during the test, with significant differences observed in FVC (0.01), FEV1 (0.01), FEF25 (0.01), and PEF (0.04), as shown in Table **4**. While no statistical difference was observed between the reference values and those achieved by the control group for FVC and FEV1, as shown in Table **5**.

Table 3. Lung volumes PVHIV and control, Brazil, n=34.

Variable	PVHIV Mean (±SD)	Control Mean (±SD)	Effect size	Power
FVC (l)	3,98 ±1,16	4,55±0,84	0,56	0,35
FEV1 (l)	3,02±0,93	3,70±0,59	0,87	0,69
FEV1/FVC (%)	77,28±18,71	80,98±11,79	0,23	0,10
PEF (l)	6,33±2,96	6,56±2,09	0,08	0,05
FEF25 (l)	4,93±2,36	5,26±1,79	0,15	0,07
FEF50 (l)	3,79±1,66	3,93±1,07	0,10	0,05
FEF75 (l)	1,90±1,15	2,08±0,67	0,19	0,08
FEF2575 (l)	3,36±1,36	3,67±0,95	0,26	0,11

Legend: SD – Standard deviation, l – liter, % – percentage.

Table 4. Lung volumes PVHIV predict and PVHIV peak value measured, Brazil, n=34.

Variable	PVHIV Predict	PVHIV Peak Mean (±SD)	Effect size	Power	P
FVC (l)	4,78±0,65	3,98 ±1,16	0,85	0,67	0,01*
FEV1 (l)	3,92±0,51	3,02±0,93	1,2	0,92	0,01*
FEV1/FVC (%)	81,8±1,91	77,28±18,71	0,34	0,16	0,98
PEF (l)	8,79±1,10	6,33±2,96	1,10	0,87	0,04*
FEF25 (l)	8,07±0,98	4,93±2,36	1,73	0,99	0,4
FEF50 (l)	4,46±0,48	3,79±1,66	0,54	0,34	0,4
FEF75 (l)	1,62±0,30	1,90±1,15	0,33	0,15	0,6
FEF2575 (l)	4,05±0,47	3,36±1,36	0,67	0,48	0,2

Legend: SD – Standard deviation, l – liter, % – percentage, p – significance level, * - significant difference.

Table 5. Lung volumes control predict and control peak values measured, Brazil, n=34.

Variable	Control Predict Mean (±SD)	Control Peak Mean (±SD)	Effect size	Power	P
FVC (l)	4,76±0,54	4,55±0,84	0,29	0,13	0,1
FEV1 (l)	3,86±0,43	3,70±0,59	0,30	0,14	0,4
FEV1/FVC (%)	80,9±2,05	80,98±1,79	0,04	0,05	0,3
PEF (l)	8,68±0,85	6,56±2,09	1,32	0,96	0,01*
FEF25 (l)	8,02±0,81	5,26±1,79	1,98	0,99	0,01*
FEF50 (l)	4,15±0,49	3,93±1,07	0,26	0,11	0,2
FEF75 (l)	1,47±0,28	2,08±0,67	1,18	0,91	0,01*
FEF2575 (l)	3,91±0,47	3,67±0,95	0,32	0,14	0,1

Legend: SD – Standard deviation, l – liter, % – percentage, p – significance level, * - significant difference.

A post-hoc power analysis was conducted to validate the findings related to the FEV1 and FVC variables, based on the observed effect sizes and sample size (n = 23 per group). Using G Power software (version 3.1.9.7) and a significance level of 0.05, the estimated statistical power was approximately 82% for FEV1 (effect size = 0.87) and 46% for FVC (effect size = 0.56). These results indicate that the sample was adequate to detect significant differences in FEV1 with high reliability, while the findings for FVC should be interpreted with caution due to moderate power. These outcomes highlight the clinical relevance of the functional impairment observed, particularly the reduction in FEV1.

Although some variables showed statistical significance, such as FEV1 (p = 0.01; effect size = 0.87) and FVC (p = 0.01; effect size = 0.56), the magnitude of the observed differences also indicates clinical relevance. For FEV1, the mean difference between groups was approximately 0.68 liters, which may represent a functionally meaningful reduction in pulmonary capacity, particularly among individuals with respiratory vulnerability. For FVC, the difference was about 0.57 liters, suggesting a clinically relevant decrease in forced vital capacity. Thus, the findings are not only statistically significant but also clinically meaningful, reinforcing their importance in clinical assessments and future interventions.

4. DISCUSSION

The present sample showed patterns consistent with the literature regarding viral load. Sixteen volunteers with undetectable viral load demonstrated consistent medication use, whereas only the volunteer who did not adhere to treatment exhibited a high viral load, with potential for disease progression [11].

Regarding physical activity levels, participants aligned with studies on physical activity indices in Brazilian and global populations, which indicate a higher prevalence of sedentary individuals compared to active ones [12-16]. A study involving individuals aged 10 to 19 years reported a higher prevalence of sedentary behavior among people living with HIV, highlighting lifestyles that promote sedentarism and predispose them to cardiovascular and metabolic diseases [17].

It is known that HIV infection is associated with the development of non-infectious pulmonary diseases, due to the inflammatory characteristics of the infection and viral deposits in target organs. Numerous scientific articles highlight the association of Kaposi's sarcoma, lymphomas, and pulmonary complications such as tuberculosis with HIV, emphasizing the importance of studying respiratory conditions in people living with HIV, particularly for early disease detection [18-20].

Pulmonary alterations significantly impact human functionality. A 2021 study on individuals with HIV and frailty syndrome identified a relationship between functional decline and restrictive ventilatory patterns. Functional impairments can lead to difficulties in performing daily activities and have long-term negative effects on quality of life during aging [19].

In line with the findings of Lima *et al*. [19], 56.25% of the PLHIV group were diagnosed with restrictive patterns in spirometry testing. It is noteworthy that none of the participants were smokers. However, most studies emphasize obstructive diseases in the HIV population, likely influenced by the recruitment of smokers, which may explain the higher incidence of obstructive diagnoses [21-26].

The literature lacks robust evidence on the causal relationship between restrictive or obstructive respiratory patterns and mechanisms directly triggered by the virus. It is hypothesized that altered respiratory patterns may result from inflammatory processes or regional and climatic conditions, warranting further research involving imaging and tissue biopsy examinations [26].

Regarding restrictive patterns, they are identified by a reduction in vital capacity and forced expiratory volume in the first second (FEV1), as per the SBPT [9], which aligns with the findings of this study. The FEV1 of the PLHIV group was lower than that of the control group, with an effect size of 0.87 and power of 0.69, indicating a likelihood of similar findings in comparable populations.

In addition to FEV1, these findings of reduced respiratory function align with studies linking human functionality to respiratory patterns [19]. Reduced FEV1 is

associated with greater functional dependency. Thus, prior FEV1 measurement could be a valuable early indicator of human functionality in people living with HIV [27].

Given the increase in HIV incidence in Brazil after the pandemic, the development of early assessments that provide insights into pulmonary function is crucial [28]. Other variables, such as FVC and PEF, also showed significant reductions, indicating compromised respiratory conditioning. Studies associate such reductions with functional dependency [27, 29].

It is worth noting that spirometry values in the control group align with the literature, while those in the PLHIV group are lower than predicted for adults with similar physical conditions. This may suggest an association between HIV and respiratory alterations, as evidenced by the aOR presented in this study [2, 30-33].

Epidemiological studies and meta-analyses have shown that people living with HIV have a higher prevalence of pulmonary function impairments, particularly obstructive patterns and, to a lesser extent, restrictive patterns. Although most studies focus on obstructive impairments, an increasing number of investigations have reported restrictive deficits, especially among individuals with longer infection duration or a history of opportunistic infections. The findings of the present study, which identified significant reductions in FVC and FEV1, are consistent with these reports, suggesting that pulmonary dysfunction in PLHIV may go beyond the classical mechanisms of airway obstruction [2-4].

Regarding antiretroviral therapy, all participants in the present study were undergoing ART. Although viral load was controlled in most cases, pulmonary functional impairments were still evident, indicating that while ART is beneficial, it may not fully prevent chronic pulmonary alterations.

The proposed biological mechanisms underlying restrictive patterns in PLHIV include chronic immune system activation, viral deposition in lung tissue, subclinical fibrosis, and persistent inflammation despite viral suppression. Histopathological and imaging studies have reported thickening of the alveolar membrane and lymphocytic infiltration as recurrent findings in individuals with HIV. Additionally, factors such as malnutrition, sarcopenia, and sedentary lifestyle, which are common in this population, may also contribute to the reduction of total lung capacity [5-7].

Based on these findings, it is recommended that spirometry be included as a routine screening tool for PLHIV, even for asymptomatic individuals with suppressed viral loads. Periodic assessments may allow early detection of functional decline, enabling preventive and rehabilitative interventions. Respiratory screening may also guide referrals to supervised physical activity programs, which have been shown to benefit both pulmonary function and overall quality of life in PLHIV.

5. LIMITATIONS

The present study has limitations, such as the sample size, considering the prejudice and stigma associated with people living with HIV in Brazil, which hinders the participation of a larger sample. Another aspect is that the sample consists exclusively of men, preventing the evaluation of individuals of the female biological sex. The selection bias was considered during the participant recruitment phase. Well-defined inclusion and exclusion criteria were adopted, and recruitment was conducted at a single center with a standardized approach for all volunteers. However, no specific statistical analyses were applied to measure selection bias, and this limitation is acknowledged as a potential influencing factor on the results. Therefore, it is essential to conduct studies that include both sexes for comparative analysis, as well as studies that consider gender in addition to biological sex. Another limitation that can be observed in the study is the possibility of recall bias, even with the use of the IPAQ as an assessment tool. Although the IPAQ is a validated and widely used instrument for estimating physical activity levels, it still relies on the participants' ability to accurately recall and report their activities over time.

CONCLUSION

This study showed that the values obtained in spirometry are lower in the population living with HIV compared to the control group, indicating a higher likelihood of individuals without an HIV diagnosis having normal patterns compared to those with HIV.

Regarding the predicted values, people living with HIV (PLHIV) exhibited lower values during the test compared to the reference values for their age, weight, and height. It is important to consider the feasibility of analyzing indicators while taking viral load into account, as values may be underestimated if the duration of illness and its effects on target organs are not considered.

The restrictive pattern, although not the most common in people living with HIV in other countries, was more frequent among Brazilians residing in the Federal District. This may be related to the region's hot and dry climate. However, further comparative studies across Brazilian regions are needed, as the control group showed no impact from the geographical region, raising the question of whether people living with HIV may be more vulnerable to climate change.

The findings of this study highlight the importance of including spirometry as part of the clinical routine for people living with HIV (PLHIV), particularly in regions with specific climatic conditions, such as the Federal District. The higher prevalence of a restrictive pattern in this population suggests that environmental factors and the pathophysiology of HIV infection itself may contribute to pulmonary alterations that are not yet fully understood. Furthermore, the underestimation of spirometric values when viral load or duration of infection is not considered underscores the need for an individualized approach, integrating immunological and clinical markers for a more accurate interpretation of results.

Future studies should explore, in larger and more representative samples, the interaction between variables

such as time since diagnosis, adherence to antiretroviral therapy, associated comorbidities, and environmental conditions. A comparison across different Brazilian regions, focusing on factors like humidity, altitude, and pollution, could clarify whether PLHIV's pulmonary vulnerability is influenced by these elements. Finally, incorporating complementary techniques, such as respiratory muscle strength assessment and imaging exams, could provide a more comprehensive understanding of pulmonary dysfunction in this population, supporting the development of more effective preventive and therapeutic protocols.

It is suggested that studies assess forced expiratory volume in the first second (FEV1) while associating it with expiratory strength evaluation, as the values that showed greater deviations compared to the control group were linked to expiratory volume and vital capacity. It is also important to conduct comparative studies with larger samples across both sexes.

LIST OF ABBREVIATIONS

aOR	=	Adjusted Odds Ratio
ART	=	Antiretroviral therapy
FVC	=	Forced vital capacity
FEF 25%-75%	=	Forced expiratory flow between 25% and 75% of FVC
FEV1	=	Forced expiratory volume in the first second
FEV1/FVC	=	Ratio of FEV1 to FVC
HIV	=	Human immunodeficiency virus
PFE	=	Peak expiratory flow
PVHIV	=	People living with HIV
SD	=	Standard deviation
VIR	=	Inspiratory volume
VR	=	Residual volume

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The experimental protocol was submitted to the Research Ethics Committee of the University of Brasília – Ceilândia Faculty (CEP FCE) and approved under opinion number 6.103.422 and CAAE 67920723.3.0000.8093, and strictly complied with all the ethical precepts in Resolution 466/12, with guidelines for research with human subjects in Brazil. The research was conducted at the Human Performance and Health Functionality Laboratory of the University of Brasília – Ceilândia Faculty under controlled temperature conditions (18 to 22°C).

HUMAN AND ANIMAL RIGHTS

The present study was conducted in accordance with the guidelines established by the Brazilian Research Ethics Committee, following the principles set forth in the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

The volunteers freely and voluntarily signed the informed consent form (ICF), ensuring that individuals who did not agree with the development of the study were not included in the research, and their data were not collected.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data can be requested *via* the corresponding author's email, ensuring that participants' names and personal information will be anonymized in accordance with the Research Ethics Committee of the University of Brasília.

FUNDING

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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