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# Arterial stiffness and leisure-time physical activity in female community health workers: a cross-sectional study

## Rigidez arterial e atividade física no lazer em agentes comunitárias de saúde: um estudo transversal

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ABSTRACT

The high prevalences of non-communicable chronic diseases have been increasing in the population, including healthcare professionals, therefore, the association between leisure-time physical activity (LTPA) and arterial stiffness (AS) was evaluated through a cross-sectional study conducted with female community health workers (CHWs) from Vitória, Espírito Santo. LTPA was assessed using the international physical activity questionnaire, and AS was measured by carotid-femoral pulse wave velocity (cfPWV). Participants were considered active if they engaged in at least 150 minutes per week of moderate LTPA, 150 minutes per week of combined moderate and vigorous LTPA, or 75 minutes per week of vigorous LTPA. Elevated AS was classified using a cut-off point of cfPWV ≥ the 90th percentile, stratified by sex and age group for a healthy population. Statistical tests were performed to compare proportions and means, with a p-value of <0.05 considered significant. A total of 221 CHWs (mean age 47.6 ± 8.6 years) were evaluated. Physical inactivity and elevated AS were observed in approximately 78% and 23% of the participants, respectively. A higher percentage of elevated AS was observed among CHWs who did not meet the LTPA recommendations (22.0%) compared to those who were physically active (6.0%) (p<0.001). Lower mean LTPA (15.6 ± 47.7 minutes per week) was observed among CHWs with elevated AS (p = 0.020). Physical inactivity is associated with elevated arterial stiffness. It is suggested that the promotion of LTPA be encouraged among professionals working on the front line of the Unified Health System, even if they perform work-related physical activities.

**Keywords**: Physical activity; Carotid-femoral pulse wave velocity; Primary Health Care; Healthcare professional.

RESUMO

*As prevalências de doenças crônicas não transmissíveis vêm crescendo na população, incluindo em profissionais da saúde, portanto, avaliou-se a ocorrência de rigidez arterial (RA) elevada segundo atividade física no lazer (AFL) através de estudo transversal realizado com agentes comunitárias de saúde (ACS) do sexo feminino de Vitória, Espírito Santo. A AFL foi avaliada pela versão longa do International Physical Activity Questionnaire e a RA foi mensurada pela Velocidade de Onda de Pulso carotídeo-femoral (VOPc-f). As participantes foram consideradas ativas quando praticavam pelo menos 150 minutos/semana de AFL moderada ou 150 minutos/semana da soma da AFL moderada e vigorosa ou 75 minutos/semana de AFL vigorosa. Para a classificação da RA elevada foi utilizado o ponto de corte que considera valor de VOPc-f ≥ ao percentil 90 estratificado por sexo e faixa etária para população saudável. Foram executados testes estatísticos para comparação de proporções e médias. Um valor de p<0,05 foi considerado significativo. Foram avaliadas 221 ACS (média de idade 47,6 ± 8,6 anos). Observou-se inatividade física no lazer e RA elevada em cerca de 78% e 23% das participantes, respectivamente. Foi evidenciado maior percentual de RA elevada entre as ACS que não atingiram a recomendação de AFL (22,0%) em comparação às ativas fisicamente (6,0%) (p<0,001). Menores médias de AFL (15,6 ± 47,7) foram observadas entre as ACS com RA elevada (p = 0,020). Conclui-se que a ocorrência de RA elevada foi maior entre as ACS inativas no lazer. Sugere-se que a promoção de AFL seja estimulada entre os profissionais que trabalham na linha de frente do Sistema Único de Saúde, ainda que realizem atividades físicas relacionadas ao trabalho.*

**Palavras-chave**: *Atividade física; Velocidade da onda de pulso carótido-femoral; Atenção Básica à Saúde; Profissional de saúde.*

## Introduction

The increase in stiffness of large arteries is an important risk factor for cardiovascular diseases, serving as a predictor of morbidity and mortality, regardless of other cardiovascular risk factors[1]. Arterial stiffness (AS) variation, measured through carotid-femoral pulse

wave velocity (cfPWV), the gold standard method for assessing aortic stiffness[2], has been associated with various factors, among which we highlight physical activity levels (PA)[3].

Data published in the document from the Surveillance of Risk Factors and Protection for Chronic Diseases by Telephone Survey (VIGITEL) in 2021[4] indicate that 48.2% of Brazilians are insufficiently active, meaning they do not engage in PA or engage in less than 150 minutes per week of moderate PA, whether during leisure, work, or commuting.

Regular PA can prevent the development of cardiovascular diseases[5]. Additionally, in recent years, several studies have shown that regular PA mitigates the increase in AS associated with aging[6-8]. Observational studies have demonstrated that middle-aged and older adults who are regularly active exhibit lower cfPWV and greater carotid compliance compared to their inactive counterparts[7,8].

However, investigations assessing the occurrence of elevated AS according to leisure-time physical activity (LTPA) levels among primary healthcare professionals are scarce in the literature, especially among community health workers (CHWs). Typically, studies in this field focus on evaluating the work methods of these professionals, without directly addressing their health[9].

CHWs are professionals who work in the Family Health Strategy of the Brazilian Unified Health System. Among their responsibilities, they focus on developing educational actions within the community they serve, aiming to promote health and prevent diseases and health issues[9]. Despite the time spent commuting during working hours, a high percentage of obesity and other non-communicable chronic diseases has been observed among these professionals[10]. Therefore, even though commuting is a work requirement, a lower inclination toward engaging in physical exercise during leisure time may be evident[11]. Given the presence of chronic outcomes that can increase the risk of cardiovascular events over time[12,13], it becomes important to assess the cardiovascular health of this professional group through AS measurements.

Furthermore, the objective of the study was to assess the occurrence of elevated AS according to LTPA among CHWs working in the municipality of Vitória, Espírito Santo. We hypothesized that a higher occurrence of elevated AS would be observed among CHWs who do not meet the recommended LTPA.

# Methods

## Study design and sample

This is a cross-sectional study using data from a larger project titled "Impact of Training Community Health Workers on Food Education"[14]. The larger study lasted for 24 months and was conducted in four stages. For the present analyses, we utilized the baseline data (October 2018/March 2019).

The study was conducted with CHWs affiliated with 23 Family Health Units (FHUs) and 2 Basic Health Units (BHUs) in Vitória, Espírito Santo. In order to facilitate the participation of CHWs, researchers visited the FHUs and BHUs in the municipality to disseminate the research and invite them to participate. At the time of recruitment, there were approximately 375 professionals affiliated with the service, as identified by the Municipal Government of Vitória, Espírito Santo.

The following exclusions were made based on their respective justifications: male CHWs (n = 15), due to the small sample size that hinders comparisons; pregnant individuals (n = 1), due to bodily and metabolic changes during this life phase; CHWs under the age of 35 (n = 19), as the cutoff point used for cfPWV, considering the 90th percentile for sex and age group, was only established for those aged 35 or older[15]; and those with missing values in exposure variables (LTPA; n = 1) and outcome (cfPWV; n = 6).

## Data collection

Clinical examinations and questionnaire administration (in-person interviews) were conducted in the morning at pre-scheduled times by a trained team at the Cardiovascular Investigation Clinic, affiliated with, University Hospital, Universidade Federal do Espírito Santo, between October 2018 and March 2019.

## Sociodemographic, health, and lifestyle data

Through questionnaires conducted in face-to-face interviews, we collected sociodemographic, health, and lifestyle data. We used criteria established by the Brazilian Association of Research Companies (ABEP)[16] for determining socioeconomic class, which was categorized as "A and B," "C," or "D and E." Self-reported race/skin color was categorized as "White," "Black," and "Mixed (Brown, Indigenous, and Asian)." Educational level was categorized as "elementary school," "high school," and "Higher Education" based on years of education. Marital status was categorized as "single," "married/cohabiting," and "separated/widowed." We identified the use of

medication for diabetes mellitus and arterial hypertension in the two weeks preceding the interview. Smoking status and current alcohol consumption were obtained through direct questions, with "yes" and "no" as response options.

## Anthropometric, hemodynamic, and biochemical assessment

Stature was measured during the inspiratory phase of the respiratory cycle using a wall-mounted stadiometer (Seca®, Hamburg, Germany) with a 0.1 cm scale. Participants stood barefoot with their gaze fixed on the horizon. Using the Inbody® 230 – Body Composition Analyzer, body mass and body fat percentage (BPF) were assessed. For those with pacemakers and/or metal prostheses in the upper and/or lower limbs, only body mass was measured using an electronic scale (Toledo®) with a capacity of 200 kg and a precision of 50 g[17]. Based on body mass and stature data, the body mass index (BMI) was calculated by dividing body mass (in kg) by height (in meters) squared. The BMI variable was expressed as mean ± standard deviation (SD), and overweight status was defined as BMI ≥ 25.0 kg/m$^2$ [18].

Waist circumference (WC) was measured with the participant in an upright position and normal breathing. The feet were together, the upper clothing was lifted, and the arms were crossed in front of the chest. This measurement was taken using a non-stretchable measuring tape at the midpoint between the lower edge of the rib cage and the iliac crest. When it was not possible to follow this protocol, the measurement was taken at the umbilical scar[19]. WC was expressed as mean ± SD.

Blood pressure was measured using a validated automatic device from Omron® (model HEM-705 CP) after a five-minute rest period. Participants were instructed to sit without crossing their legs, with feet flat on the floor, left arm supported, and no clothing covering the arm. Measurements were taken in a quiet environment with controlled temperature (20°C-24°C). Three readings were obtained from the left arm at one-minute intervals. Casual systolic blood pressure (SBP) and diastolic blood pressure (DBP) were calculated as the average of the last two measurements[20]. Mean arterial pressure (MAP) was calculated using the following formula: MAP = DBP + ([SBP – DBP]/3)[20].

Fasting blood samples were collected after an overnight fast (10-14 hours) via venipuncture. The samples were sent to the Clinical Analysis Laboratory (Tommasi Laboratory) for determination of the parameters of interest. The following parameters were evaluated: fasting glucose (mg/dL), glucose measured 120 minutes after a flavored 75 g dextrose load (mg/dL [administered to CHWs who did not declare themselves as diabetic and/or had not undergone prior bariatric surgery]), total cholesterol (mg/dL), HDL-cholesterol (mg/dL), LDL-cholesterol (mg/dL), non-HDL-cholesterol (mg/dL), and triglycerides (mg/dL).

CHWs were considered to have diabetes mellitus if they met at least one of the following three criteria: self-reported use of hypoglycemic medication (insulin or oral hypoglycemic agents) and/or fasting glucose ≥ 126 mg/dL and/or glucose measured 120 minutes after a glucose solution load ≥ 200 mg/dL[21]. For the classification of arterial hypertension, the presence of at least one of the following three criteria was considered: use of antihypertensive medication and/or SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg. Elevated values for total cholesterol and triglycerides were defined as ≥ 190 mg/dL and ≥ 150 mg/dL, respectively[22].

## Assessment of leisure-time physical activity (LTPA)

The assessment of LTPA was conducted using the "leisure-time" domain of the long version of the International Physical Activity Questionnaire (IPAQ), adapted for the Brazilian population[23]. The LTPA pattern was reported in minutes per week, calculated by multiplying the weekly frequency by the duration of each activity performed (both moderate and vigorous PA). Participants were considered active if they engaged in ≥ 150 minutes/week of moderate LTPA or ≥ 150 minutes/week of the combined moderate and vigorous LTPA, or ≥ 75 minutes/week of vigorous LTPA[23]. Those who did not meet these criteria were classified as inactive.

## Assessment of commuting physical activity (PA)

For this assessment, we used the "commuting PA" domain from the long version of the IPAQ[23]. The variable was obtained in minutes per week, considering walking or cycling for commuting purposes.

## Assessment of arterial stiffness (AS)

The cfPWV was measured using a validated automatic device (Complior, Artech Medical, France) while the CHWs were lying on an examination table in a room with controlled temperature (20°C-24°C). The measurement of the distance from the sternal notch to the

right femoral pulse was performed using a non-stretchable measuring tape, as was the measurement from the sternal notch to the mandibular angle. Pulse sensors were positioned on the right carotid and femoral arteries, allowing visualization of the pulse waves on a computer screen. A software program identified the pulse waves, and cfPWV was calculated by dividing the distance from the sternal notch to the femoral pulse by the time delay between the carotid and femoral pulses. The cfPWV for each CHA was calculated as the arithmetic mean obtained from ten consecutive cardiac cycles during regular heart rhythm[15]. To determine elevated AS, a cutoff value was used, considering a cfPWV ≥ 90th percentile stratified by sex and age group for a healthy population[15].

### Statistical analysis

The Kolmogorov-Smirnov test was used to assess the normality of continuous variables. The Chi-Square test and Fisher's exact test were employed to examine differences in proportions among categorical variables. Mean comparisons between two independent samples were performed using the Student's t-test and Mann-Whitney test. To identify the percentage of elevated AS according to LTPA, Fisher's exact test was conducted. Additionally, to evaluate differences in LTPA means according to AS, the Mann-Whitney test was applied. Statistical analysis was performed using SPSS version 21.0, with a significance level set at $p < 0.05$.

### Ethical considerations

The study project was approved by the Human Research Ethics Committee of the Centro de Ciências da Saúde, Universidade Federal do Espírito Santo (Certificate of Submission for Ethical Appraisal No. 88008418.6.0000.5060; Opinion No. 2.669.734), after authorization had been given by the Vitória Municipal Health Department and the Espírito Santo State Health Department. The project was registered with the WHO (UTN - U1111-1232-4086) and with the Brazilian Clinical Trials Registry (REQ: RBR-4z26bv). CHWs who agreed to take part in the study signed a Free and Informed Consent form.

## Results

The sample consisted of 221 female CHWs, predominantly of Mixed race (Brown, Indigenous, and Asian) (51.1%), with a high school education (82.3%), married or in a stable union (68.3%), belonging to socioeconomic class C (58.8%), and with a mean age of 47.6 ± 8.6 years (Table 1). Table 1 also includes sociodemographic and health characteristics stratified by LTPA level. Inactivity during leisure was observed in 77.8% of the sample. Inactive CHWs during leisure had a higher mean age ($p = 0.037$), a higher percentage of diabetes mellitus ($p = 0.011$), elevated total cholesterol ($p = 0.049$), hypertriglyceridemia ($p = 0.038$), and overweight ($p = 0.006$) compared to active CHWs. Additionally, CHWs inactive during leisure had a lower mean commuting PA compared to active ones ($p<0.001$).

Table 2 presents biochemical, anthropometric, and hemodynamic parameters stratified by LTPA. Higher means of non-HDL-cholesterol ($p = 0.038$), triglycerides ($p = 0.003$), fasting glucose ($p = 0.012$), BMI ($p = 0.022$), BFP ($p = 0.012$), and WC ($p = 0.010$) were observed among inactive CHWs.

Figure 1 shows the percentage of elevated AS according to LTPA. It was observed that 22.0% of CHWs who did not meet the LTPA recommendation had elevated AS, while only 6.0% of physically active CHWs exhibited this outcome ($p<0.001$).

## Discussion

The present study identified that approximately 23.0% of CHWs exhibited elevated AS, and nearly 80% did not meet the LTPA recommendation. Furthermore, the group of CHWs who met the LTPA recommendations had a lower average age, engaged in more commuting physical activity, had a better cardiometabolic profile, and exhibited lower AS levels compared to the group that did not meet the recommendations.

The sample in the present study is predominantly inactive during leisure time, as only 22.0% met the PA recommendations set by the World Health Organization[24]. This scenario is also evident in the VIGITEL survey among women aged 45 to 54 years[4]. Overall, the CHWs showed high averages of commuting PA the demands of their work. It's worth noting that those with higher averages of LTPA were also more active at work, suggesting a positive influence between the two practices.

In the present study, inactive CHWs exhibited a higher mean age compared to active ones. This age group is characterized by various physiological changes, such as menopause[25], which can directly impact muscle strength and power[25,2]. These factors may contribute to a potential reduction in quality of life due to physical inactivity. Additionally, studies indicate that

**Table 1 –** Sociodemographic and health characterization stratified by leisure-time physical activity in female community health agents, Vitória, Espírito Santo, 2018-2019.

| Variables | Total (n = 221) | Leisure-time physical activity | | p-value |
|---|---|---|---|---|
| | | Active (n = 49; 22.2%) | Inactive (n = 172; 77.8%) | |
| Race/skin color | | | | 0,387* |
| White | 40 (18.1) | 12 (24.5) | 28 (16.3) | |
| Black | 68 (30.8) | 15 (30.6) | 53 (30.8) | |
| Brown, Indigenous and Yellow | 113 (51.1) | 22 (44.9) | 91 (52.9) | |
| Schooling | | | | 0,789# |
| Elementary school | 9 (4.1) | 2 (4.1) | 7 (4.1) | |
| High school | 182 (82.4) | 42 (85.7) | 140 (81.4) | |
| Higher education | 30 (13.6) | 5 (10.2) | 25 (14.5) | |
| Socioeconomic class | | | | 0,312# |
| A/B | 87 (39.4) | 20 (40.8) | 67 (39.0) | |
| C | 130 (58.5) | 27 (55.1) | 103 (59.9) | |
| D/E | 4 (1.8) | 2 (1.2) | 2 (4.1) | |
| Marital Status | | | | 0,224* |
| Single | 29 (13.1) | 7 (14.3) | 22 (12.8) | |
| Married/stable union | 151 (68.3) | 29 (59.2) | 122 (70.9) | |
| Divorced or widowed | 41 (18.6) | 13 (26.5) | 28 (16.3) | |
| Diabetes mellitus | 41 (18.6) | 3 (6.1) | 38 (22.1) | 0,011#a |
| Hypertension | 84 (38.0) | 15 (30.6) | 69 (40.1) | 0,227* |
| High cholesterol | 135 (61.1) | 24 (49.0) | 111 (64.5) | 0,049*a |
| Hypertriglyceridemia | 62 (28.1) | 8 (16.3) | 54 (31.4) | 0,038*a |
| Overweight | 164 (74.2) | 29 (59.2) | 135 (78.5) | 0,006*a |
| Smoking | 6 (2.7) | 0 (0.0) | 6 (3.5) | 0,342# |
| Alcohol drinking | 85 (38.5) | 29 (59.2) | 56 (32.6) | 0,001*a |
| Age (years) | 47.6 ± 8.6 | 45.3 ± 8.9 | 48.2 ± 8.4 | 0,037$a |
| Commuting physical activity (minutes/week) | 771.1 ± 575.4 | 1125 ± 526.1 | 670.3 ± 549.6 | <0,001⸸a |

Data expressed as n (%) and mean ± standard deviation. * = Chi-Square Test; # = Fisher's Exact Test; $ = Student's t-test; ⸸ = Mann-Whitney test; a = statistically significant.

cfPWV increases by approximately 0.5 to 2.0 m/s per decade of life. To mitigate the impact of age on the classification of elevated AS, cfPWV values above the 90th percentile stratified by age group were used in the present study.

The regular practice of PA is one of the main pillars in the non-pharmacological treatment of cardiometabolic diseases. Our study revealed that inactive CHWs had higher percentages of overweight, diabetes mellitus, dyslipidemia, and hypertriglyceridemia, as well as higher mean values of non-HDL-cholesterol, BMI, WC, and BFP. The literature remains controversial regarding the association between LTPA and dyslipidemias[26-28], but there is a well-established association between LTPA and protection against overweight[28] and diabetes mellitus[29,30].

The results indicate that higher average levels of LTPA are associated with an increase in average commuting physical activity. These findings may be relevant for promoting LTPA practice, especially considering that LTPA supplementation, as evaluated by systematic reviews[31,32], leads to better health outcomes.

The present study presents limitations and potentialities. One possible limitation of this study is that information about PA was obtained through a questionnaire, thus relying on self-reported data. This method is subject to errors and may be influenced by memory bias. On the other hand, this instrument is widely used in national and international epidemiological studies. Furthermore, it is not possible to generalize the findings to CHWs from other municipalities, as only female CHWs from Vitória, Espírito Santo were in-

**Table 2 –** Biochemical, anthropometric and hemodynamic parameters stratified by leisure-time physical activity in female community health workers, Vitória, Espírito Santo, 2018-2019.

| Variables | Leisure-time physical activity | | p-value |
|---|---|---|---|
| | Active (n = 49; 22.2%) | Inactive (n = 172; 77.8%) | |
| Total cholesterol (mg/dL) | 192.9 ± 37.8 | 204.3 ± 38.0 | 0,065* |
| HDL-cholesterol (mg/dL) | 52.0 ± 9.2 | 50.7 ± 10.6 | 0,317* |
| LDL-cholesterol (mg/dL) | 116.1 ± 35.6 | 126.2 ± 35.6 | 0,081* |
| Non-HDL-cholesterol (mg/dL) | 140.8 ± 38.1 | 153.5 ± 37.3 | 0,038#a |
| Triglycerides (mg/dL) | 109.7 ± 53.5 | 133.4 ± 61.9 | 0,003#a |
| Fasting blood glucose (mg/dL) | 94.3 ± 13.6 | 106.5 ± 32.8 | 0,012#a |
| BMI (Kg/m$^2$) | 27.3 ± 4.7 | 29.4 ± 5.5 | 0,022*a |
| PBF (%) | 36.7 ± 7.2 | 39.6 ± 6.9 | 0,012*a |
| WC (cm) | 85.9 ± 12.1 | 92.1 ± 15.3 | 0,010*a |
| SBP (mmHg) | 115.1 ± 15.6 | 116.2 ± 13.3 | 0,626# |
| DBP (mmHg) | 73.8 ± 11.1 | 74.8 ± 8.6 | 0,515# |
| MAP (mmHg) | 87.6 ± 11.9 | 88.6 ± 9.5 | 0,214# |
| cfPWV (m/s) | 8.43 ± 1.58 | 8.87 ± 1.45 | 0,281* |

Data expressed as mean ± SD. HDL = high density lipoprotein; LDL = lower density lipoprotein; BMI = body mass index; PBF = percentage of body fat; WC = waist circumference; SBP = systolic blood pressure; DBP =diastolic blood pressure; MAP = Mean arterial pressure; cfPWV = carotid-femoral pulse wave velocity # = cfPWV high (≥ 90th percentile stratified by gender and age group). * = Student's t-test; # = Mann-Whitney test; a = statistically significant.

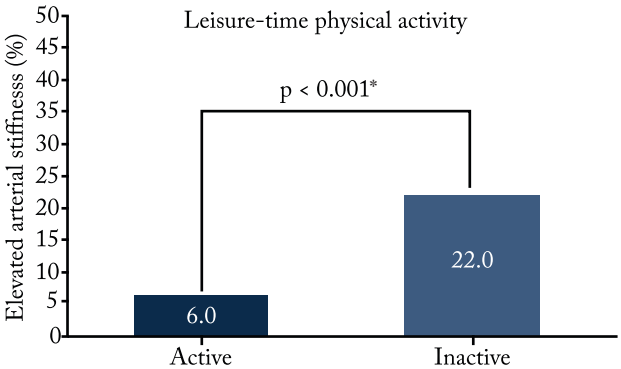


**Figure 1 –** Elevated arterial stiffness according to leisure-time physical activity in female community health Workers, Vitória, Espírito Santo, 2018-2019 (n = 221).
Legend: * = Fisher's Exact Test.

cluded in the present analysis. However, given the high participation rate of professionals in the larger study (approximately 70.0%)[10], and considering that women accounted for 94.3% of the sample[10], we can say that our study sample is representative of these professionals in the city of Vitória, Espírito Santo. It is important to note that small samples tend to produce estimates with lower reliability, which is why multivariate analyses were not presented. No significant difference was observed between commuting PA and cardiovascular risk. Although the protective role of LTPA against cardiovascular diseases is widely recognized, evidence regarding the protective effect of commuting physical activity, especially walking, is limited. This is because exercise intensity appears to influence this effect[33,34]. Our findings provide the first evidence of a relationship between LTPA and elevated cardiovascular risk in Brazilian healthcare professionals who engage in commuting-related work activities.

In conclusion, we observed that among CHWs who did not meet the recommendations for LTPA, there was a higher occurrence of elevated cardiovascular risk compared to those who were physically active during leisure. These findings can inform actions aimed at preventing risk factors for non-communicable chronic diseases in professionals who play a frontline role in population care and have a key role in health promotion in primary care. Therefore, promoting and understanding the potential factors that limit LTPA should be considered to make it a viable and sustainable part of these individuals' lifestyle.

## Conflict of interest

The authors declare no conflict of interest.

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## Author's contributions

Azevedo LB: Methodology; Software; Formal analysis; Investigation; Visualization; Writing – original draft; Approval of the final version. Martins HX: Conceptualization; Methodology; Software; Formal analysis; Data curation; Project administration; Writing - original draft; Approval of the final version. Siqueira JH: Conceptualization; Methodology; Data curation; Project administration; Writing original draft; Approval of the final version. Siqueira JH: Conceptualization; Methodology; Data curation; Project administration; Writing - original draft; Approval of the final version. Alvim RO: Development, Data analysis; Data curation; Writing of the original manuscript; Approval of the final version of the manuscript. Oliveira AMA: Conceptualization; Validation; Project administration; Writing - review & editing; Approval of the final version. Jesus HC: Conceptualization; Methodology; Project administration; Writing - original draft;

Approval of the final version. Faria CP: Formal analysis; Resources; Supervision; Writing - review & editing; Approval of the final version. Molina MDCB: Conceptualization; Methodology; Resources; Supervision; Project administration; Funding acquisition; Writing - review & editing; Approval of the final version.

## Declaration regarding the use of artificial intelligence tools in the article writing process

The manuscript did not use artificial intelligence tools for its preparation.

## Availability of research data and other materials

After publication the data will be available on demand to authors - a condition justified in the manuscript

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