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Original article

# Metabolic responses during practice of exergames in adults according to sex

## Respostas metabólicas durante a prática de exergames em adultos de acordo com o sexo

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**ABSTRACT**

**Objective:** To analyze the metabolic responses occurring during the practice of exergames in terms of energy expenditure, oxygen consumption rate, metabolic equivalent and heart rate in adult men and women. **Methods:** The present study sample was comprised of 102 adults (52 males). Energy expenditure, oxygen consumption rate and metabolic equivalent were assessed with a portable gas analyzer (K4b2). Heart rate was measured with a frequencymeter. All dependent variables were assessed at rest and during the exergame session, which was comprised of four X-box 360 games (volleyball, boxing, athletics, and bowling). **Results:** Mean age was 34.8 ± 13.4 years. There was a significant increase in resting values during exergame sessions for energy expenditure (male: 467.52%; $p < 0.001$; female: 393.72%; $p < 0.001$), oxygen consumption rate (male: 453.97%; $p < 0.01$; female: 384.74%; $p < 0.001$), metabolic equivalent (male: 457.40%; $p < 0.001$; female: 384.74%; $p < 0.001$) and heart rate (male: 95.10%; $p < 0.001$; female: 92.26; $p < 0.001$). When compared to women, men showed significantly higher values for energy expenditure (95% confidence interval = -12.53; -6.67), oxygen consumption rate (95% confidence interval = -4.01; -0.80) and metabolic equivalent (95% confidence interval = -1.18; 0.27) during exergames. **Conclusion:** A session of exergames is capable of increasing energy expenditure, oxygen consumption rate, metabolic equivalent and heart rate in adults. Men showed higher values in metabolic parameters when compared to women.

**Keywords:** energy metabolism, video games, heart rate.

**RESUMO**

**Objetivo:** Analisar as respostas metabólicas ocorridas durante a prática de exergames em termos de gasto energético, taxa de consumo de oxigênio, equivalente metabólico e frequência cardíaca em homens e mulheres adultos. **Métodos:** A amostra do presente estudo foi composta por 102 adultos (52 homens). O gasto energético, a taxa de consumo de oxigênio e o equivalente metabólico foram avaliados com um analisador de gases portátil (K4b2). A frequência cardíaca foi medida com um frequencímetro. Todas as variáveis dependentes foram avaliadas em repouso e durante a sessão de exergame, que foi composta por quatro jogos no console X-box 360 (voleibol, boxe, atletismo e boliche). **Resultados:** A média de idade foi de 34,8 ± 13,4 anos. Houve um aumento significativo nos valores de repouso durante as sessões de exergame para gasto de energia (masculino: 467,52%; $p < 0,001$; feminino: 393,72%; $p < 0,001$), taxa de consumo de oxigênio (masculino: 453,97%; $p < 0,01$; feminino: 384,74 %; $p < 0,001$), equivalente metabólico (masculino: 457,40%; $p < 0,001$; feminino: 384,74%; $p < 0,001$) e frequência cardíaca (masculino: 95,10%; $p < 0,001$; feminino: 92,26; $p < 0,001$). Quando comparados às mulheres, os homens apresentaram valores significativamente maiores para gasto energético (intervalo de confiança de 95% = -12,53; -6,67), taxa de consumo de oxigênio (intervalo de confiança de 95% = -4,01; -0,80) e equivalente metabólico (95% de confiança intervalo = -1,18; 0,27) durante exergames. **Conclusão:** Uma sessão de exergames é capaz de aumentar o gasto energético, a taxa de consumo de oxigênio, o equivalente metabólico e a frequência cardíaca em adultos. Os homens apresentaram valores mais elevados nos parâmetros metabólicos quando comparados às mulheres.

**Palavras-chave:** metabolismo energético, jogos de vídeo, frequência cardíaca.

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## Introduction

Electronic games stand out worldwide among innovations in home technology in recent decades as they attract children, adolescents, and adults [1]. These technologies are used as entertainment because they provide amusement and allow a sensation of well-being for users [2,3]. On the other hand, they also promote low physical activity levels, which can have a repercussion on the onset of non-communicable chronic diseases [4].

In the last decade, a new type of videogame known as exergames appeared in the world of technology and raised the interest of the scientific community [5]. In this type of videogame, players need to perform body movements to control and reach its goal [6,7].

Several studies [8,9] showed that these body movements cause an increase in energy expenditure (EE) [10,11], oxygen consumption rate ($VO_2$/kg) [11,12] metabolic equivalent (METs) and heart rate (HR) [12].

However, most studies with exergames have been performed with children and adolescents [1,13] or with individuals in rehabilitation [14-16]. Few studies have investigated adults and taken into consideration the differences between sex and $VO_2$/kg, METs and HR [6,17].

Thus, the present study aimed to analyze the metabolic responses occurring during the practice of exergames for EE, $VO_2$/kg, METs and HR in both sexes.

## Methods

### *Type of study*

A cross-sectional, descriptive and correlational study was performed.

### *Sample*

The study sample was non-probabilistic and included 102 Brazilian adults. The inclusion criteria were as follows: to be a member of a public university community of Southern Brazil (students, employees, professors, and extension project participants); and to be aged ≥21 years. In contrast, the following individuals were excluded: those who used beta-blockers; those with thyroid disorders or orthopedic injuries, those who were mobility challenged; and those who had visual or hearing impairments which could affect the understanding of exergame instructions.

Participants were recruited through invitations aimed at the target population. E-mails were sent to the coordination offices of the courses held at the Universidade Federal de Santa Catarina and individually to the addresses registered with the service of this university. Additionally, this project was promoted on social media and the university website, as well as through visits to extension projects and classrooms.

The study protocol was approved by the Research Ethics Committee of the Universidade Federal de Santa Catarina (CAAE 32996914.0.0000.0121).

### *Study variables*

Age (in years) and sex (female and male) were collected through a questionnaire. Body mass index (BMI = $kg/m^2$) was determined by assessing body weight and height. Body weight (kg) was measured with a scale (Toledo®; 100 g accuracy). During measurement, individuals remained barefoot and wearing light clothing.

Height (in meters) was determined with the use of a stadiometer (Sanny®; 0.5 cm accuracy). During measurement, participants were barefoot, standing in a straight position, with their feet together and heels, buttocks and head touching the stadiometer.

Muscle mass index (MMI) was assessed with the calculation proposed by Lee *et al.* [18]: MMI = height (in meters) x (0.244 x body weight) + (7.8 x height) + (6.6 x sex) (0.098 x age) + (ethnicity – 3.3). The values attributed to sex and ethnicity were as follows: male = 1; female = 0; Asian = 1.2; African descendant = 1.4; Caucasian = 0.

The assessment of EE, $VO_2$ and MET were performed at rest and the practice of exergames through indirect calorimetry, using a COSMED portable gas analyzer, K4b2 model. During rest, participants were sitting in silence for ten minutes. During exergames, the metabolic variables were assessed per game, which lasted ten minutes each for the stabilization of physiological variables at rest.

The K4b2 system was calibrated before each test to guarantee the exact measures of the surrounding air, cylinder gas, turbine, and delay, according to the manufacturer's recommendations (COSMED SRL).

EE ($kcal.min^{-1}$) was assessed using the Tufts University Nutrition Collaborative protocol, when individuals under evaluation must be fasting for at least four hours, are only allowed to drink water, and must not have performed physical exercises in the previous 48 hours.

METs were used as they were multiples of resting metabolic rates [19]. They were calculated as follows: $VO_2$ of activity ($ml(kg.min)^{-1}$)/$VO^2$ at rest ($ml(kg.min)^{-1}$).

HR was measured with a frequencymeter (Polar®, 610i model) and it was reported as heartbeats/minute. The maximum HR (HRmax) was found through the calculation proposed by Karvonen, Kentala and Mustala [20].

### *Exergame protocol*

The exergame session was performed using the XBox360 with Kinecttm. A 4x4 $m^2$ area was reserved for the Kinect sensor camera to monitor participants' movements during games. Games were performed individually and before the beginning of a session, interviewers provided a verbal explanation and showed how to play each game, seeking to facilitate participants' performance.

Kinect Sports (1st and 2nd seasons) was used, including boxing, bowling, volleyball, and athletics, and each game lasted ten minutes. The sequence of games was randomly selected for each player and the first five minutes were disregarded to allow for the stabilization of metabolic parameters. Resting periods were included between game categories when players remained sitting and rested for five minutes.

The practice of exergame, the interviews, as well as the measurements of the physiological variables (GE, $VO_2$, METs and HR), during rest and games, were carried out in a previously prepared room.

Data were collected in a single session in the facilities of the Sports Center of the Federal University of Santa Catarina (CDS/EFSC). The practice of exergames, interviews and measurements of physiological variables (EE, $VO_2$, METs and HR) at rest and games were performed in a previously prepared classroom. Anthropometric measurements (body weight and height) were taken in the Laboratory of Physiology.

### *Statistical procedures*

Means and standard deviations were calculated for EE, $VO_2$, METs and HR, according to sex. Aiming to compare the EE, $VO_2$, METs and HR parameters between women and men, Student's t test for independent samples was used.

Variance analysis (ANOVA) for repeated measurements and pos-hoc multiple comparison (Tukey) were applied to compare the means of EE, $VO_2$, METs and HR during rest and each exergame (boxing, athletics, volleyball, and bowling).

A statistical significance level of 5% was defined for all analyses and STATA (Stata Corporation, College Station, USA) 13.0® was used.

## Results

Table I shows the sample characteristics. There were significant differences between men and women for anthropometric characteristics and higher values were found for males.

**Table I** - Sample characteristics. Florianópolis, Santa Catarina, Brazil, 2014

| | Female (n = 50) Mean ± SD | Male (n = 52) Mean ± SD | Total (n = 102) Mean ± SD | p |
|---|---|---|---|---|
| Age (years) | 33.7 ± 13.0 | 35.9 ± 13.9 | 34.8 ± 13.4 | 0.423 |
| Body weight (kg) | 63.61 ± 10.35 | 78.56 ± 12.19 | 71.31 ± 13.55 | <0.001 |
| Height (m) | 1.64 ± 0.07 | 1.75 ± 0.09 | 1.69 ± 0.10 | <0.001 |
| BMI (kg/m²) | 23.79 ± 3.77 | 25.53 ± 2.81 | 24.68 ± 3.41 | 0.011 |
| MMI (kg) | 12.95 ± 57.60 | 14.01 ± 73.41 | 13.49 ± 84.84 | <0.001 |

SD = Standard deviation; kg = kilogram; m = meters; BMI = body mass index; IMM = muscle mass index

According to Table II, there was a significant increase ($p < 0.001$) in EE, $VO_2$/kg, METs and HR values during the four games for both sexes. Comparisons between exergame categories showed significant differences in $VO_2$/kg and METs for bowling and boxing, indicating statistically higher values during boxing practice.

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**Table II** - Means and standard deviations for EE (kcal/min)$^{-1}$, $VO_2$ ml(kg.min)$^{-1}$, METs and HR (bpm), in different games according to sex. Florianópolis, Santa Catarina, Brazil, 2014 (n = 102)

| | EE (kcal/min)$^{-1}$ | $VO_2$ mL (kg.min)$^{-1}$ | METs | HR (bpm) | HRmax |
|---|---|---|---|---|---|
| **Masle** | **Mean ± SD** | **Mean ± SD** | **Mean ± SD** | **Mean ± SD** | **%** |
| **Resting** | 1.68 ± 0.06[a] | 4.49 ± 0.17[a] | 1.28 ± 0.05[a] | 68.85 ± 2.09[a] | 41.26 |
| **Volleyball** | 8.39 ± 2.28[b] | 22.27 ± 4.97[bc] | 6.36 ± 1.42[bc] | 129.78 ± 21.06[b] | 76.40 |
| **Boxing** | 9.38 ± 2.77[b] | 24.28 ± 6.29[c] | 6.94 ± 1.80[c] | 139.40 ± 24.07[b] | 78.51 |
| **Athletics** | 8.92 ± 2.33[b] | 22.63 ± 4.87[bc] | 6.47 ± 1.39[bc] | 132.29 ± 22.49[b] | 76.77 |
| **Bowling** | 8.52 ± 2.56[b] | 21.27 ± 6.56[b] | 6.22 ± 1.76[b] | 137.73 ± 19.54[b] | 75.88 |
| **Female** | | | | | |
| **Resting** | 1.43 ± 0.07[a] | 4.58 ± 1.17[a] | 1.31 ± 0.04[a] | 76.33 ± 1.91[a] | 37.75 |
| **Volleyball** | 6.43 ± 1.99[b] | 20.49 ± 4.50[bc] | 5.85 ± 1.29[bc] | 142.06 ± 21.48[b] | 70.23 |
| **Boxing** | 6.74 ± 1.80[b] | 21.26 ± 4.44[c] | 6.07 ± 1.27[c] | 146.33 ± 23.71[b] | 76.02 |
| **Athletics** | 6.69 ± 1.55[b] | 20.90 ± 4.22[bc] | 5.97 ± 1.20[bc] | 143.53 ± 19.41[b] | 72.04 |
| **Bowling** | 6.02 ± 1.73[b] | 18.98 ± 4.248[b] | 5.42 ± 1.21[b] | 141.38 ± 22.94[b] | 74.58 |
| **All** | | | | | |
| **Resting** | 1.65 ± 1.04[a] | 4.52 ± 1.18[a] | 1.29 ± 0.34[a] | 72.40 ± 14.45[a] | 39.36 |
| **Volleyball** | 7.47 ± 2.36[b] | 21.43 ± 4.82[bc] | 6.12 ± 1.38[bc] | 135.56 ± 22.03[b] | 73.28 |
| **Boxing** | 8.14 ± 2.70[b] | 22.86 ± 5.68[c] | 6.53 ± 1.62[c] | 142.63 ± 24.04[b] | 77.24 |
| **Athletics** | 7.86 ± 2.28[b] | 21.81 ± 4.63[bc] | 6.23 ± 1.32[bc] | 137.63 ± 21.73[b] | 74.38 |
| **Bowling** | 7.31 ± 2.52[b] | 20.18 ± 5.67[b] | 5.83 ± 1.56[b] | 139.50 ± 21.22[b] | 75.23 |

abcd = Means followed by letters may show differences between them; p-value < 0,001

Boxing was the most intense game for both men and women, reaching the highest EE, $VO_2$/kg, METs and HR values. Bowling was the least intense game for both sexes, according to the values found for EE (7.31 ± 2.52kcal.min$^{-1}$), $VO_2$/kg (20.18 ± 5.67 mL.kg$^{-1}$.min$^{-1}$) and METs (5.83 ± 1.56), while HR (141.38 ± 22.94 bpm) was the least intense for women exclusively. Among men, the lowest mean values of HR were found for volleyball (129.78 ± 21.06 bpm). These data are shown in Table II.

Additionally, the percentage area of HRmax reached during the practice of exergames was higher than 70% for both women and men. Boxing was the game that showed the highest values, 78% and 76% of the HRmax for males and females respectively (Table II).

Tables III and IV show the comparison between metabolic parameters, measured during rest and game session for males and females, respectively. There was a significant increase in resting values during the game session for EE (male: 467.52%; $p < 0.001$; female: 393.72%; $p < 0.001$), $VO_2$/kg (male: 453.97%; $p < 0.01$; female: 384.74%; $p < 0.001$), METs (male: 457.0%; $p < 0.001$; female: 384.74%; $p < 0.001$) and HR (male: 95.10%; $p < 0.001$; female: 92.26; $p < 0.001$). The effect size was high for all variables ($d \geq 0.80$).

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**Table III** - Comparison of metabolic parameters measured during rest and exergames: data for men. Florianópolis, Santa Catarina, Brazil, 2014 (n=52)

| Variable | Rest Mean ± SD (95%CI) | During games Mean ± SD (95%CI) | % of change (95%CI) | p-value | Cohen d | ES |
|---|---|---|---|---|---|---|
| EE ($kcal.min^{-1}$) | 1.68 ± 0.06 (1.55-1.81) | 8.85 ± 0.29 (8.26-9.43) | 467.52 (541.00; 393.66) | <0.001 | 7.67 | 0.97 |
| $VO_2$ ($mL.kg^{-1}.min.^{-1}$) | 4.49 ± 0.17 (4.12-4.82) | 22.83 ± 0.63 (21.55-24.10) | 453.97 (525.33; 382.61) | <0.001 | 8.92 | 0.97 |
| METS | 1.28 ± 0.05 (1.18-1.38) | 6.53 ± 0.18 (6.18-6.89) | 457.40 (529.93; 384.88) | <0.001 | 9.13 | 0.98 |
| HR (bpm) | 68.85 ± 2.09 (64.65-73.06) | 134.90 ± 2.60 (129.71-140.10) | 95.10 (102.72; 87.50) | <0.001 | 7.43 | 0.96 |

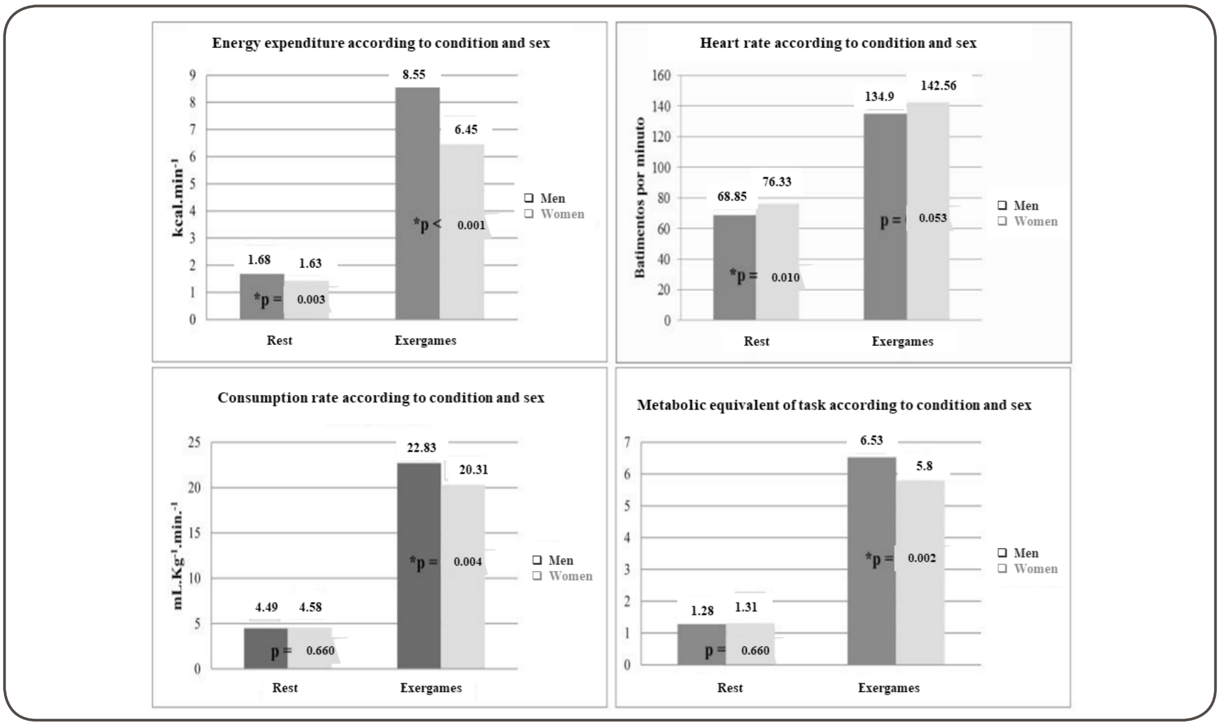
SD = standard deviation; CI = confidence interval; EE = energy expenditure; $VO_2$ = oxygen consumption; METs = metabolic equivalent; HR = heart rate; bpm = beats per minute; % = percentage; ES = effect size

**Table IV** - Comparison of metabolic parameters measured during rest and exergames: data for women. Florianópolis, Santa Catarina, Brazil, 2014 (n = 50)

| Variable | Rest Mean ± SD (95%CI) | During games Mean ± SD (95%CI) | % of change (95%CI) | p | Cohen d | ES |
|---|---|---|---|---|---|---|
| EE ($kcal.min^{-1}$) | 1.43 ± 0.07 (1.31-1.55) | 6.45 ± 0.23 (5.99-6.90) | 393.72 (-460.67;-326.77) | <0.001 | 6.93 | 1.00 |
| $VO_2$ ($mL.kg^{-1}.min.^{-1}$) | 4.58 ± 1.17 (4.24 – 4.93) | 20.31 ± 0.50 (19.30-21.32) | 384.74 (-450.85;-318.63) | <0.001 | 9.72 | 0.98 |
| METS | 1.31 ± 0.04 (1.21-1.41) | 5.80 ± 0.14 (5.51-6.09) | 384.74 (-450.00;-318.63) | <0.001 | 9.72 | 0.98 |
| HR (bpm) | 76.33 ± 1.91 (72.45 – 80.17) | 142.56 ± 2.94 (136.65-148.47) | 92.26 (-101.64; -82.88) | <0.001 | 7.94 | 0.99 |

SD = standard deviation; CI = confidence interval; EE = energy expenditure; $VO_2$ = oxygen consumption; METs = metabolic equivalent; HR = heart rate; bpm = beats per minute; % = percentage; ES = effect size

Figure 1 shows the comparisons between sexes during rest and practice of exergames. EE showed a significant difference during rest (95%CI = -0.043; -0.09) and games (95%CI = -12.53; -6.67) between men and women, indicating higher values for males. In resting conditions, there were no differences between sexes for $VO_2$/kg and METs. During the session of exergames, men showed significantly higher values compared to women in $VO_2$/kg (95%CI = -4.01; -0.80) and METs (95%CI = -1.18; 0.27). Women showed higher HR values than men did at rest (95%CI = 1.85; 13.1).




Energy expenditure according to condition and sex – rest/exergames – men/women; Heart rate according to condition and sex – beats per minute – rest/exergames – men/women; Oxygen consumption rate according to condition and sex – rest/exergames – men/women; Metabolic equivalent of task according to condition and sex – rest/exergames – men/women

**Figure 1** - Energy expenditure, oxygen consumption rate, metabolic equivalent of task and heart rate at rest and during the exergame session: comparison between sex performed with Student's t-test for independent samples

## Discussion

The results showed that the practice or exergames increase EE, $VO_2$/kg, METs and HR values, when compared to resting conditions. Among the games performed, boxing was the one that enabled the highest increase in such parameters in both sexes.

The increase in metabolic parameters in response to the practice of exergames has been found by other authors [9,21-23] and it can be explained by the increase in the metabolic demands of muscles activated when body movements are performed [23].

In the present study, EE increased approximately 460% during exergames, compared to the resting condition. This significant increase was like that found by Siegel *et al.* [9] in a study performed with young adults and higher than those of other studies conducted with adults [21-23]. The differences between studies can be explained by the characteristics of each sample, in addition to the game type and duration. In the study performed by Lyons *et al.* [24], apart from participants' mean age being lower than that of the present study, the exergames selected were as follows: Dance Dance Revolution (dance), Medal Honor and Resident Evil (shooting), Guitar Hero and Rock Band (bands) and Wii Fit (physical activities).

$VO_2$/kg increased significantly during the practice of exergames, when compared to the resting period. Other authors [21,22,24,25] also reported an increase in this parameter in response to the practice of exergames, although on a lower level.

The differences in $VO_2$/kg pointed out between studies can be explained by the participant characteristics [26]. In the study conducted by Noah *et al.* [21], most participants were female, a factor that influenced the lower $VO_2$/kg values. On the other hand, the study conducted with young adult males showed greater increases in $VO_2$/kg during the practice of X-box [27], when compared to the results of the present study.

Sex explains the difference in values found in the studies, as males showed higher $VO_2$/kg values when compared to females [28], mainly due to men's greater muscle mass [29].

The results showed an increase in the estimates of MET values during exergames, compared to resting values, as observed by other authors [8,9]. However, data from the present study were higher than those found in other studies with adults [9,30] and elderly individuals [31].

The differences found between studies regarding MET values obtained during exergames [9,31,32] were probably influenced by the characteristics of samples (sex, age, ethnicity, and body composition). In the study performed by Taylor *et al.* [31], the sample included elderly individuals, which probably explains the lower MET values found, when compared to those of the present study. Another factor that could have influenced these differences is the type of game and its duration. When investigating adults, O'Donavan *et al.* [30] found lower MET values than those found in the present study. Such differences could have occurred due to the game duration, which was shorter in the present study.

Although not being the objective of the present study, it should be emphasized that, according to the recommendations from the American College of Sports Medicine [33], exergame categories can be classified as moderate (bowling) and vigorous (boxing, volleyball and athletics).

The results showed an increase in HR during the practice of exergames, when compared to resting values, as observed in other studies [5,6,9,22]. The increase in HR is the result of autonomous and hemodynamic adaptations that influence the cardiovascular system [4,34,35].

Other studies have reported significant increases in HR during the practice of exergames that were lower than those found in the present study [9,36]. One such study was that conducted by O'Donavan and Hussey [22], which showed a significant increase of 86% in HR during the practice of boxing with Nintendo Wii, with resting values used as reference.

In the present study, boxing was the exergame category that led to the highest EE, $VO_2$/kg, METs and HR values. In this game, all body parts are used, although there is a predominance of the upper limbs. Players move constantly and the pauses during this game are shorter than those of other categories (volleyball, athletics, and bowling).

Maddison *et al.* [37] explain that exergames using all body parts show higher energy expenditure, when compared to those involving the upper limbs exclusively. Graves, Ridgers and Stratton [38] found higher EE values in games including the upper limbs, when compared to the entire body.

Although bowling includes the upper limbs, this was the least intense game in the present study. However, differently from boxing, bowling does not involve a virtual opponent due to the precision of movements and players perform tasks at a slower speed.

The comparisons between sexes point to higher EE, $VO_2$/kg and METs values for men when compared to women during the practice of exergames. The differences between sexes can be explained by the higher MMI found in males, compared to females. The more muscle mass, the more contractions are performed and the higher the effort rate [28].

Differences between sexes for EE, $VO_2$/kg, METs and HR during the practice of exergames are controversial. Some authors point out that, during the practice of exergames, EE values are higher for males [39], while others did not find differences between women and men [17], although differences in some types of game were reported [38].

The present study showed limitations and strong points that should be emphasized. One of the limitations refers to the intentional sample, as it does not enable data from the present study to be extrapolated to other populations. Moreover, although the time set for each game was equal for all participants, individual motor skills could have interfered with this time.

One of the strong points was the technique used for data collection (indirect calorimetry), which enabled accurate and reliable results. Additionally, another point that stood out was participants' age. Most of the studies published to date have been with children, adolescents, and the elderly, with a gap on the behavior of metabolic parameters during the practice of exergames in adults. Finally, the sample size must be reported as a positive point, in view of the quantity if analyzed subjects.

## Conclusion

According to the data obtained in the present study, the practice of exergames could promote a relevant increase in EE, $VO_2$/kg, METs, and HR values, when compared to the resting period, in adults of both sexes. Comparisons between sexes showed higher EE, $VO_2$/kg, METs values for men, when compared to women, except for HR, which did not show differences between sexes. Thus, such practices could be improved and used to promote population health through an increase in physical activity level. Finally, new studies on the implications of a session of exergames on EE, $VO_2$/kg, METs, and HR of men and women must be performed, aiming to reduce the inconsistencies found in the literature.

**Potential conflict of interest**
No conflicts of interest with potential potential for this article have been reported.

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**Authors' contributions**
**Conception and design of the research:** Krug MM, Barbosa AR; Data collection: Krug MM; **Analysis and interpretation of data:** Krug MM; **Statistical analysis:** Krug MM; **Writing of the manuscript:** Krug MM, Barbosa AR; **Critical revision of the manuscript for important intellectual content:** Krug MM, Barbosa AR.

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