

## **Hip-Hop Party Dance: Cardiorespiratory Profile and Responses to a Predefined Sequence**

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### **ABSTRACT**

Hip-hop is a popular dance genre practised worldwide that has gained popularity since the 1970's. Despite which, studies related to the area and its physiological demands are still scarce. The purpose of this study was to report the cardiorespiratory profile of a group of male and female hip-hop dancers and determine the zones of intensity of a predefined hip-hop party dance sequence. Eight Brazilian professional hip-hop dancers, 4 women and 4 men, mean age  $22 \pm 2.3$  years participated in the study. Using a portable gas analyser (Cosmed K5) their cardiorespiratory variables were measured at two different times: first, during a maximal treadmill test; and later during a predefined hip-hop party dance sequence. Descriptive statistics (mean, standard deviation) were used for calculated the dependent variables: oxygen consumption ( $\text{VO}_2$ ), heart rate (HR), and the intensity zones for the predefined hip-hop sequence. Data normality was verified using the Shapiro-Wilk test. The Mann-Whitney U-test was performed to check any sex-related difference ( $p < 0.01$ ). No statistical difference

between male and female dancers was found in the cardiorespiratory profile and responses to the predefined hip-hop party dance sequence. On the treadmill, the participants'  $VO_{2peak}$  was  $57.3 \pm 12.7 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ , and  $HR_{max}$  was  $190.0 \pm 9.1 \text{ b}\cdot\text{min}^{-1}$ . The predefined hip-hop party dance sequence was mainly performed (61% of the sequence) in the moderate aerobic zone. However, when the dancers jumped, the intensity of the sequence increased. This information could be used to develop a specific supplementary training protocols for hip-hop dancers, thus helping to improve their physiological fitness parameters and reduce the incidence of injury.

**Key-words:** Dancing; Physiology; Hip-Hop; Cardiorespiratory Profile; Zones of intensity.

**Key points:**

- This is the first study to examine the cardiorespiratory profile of hip-hop dancers, using predefined hip-hop party dance movement vocabulary, and to determine the levels of workload in a predefined hip-hop party dance sequence.
- The results of this study are relevant and novel, and could help hip-hop professionals to plan their classes and training, bearing in mind the anaerobic potential of jump movements.

## **INTRODUCTION**

Dancers have been classified as performing athletes, as the aesthetic goals are of the greatest importance in dance training.<sup>1</sup> The physical demands placed on dancers by choreographers, performance schedules and teachers, make their physiological and fitness components an important element of their training.<sup>1-2</sup> However, while some data suggest that supplementary training can improve the artistic aspects of dance performance by increasing fitness-related parameters<sup>3-4</sup>, other research suggests that cardiorespiratory fitness levels in dancers do not correlate with a better performance in aesthetic terms.<sup>5</sup>

Hip-hop culture includes breaking as its original dance artform, and has been gaining popularity in the streets, clubs, battles, dance schools, gyms, and other dance environments since the 1970s.<sup>6</sup> Nowadays, hip-hop culture is a combination of social and party dances, including old (e.g. breaking, popping, locking) and new school genres (e.g. house, krumping, street jazz)<sup>7</sup>, that combine complex movements with a varied movement vocabulary (jumps, spins, floor movements, weight transfers, acrobatic movements, etc.), changing directions and levels in different rhythms. Grčić et al.<sup>8</sup> built a qualitative test to evaluate hip-hop party dance steps (e.g. Brooklyn, Party Machine, and Roger Rabbit) level of performance and technique, showing that the Brooklyn step proved to be the most simple and basic step, which, in terms of motor learning should be acquired first. By contrast, the Roger Rabbit and Party Machine steps proved to have more complex structures, being more difficult to perform and learn.

Highlighting the physicality of hip-hop dance genres, most studies about hip-hop dance are related to injury occurrence. Amateur and professional breakers' main injury sites are upper body (arm-hand, wrist-hand, shoulder, neck, spine), as well as lower limbs (knee, ankle).<sup>9,10</sup> However, hip-hop new school dancers have a higher injury rate in the lower limbs.<sup>11</sup> This may be related to the fact that breaking's physicality focuses more on the upper body weight-bearing and acrobatic movements<sup>9-11</sup>, rather than the stand-up dance genres, such as hip-hop party dances.

Although hip-hop party dance is a popular dance genre and is practised worldwide, studies related to this dance genre and its physiological demands are still scarce. Several studies have reported the physiological demands of other dance styles, such as ballet, modern, contemporary, jazz, ballroom, tap and folk dance.<sup>2,13,14</sup> However, only one study has examined the physiological demands of two hip-hop styles (new style and breaking).<sup>15</sup> This study shows that hip-hop new style dancers have a lower relative mean  $\text{VO}_2$  demand, being more comparable to other theatrical dance genres, than breakers whose mean  $\text{VO}_2$  was

significantly greater than contemporary dancers (48.1 vs 24.8 ml·kg<sup>-1</sup>·min<sup>-1</sup>, p<0.001), while their peak heart rate is significantly higher than ballet dancers (191 vs 178 bpm, p<0.001).<sup>15</sup> Thus, break dance generates a higher cardiorespiratory demand, although for a shorter duration.<sup>15</sup>

Given the lack of research in this area, this study aims to report the cardiorespiratory profile of a group of male and female hip-hop dancers and determine the zones of intensity of a predefined hip-hop party dance sequence. Knowing more about the hip-hop cardiorespiratory demands, hip-hop dancers and teachers could improve training techniques and performance, facilitating better physical fitness and helping to build injury prevention strategies.

## **METHODS**

This is a cross-sectional observational study design. The cardiorespiratory profile and responses (oxygen consumption - VO<sub>2</sub>; and heart rate – HR) of the treadmill test and predefined hip-hop party dance sequence were analysed for the group. The study was approved by the Federal University of Rio Grande do Sul ethics committee (CAAE: 85792218.1.0000.5347). A participant informed consent form was obtained prior to data collection.

### **Participants**

Eight professional hip-hop dancers from Porto Alegre, Brazil, four men and four women, mean age 22.1 ± 2.3 years, with more than five years of hip-hop dance experience, participated in this study. All participants were non-smokers and injury-free in the six months prior to data collection.

**Table 1** – Participants' descriptive demographic data

## Procedures

The participants attended three data collection sessions at the Exercise Research Laboratory (LAPEX): session one, included anthropometric measurements (age, height, body mass, body fat %, and body mass index - BMI), familiarisation with the data collection apparatus, and learning the predefined hip-hop party dance sequence wearing the portable gas analyser; session two, to complete a  $VO_{2max}$  test in a treadmill; session three, to perform the predefined hip-hop party dance sequence. The participants were given access to a recorded video a week before session three, in order to memorize and learn the hip-hop party dance sequence, which was performed and explained by a qualified hip-hop dance teacher. Participants were told not to eat or consume stimulants at least three hours before the two data collection sessions and not perform intense exercise 12 hours preceding the tests.<sup>16</sup>

During session one, height was measured using a stadiometer (SECA, 1mm solution), without shoes; body mass was assessed by a digital scale (Urano, 100g resolution) while wearing minimal clothing; and age as a whole year (Table 1). Seven skinfold thickness measurements were performed (triceps - T, subscapular - SS, suprailiac - SI, midaxillary – MA - medial thigh – MT, medial calf - MC), using LANGE (Lange, Beta Technology, Inc., Cambridge, MD) skinfold caliper with 1mm sensitivity. Each skinfold thickness was measured three times by the same evaluator on the right side of the body, according to International Society for the Advancement of Kinanthropometry.<sup>17</sup> The body fat percentage (% Body Fat) was calculated using the Siri<sup>18</sup> equation: %BF (% Body Fat) =  $[(4.95/D) - 450] \times 100$ . Body density (D) was calculated using the Petrosky<sup>19</sup> equation: men:  $D=1.10726863 - 0.00081201 (SS+T+SI+MC) - 0.00041761 (Age)$ ; women:  $D=1.19547130 - 0.07513507 * \text{Log}_{10} (T+SI+MT+MC) - 0.00041072 (Age)$ .

During session two, a heart rate monitor (HRM – Polar S810, Finland) was fitted prior to a 10-minute warm-up on a treadmill (Super ATL, Imbramed, Porto Alegre, Brazil). The warm-up was used to calculate the speed of the first stage of the test with a target HR of 120  $\text{b}\cdot\text{min}^{-1}$ . After the portable gas analyser (Cosmed K5, Italy) was calibrated, the participants were fitted with the appropriate mask and five minutes of resting data were collected while the participant stood on the treadmill. The continuous test started at approximately 6-8km/hr, as determined by the warm-up.<sup>15</sup> At the end of each 1-min stage, the speed was increased by 1km/hr until the termination criteria were met or the participant stopped the test by stepping off the treadmill<sup>14</sup>. Rate of perceived exertion (RPE) was assessed at the end of each stage using Borg's 6–20point scale<sup>20</sup> (Figure 1).

The termination criteria were: maximum heart rate ( $220 - \text{age}$ ); respiratory exchange ratio (RER) greater than 1.15;  $\text{VO}_2$  plateau despite increases in the workload; and participants'  $\text{RPE} \geq 17$  at Borg's Perceived Exertion Scale.<sup>20</sup> After the end of the test, the participant remained on the treadmill for three minutes, walking at low intensity.<sup>21</sup> The participants finished the treadmill test when they reached two of the four termination criteria for  $\text{VO}_{2\text{max}}$  uptake, and therefore  $\text{VO}_{2\text{peak}}$  was reported.

In the third session, held 48 hours after the treadmill test, the participants returned to the LAPEX to perform the predefined hip-hop party dance sequence wearing the same portable gas analyser (Cosmed K5) and HRM (Polar S810, Finland) (Figure 1). After a self-administered warm-up, subjects were fitted with a HRM and the portable gas analyser. Five minutes of resting data were collected prior to commencement of the hip-hop predefined sequence.

During the treadmill test and performance of the sequence, the dependent variables were  $\text{VO}_2$ ,  $\text{VCO}_2$ ,  $V_e$  and HR by breath-by-breath analysis.

**Figure 1** – Session two ( $\text{VO}_{2\text{max}}$  test in a treadmill) and session three (predefined hip-hop party dance sequence)

### **Predefined Hip-hop party dance sequence: description**

The predefined sequence included hip-hop party dance steps<sup>8,22</sup>, with different levels of complexity (from basic to more complex steps), and was designed to determine its physiological demands. The predefined hip-hop party dance sequence was choreographed by two qualified hip-hop dance choreographers, and has eight parts, starting with basic steps (part 1) and finishing with more complex (part 3)<sup>8</sup>: part 1 (P1), chorus 1 (C1), transition 1 (T1), part 2 (P2), chorus 2 (C2), transition 2 (T2), part 3 (P3), chorus 3 (C3). The predefined sequence, performed at a moderate speed (120 bpm), lasted 3'46'' minutes/seconds (= 226 seconds), corresponding to 100%. To calculate the total time spent in each part of the sequence in percentage terms, the rule of three was used. All the participants performed the predefined sequence, and its parts within the time-frame determined by the time and tempo of the music. This time and tempo are based on hip-hop dancers' performance and training.<sup>15,8</sup>

Table 2 describes the parts of the predefined sequence, step names, repetitions, length in minutes/seconds (min/sec), and total time spent in each part (sec and percentage - %).

**Table 2** – Description of the predefined hip-hop party dance sequence

### **Data analysis**

The treadmill test expired gas data was reviewed for single-breath anomalies (single data points 20% greater than the stage mean) and were removed prior to a five-breath smoothing using the portable gas analyser (Cosmed K5, Italy) software. After this, the data were exported to Excel software (version 2018) to analyse and determine the VT1, VT2, and  $\text{VO}_2$  peak, using scatter plotting. Expired gas data were analysed using Wasserman methodology to calculate the ventilatory thresholds.<sup>23</sup> The first ventilatory threshold (VT1)

was obtained by verifying the lowest workload at which  $VE/VO_2$  increased without concomitant rises in  $VE/VCO_2$ ; and the second ventilatory threshold (VT2), was determined in the lowest workload at which  $VE/VO_2$  increased with  $VE/VCO_2$ .

Two independent physiologists visually detected the VT1, VT2, and  $VO_2$  curves based on the content of the scatter plots. If two values were equal, this value was recorded; with a discrepancy up to 3%, a third physiologist participated in the analysis; and, if there were still disparate values with the other two found (discrepancy up to 3%), the values were added and divided by three (average).

The absolute and relative HR data were obtained using the average of the recorded values every 30 seconds. The HR corresponding to the VT1 and VT2 were determined using the absolute and relative HR data.

The hip-hop party dance sequence zones of intensity are displayed in relation to the dancer's VT1 and VT2, as follows: low aerobic zone of intensity ( $VO_2$  below VT1), moderate aerobic zone of intensity ( $VO_2$  between VT1 and VT2), and anaerobic zone of intensity ( $VO_2$  above VT2)<sup>13</sup> (Figure 2).

Statistical analyses were carried out using SPSS (ver. 23, IBM-SPSS, Armonk, NY, USA). The cardiorespiratory profile and responses data were analysed for descriptive statistics (mean, standard deviation). Data normality was verified using the Shapiro-Wilk test. Due to the low number of participants, Mann-Whitney U-tests were performed to test the difference between sex. The significance level was set at  $p < 0.01$  in recognition of the low participant numbers.

**Figure 2** – An example of a hip-hop dancer maximum treadmill test in order to determine the zones of intensity by VE



## RESULTS

Table 3 provides mean and standard deviation on the hip-hop dancers' cardiorespiratory profile. No statistical difference was found between male and female hip-hop dancers' cardiorespiratory profile.

### **Table 3** – Hip-hop dancers' cardiorespiratory profile

#### **Predefined hip-hop party dance sequence**

Table 4 shows absolute and relative cardiorespiratory responses ( $\text{VO}_2$  and HR) during the predefined hip-hop party dance sequence. The predefined hip-hop party dance sequence was performed, predominantly, in the moderate aerobic zone, as the  $\text{VO}_2$  mean value of the sequence ( $31.7 \pm 8.6 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) is between  $\text{VO}_2\text{VT1}$  and  $\text{VO}_2\text{VT2}$  (Table 3). No statistical difference was found between male and female hip-hop dancers in the absolute and relative cardiorespiratory responses during the predefined hip-hop party dance sequence.

### **Table 4** – Absolute and relative cardiorespiratory descriptive data ( $\text{VO}_2$ and HR) for the predefined hip-hop party dance sequence

Table 5 shows absolute and relative cardiorespiratory mean responses ( $\text{VO}_2$  and HR) related to the predefined hip-hop party dance sequence, time spent to perform the parts of the sequence (%), and zones of intensity, in the full group ( $n=8$ ). Dividing the predefined sequence into 8 parts we found: 38% of the total time of the sequence (P1, C1, and T1) was performed in the lower aerobic zone ( $\text{VO}_2 < \text{VT1}$ ); and 62% (P2, C2, T2, P3, and C3), in the moderate aerobic zone ( $\text{VO}_2$  between the  $\text{VT1}$  and  $\text{VT2}$ ). In P3 and C3, when the participants

performed jump steps (“running man”, “happy feet”, “roger rabbit”, “party machine” and “kicks”), the  $VO_2$  mean values were closer to VT2, than P2, C2 and T2.

**Table 5** – Absolute and relative cardiorespiratory descriptive data ( $VO_2$  and HR) related to each part of the predefined hip-hop party dance sequence, time spent (%), and zones of intensity

Figure 3 illustrates the mean and standard deviation of the  $VO_2$  responses for each part of the predefined hip-hop party dance sequence in relation to the mean VT1 and VT2 of the full group (vertical dashed orange lines).

**Figure 3** – Mean and standard deviation  $VO_2$  responses to each part of the predefined hip-hop party dance sequence in relation to the mean VT1 and VT2 of the full group

Table 6 shows absolute and relative cardiorespiratory mean responses ( $VO_2$  and HR) related to the predefined hip-hop party dance sequence, time spent (%), and zones of intensity of the predefined hip-hop party dance sequence, of the male and female dancers. The female hip-hop dancers performed 38% of the total time of the sequence (P1, C1, and T1) in the lower aerobic zone ( $VO_2 < VT1$ ); and 62% (P2, C2, T2, P3, and C3), in the moderate aerobic zone ( $VO_2$  between the VT1 and VT2). The male hip-hop dancers performed 38% of the total time of the sequence (P1, C1, and T1) in the lower aerobic zone ( $VO_2 < VT1$ ); 54% (P2, C2, T2, and P3), in the moderate aerobic zone ( $VO_2$  between the VT1 and VT2); and 8% (C3), in the anaerobic zone ( $VO_2$  above VT2).

**Table 6** – Male and female absolute and relative cardiorespiratory descriptive data ( $VO_2$  and

HR) related to each part of the predefined hip-hop party dance sequence, time spent (%), and zones of intensity

## DISCUSSION

Considering both the relevance of this topic and the lack of related studies in the literature, the objective of this study was to report the cardiorespiratory profile of a group of male and female hip-hop dancers and determine the zones of intensity of a predefined hip-hop party dance sequence. No statistical difference between male and female dancers was found in the cardiorespiratory profile and responses to the predefined hip-hop party dance sequence ( $p < 0.01$ ).

Hip hop dancers seem to have a better developed cardiorespiratory system than their counterparts in other theatrical dance genres, such as ballet, modern and contemporary dance<sup>15</sup>. In our study, the hip-hop dancers'  $VO_{2peak}$  mean value ( $57.3 \pm 12.7 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) from the treadmill test was higher than that found by Wyon et al.<sup>15</sup> in hip-hop new style dancers ( $45.9 \pm 5.4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ), as well as the values found in other dance genres reported in previous studies.<sup>2,13-14</sup> However, this value was lower than that found in breakers ( $64.8 \pm 3.0 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ )<sup>15</sup>. Also, regarding the mean  $VO_{2peak}$  from the treadmill, in our study, the male hip hop dancers value was higher than that of male musical theatre performers ( $66.8 \pm 8.8$  vs  $67.6 \pm 2.3 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ), while the value for the female hip-hop dancers was lower than that of female musical theatre performers ( $47.8 \pm 7.5$  vs  $55.6 \pm 4.4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ).<sup>24</sup>

The literature highlights the influences of total time spent dancing on cardiorespiratory demand.<sup>25</sup> Regarding duration, hip-hop dance performances and breaking battles are shorter than other theatrical dance genres, lasting to 2–10 min compared with 2-hours ballet or 20-minutes contemporary performance.<sup>15</sup> The total time of the predefined hip-hop party dance sequence lasted 3'46''minutes (Table 2), during which, the full group

mean  $HR_{max}$  and  $VO_{2peak}$  values (Table 4) were lower than those of breakers ( $HR_{max} = 178 \pm 8.26$  bpm;  $VO_{2peak} = 64.8 \pm 15.43$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) during a 2-min improvised routine<sup>15</sup>; and new style dancer's ( $HR_{max} = 157 \pm 12.17$  bpm;  $VO_{2peak} = 58.6 \pm 19.48$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) during a specific choreographed dance routine<sup>15</sup>. However, in our study, the male hip-hop dancers mean  $VO_{2peak}$  ( $37.8 \pm 7.9$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) was higher than that of male musical theater performers (dance  $34.9 \pm 5.39$  ml·kg<sup>-1</sup>·min<sup>-1</sup>; dance + singing  $35.7 \pm 5.89$  ml·kg<sup>-1</sup>·min<sup>-1</sup>), while the value for the female hip-hop dancers ( $25.7 \pm 3.3$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) is lower than that of female musical theater performers (dance  $29.3 \pm 7.11$  ml·kg<sup>-1</sup>·min<sup>-1</sup>; dance + singing  $32.2 \pm 5.81$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) during a 4-min section from the Chorus line.<sup>24</sup>

These differing cardiorespiratory demands between dance genres, mentioned above, are related to the specific movements and training demands required in the dance classes, rehearsals and performances.<sup>25</sup> Musical theater performers perform complex routines, with a high level of athletic ability, while singing, thus requiring different abilities and generating a higher cardiorespiratory demand.<sup>24</sup> Even in the hip-hop old and new school genres, technical and stylistic elements of the movement vocabulary are specific, and training and rehearsal energy demands are different. Breakers need more strength and power than new style dancers, because they perform acrobatic movements, jumps and ground supports<sup>7,12</sup>, which generate a higher cardiorespiratory demand.<sup>15</sup> Regarding the training for new style dancers, it is similar to other theatrical dance genres with a more codified movement system and a more rehearsed dance sequence.

The predefined hip-hop party dance sequence was mainly performed (61% of the sequence) in the moderate aerobic zone in relation to mean VT1 and VT2 of the full group (Figure 3). However, in P3 and C3, the intensity of the predefined sequence increased when the dancers performed hip-hop jump steps (“running man”, “happy feet”, “roger rabbit”, “party machine” and “kicks”). For the full group and female dancers mean  $VO_2$  values were

closer to VT2, performing P3 and C3 in the moderate aerobic zone (Table 5 and 6). The same phenomenon has been reported in other studies that analysed specific jumping ballet movements in isolation, such as *grand battements*, *chassé*, *sautés* and *temps levés*, indicating they are performed at a moderate intensity.<sup>21,26,27</sup> However, for the male hip-hop dancers the mean VO<sub>2</sub> was higher than VT2 in C3, entering the anaerobic zone (Table 6). Thus, these results indicate the anaerobic potential of jumps<sup>21,26</sup>, as the metabolic demands during jumps are higher, due to the movement speed and the greater demand of the muscle contraction, which generates greater metabolic power.<sup>27-30</sup>

During the predefined hip-hop party dance sequence, the full group mean %HR<sub>max</sub> (Table 4) indicated a moderate intensity according to Jeffries et al.<sup>31</sup>, as the value is between 70-85% for the HR<sub>max</sub>. During P3 and C3, the full group mean %HR<sub>max</sub> indicated a high intensity (>90% for HR<sub>max</sub>)<sup>31</sup>, and also showed that jumps could increase the intensity of the sequence.

Similar to other dance genres, hip-hop dancers do little additional supplemental training alongside their dance training.<sup>15,32,33</sup> The importance of supplemental fitness training for dancers has been demonstrated in previous studies<sup>3-4</sup> and reviews.<sup>2,25,32</sup> Since dance training alone is not insufficient to attain physiological fitness parameters<sup>1-2,32</sup>. Furthermore, considering the high injury rates found in hip-hop dancers<sup>9-11</sup>, the implementation of supplementary training could be recommended to improve these parameters, and help prevent injury. Supplementary training involving aerobic endurance of medium to high cardiorespiratory intensity (HR and VO<sub>2</sub>), anaerobic power exercises, and plyometric training could be recommended<sup>34,35</sup>, considering that hip-hop dancers need these skills to improve their performance. As our results suggest that hip-hop dancers differ in terms of physiological fitness parameters in comparison to other dance genres, knowing the zones of

intensity in a predefined hip-hop party dance sequence could help accurately plan specific supplementary training protocols.

The results of this study are relevant and novel, and could help hip-hop professionals to plan their classes and training, bearing in mind the anaerobic potential of jump movements. This is the first study to examine the cardiorespiratory profile of hip-hop dancers, using defined hip-hop party dance movement vocabulary. To the best of the author's knowledge, no prior studies have determined the levels of workload in a predefined hip-hop party dance sequence. However, the ability to generalize the results of this study may be limited by having a convenience sample that includes a small number of participants from one country. Further studies with larger samples, alternative hip-hop dance sequences and subgenres are suggested.

## **CONCLUSION**

The study results show hip-hop dancers have specific cardiorespiratory demands in relation to other dance genres. The predefined hip-hop party dance sequence was mainly performed in the moderate aerobic zone (61% of the sequence). However, when the dancers jumped, the intensity of the sequence increased. This information could be used to develop a specific supplementary training protocols for hip-hop dancers, thus helping to improve their physiological fitness parameters and reduce the incidence of injury.

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**Table 1 – Participants’ descriptive demographic data**

|   | <b>DANCERS (n=8)</b> | <b>MALE (n=4)</b> | <b>FEMALE (n=4)</b> | <b>p value</b> |
|---|----------------------|-------------------|---------------------|----------------|
|   | <b>Mean ± SD</b>     | <b>Mean ± SD</b>  | <b>Mean ± SD</b>    |                |
| <b>Age (years)</b>                        | 22.1 ± 2.3           | 22.3 ± 2.9        | 22.0 ± 1.8          | 0.7            |
| <b>Body Mass (kg)</b>                     | 61.5 ± 12.7          | 59.3 ± 4.3        | 63.7 ± 19.0         | 0.7            |
| <b>Height (cm)</b>                        | 164.3 ± 8.24         | 169.5 ± 5.8       | 159.1 ± 7.3         | 0.6            |
| <b>Body Mass Index (kg/m<sup>2</sup>)</b> | 22.7 ± 3.9           | 20.6 ± 1.0        | 24.8 ± 4.8          | 0.7            |
| <b>Body Fat (%)</b>                       | 16.7 ± 7.5           | 11.5 ± 2.7        | 21.8 ± 7.3          | 0.2            |

**Table 2 – Description of the hip-hop party dance predefined sequence**

|                       | <b>Step</b>  | <b>Repetitions</b> | <b>Length (min/sec)</b> | <b>Time Spent sec (%)</b> |
|-----------------------|--|--------------------|-------------------------|---------------------------|
| <b>P1 (repeat 2x)</b> | Bounce   | 8                  | 0'00''- 1'00''          | 0'60'' (26)               |
|                       | Open Bounce  | 8                  |                         |                           |
|                       | Bounce variation   | 4                  |                         |                           |
|                       | Weight transfer side to side/step touch (side to side)     | 8                  |                         |                           |
|                       | Weight transfer front and back/step touch (front and back) | 8                  |                         |                           |
| <b>C1</b>             | Smurf  | 4                  | 1'00''- 1'18''          | 0'18'' (8)                |
|                       | Prep   | 4                  |                         |                           |
|                       | ATL Stomp  | 4                  |                         |                           |
|                       | Cabbage Patch  | 2                  |                         |                           |
| <b>T1</b>             | Bounce   | 8                  | 1'18''- 1'27''          | 0'09'' (4)                |
|                       | Open Bounce  | 8                  |                         |                           |
| <b>P2 (repeat 2x)</b> | Bart Simpson   | 4                  | 1'27''- 2'02''          | 0'35'' (16)               |
|                       | Fila   | 8                  |                         |                           |
|                       | Reebok   | 4                  |                         |                           |
|                       | Alf  | 8                  |                         |                           |
| <b>C2</b>             | Smurf  | 4                  | 2'02''- 2'19''          | 0'17'' (8)                |
|                       | Prep   | 4                  |                         |                           |
|                       | ATL Stomp  | 4                  |                         |                           |
|                       | Cabbage Patch  | 2                  |                         |                           |
| <b>T2</b>             | Weight transfer side to side/ step touch side to side      | 8                  | 2'19''- 2'28''          | 0'09'' (4)                |
| <b>P3</b>             | Happy Feet variation 1                                     | 8                  | 2'28''- 3'28''          | 0'60'' (26)               |
|                       | Happy Feet variation 2                                     | 8                  |                         |                           |
|                       | Happy Feet variation 3 (slow)                              | 4                  |                         |                           |
|                       | Happy Feet variation 3 (fast)                              | 8                  |                         |                           |
|                       | Kicks  | 4                  |                         |                           |
|                       | Running Man  | 32                 |                         |                           |
| Roger Rabbit          | 16   |                    |                         |                           |

|   |               |    |                 |          |
|---|---------------|----|-----------------|----------|
|   | Party Machine | 16 |                 |          |
| 3 | Smurf         | 4  | 3'28'' - 3'46'' | 0'18 (8) |
|   | Prep          | 4  |                 |          |
|   | ATL Stomp     | 4  |                 |          |
|   | Cabbage Patch | 2  |                 |          |

**Table 3** – Hip-hop dancers' cardiorespiratory profile

|  | <b>DANCERS (n=8)</b><br><b>Mean ± SD</b> | <b>MALE (n=4)</b><br><b>Mean ± SD</b> | <b>FEMALE (n=4)</b><br><b>Mean ± SD</b> | <b>p value</b> |
|--|--|---------------------------------------|---|----------------|
| VO <sub>2peak</sub> (ml·kg <sup>-1</sup> ·min <sup>-1</sup> )    | 57.3 ± 12.7                              | 66.8 ± 8.8                            | 47.8 ± 7.5                              | 0.4            |
| HR <sub>max</sub> (b·min <sup>-1</sup> )                         | 190.0 ± 9.1                              | 190.0 ± 13.8                          | 191.0 ± 1.0                             | 0.6            |
| VO <sub>2</sub> (ml·kg <sup>-1</sup> ·min <sup>-1</sup> ) at VT1 | 30.5 ± 11.7                              | 36.6 ± 13.8                           | 24.3 ± 5.1                              | 0.0            |
| VO <sub>2</sub> (%VO <sub>2peak</sub> ) at VT1                   | 53.0 ± 14.1                              | 53.5 ± 14.2                           | 52.4 ± 16.1                             | 0.9            |
| VO <sub>2</sub> (ml·kg <sup>-1</sup> ·min <sup>-1</sup> ) at VT2 | 43.7 ± 9.3                               | 50.8 ± 7.0                            | 36.6 ± 4.3                              | 0.2            |
| VO <sub>2</sub> (%VO <sub>2peak</sub> ) at VT2                   | 78.1 ± 7.4                               | 79.6 ± 9.5                            | 77.0 ± 5.8                              | 0.2            |
| HR (b·min <sup>-1</sup> ) at VT1                                 | 157.0 ± 13.6                             | 154.0 ± 10.4                          | 159.0 ± 17.49                           | 0.4            |
| HR (%HR <sub>max</sub> ) at VT1                                  | 82.2 ± 5.9                               | 81.3 ± 1.4                            | 83.1 ± 8.8                              | 0.9            |
| HR (b·min <sup>-1</sup> ) at VT2                                 | 190.0 ± 9.1                              | 190.0 ± 13.8                          | 191.0 ± 1.0                             | 0.1            |
| HR (%HR <sub>max</sub> ) at VT2                                  | 57.3 ± 12.7                              | 66.8 ± 8.8                            | 47.8 ± 7.5                              | 0.9            |

**Table 4** – Absolute and relative cardiorespiratory descriptive data (VO<sub>2</sub> and HR) for the predefined hip-hop party dance sequence

|   | <b>DANCERS (n=8)</b><br><b>Mean ± SD</b> | <b>MALE (n=4)</b><br><b>Mean ± SD</b> | <b>FEMALE (n=4)</b><br><b>Mean ± SD</b> | <b>p value</b> |
|---|--|---------------------------------------|---|----------------|
| VO <sub>2</sub> (ml·kg <sup>-1</sup> ·min <sup>-1</sup> ) | 31.7 ± 8.6                               | 37.8 ± 7.9                            | 25.7 ± 3.3                              | 0.5            |
| VO <sub>2</sub> (%VO <sub>2peak</sub> )                   | 55.5 ± 8.8                               | 56.9 ± 11.0                           | 54.2 ± 7.4                              | 0.1            |
| HR (b·min <sup>-1</sup> )                                 | 144.0 ± 15.5                             | 143.0 ± 22.8                          | 147.0 ± 10.7                            | 0.7            |
| HR (%HR <sub>max</sub> )                                  | 75.7 ± 6.8                               | 72.9 ± 7.6                            | 78.5 ± 5.5                              | 0.3            |

**Table 5** – Absolute and relative cardiorespiratory descriptive data (VO<sub>2</sub> and HR) related to each part of the predefined hip-hop party dance sequence, time spent (%), and zones of intensity, full group (n=8)

| <b>DANCERS (n=8)</b> |  |  |   |                             |                   |                          |
|----------------------|--|--|---|-----------------------------|-------------------|--------------------------|
| <b>Mean ± SD</b>     |  |  |   |                             |                   |                          |
|                      | VO <sub>2</sub><br>(ml·kg <sup>-1</sup> ·min <sup>-1</sup> ) | VO <sub>2</sub><br>(%VO <sub>2peak</sub> ) | HR <sub>max</sub><br>(b·min <sup>-1</sup> ) | HR<br>(%HR <sub>max</sub> ) | Time Spent<br>(%) | Zones of<br>Intensity    |
| <b>P1</b>            | 14.9 ± 4.8   | 26.6 ± 8.2                                 | 128.0 ± 18.1                                | 67.4 ± 7.9                  |                   | Lower Aerobic<br>Zone    |
| <b>C1</b>            | 25.6 ± 8.6   | 45.1 ± 11.9                                | 140.0 ± 24.3                                | 73.8 ± 11.6                 | 38                |                          |
| <b>T1</b>            | 27.2 ± 7.8   | 48.3 ± 11.5                                | 140.0 ± 24.3                                | 73.8 ± 11.6                 |                   |                          |
| <b>P2</b>            | 31.9 ± 10.2  | 55.9 ± 13.0                                | 146.0 ± 25.1                                | 77.0 ± 12.0                 |                   | Moderate<br>Aerobic Zone |
| <b>C2</b>            | 35.3 ± 9.3   | 61.9 ± 11.2                                | 153.0 ± 23.1                                | 80.7 ± 12.1                 |                   |                          |
| <b>T2</b>            | 35.5 ± 9.1   | 62.5 ± 11.3                                | 153.0 ± 23.1                                | 80.7 ± 12.1                 | 62                |                          |
| <b>P3</b>            | 40.2 ± 10.7  | 70.1 ± 10.7                                | 172.0 ± 17.5                                | 90.4 ± 7.6                  |                   |                          |
| <b>C3</b>            | 42.5 ± 12.7  | 73.6 ± 12.7                                | 173.0 ± 12.1                                | 91.0 ± 5.8                  |                   |                          |

**Table 6** – Male and female absolute and relative cardiorespiratory descriptive data (VO<sub>2</sub> and HR) related to each part of the predefined hip-hop party dance, time spent (%), and zones of intensity

|           | <b>MALE (n=4)</b>  |  |                              |                             |                      | <b>FEMALE (n=4)</b>         |  |  |                              |                             |                      |                             |
|-----------|--|--|------------------------------|-----------------------------|----------------------|-----------------------------|--|--|------------------------------|-----------------------------|----------------------|-----------------------------|
|           | <b>Mean ±SD</b>  |  |                              |                             |                      | <b>Mean ±SD</b>             |  |  |                              |                             |                      |                             |
|           | VO <sub>2</sub><br>(ml·kg <sup>-1</sup> ·min <sup>-1</sup> ) | VO <sub>2</sub><br>(%VO <sub>2peak</sub> ) | HR<br>(b·min <sup>-1</sup> ) | HR<br>(%HR <sub>max</sub> ) | Time<br>Spent<br>(%) | Zones of<br>Intensity       | VO <sub>2</sub><br>(ml·kg <sup>-1</sup> ·min <sup>-1</sup> ) | VO <sub>2</sub><br>(%VO <sub>2peak</sub> ) | HR<br>(b·min <sup>-1</sup> ) | HR<br>(%HR <sub>max</sub> ) | Time<br>Spent<br>(%) | Zones of<br>Intensity       |
| <b>P1</b> | 17.8 ± 4.3   | 27.0 ± 6.8                                 | 124.0 ± 22.3                 | 65.9 ± 8.5                  |                      |                             | 11.9 ± 3.5   | 26.2 ± 10.5                                | 132.0 ± 15.4                 | 68.9 ± 8.1                  |                      |                             |
| <b>C1</b> | 30.9 ± 9.1   | 46.4 ± 12.7                                | 131.0 ± 28.4                 | 69.8 ± 13.1                 | 38                   | Lower<br>Aerobic<br>Zone    | 20.2 ± 3.6   | 43.7 ± 12.8                                | 149.0 ± 18.9                 | 77.9 ± 10.1                 | 38                   | Lower<br>Aerobic<br>Zone    |
| <b>T1</b> | 32.4 ± 7.0   | 48.8 ± 9.9                                 | 131.0 ± 28.4                 | 69.8 ± 13.1                 |                      |                             | 22.0 ± 4.4   | 47.7 ± 14.6                                | 149.0 ± 18.9                 | 77.9 ± 10.1                 |                      |                             |
| <b>P2</b> | 38.7 ± 10.6  | 58.3 ± 15.5                                | 136.0 ± 27.4                 | 72.8 ± 12.2                 |                      |                             | 25.0 ± 2.5   | 53.6 ± 11.8                                | 155.0 ± 22.1                 | 81.2 ± 11.7                 |                      |                             |
| <b>C2</b> | 42.2 ± 7.9   | 63.4 ± 11.5                                | 154.0 ± 17.3                 | 81.4 ± 8.6                  | 54                   | Moderate<br>Aerobic<br>Zone | 28.4 ± 3.7   | 60.5 ± 12.4                                | 152.0 ± 30.6                 | 79.9 ± 16.2                 |                      |                             |
| <b>T2</b> | 42.1 ± 7.7   | 63.3 ± 10.0                                | 154.0 ± 17.3                 | 81.4 ± 8.6                  |                      |                             | 28.8 ± 4.1   | 61.6 ± 14.1                                | 152.0 ± 30.6                 | 79.9 ± 16.2                 | 62                   | Moderate<br>Aerobic<br>Zone |
| <b>P3</b> | 47.8 ± 7.0   | 72.2 ± 11.4                                | 162.0 ± 14.7                 | 85.1 ± 3.2                  |                      |                             | 32.5 ± 7.8   | 68.0 ± 11.2                                | 183.0 ± 14.1                 | 95.7 ± 7.0                  |                      |                             |
| <b>C3</b> | 51.4 ± 8.9   | 77.7 ± 14.9                                | 167.0 ± 12.7                 | 88.1 ± 5.8                  | 8                    | Anaerobic<br>zone           | 33.5 ± 9.3   | 69.4 ± 10.5                                | 179.0 ± 9.0                  | 93.8 ± 4.8                  |                      |                             |