

## A comparative case study of caloric expenditure of two fitness activities: Cinta Dance® and continuous running

### Estudio de caso comparativo de gasto calórico de dos actividades de fitness: Cinta Dance® y carrera continua

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**Resumen.** El propósito de este estudio de caso fue determinar el gasto calórico de la actividad de Cinta Dance® y comparar esta con el gasto calórico de correr a velocidad constante en las mismas condiciones. Para ello, dos sujetos, un varón y una mujer realizaron una sesión de 45 minutos de Cinta Dance®, ejecutando una coreografía sobre un tapiz rodante, y corrieron a la misma velocidad para comparar el gasto calórico que supuso cada actividad. Los datos obtenidos del gasto calórico fueron medidos a través del calorímetro Sense Wear Armband Pro3. Así mismo, se analizaron los posibles cambios de ánimo inducidos por cada actividad mediante la Escala de Valoración del Estado de Ánimo y parámetros de fatiga muscular y cardiorrespiratoria percibida a través de una Escala de Borg. Para ambos sujetos la actividad de Cinta Dance® supuso un gasto calórico mayor que el producido durante la carrera continua. Cinta Dance® disminuye el estado de depresión y aumenta la alegría tras la realización de esta en ambos sexos, además, supone una mayor fatiga cardiorrespiratoria y muscular en comparación con la carrera continua. Se clasifica Cinta Dance®, en función de los valores percibidos en la escala de Borg, como un ejercicio de baile de alta intensidad. Finalmente, se posiciona la sesión de Cinta Dance® como una actividad aeróbica más con la que incrementar el gasto calórico.

**Palabras clave:** BodyMedia SenseWear; Cinta Dance®; Danza; Gasto Calórico; Tapiz rodante.

**Abstract.** The purpose of this case study is to determine the caloric expenditure of Cinta Dance® and compare it to running at a constant speed under the same conditions. A man and a woman completed a 45-minute Cinta Dance® session, performing a choreographed routine on a treadmill, and ran at the same speed to compare the caloric expenditure of each activity. Caloric expenditure was measured using the BodyMedia SenseWear calorimeter. Possible induced mood changes were analyzed by means of the Scale for Mood Assessment (EVEA) and parameters of perceived muscular and cardiorespiratory fatigue through a Borg Scale. For both subjects, the Cinta Dance® activity resulted in a higher caloric expenditure than that produced during continuous running, with a difference of 201.58 kcal in the case of the male and 57.08 kcal in the case of the female. Cinta Dance® decreases the state of sadness-depression and increases joy after the session in both sexes, and, in addition, it incurs a greater cardiorespiratory and muscular fatigue in comparison to continuous running. Therefore, Cinta Dance® is classified as a high intensity dance exercise. We conclude that Cinta Dance® can be one more aerobic activity with which to increase caloric expenditure.

**Keywords:** BodyMedia SenseWear; Cinta Dance®; Caloric Expenditure; Dance; Treadmill.

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## Introduction

Nowadays, gyms offer a wide variety of collective physical activities. Therefore, these activities must be studied in order to understand the benefits they may present and their influence on the improvement of the quality of life of the subjects who participate in them. That is why the scientific support that accompanies Cinta Dance® will sustain its implementation as one more available exercise option.

It must be noted that, although participating in physical activity may not always lead to increases in traditional markers of physiological performance and fitness (e.g., VO<sub>2</sub>max, mitochondrial oxidative capacity, body composition), it does improve one's health (reduction of disease risk) and functional capacity. The benefits associated with regular exercise and physical activity contribute to a healthier and more independent lifestyle, greatly improving functional capacity and quality of life. (American College of Sports Medicine (ACSM), 1999).

Aerobic dance exercise is one of the most widely practiced adult fitness activities. Most of the research regarding this form of exercise supports its application as a valid alternative cardiovascular workout, especially for adult women. (Williford, Scharff-olson & Blessing, 1989).

Domene, Moir, Pummell, Knox, Easton, (2015) in their study endorse how aerobic dance like Zumba® is an efficacious health-enhancing activity for adults.

Energy expenditure is an important element when considering physical activities. Choosing optimal modes and intensities of activity according to energy expenditure characteristics can enhance physical activity prescriptions for improving quality of life. (Li, Xue, Hong, Song, & He, 2020).

In terms of caloric expenditure there is a wealth of information on continuous running at different speeds (Mayhew, 1977) (Haymes & Byrnes, 1993) (Hall, Figueroa, Fernhall, & Kanaley, 2004). With our study we aimed to discern whether dancing on a treadmill (Cinta Dance®) causes a similar caloric expenditure or if it differs significantly to conventional running.

This analyzes a new physical activity resulting from the collaboration of a professor of the Universidad Pablo de Olavide and a student of Sports Sciences. This activity is called Cinta Dance® and is based on performing a choreography on a treadmill accompanied by music with pre-programmed and preset increases in intensity thanks to a musical arrangement made specifically for this purpose. The intensity is modified through the beats/min of the music, so that an increase in beats per minute (BPM)

means an increase in intensity. The average tempo of the Cinta Dance® session is 122 BPM.

Given the innovative proposal of performing a choreography on a treadmill, it is necessary to seek scientific support that positions Cinta Dance® as another alternative in the world of aerobic exercise. In their study, Cihan Aygün, Bircan Dokumaci, Hayriye Çakir-Atabek (2018) observed the energy expenditure of two dance activities, one of them through an interactive dance videogame. Their findings demonstrate that dancing through a videogame provides high intensity exercise for both dancers and non-dancers ( $> 6$  MET), discovering one more dance exercise with which to increase energy expenditure.

A recent study compared two physical activities: choreographed aerobic endurance training and treadmill endurance exercise. In addition to their conclusion in terms of body composition, they confirmed the positive effects on the results given by the motivation of the subjects due to they chose the modality based on their personal preferences (Idrizovic, Ahmeti, Sekulic, Zevrnja, Ostojic, Versic, Zenic, 2021). Delextrata & Neupert (2015) study the caloric differences in Zumba® fitness workout. They conclude that psychological factors must be taken into account when prescribing exercise as it influences energy expenditure.

Regarding the influence of music on performance and how it reduces the level of perception of effort made, there are many studies that talk about it (Aguilar, Florez & Saavedra, 2021), (Bravo-Herrera, & Carazo-Vargas, 2019), (Potteiger, Schoreder, & Goff, 2000), (Savitha, Sejil, Rao, Roshan, & Avadhany, 2013), (Silva, Ferreira, Alves, & Follador, 2016). For this reason, dancing on a treadmill with the musical support that this entails can be an opportunity with which to improve adherence and enjoyment of physical activity.

Finally, it should be noted that this study proposes a new way of using a common element in gyms, fitness and wellness rooms as is the treadmill, giving it greater use in an attractive and novel way.

The main objective of this case study is to know the caloric expenditure of dancing on a treadmill, what we call Cinta Dance®, and to compare this activity with running at a constant speed in the same conditions in which the Cinta Dance® session was carried out.

### **Purpose of research**

Most of the fitness and wellness activities are not treated from a scientific research. The idea of this research is based on the need to check whether the new activity of Cinta Dance is more profitable in terms of caloric expenditure compared to continuous running.

### **Methodology**

#### **Sample**

The sample consists of two participants, one male and one female, both physically active undergraduate students

of Sports Science. They were previously asked for informed consent to participate in the present study for non-invasive tests. The 28-year-old male participant weighed 72kg and was 179cm tall. The female participant was 31 years old, weighed 64 kg and was 169 cm tall.

### **Materials**

To record data on energy expenditure, we evaluated the most commonly used portable accelerometers/calorimeters. Given their proven reliability in multiple studies, we narrowed our search down to the Tritrac-R3D (Davies & Mackinnon, 2001) and Bodymedia SenseWear Armband (Fruin & Rankin, 2004) (Jakicic, Marcus, Gallagher, Randall, Thomas, Goss, & Robertson, 2004) (Drenowatz & Eisenmann, 2011) (Van Hoyea, Boena & Lefevre, 2014) (Reece Barry, Fuller, & Caputo, 2015) (Bhammar, Sawyer, Tucker, Lee, & Gaesser 2016). Finally, we used two portable, self-calibrating SenseWear ArmBand accelerometers/calorimeters, as other studies have used it for the analysis of caloric expenditure in dancers (Morente Ponce & Calvo Lluich, 2020).

Two Matrix Ultimate Deck treadmills were used to carry out the study. The "Seca 217" stadiometer and the "Seca 813" electronic floor scale were used to obtain the data required by the calorimeters. In addition, information was obtained from questionnaires including the Scale for Mood Assessment (EVEA) (Sanz, 2001) and a set of questions regarding the subject's subjective perception of the variables studied, measured through a modified Borg scale (from 1 to 10).

#### **Matrix Ultimate Deck (Model: T-5X-07- C)**

This treadmill, with a running surface of  $56 \times 152$  cm, was used for the field tests. Two treadmills of this model were available so that each subject used the same treadmill for both tests.

#### **BODYMEDIA SenseWear Armband PRO 3 (version 7.0).**

It is a multisensory metabolic analysis device that monitors, measures and quantifies daily physical activity, including total energy expenditure, active energy expenditure, average METs, level of physical activity, duration of physical activity, number of steps and time spent exercising. The SenseWear ArmBand is wearable and self-calibrating. This sensor is placed on the back of the upper arm, on the left triceps brachii, at the area of the "V deltoïd". It records physiological signals from five sensors: three accelerometers, body temperature, heat dissipation, and skin impedance/moisture content. These sensors provide data on total daily expenditure (kcal consumed), duration, quantification and classification of physical activity, MET's (kcal /h/ kg), active energy expenditure during activity, number of steps taken, etc. The program, prior to data collection, requires the introduction of the following characteristics of the participants: date of birth, body weight, height and whether or not the subject is a regular

smoker. In this way each subject used their calorimeter with their previously established data.



Figure 1. BodyMedia SenseWear Armband Pro.

### **Stadiometer “Seca 217”**

The stadiometer measured the height of participants, which is required for the individualization of data required by the calorimeters.

### **Electronic Floor Scale “Seca 813”**

This calibrated scale was used to obtain the body weight of the participants, which was required by the calorimeter program prior to recording data on the participant.

### **Scale for Mood Assessment (EVEA)**

This instrument evaluates the efficacy of mood induction procedures. It is a questionnaire consisting of 16 items, each containing an 11-point Likert-type graphic scale (from 0 to 10) with a short statement describing a mood state on the left margin. The EVEA is intended to assess four mood states: anxiety, hostility, sadness-depression and joy. Each mood state is represented by four items with different adjectives defining a subscale, worded in the same direction. To obtain a person's score in each of the mood states evaluated by the EVEA, it is sufficient to add the scores of the four adjectives corresponding to each subscale and divide the sum by 4. In this way, four scores between 0 and 10 are obtained, reflecting the subject's sad-depressive, anxious, cheerful and hostile states at that moment (Sanz, 2001).

### **Modified Borg Scale (1-10)**

This nominal scale from 1 to 10 provides quick and simple information on the subjective state of participants regarding the variables studied (Fajardo, Rull & Antonio, 2009). By means of this scale, we observed parameters of muscular fatigue and cardiorespiratory fatigue corresponding to the subjective perception of the effort involved in the physical activity carried out by the participants.

### **Field tests**

Prior to the field tests, the participants' food and rest

were monitored. Prior to the test, the participants rested for the two previous days, had not eaten in the two hours prior to the test, and the last meal had not been particularly large. Likewise, it was controlled that the subjects had not consumed alcohol or any stimulating substances in the previous 48 hours.

To carry out the test, we used two BODYMEDIA SenseWear Armband Pro3 calorimeters, two Matrix Ultimate Deck treadmills, the EVEA questionnaire, and an Excel template with the variables to be studied measured using the Borg Scale.

The testing procedure, which was the same for both tests, consisted of having the participants fill out the EVEA before performing the corresponding test.

After this, the calorimeters, disinfected in advance, were placed on each of the participants ten minutes prior to the activity, as indicated by the instructions for this instrument. Once the ten minutes had elapsed and after hearing the sound signal emitted by the device indicating its correct activation and the start of data collection, the corresponding activity was carried out. At the end of the activity, the calorimeters were removed, the patients were asked individually about their perception of muscular and cardiorespiratory fatigue, which they would indicate using the modified Borg Scale from 1 to 10, and finally, they filled out the EVEA again.

It should be noted that both tests were carried out on the same treadmill at the same time of day, at a temperature of approximately 22° C and similar humidity levels, so that the conditions were the same on both days of intervention, between which at least 48 hours elapsed.

### **Cinta Dance®**

The Cinta Dance® session is based on the proposal made by Palma-Leon, Velasco-Merida, Calvo-Lluch (2022). It was composed of a music track that lasted 45 uninterrupted minutes, with an average tempo of 122 BPM.

The speed at which the treadmill is set depends on the tempo of the music, specifically the song's beats per minute (BPM). Another variable that influences the treadmill's speed is the anthropometry of the subject, so that those with a longer leg length require a higher speed. This is the case for the male participant, whose treadmill speed was increased to 5 km/h, as opposed to the female, who was kept at 4 km/h in line with the musical needs.

The routine consisted of a three-minute warm-up accompanied by a song, followed by a 40-minute session that consisted of a methodological progression of steps that formed the choreography. Finally, the speed of the treadmill was slowed down in order to get off of from it with caution and, in the last two minutes, a series of static stretches of the muscles most involved in this activity were performed: rectus femoris, biceps femoris and gluteus medius.

The steps performed in the session are basic aerobic, step, ballroom, jazz, and modern dance, chosen due to the easy execution of these on the treadmill.

### Continuous run

The participants had to run for 45 minutes on the treadmill at the same speed at which they performed the Cinta Dance® session. Therefore, the male subject ran at a speed of 5 km/h and the female at 4 km/h for the reasons mentioned above.

### Results

Table 1 and Table 2 show the exported data from the calorimeters in both tests performed. It is worth highlighting the calorimetric difference between both activities. For both participants the Cinta Dance® activity resulted in a higher caloric expenditure than that produced during continuous running. In the case of the male participant, the difference between the Cinta Dance® session and continuous running was 201.58 kcal, the caloric expenditure being higher in the Cinta Dance® activity. In the case of the female subject, the caloric expenditure in the Cinta Dance® session was again higher, with a slight difference of 57.08 kcal.

We would like to highlight the differences between the two participants, where the female participant experienced higher levels of caloric expenditure (specifically 200kcal more) than the male participant during the *Cinta Dance®* session.

Furthermore, when looking at the number of steps taken, the male participant took more steps than the female participant in both activities. The number of steps taken in Cinta Dance® were higher, with a difference of 1,210 steps more than in continuous running. The female participant took 533 more steps in the Cinta Dance® session than in the continuous running session.

In the case of the male participant, the Cinta Dance® session led to an energy expenditure of 10.42 kcal/min, obtained by dividing the measured energy expenditure by the 45 minutes that the activity lasted. In the case of the female participant, the energy expenditure corresponding to the Cinta Dance® activity was 14.8 kcal/min. The energy expenditure involved in continuous running for the male participant was 5.95 kcal/min, while for the female participant it was 13.62 kcal/min.

Table 1.  
Data obtained from the male's calorimeter.

MALE	Date	Active Caloric Expenditure (kJ)	Active Caloric Expenditure (kcal)	Duration of Physical Activity	Steps
CINTA DANCE®	2021/04/12	1966	469.57	0:55	5918
RUNNING	2021/04/16	1122	267.99	0:55	4708

Table 2.  
Data obtained from the female's calorimeter.

FEMALE	Date	Active Caloric Expenditure (kJ)	Active Caloric Expenditure (kcal)	Duration of Physical Activity	Steps
CINTA DANCE®	2021/04/12	2805	669.96	0:55	5163
RUNNING	2021/04/16	2566	612.88	0:55	4630

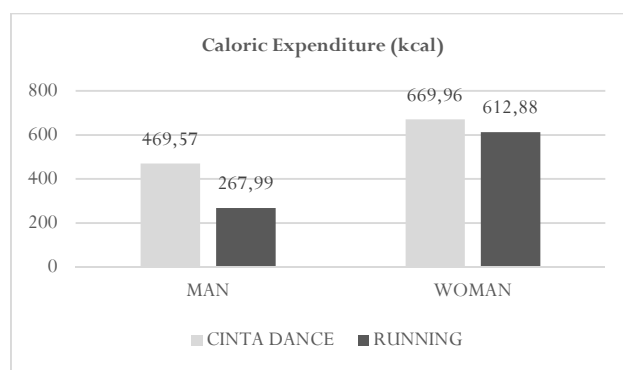


Figure 2. Caloric expenditure in both participants and activities. (Prepared by the authors).

Regarding the results obtained in the EVEA in relation to the Cinta Dance® session, it is worth noting how the levels of sadness-depression decrease in both participants after the session. Likewise, the state of happiness increases in both subjects after the activity. None of the subjects display any hostility either before or after the activity. Finally, anxiety decreases in the case of women after the execution of the Cinta Dance® session. In the case of the male participant, anxiety increases after the activity. It might be the case that the male participant misinterpreted the items corresponding to the state of anxiety, leading to a possible error.

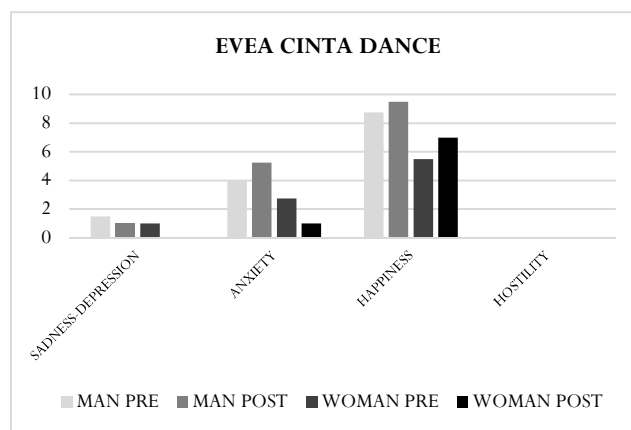


Figure 3. EVEA results in the Cinta Dance® session. (Prepared by the authors).

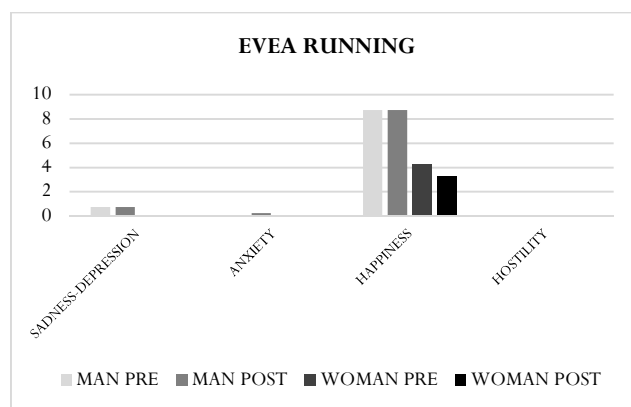


Figure 4. EVEA results in the continuous run session. (Prepared by the authors).

On the other hand, as for the results obtained in continuous race in relation to the EVEA, it should be noted that the female participant shows levels of happiness be-

fore and after continuous running, although it diminishes after running.

The male participant maintains the same recorded levels of both joy and sadness-depression after the race, with anxiety decreasing once the race is over.

When observing the results of muscular fatigue and cardiorespiratory fatigue measured through a modified Borg scale (from 1 to 10), the difference between the two participants and the activities studied stands out. The Cinta Dance® session resulted in greater fatigue at both the muscular and cardiorespiratory levels than continuous running. In the case of the male participant, cardiorespiratory fatigue was greater than that of the female participant in the Cinta Dance® activity, but we observed less muscular fatigue compared to the female participant. In continuous running, both subjects perceived equal cardiorespiratory fatigue; however, the female participant reported greater muscular fatigue than the male.

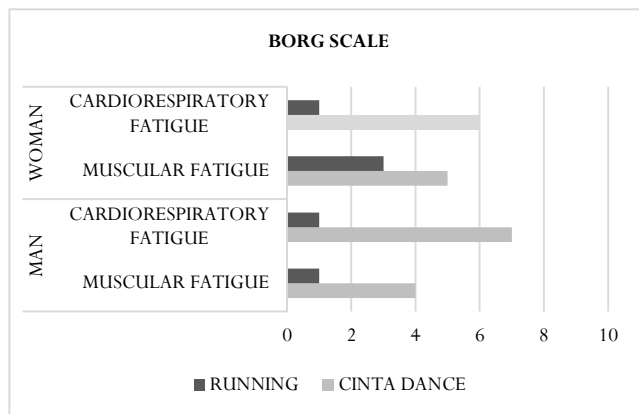


Figure 5. Results of the Borg Scale in both participants and activities. (Prepared by the authors).

## Discussion

The purpose of this research is to determine the caloric expenditure of the proposed new physical activity, Cinta Dance®, in a case study applied to a male and a female participant, and to compare it with the results obtained from running at a constant speed in the same conditions as in the Cinta Dance® session.

"Low intensity" dance exercise is generally characterized by less musculature, less impact on the lower body, and slower tempo music. Dance exercise of this kind requires an expenditure of approximately 4 to 5 kcal/minute. Several trials, however, have shown that vigorous "high intensity" aerobic dance, which involves the use of large muscle groups, may require 10 to 11 kcal/minute (Williford, Scharff-olson & Blessing, 1989). Based on the results obtained in this case study, where the energy expenditure of the male participant in the Cinta Dance® session was 10.42 kcal/min and in the female participant was 14.8 kcal/min, the proposed Cinta Dance® session can be considered as a high intensity dance exercise.

Moreover, there are studies that classify the intensity

of activities based on the subject's subjective perception of effort during the activity. These studies contemplate how during moderate intensity activities, the subject should still be able to speak, but not sing, which is associated with a perception of effort between 5 and 6 on a scale of 1 to 10. Vigorous intensity activities require greater effort, allowing participants to say no more than a few words without running out of breath, and is associated with a perception of approximately 7-8 out of 10 (Khoury, Evans & Ratchford, 2019). This would support the classification of Cinta Dance® as an activity of moderate to vigorous intensity, given that the results obtained in this case study are close to those established by Khoury, et.al (2019) where the male participant signaled a perceived effort of 7 out of 10, and the female participant of 6 out of 10.

Altamirano, Castillo, & Rodríguez (2021) analyze the benefits of biodanza on health. They observe a positive relationship between biodanza practitioners and some health parameters, especially wellbeing variables. Depression, anxiety, quality of sleep, or emotional intelligence were among the health variables analyzed. Regarding the results obtained in the EVEA, Cinta Dance® session decreases the state of sadness-depression and increases happiness in both sexes after partaking in a session.

Given that Cinta Dance® is a new activity created by a professor of Sports Science and a colleague, there are no scientific articles to which compare the results obtained in this case study, therefore, we compare our results to the caloric results of aerobic dance or other similar activities.

In terms of caloric expenditure, Rixon, Rehor, & Bemben, (2006) estimated the energy expenditure per heart rate in Bodypump®, Bodycombat®, Step, and Spinning activities, comparing these with two running speeds (8.05 km/h and 8.37 km/h). The four activities analyzed in the study registered the following average energy expenditures: BodyPump® ( $8.0 \pm 1.62$  kcal/ min), Bodycombat® ( $9.73 \pm 2.0$  kcal/ min), Step ( $9.6 \pm 1.79$  kcal/ min) and Spinning ( $9.88 \pm 1.85$  kcal/ min). When comparing these activities with the energy expenditure obtained at the two proposed running speeds, they concluded that Spinning, Bodycombat® and Step were as effective as jogging between 8.05 km/h and 8.37 km/h, and met the ACSM guidelines for body weight modification and maintenance.

When comparing the Rixon, et al., (2006) study with the results obtained in our study, it is worth mentioning how both subjects in this case study obtained higher energy expenditures in the Cinta Dance® session than in the activities proposed in the Rixon, et al., (2006) study.

The results of this case study show that a Cinta Dance® session results in a greater amount of energy expenditure than in continuous running, in contrast with the Rixon, et al. (2006) study in which the aerobic and continuous running activities were equally effective in terms of caloric expenditure. To a greater extent, this difference may be due to the fact that the speed of the treadmill in this case study was lower than that used in by

Rixon, et al., (2006).

In the absence of studies on Cinta Dance®, we have to look for literature as similar as possible, which is why we have included studies on ballroom dancing and dance. One study analyzed the caloric expenditure of ballroom dancing, where participants were asked to perform a series of dances consisting of the Waltz, Foxtrot, Swing and Cha-Cha (Lankford, Bennion, King, Hessing, Lee & Heil, 2019). The tempo for each dance corresponded to the following: Waltz at 96 BPM, Foxtrot at 128 BPM, Cha-Cha at 132 BPM and Swing and 132 BPM. The average energy expenditure of 30 minutes of recreational ballroom dancing was  $176.44 \pm 49.9$  kcal,  $5.88 \pm 1.7$  kcal/min. This study validates the intensity of recreational ballroom dancing coinciding with the criteria established by the ACSM (2013) to improve cardiorespiratory function and reduce the risk of chronic disease, meeting the criteria for moderate vigorous aerobic exercise (Lankford et al., 2019).

The average tempo of the proposed Cinta Dance® session was 122 BPM, same as the average tempo of the previous study (Lankford et al., 2019), which, despite this, obtained a lower energy expenditure than that present in this case study during the Cinta Dance® session. This fact calls for further investigation in terms of caloric expenditure of the Cinta Dance® session, and more specifically, regarding the calorimetric differences with respect to other dance modalities with the same average tempo. This way, we will be able to observe the possible variables that influence energy expenditure between different activities with the same average tempo and compare them with Cinta Dance®.

Although the energy expenditure during a session of different ballroom dances was lower than that obtained in the Cinta Dance® session, they validate this new fitness activity as an alternative for the improvement of cardiorespiratory function and the improvement of the quality of life of the practitioners. In this case study, it is reasonable to think that the Cinta Dance® session, in turn, meets these criteria in terms of energy expenditure.

Finally, one study observed the benefits of a training program based on 40-minute aerobic dance sessions. The estimated caloric expenditure was 289.3 kcal for the entire 40-minute session, 7.23kcal/min (Rockefeller & Burke, 1979). These results, which, despite obtaining a lower energy expenditure than that recorded in this case study during the Cinta Dance® proposal, demonstrate how aerobic dance is presented as an alternative to increase caloric expenditure. This fact coincides with and supports the idea of presenting the Cinta Dance® session as a more accentuated option of aerobic activity that leads to an increase in caloric expenditure.

### Practical application

The world of fitness is constantly evolving. Every year new forms of activities and innovations in gyms and train-

ing rooms appear on the market. With Cinta Dance® we are innovating in the world of directed physical activities and the learning methodology has already been published in a JCR magazine. The evolution of the treadmill has always been subject to use with continuous running, and the intention with this system is to provide more alternatives to its use.

### Conclusion

Given the results obtained in this case study, we conclude that the proposed activity, Cinta Dance®, involves a higher caloric expenditure than continuous running for both sexes. In terms of mood, Cinta Dance®, decreases the state of sadness-depression and increases happiness in both sexes after partaking in a session. Cinta Dance® entails a greater cardiorespiratory and muscular fatigue compared to continuous running, performed at the same speed as the Cinta Dance® session, and the values perceived on the Borg scale classify this activity as a high-intensity dance exercise. Finally, a Cinta Dance® session positions itself as an aerobic activity with which to increase the caloric expenditure of the participants.

### Disclosure of interest

The authors report no conflict of interest.

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