Original Research

The Energy Expenditure of Recreational Ballroom Dance

D. ELI LANKFORD[1]‡, TREVOR W. BENNION[1]†, JASON KING[1]*, NATALIE HESSING[1]*, LLOYD LEE[1]*, DANIEL P. HEIL[2]‡

[1]Brigham Young University – Idaho, Rexburg, ID, USA; [2]Montana State University, Bozeman, MT, USA

* Denotes undergraduate student author, †Denotes graduate student author, ‡Denotes professional author

ABSTRACT

International Journal of Exercise Science 7(3) : 228-235, 2014. The popularity of recreational ballroom dancing has increased dramatically in recent years. Yet, relatively little information is known regarding the physiological demands of ballroom dancing. The purpose of this study was to determine the energy requirements for recreational ballroom dancing. 24 participants volunteered including 12 women (mean ± SD: 21 ± 3 yrs, 165.8 ± 7.4 cm, 56.8 ± 11.1 kg) and 12 men (23 ± 1 yr, 175.5 ± 8.4 cm, 78.1 ± 15.6 kg). Gas exchange was recorded using a portable metabolic system during a series of five ballroom dances: Waltz, Foxtrot, Swing, Cha-Cha, and Swing. Each song was four minutes in duration, separated by a two minute rest period, totaling 30 minutes of testing. The intensity of each dance in metabolic equivalents (METs) is: Waltz = 5.3 ± 1.3, Foxtrot = 5.3 ± 1.5, Cha-Cha = 6.4 ± 1.6 and Swing = 7.1 ± 1.6 and 6.9 ± 1.7. Mean energy cost for the 30 minutes of testing was 5.88 ±1.7 kilocalories ($kcal \bullet min^{-1}$), 6.12 ± 1.2 METs. Mean energy cost and months of recreational dance experience were not significantly related ($R^2 = 0.04$, $p = 0.35$). Energy expenditure of the follow partner was significantly related to the energy expenditure of the lead partner ($R^2 = 0.52$, $p < 0.01$). Finally, this study validates the intensity of recreational ballroom dance as matching the criteria established by the American College of Sports Medicine for improving cardiorespiratory fitness and reducing the risk of chronic diseases.

KEY WORDS: ACSM guidelines, physical activity, cardiorespiratory fitness

INTRODUCTION

Over past several decades, The American College of Sports Medicine (ACSM), the Centers for Disease Control (CDC), and The American Heart Association (AHA) have published recommendations for aerobic activity for the prevention and management of chronic diseases (8). The scope of those guidelines are continually being investigated to find appropriate volumes and intensities of activities to achieve adequate health benefits and prevent chronic disease. Various sports are commonly researched as modes of physical activity for practical application of the establisehd activity recommendations. Under current invesitigation is the energy requirements of recreational ballroom dance and determining the role of dance in meeting the prescribed physical activity requirements.

The USA Ballroom Dance Association (USABDA) has published that "… During the last few years there has been an explosive growth in the interest in ballroom dancing throughout the United States (9)." This growth reflects registrations for social and competitive dance memberships ranging from school-aged (K-12) to adult (≥19 years old) registrants. This steady growth in ballroom dance has accelerated in recent years, including the International Olympic Committee officially recognizing ballroom dance as a sport in 1997. Ballroom dance appears to be a form of physical activity with the potential for high compliance among participants. Kohler, Kressig, Schindler, and Granacher (11) analyzed correlations of exercise adherence against factors such as the amount of training (i.e., learning curve for motor skill acquisition), exercise frequency, and number of participants involved. The exercise programs with the greatest adherence were those with a reduced focus on the amount of training, and a greater emphasis on frequency and group participation (11). Recreational ballroom dance can be approached with little training and is often enjoyed in the company of multiple participants, which may explain its gain in popularity among various populations.

Despite the increasing popularity of ballroom dance, the scientific community has investigated this topic relatively little. To date, the only study determining the energy cost of ballroom dance used competitive dancers as participants and was limited to the use of heart rate monitors for estimating oxygen consumption of ballroom dance (6). Heart rate typically increases in a linear relationship to work rate during dynamic exercises, but can be limited in estimating total energy expenditure due to high heart rate variability among participants and error in estimating maximal heart rate (1). While previous studies may provide beneficial information for competitive dance, lack of precise measurement leaves the metabolic demand in terms of energy expenditure for each dance (EE, $kcal \cdot min^{-1}$), mean energy costs for an entire 30 minute dance session ($kcal \cdot min^{-1}$), and metabolic equivalents (METs) of recreational ballroom dance relatively unknown. Furthermore, since the movement during dance is largely dependent on the tempo of the music, it appears that tempo should be controlled when investigating the energy requirements of ballroom dance.

The primary purpose of our study was to characterize the energy requirements for several common forms of recreational ballroom dance using a portable metabolic measurement system. A secondary goal was to relate these finding to the current recommendations for physical activity in healthy adults (8, 10).

METHODS

Participants

Twenty-four college-age recreational dancers (12 females and 12 males), were recruited from Brigham Young University – Idaho. Prior to any involvement, participants were screened using a physical activity questionnaire (PAR-Q) to determine health qualification, and signed an informed consent agreement approved by the university's institutional review board. Each participant's body height, body mass, age, gender and months of recreational ballroom dance experience were recorded (see table 1).

Table 1. Descriptive statistics of subjects.

	Male (n = 12)	Female (n = 12)
Age (yrs)	23 ± 1.3	21 ± 2.8
Height (in)	69.1 ± 3.3	65 ± 2.9
Weight (kg)	78.1 ± 15.6	56.8 ± 11.1
Dance experience (months)	51.3 ± 43.7	61 ± 45.7

Values are mean ± SD.

Protocol

Participants were asked to perform a series of dances consisting of the Waltz, Foxtrot, Swing, and Cha-Cha. Tempo for each dance was established using guidelines from the United States Amateur Ballroom Dance Association: Waltz at 96 bpm, Foxtrot at 128 bpm, Cha-Cha at 132 bpm, and Swing and 132 bpm. Gas exchange was determined using a portable metabolic system (Oxycon® mobile, VIASYS, San Diego, CA). Each participant was paired with a different participant of the opposite gender, with the male acting as the lead partner and the female as the follow partner. Data was collected on either the lead or follow partner in a randomized order. The same dance partnership then returned following a minimum 2 hour recovery for data collection on the subsequent partner. One complete test consisted of the five dances, with each dance lasting four minutes in duration followed by a two minute rest period consisting of sitting quietly in a chair. The order of performed dances during each test were Waltz, Foxtrot, Swing, Cha-Cha, Swing. The order of the performed dances was predetermined, with dances of lower tempo being performed first to serve as a warm up for higher tempo dances to reduce the risk of injury. The Swing was repeated due to its popularity in recreational ballroom dance, as well as to establish a total testing duration of 30 minutes. Oxygen uptake was continuously recorded during each 30 minute test, including 2 minute rest periods. Each dance followed its respective dance style and was not choreographed; therefore no two tests were identical. Participants were instructed to avoid strenuous activity, alcohol and caffeine consumption 24 hours prior to dance testing. Participants were also instructed to avoid food consumption four hours prior to testing.

Statistical Analysis

Gas exchange was used to calculate relative oxygen uptake, EE ($kcal \bullet min^{-1}$), and METs of each respective dance. Mean energy cost of the 30 minutes of testing was determined by adding the energy expenditure of each dance and subsequent rest period then dividing by 30. EE was calculated using the Weir equation (17): $kcal \bullet min^{-1} = ((1.1 \times RER) + 3.9) \times VO_2$. Mean energy cost ($kcal \bullet min^{-1}$) of lead vs. follow, and months of dance experience vs. mean energy cost were analyzed using a Coefficient of Determination.

RESULTS

Months of experience was not a significant predictor of mean energy cost during 30 minutes of ballroom dance (Figure 1; $R^2 = 0.04$, $p = 0.3487$). EE of the lead dancer was significantly related to EE of the follow dancer (Figure 2; $R^2 = 0.5166$, $p = 0.0084$). In our study, the mean energy cost of recreational ballroom dance met guidelines set forth by ACSM to be classified as vigorous (2). Independently, Waltz (5.3 ± 1.3 METs) and Foxtrot (5.3 ± 1.5 METs) were considered moderate intensity, and Cha-Cha (6.4 ± 1.6 METs) and Swing (7.1 ± 1.6 METs and 6.9 ± 1.7 METs) were vigorous based off ACSM guidelines (2). Mean energy cost of 30 minutes of recreational ballroom dance was 176.44 ± 49.9 kcal, 5.88 ±1.7 kilocalories ($kcal•min^{-1}$), 6.12 ± 1.2 METs.

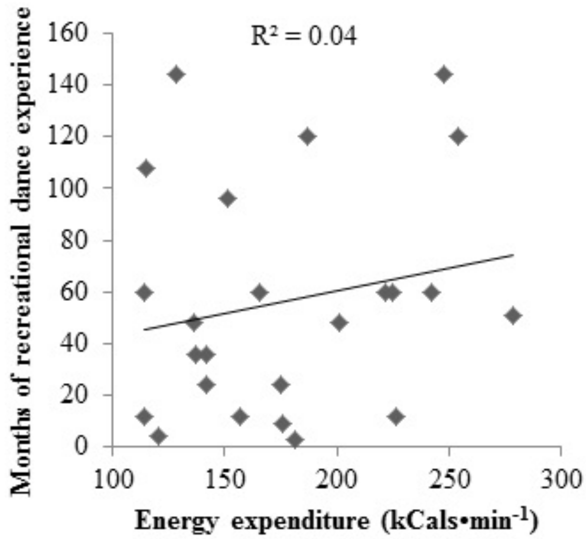

Figure 1. The relationship between energy expenditure during 30-minutes of recreational ballroom dance and months of recreational ballroom dance experience.

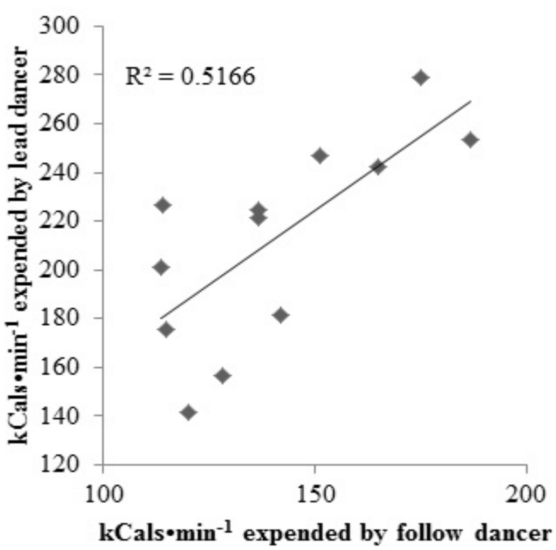

Figure 2. The relationship between energy expenditure (kcal•min-1) of the lead partner and the follow partner during 30-minutes of recreational ballroom dance testing.

DISCUSSION

An important finding of this study is that recreational ballroom dance can be used to meet the intensity component of the aerobic activity recommendations set forth by the ACSM, CDC, and AHA (2, 8, 10, 13). The physical activity recommendations set forth in 1995 suggested that the 30-minute volume of moderate intensity aerobic exercise could be accumulated from short bouts of exercise (13). Since that publication, health professionals have been left asking how short of an exercise bout can still be effective towards the accumulation of the desired duration of physical activity. The guidelines were changed in 2007 for "clarity and consistency" to require at least 10 minutes duration for each bout of aerobic activity (10). Yet, less than 10-minute bouts may prove beneficial for fitness and health among unfit populations (8). While the duration of ballroom dance is dependent upon song length, modifications may be made to allow the dance to extend in duration necessary to meet the ACSM guidelines. Additionally, interval training of short duration performed by highly trained athletes has demonstrated that small bouts of exercise, when performed at high intensity, are capable of improving cardiorespiratory fitness (12). As a moderate – vigorous intensity activity, recreational ballroom dance may yield cardiorespiratory adaptations for improving maximal aerobic fitness (VO_{2max}). The degree of VO_{2max} improvement depends on the initial fitness level of the individual. Research indicates that individuals with low cardiovascular fitness (VO_{2max} < 30 $mL•kg^{-1}•min^{-1}$) and also high cardiovascular fitness (VO_{2max} 40 - 51 $mL•kg^{-1}•min^{-1}$) may improve VO_{2max}

(up to 16% and 8% respectively) when a moderate-intensity aerobic exercise stimulus is provided (15, 16). Therefore, ballroom dance in its current form, may provide adequate exercise intensity to increase fitness levels and reduce the incidence of disease. Future research would need to be necessary to clarify the impact of recreational ballroom dance on changes in cardiorespiratory fitness.

Another important finding of this study is the redefined MET value for recreational ballroom dance. METs are often used to define exercise intensity, where moderate intensity exercise ranges from 3 to 5.9 METs and vigorous intensity exercise is classified as 6 – 8.7 METs (2). A popular study comparing the MET value of various activities has inaccurately represented ballroom dance, even at recreational intensities. In a compendium of physical activities and MET comparisons, Ainsworth et al (3) classified slow ballroom dance (i.e., waltz, and foxtrot) as a 3 MET activity. Our data demonstrate that the waltz and foxtrot are 5.3 ± 1.3 and 5.3 ± 1.5 METs respectively (see table 2). Possible discrepancies between our results and those of others may be resultant of varying dance tempo. Ainsworth et al does not indicate the dance tempo for the reported activity rating. Our dance tempo was based off a standard established by United States Amateur Ballroom Dance Association. Additionally, no previous MET classification has been given for the Cha-Cha and Swing. To our knowledge, this study is the first to identify the MET intensity, and EE of recreational Waltz, Foxtrot, Cha-Cha and Swing using indirect calorimetry. The ASCM recommends a total energy expenditure of 1,000 kcal•week^{-1}, or 1,000 MET•min^{-1}, which is associated with a 20% – 30% reduction in risk for all-cause mortality (2). To match the volume for health and fitness benefits, according to the ≥500-1,000 MET-min • wk^{-1} model by the ACSM (2) and the redefined intensity level of approximately 6 METs as reported in our study, an individual can achieve the recommended MET-volume with approximately 100 – 200 min • wk^{-1} of recreational ballroom dance. Additionally, the weight-bearing component of recreational ballroom dance may contribute to its exercise prescription

Table 2. Energy expenditure of ballroom dances and exercise guidelines.

	Energy Expenditure (kcal•min^{-1})	Mean Relative O_2 Uptake (mL•$^{-1}$•min^{-1})	Mean MET Expenditure	Mean MET•min^{-1}	ACSM Recommended Cardiorespiratory Exercise Intensities for Healthy Adults (METs) (2)	ACSM Recommended Cardiorespiratory Exercise Intensities for Healthy Adults (MET•min^{-1}) (2)
Waltz	6.01 ± 1.8	18.7 ± 4.6	5.3 ± 1.3	21.3 ± 5.3	Moderate = 3 – 5.9 Vigorous = 6 – 8.7	500 – 1,000
Foxtrot	6.01 ± 1.9	18.4 ± 5.1	5.3 ± 1.5	21.0 ± 5.9		
Cha-Cha	6.41 ± 2.1	22.3 ± 5.4	6.4 ± 1.6	25.5 ± 6.2		
Swing	8.14 ± 2.5 and 7.92 ± 2.5	24.8 ± 5.6 and 24.1 ± 5.8	7.1 ± 1.6 and 6.9 ± 1.7	28.3 ± 6.4 and 27.5 ± 6.6		
Test Total*	5.88 ± 1.7	18.3 ± 4.1	6.12 ± 1.2	157.1 ± 35.5		

Data for Waltz, Foxtrot, Cha-Cha, Swing and Test Total are mean ± SD. *Average of all dances including two minute rest periods.

for the management of cardiovascular disease risk factors (2). Future research may investigate the long-term health benefits of recreational ballroom dance and its relationship to chronic disease.

Another important factor of this study is the dancers participating in our study were experienced only in recreational and not competitive dance. Looking at recreational dance compared to competitive dance provides insight for those who are interested in dance as an alternative mode of aerobic exercise, but unfamiliar with the skill to participate at a competitive level. Dancers in this study had a range of 3 – 144 months of recreational dance experience. Months of dance experience did not significantly explain the mean energy cost during 30 minutes of ballroom dance (see figure 1). Therefore, recreational ballroom dance can be a mode of physical activity for individuals looking to meet the accepted cardiorespiratory fitness recommendations for moderate and vigorous intensities with little to no previous experience. Our data also demonstrate that when dancers were partnered with a more active dance partner, a greater mean energy cost occurred (see figure 2). This data indicates that dancers may increase their exercise intensity and therefore health and fitness benefits, by selecting a more active dance partner.

The benefits of exercise are becoming more pronounced as the epidemiology of physical inactivity becomes a more popular research trend. Blair (5) has charted the relationship between physical inactivity and all-cause mortality concluding that physical inactivity is the "biggest public health problem of the 21st century." Research indicates that when individuals begin an exercise program, more than 50% will drop out within the first 6 months (14). This drop off in exercise participation rates is hypothesized to be a factor of barriers rather than motivators, with "bad weather prevents me from exercising," and "I am not interested in exercise" among the most statistically significant barriers (7). It would seem that indoor and interesting activities may be more effective at overcoming barriers that interfere with performing regular physical activity. According to Belza et al (4), ideal physical activity programs that overcome the most barriers and include the most powerful motivators are ones that are budget-friendly and appeal to more than one cultural group. These evidence-based reports indirectly point to ballroom dance as a positive choice for long-term compliance of physical activity since the Waltz, Foxtrot, Cha Cha, and Swing dance styles originate from varying international sources, lending to a potential multi-cultural appeal, and can be recreated in most any environment (including the participant's home) at relatively little to no cost. Compliance as a function of interest level and fun is further supported by Young (18), reporting that participation in sports is declining because of a shift of emphasis from "fun" to "winning". Young continues to define "fun in sports" based on surveyed data from youth sportsmen as (a) being part of a team, (b) experiencing success, (c) having an encouraging coach, and (d) learning and developing new skills. Many of these qualities can be established in recreational ballroom dance because of the partner-based nature of ballroom dance, the potential for learning from your dance partner, and having fun. Whereas many sports are rooted in winning, recreational dance has its roots in having fun and participation which may contribute to a capacity for long-term compliance of increased physical activity.

Accurate quantification of METs and EE for recreational ballroom dance provides a deeper understanding of its physiological demands and how it interacts with cardiorespiratory fitness and the prevention and maintenance of chronic diseases. This is the first study to measure the energy requirements of ballroom dance using indirect calorimetry, and the first to appropriately define the mean physiological work in METs for accurate classification of intensity. Recreational ballroom dance consisting of Waltz, Foxtrot, Cha-Cha, and Swing match the recommended intensities for cardiorespiratory fitness by the ACSM. Ballroom dance can be an effective entry point for increased aerobic fitness and can be used by health professionals to increase the health and fitness of varying populations with the current understanding that recreational ballroom dance does, in fact, meet the criteria for moderate-vigorous aerobic exercise.

ACKNOWLEDGEMENTS

The authors would like to thank the participants for their involvement.

REFERENCES

1. ACSM. ACSM's Guidelines for Exercise Testing and Prescription. 9th ed. Philadelphia: Lippincott Williams & Wilkins, 2013.

2. ACSM. ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription. 7th ed. Philadelphia: Lippincott Williams & Wilkins, 2013.

3. Ainsworth B, Haskell W, Whitt M, Irwin M, Swartz A, Strath S, O'Brien W, Bassett Jr. D, Schmitz K, Emplaincourt P, Jacobs Jr. D, Leon A. Compendium of physical activities: An update of activity codes and MET intensities. Med Sci Sports Exerc 32(9):S498 - S516, 2000.

4. Belza B, Walwick J, Siu-Thornton S, Schwartz S, Taylor M, LoGerfo J. Older adult perspectives on physical activity and exercise: Voices from multiple cultures. Preventing Chronic Disease: Public Health Research, Practice and Policy 1(4): 1-12, 2004.

5. Blair S. Physical inactivity: The biggest public health problem of the 21st century. Br J Sports Med 43(1): 1-2, 2009.

6. Blanksby B, Reidy P. Heart rate and estimated energy expenditure during ballroom dancing. Br J Sports Med 22(2): 57-60. 1988.

7. Forkan R, Pumper B, Smyth N, Wirkkala H, Ciol M, Shumway-Cook A. Exercise adherence following physical therapy intervention in older adults with impaired balance. Physical Therapy 86(3): 401-410, 2006.

8. Garber C, Blissmer B, Deschenes M, Franklin B, Lamonte M, I-Min L, Nieman D, Swain D. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apperntly health adults: Guidance for prescribing exercise. Med Sci Sports Exerc 43(7): 1334-1359, 2011,

9. Growth and new image [Internet]: USABDA [cited 2013. Available from: http://usadance.org/about/growth-and-new-image.

10. Haskell W, Lee I, Pate R, Powell K, Blair S, Franklin B, Macera C, Heath G, Thompson P, Bauman A. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc 39(8): 1423-1434, 2007.

11. Kohler A, Kressig R, Schindler C, Granacher U. Adherence rate in intervention programs for the promotion of physical activity in older adults: A systematic literature review. Praxis 101(24): 1535-1547, 2012.

12. Laursen P, Jenkins D. The scientific basis for high-intensity interval training: Optimising training and maximising performance in highly trained endurance athletes. Sports Med 32(1): 53-73, 2002.

13. Pate R, Pratt M, Blair S, Haskell W, Macera C, Bouchard C, Buchner D, Ettinger W, Heath G, King A, Kriska A, Leon A, Marcus B, Morris J, Paffenbarger R, Patrick K, Pollock M, Rippe J, Sallis J, Wilmore J. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. J Am Med Assoc 273(5):402-407, 1995.

14. Riebe D. It's time for a change ... Behavioral change. ACSMs Health Fit J 16(4): 33-34, 2012.

15. Swain DP. Moderate or vigorous intensity exercise: Which is better for improving aerobic fitness? Prev Cardiol 8(1): 55-58, 2005.

16. Swain D, Franklin B. VO2 reserve and the minimal intensity for improving cardiorespiratory fitness. Med Sci Sports Exerc 34(1): 152-157, 2002.

17. Weir J. New methods for calculating metabolic rate with special reference to protein metabolism. J Physiol 109(1 - 2): 1-9, 1949.

18. Young C. The importance of putting the fun back in to youth sports. ACSMs Health Fit J 16(6): 39-40, 2012.