UNIVERSITY OF WISCONSIN- LA CROSSE

Graduate Studies

THE ENERGY EXPENDITURE AND RELATIVE EXERCISE INTENSITY OF BODYJAM

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Clinical Exercise Physiology

Kristin N. DeMers, B.S.

College of Science and Health
Clinical Exercise Physiology

December, 2019

THE ENERGY EXPENDITURE AND RELATIVE EXERCISE INTENSITY OF BODYJAM

By Kristin DeMers

We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Clinical Exercise Physiology

The candidate has completed the oral defense of the thesis.

John Porcari, Ph.D. Thesis Committee Chairperson	5/8/19 Date
Susan Bramwell, M.S. Thesis Committee Member	5.8.19 Date
Kari Emineth, M.S. Thesis Committee Member	5/8/19 Date

Thesis accepted

Meredith Thomsen, Ph.D. Director of Graduate Studies	5-20-19 Date

ABSTRACT

DeMers, K.N. The energy expenditure and relative exercise intensity of BODYJAM. MS in Clinical Exercise Physiology, December 2019, 51pp. (J. Porcari)

Purpose: To determine the energy expenditure and relative exercise intensity during a BODYJAM session. **Methods:** Nineteen female (age 20.1 ± 1.14 years) subjects completed a maximal treadmill test and a 55-minute BODYJAM session. Heart rate and RPE recorded throughout the BODYJAM session. The HRs that were recorded during the workout were inserted into individual HR/VO_2 regression equations to estimate VO_2 and energy expenditure. **Results:** It was found that subjects exercised at an average of 73 ± 3.5% of %HRmax and 52 ± 6.6% of %VO_2max. Energy expenditure averaged 393 ± 86.4 kcal/session and RPE during the workout averaged 11.5 ± 1.91. **Conclusion:** The BODYJAM session meets the standards set forth by ACSM to improve cardiorespiratory fitness and body composition, despite being perceived a light exertion.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to my thesis advisor Dr. John Porcari for his support and guidance throughout my thesis. I would like to thank Susan Bramwell and Kari Emineth for sitting on my thesis committee as well as Chris Dodge for all of his support in the Human Performance Lab. I would like to acknowledge my fellow classmates and the participants involved in my study, you all helped me along the way and I am eternally grateful for that. Finally, I want to extend my deepest appreciation to my family even though they are far away from me physically, I have always felt their unwavering love and support through this year of graduate school.

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

FIGURE PAGE

LIST OF APPENDICES

INTRODUCTION

In 1969, Jacki Sorensen was asked to create a fitness program for Air Force wives at a military base in Puerto Rico (Jacki Sorensen's Fitness Classes, 2018). Jacki developed a fitness routine based on her own regimen which entailed the combination of aerobic exercise and dance. She created the concept of "aerobic dancing" by merging choreographed routines to upbeat music.

Over the years, many studies have been completed to evaluate the physiological responses to aerobic dance. Foster (1975) evaluated four female subjects who performed an aerobic dance routine while oxygen consumption (VO_2) was monitored. It was found that the subjects exercised at an average of 77% of estimated VO_2max (maximal oxygen consumption) during the routine. It was concluded that aerobic dance could improve cardiorespiratory fitness and was a viable option for individuals looking for an alternative to traditional exercise training.

Milburn and Butts (1983) compared the training responses to aerobic dance and jogging in 46 untrained female subjects. The subjects were divided into three groups: dancers, joggers, and control (who participated in bowling). Both the jogging and aerobic dance groups exercised for 30 min/day, 4 days/week, for 7 weeks while heart rates (HRs) were recorded. It was found that the relative VO_2max of dancers increased by 10.2% and the joggers increased by 8.2%. This data suggested that both jogging and aerobic dance

could increase cardiorespiratory fitness to a similar degree if performed at the same frequency, duration, and intensity.

Martin, Price & Butts (1985) assessed whether or not Jazzercise was effective in producing positive body composition and cardiovascular responses in women during a 7 week training study. Twenty-one females participated in either a 2-day or 3-day Jazzercise routine of 50 minutes each session for 7 weeks. After statistical analyzes were completed, it was found that the two-day and three-day training groups exercised at an intensity of 78.7% and 77.3% HRmax, respectively. It was found that both relative and absolute VO_2max showed significant improvement in the 2-day and 3-day group. Researchers found a 7.4% relative increased and a 7.5% absolute increase in VO_2 for the tw0-day group with a 6.2% relative increase and a 5.7% absolute increase for the three-day group. This shows when working at the same relative intensity, an individual could see increases in cardiorespiratory benefits in both a 2-day and 3-day per week program. In terms of body composition, researchers found a significant different in percent body fat pre and post training period in both the 2-day and 3-day groups. This study indicates that Jazzercise can elicit improvements in both cardiovascular fitness and positive changes in body composition when completed two or three times per week.

Rixon, Rehor, and Bemben (2006) analyzed whether there was a significant difference in caloric expenditure between Bodycombat, Spinning (cycling), step aerobics, and Pump aerobic dance. Twenty-eight female subjects participated in one session of each of the four different modes of “aerobic dance” classes while HR was continuously monitored. It was found that during Pump, Bodycombat, step, and Spinning subjects exercised between 60%-74% of maximal heart rate (HRmax). In terms of energy cost, all

of the classes (with the exception of Pump) elicited a similar degree of caloric expenditure, even when compared to jogging at a speed of 8.05-8.37 km/hr. In conclusion, RPM, Bodycombat, and step aerobics offered a more attractive, yet still effective, form of cardiovascular training.

Petrofsky et al. (2008) studied the effects of a 10-day aerobic dance and diet program on cardiovascular fitness, body composition, and weight loss in women. Subjects completed a 1- hour aerobic dance video every day for 10 days and followed a caloric-restrictive diet. After the 10-day program, subjects lost an average of 1.78 kg, reduced systolic blood pressure by 4 mmHg and diastolic blood pressure by 6 mmHg, reduced resting HR by 14 bpm, and showed an average reduction in waist girth of 3.7 cm. This data suggested that the combination of aerobic dance and a caloric-restrictive diet could result in improved cardiovascular fitness and improved body composition.

A more recent form of aerobic dance is QiDance, which utilizes pre-choreographed routines covering many genres of dance. Buermann, Porcari, Gillette, and Foster (2012) investigated the physiological responses to QiDance and found that subjects exercised at an average of 83% of HRmax and 69% of VO_2max. Subjects exercised at an average workload of 8.1 metabolic equivalents (METs) and burned an average of 498 kilocalories (kcals) per hour. It was concluded that QiDance can provide a vigorous workout based on American College of Sports Medicine (ACSM) guidelines.

Another form of aerobic dance class is Zumba®. Zumba® is a Latin dance workout that is designed to give participants the feel of a dance party. Luettgen, Foster, Doberstein, Mikat, and Porcari (2012) evaluated the physiological responses to a Zumba® class. It was found that subjects exercised at an average of 79% of HRmax, 66%

of VO_2max, and expended ~570 kcal per hour. Subjects exercised at an average of 8.8 METs, which categorized Zumba® as vigorous intensity exercise based on ACSM guidelines.

Similar to many of these newer dance classes, BODYJAM by Les Mills offers a combination of hip hop dance moves synchronized to the latest music. BODYJAM is taught by layering moves in order for individuals to adjust intensity as they feel appropriate. A study by Rehfeld et al. (2017) compared the effects of dancing and aerobic training on the brain structure and function in healthy elderly seniors. Both the dance and aerobic training group showed increases of function in the hippocampus, (an organ associated with long-term memory), however only the dancers showed a notable improvement in balance. These results suggest that dance may be an important modality which could decrease the progression of age-related loss of balance and coordination. To our knowledge there is no research evaluating the energy expenditure (EE) or relative exercise intensity of BODYJAM relative to ACSM guidelines.

The purpose of this study was to determine the relative exercise intensity and EE of a BODYJAM class relative to ACSM guidelines. ACSM (2018) recommends that an individual should exercise between 64-95% of HRmax or 46-90% of VO_2max in order to improve cardiorespiratory endurance. Exercise intensity is often classified based on absolute METs. Light-intensity physical activity is defined as being 2.0-2.9 METs, moderate-intensity ranges from 3.0-5.9 METs, and activities requiring $\geq$ 6.0 METs are considered vigorous. In terms of EE, it is recommended that individuals expend 1,200-2,000 kcal per week (240-400 kcal per exercise session) in order to positively affect body composition (Donnelly et al., 2009).

METHODS

Subjects

Subjects for this study included 19 apparently healthy, college-aged females (18-22 years of age) recruited from the University of Wisconsin-La Crosse. All of the subjects had participated in aerobic dance classes previously so they were familiar with the basic format of the workout. Initially, each subject completed the PAR-Q to screen for cardiovascular and orthopedic limitations to exercise and eligible subjects then had the study explained to them, were given the opportunity to ask questions, and provided written informed consent. The study was approved by the University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects.

Procedures

Each subject performed a maximal graded exercise test on a treadmill utilizing a modified Balke protocol to determine HRmax and VO_2max. Subjects walked or ran at a self-selected pace and started the test at 0% grade. Treadmill speed remained constant throughout the test while the incline increased 2.5% every 2 minutes until volitional exhaustion. Throughout the test HR was recorded every minute using a Polar HR monitor (Polar Electro, Kempele, Finland) and respiratory gas exchange was measured continuously using a metabolic cart (Moxus Modular Metabolic System, AEI Technologies, Naperville, IL). Maximal HR was defined as the highest HR observed at any point in the test and VO_2max was defined as the highest continuous 30-second value for VO_2 that was seen during the test. Prior to each test, the metabolic system was

calibrated with gases of known concentrations (15.98% O_2, 4.12% CO_2) and with room air (20.94% O_2 and 0.03% CO_2) as per the manufacturer guidelines. Calibration of the pneumotachometer was completed using a 3 liter calibration syringe. Rating of perceived exertion (RPE) was recorded every 2 minutes and at maximal exertion using the 6-20 Borg scale (Borg, 1982). Additionally, individual HR/VO_2 regression equations were developed using the HR and VO_2 responses during the last 30 seconds of each stage of the incremental treadmill test. These regression equations were then used to predict VO_2 based on the HR responses during the BODYJAM workout.

Each subject practiced the BODYJAM session at least three times in order to become familiar with the BODYJAM workout. Once deemed proficient by the primary investigator, each subject completed a 55-minute BODYJAM session by following along to a pre-recorded BODYJAM workout video. Each dance session included at least four subjects exercising together in order to achieve the "group effect" that Les Mills is known for in their classes. Each session included approximately a 5-minute warm-up and cool-down. After the warm-up, the instructor introduced various dance combinations which is known as the "rehearsal phase." The combinations began with basic steps. Layering was then incorporated by starting with a base move, then adding various upper and lower body movements. After all the dance combinations were taught, the class performed a double time "bust out performance." Throughout the workout HRs were recorded continuously with a Polar HR monitor and RPE was assessed after the warm-up, every 3-5 minutes during the "bust out performance," and after the cool-down using the 6-20 Borg scale. Heart rate at each minute during the BODYJAM exercise session were inserted into the individual HR/VO_2 regression equations to estimate VO_2. Energy

expenditure was calculated from the predicted VO_2 data assuming a constant of 5 kcal per liter of O_2 consumed per minute.

Figure 1 illustrates the HR-VO_2 regression line for a sample subject.

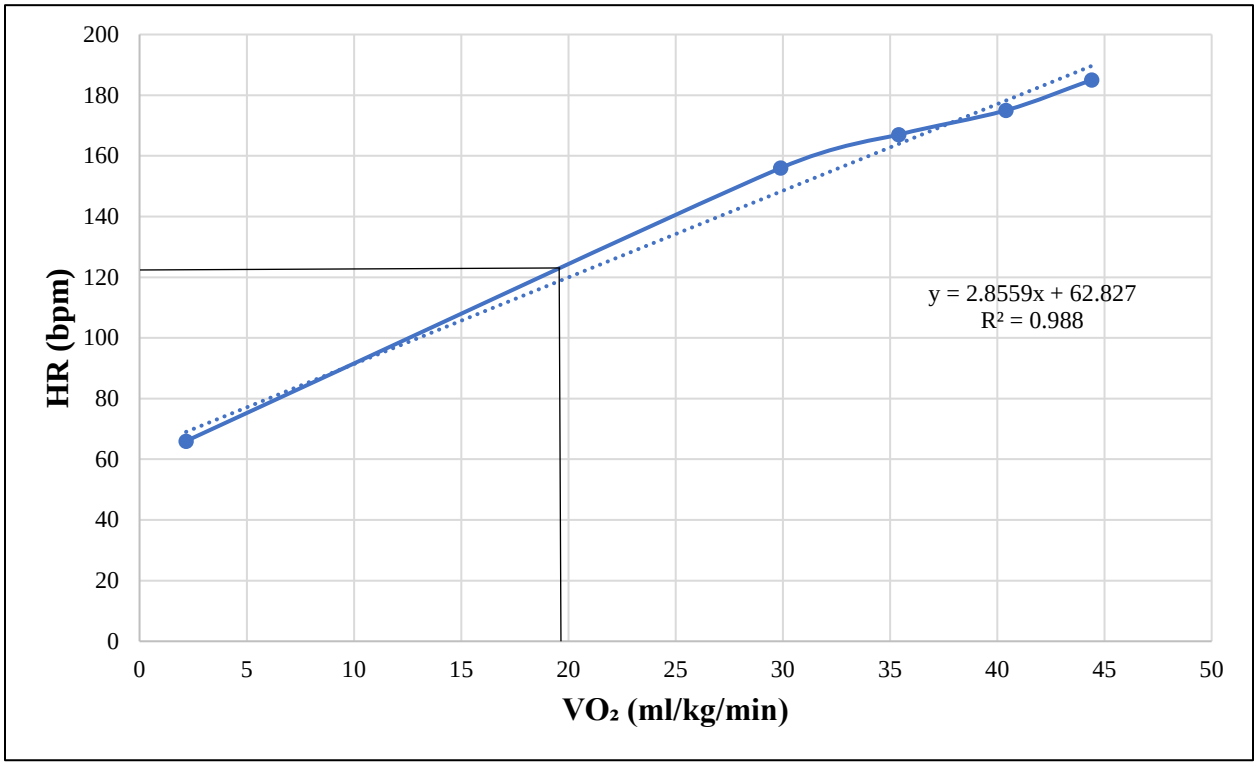

Figure 1. Sample graded exercise treadmill HR-VO_2 linear regression line.

STATISTICAL ANALYSIS

Standard descriptive statistics were used to characterize the subjects (age, height, weight, HRmax, VO_2max) as well as to determine exercise intensity, energy expenditure, and RPE during the BODYJAM session. All data are represented as mean ± standard deviation. Data were analyzed using SPSS version 25.0 (Chicago, IL).

RESULTS

All 19 subjects completed the VO_2max treadmill test as well as the 55-minute BODYJAM session. Descriptive characteristics of the 19 subjects who participated in the study are presented in Table 1.

Table 1. Descriptive characteristics of the subjects (N=19).

Parameter	Mean ± SD	Range
Age (yr)	20.1 ± 1.14	18 - 22
Height (cm)	64.8 ± 2.97	59 - 70
Weight (kg)	64.6 ± 7.94	50.0 - 80.6
HRmax (bpm)	189.8 ± 6.90	174 - 204
VO_2max (ml/kg/min)	43.0 ± 4.18	34.7 - 49.4

The HR and % HRmax responses to the 55-minute BODYJAM session are presented in Figures 2 and 3, respectively. The average HR and %HRmax were 139 ± 6.59 bpm and 73 ± 3.5%, respectively. Average predicted VO_2 and %VO_2max responses during the BODYJAM session are presented in Figure 4 and 5, respectively. The average predicted VO_2 and %VO_2max during the session were 22.3 ± 2.81 ml/kg/min and 52 ± 6.6%, respectively. The VO_2 corresponded to an average of 6.4 ± 0.80 METs. The average energy expenditure was 7.1 ± 1.57 kcal/min and the number of calories expended during the 55-minute workout averaged 393 ± 86.4 kcals. Average RPE values at the end of each segment throughout the BODYJAM session are presented in Figure 6. The average RPE for the entire BODYJAM class was 11.1 ± 1.36. Excluding the warm-up and cool-down, the average for the 55-minute workout portion of the class was 11.5 ±

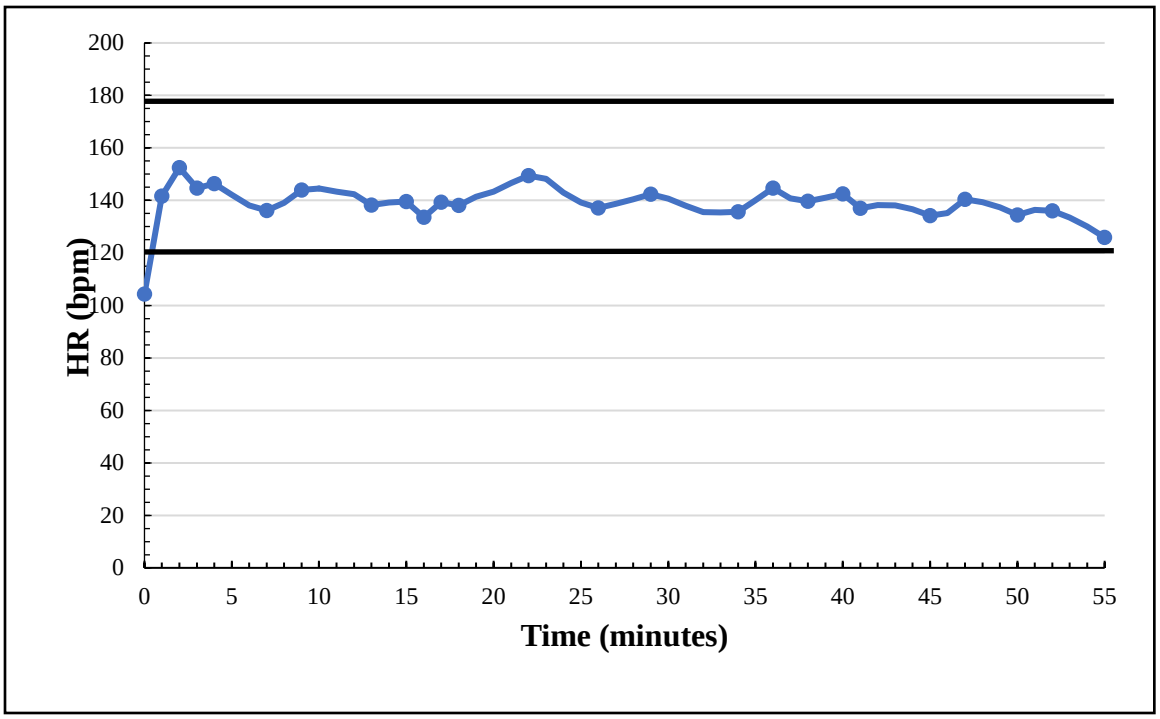

Figure 2. Minute-by-minute HR responses to the BODYJAM session. The shaded area represents 64%–95% of HRmax (ACSM, 2018).

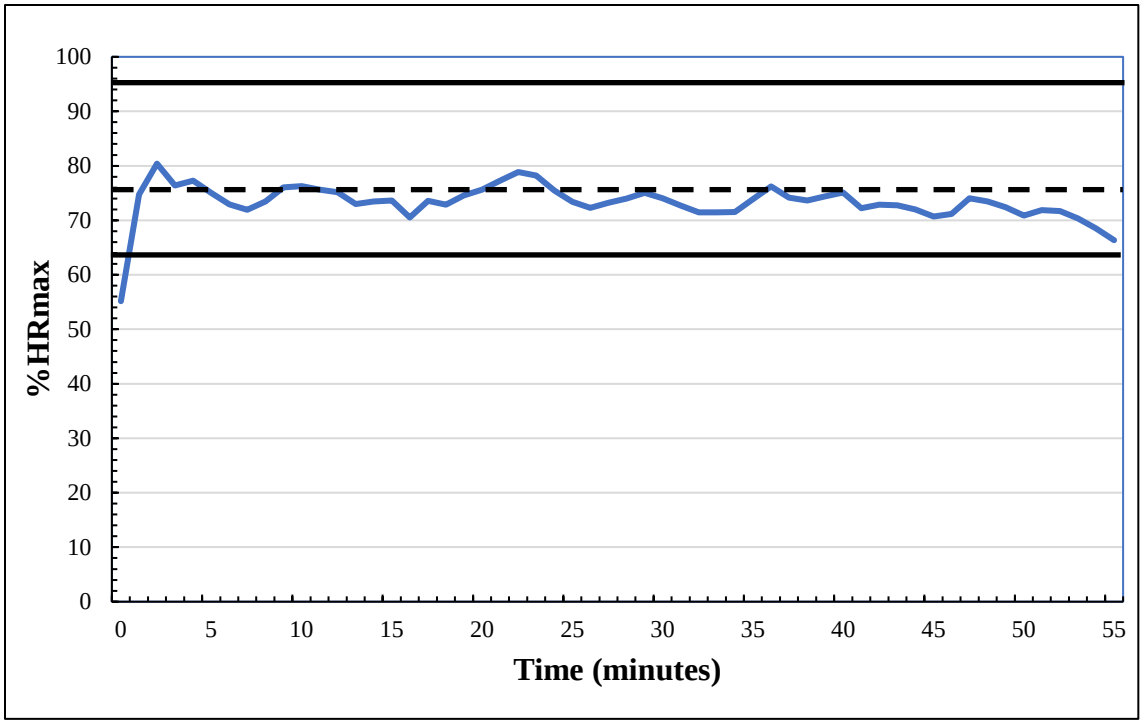

Figure 3. Minute-by-minute relative HR responses (%HRmax) to the BODYJAM session. ACSM guidelines (2018) recommend exercising between 64%-95% of HRmax which is represented by the boxed area on the graph. The separation between moderate and vigorous intensity ranges within the guidelines is represented by the dotted line.

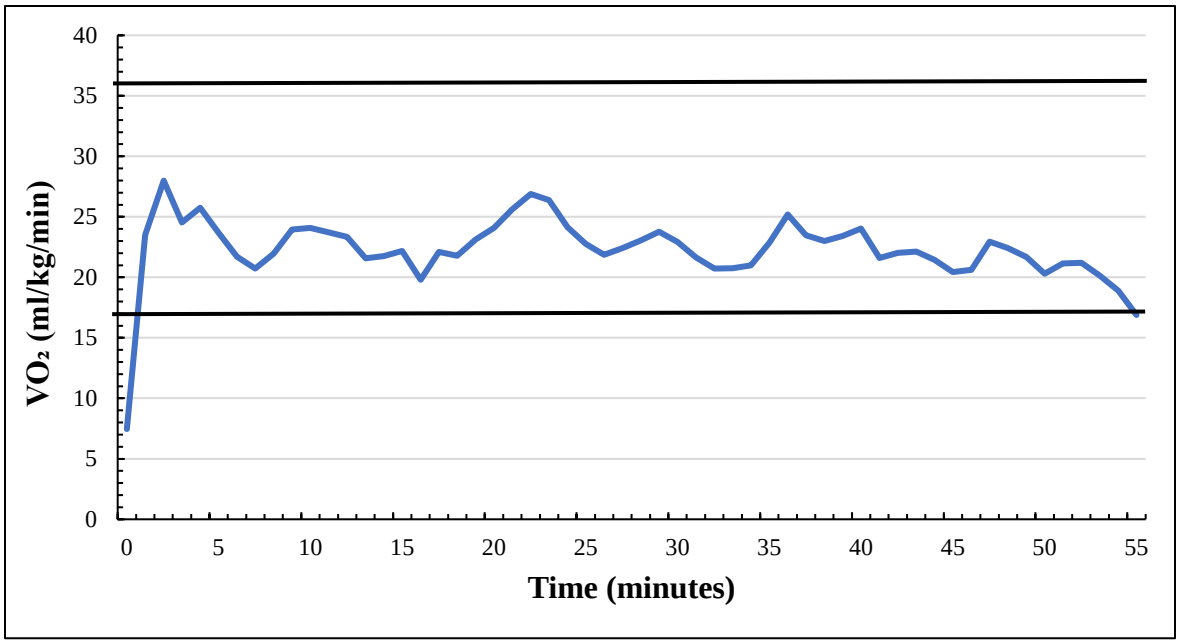

Figure 4. Minute-by-minute VO_2 responses to the BODYJAM session. The shaded area represents 40-85% of VO_2max (ACSM, 2018).

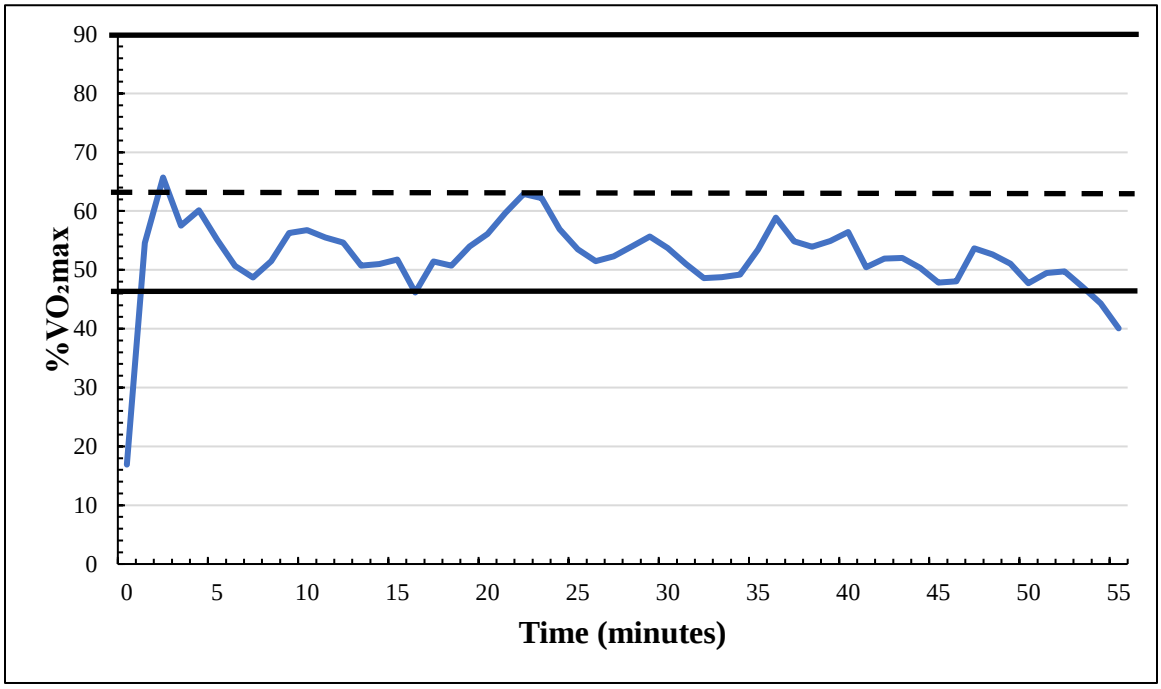

Figure 5. Minute-by-minute relative VO_2 responses (%VO_2max) to the BODYJAM session. ACSM guidelines (2018) recommend exercising between 46%–90% of VO_2max, which is represented by the boxed area on the graph. The separation between moderate and vigorous intensity ranges within the guidelines is represented by the dotted line.

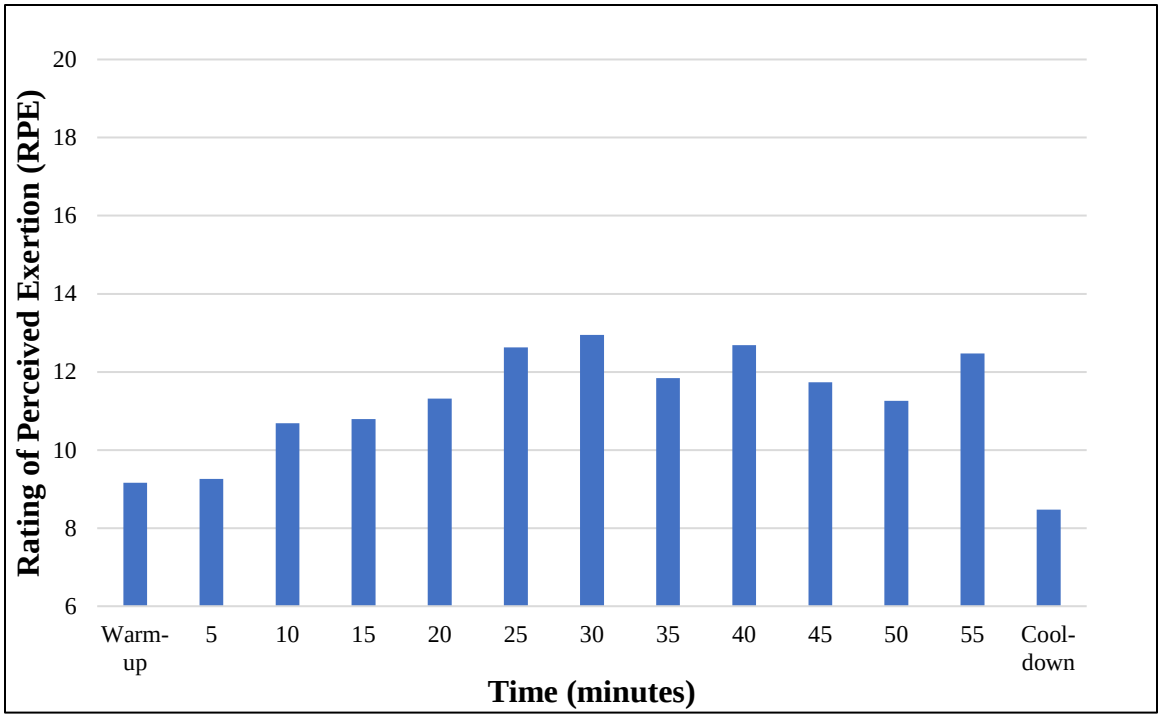

Figure 6. Rating of perceived exertion (RPE) responses to the BODYJAM session.

DISCUSSION

The purpose of this study was to determine the relative exercise intensity and EE of a BODYJAM class relative to ACSM guidelines. ACSM (2018) recommends that an individual should exercise between 64-95% of HRmax or 46-90% of VO_2max in order to improve cardiorespiratory endurance. The current study found that subjects were exercising at an average of 73% of HRmax and 52% of VO_2max which would be within moderate intensity range (64–76% of HRmax and 46–63% VO_2max).

In terms of EE, it is recommended that individuals expend 1,200-2,000 kcal per week (240-400 kcal per exercise session) in order to positively affect body composition (Donnelly et al., 2009). Subjects in the study expended an average of 393 kcal during the 55-minute class. This indicates that BODYJAM could be used as an effective workout for weight management. This is especially important for individuals who are looking for a viable alternative option to traditional exercise training.

Comparisons between different workouts can be made using METs. Light-intensity physical activity is defined as being 2.0-2.9 METs, moderate-intensity ranges from 3.0-5.9 METs, and activities requiring $\geq$ 6.0 METs are considered vigorous (ACSM, 2018). In the current study, the average MET requirement was 6.4 ± 0.80 METs, which falls within the vigorous-intensity category. This is a disagreement with the %HRmax and %VO_2max data which both fell into the moderate intensity range and the RPE data which would rank the subjective intensity as “fairly

light". These discrepancies are most likely due to the relative fitness level of the subjects in the current study, who fell into the "good" fitness category based on published norms (ACSM, 2018). When the average workout VO_2 (22.3 ml/kg/min) was divided by average VO_2max (43.0 ml/kg/min), the calculated relative VO_2 (%VO_2max) was only 52%, despite the fact that subjects were working at 6.4 METs. Also, because there were frequent teaching/free styling breaks throughout the video, this could have reduced the overall intensity of the workout. Other activities that are of similar intensity include walking at 4.0 mph on level ground (5.0 METs) (Ainsworth et al., 2011), hula-hooping (5.9 METs) (Holthusen, Porcari, Foster & Doberstein, 2010), TRX Suspension Training (5.8 METs) (Smith, Snow, Fargo, Buchanon & Dalleck, 2016), stand-up paddle boarding at an easy pace (6.3 METs) (Andres et al., 2017), Pound® (5.1 METs) (Ryskey et al., 2017), and Aqua-Cycling (5.8 METs) (Johnson et al., 2018).

Possible limitations of the current study include the fact that subjects performed this work out on a pre-recorded BODYJAM workout video without a live instructor. Therefore, observed responses could possibly represent a conservative estimate of the exercise intensity of a typical BODYJAM class. Another limitation to this study included the inability to directly measure VO_2 during the BODYJAM workout. It was felt wearing the portable equipment would have inhibited the subject's ability to fully perform the choreographed workout, decreasing the intensity of the workout. A final limitation was the different levels of skill each participant possessed. Even though each subject practiced the dance session on three separate occasions, some subjects were more skilled than others, which could have affected physiological responses during the final dance session.

To our knowledge, this is the first research project to be conducted on BODYJAM evaluating relative intensity and EE. Future research could be conducted to evaluate the cardiorespiratory responses and relative exercise intensity of BODYJAM in other populations such as males or an older population.

In summary, BODYJAM generally meets ACSM intensity guidelines to be considered an effective workout for improving cardiorespiratory fitness, as well as providing weight loss and weight maintenance benefits. Thus, it could be considered a viable option for individuals looking for alternative to traditional exercise training

Disclosure

This study was funded by the American Council on Exercise (ACE). However, ACE was not involved in the design of the study, collection or analysis of the data, or the preparation of this manuscript.

REFERENCES

Ainsworth, B., Haskell, W., Hermann, S., Meckes, N., Bassett, J., Tudor-Locke, C., Freer, J., Venzina, J., Whitt-Glover, M., & Leon, A. (2011). 2011 Compendium of physical activities: a second update of codes and MET values. *Medicine Science Sports Exercise, 42(*8), 1575-1581.

American College of Sports Medicine. (2018). *ACSM's Guidelines for Exercise Testing and Prescription* (10th edition). Philadelphia, PA: Wolters Kluwer Health.

Andres, J., Porcari, J., Cress, M., Camic, C., Radtke, K., & Foster, C. (2017). Physiologic responses to standup paddle boarding. *Gundersen Medical Journal, 10*(1), 26-28.

Borg G. (1982). Psychophysical bases of perceived exertion. *Medicine Science Sports Exercise, 14*(5), 377-381.

Borg, G. (1998). *Borg's perceived exertion and pain scales*. Champaign, IL: Human Kinetics.

Buermann, M., Porcari, J., Gillette, C. & Foster, C. (2012). Turn it on!: the relative exercise intensity and caloric expenditure of qidance. *Journal of Sports Science and Medicine 11*, 771-772.

Centers for Disease Control and Prevention. (2017). Early release of selected estimates based on data from the national health interview survey, 2016. Retrieved from https://www.cdc.gov/nchs/data/nhis/earlyrelease/earlyrelease201705.pdf

Donnelly, J., Blair, S., Jakicic, J., Manore, M., Rankin, J., & Smith, B. (2009). Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults, *Medicine Science Sports Exercise, 41,* 459-471.

Foster, C. (1975). Physiological requirements of aerobic dancing. *The Research. Quarterly, 46*, 120-123.

Holthusen, J., Porcari, J., Foster, C., & Doberstein, S. (2010). Hooping: effective workout or child's play? *ACE Certified News*, 1-3.

Jacki Sorensen's Fitness Classes. (2018). *Team Sorenson Bios.* Retrieved from https://www.jackis.com/about/team-sorenson-bios

Les Mills International LTD. (2015). *The Group Effect.* Retrieved from http://w3.lesmills.com/israel/en/classes/bodyjam/the-group-effect/

Luettgen, M., Foster, C., Doberstein, S., Mikat, R. & Porcari, J. (2012). Zumba: is the "fitness party" a good workout, *Journal Sports Science Medicine, 11,* 357-358.

Martin, S., Price, S., & Butts, N (1985). Jazzercise as a training mode in women.

Milburn, S. & Butts, N. (1983). A comparison of the training responses to aerobic dance and jogging in college females. *Medicine and Science in Sports and Exercise, 15*(6), 510-513.

Petrofsky, J., Batt, J., Berk, L., Collins, K., Yang, T., LeMoine, M., Bains, G., Gunda, S., Raju, C., Vanarasa, D., Kim, Y., Beard, C., Broussard, K., Christensen, J., Ellstrom, C., George, I., Holland, M., Vallabhaneni, P., & Brown, J. (2008). The effect of an aerobic dance and diet program on cardiovascular fitness, body composition, and weight loss in women. *The Journal of Applied Research, 8*(3), 179-188.

Smith, L., Snow, J., Fargo, J., Buchanan, C., & Dalleck, L. (2016). The acute and chronic health benefits of TRX suspension training® in healthy adults. *International Journal of Research in Exercise Physiology, 11*(2), 1-15.

Rehfeld, K., Müller, P., Aye, N., Schmicker, M., Dordevic, M., Kaufmann, J., Hökelmann, A. & Müller, N. (2017). Dancing or fitness sport? The effects of two training programs on hippocampal plasticity and balance abilities in healthy seniors. *Frontiers in Human Neuroscience, 11,* 305. doi: 10.3389/fnhum.2017.00305

Rixon, K.P., Rehor, P.R. & Bemben, M.G. (2006). Analysis of the assessment of caloric expenditure in four modes of aerobic dance. *Journal of Strength and Conditioning Research, 20*(3), 593-596.

Ryskey, A., Porcari, J., Radtke, K., Bramwell, S., Lee, T. & Foster, C. (2017). The energy expenditure and relative exercise intensity of pound. *International Journal of Research in Exercise Physiology, 13*(1), 39-47.

APPENDIX A

INFORMED CONSET FORM

Informed Consent

Energy Expenditure and Relative Exercise Intensity of BODYJAM

I, _____, volunteer to participate in a research study being conducted at the University of Wisconsin- La Crosse.

Purpose and Procedures

- The purpose of this study is to evaluate the relative exercise intensity of a BODYJAM workout and to determine how many calories are being expended during the workout. BODYJAM is a full-body workout that consists of aerobic dance moves synchronized to music.
- Prior to testing, I will practice the BODYJAM workout by following along to a DVD until the lead investigator deems that I am proficient.
- Testing will consist of two separate sessions.
- The first session will be a maximal exercise test on the treadmill. The test will start out at a low level and progressively increase until I can no longer continue. During the maximal treadmill test, I will wear a chest strap to measure my heart rate and a scuba-like mask to collect my expired air.
- The next session will consist of a completing a 45-minute BODYJAM session. During this session I will again wear a chest strap to measure my heart rate and wear a scuba-like mask to collect expired air.
- The total time requirement will be approximately 3 hours.
- Testing will take place in Mitchell Hall on UW-L campus.
- Research assistants will be conducting the research under the direction of Dr. John Porcari, a Professor in the department of Exercise and Sports Science.

Potential Risks

- I may experience substantial overall muscle fatigue, shortness of breath, and muscle soreness as a result of the exercise performed in the current study.
- Minor injuries and pulled muscles may occur as with any other high intensity workout.
- The risk of serious or life-threatening complications (i.e., heart attack, stroke, death) is very low (<1/10,000 tests) in healthy, regularly exercising adults, but are always a possibility of any exercise.
- The test will be stopped immediately upon the development of any complications.
- There will be persons trained in CPR and Advanced Cardiac Life Support available for every testing session and an AED is present in the laboratory where all testing will take place.

Benefits of Participation

- By volunteering in this study, I will gain a better understanding of my physical fitness level.
- This study will also be important for exercise professionals, researchers, and the general public who are interested in the effectiveness of BODYJAM for improving cardiorespiratory fitness and controlling body weight.

Rights and Confidentiality

- My participation is voluntary.
- I may choose to discontinue my involvement in this study at any time without penalty.
- The results of this study have the potential of being published or presented at professional meetings, but only group data will be presented.

I have read the information provided on this consent form. I have been informed of the purpose of this study, the procedures, and the expectation of myself as well as the testers, and of the potential risks and benefits that may be associated with volunteering for this study. I have asked any and all questions that concerned me and received clear answers so as to fully understand all aspects of this study.

Concerns about any aspects of this study may be directed to the principal investigator, Dr. John Porcari (608-785-8684), a Professor in the Department of Exercise and Sport Science. Questions about the protection of human subjects may be addressed to Dr. Bart Vanvoorhis (608-785-6892), Chair of the UW-L Institutional Review Board for the Protection of Human Subjects.

Participant's Signature: _____ Date: _____

Researcher's Signature: _____ Date: _____

APPENDIX B

PAR-Q FORM

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	**Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?**
☐	☐	2.	**Do you feel pain in your chest when you do physical activity?**
☐	☐	3.	**In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	4.	**Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	5.	**Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	6.	**Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	7.	**Do you know of <u>any other reason</u> why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to <u>all</u> PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

→

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

<u>Informed Use of the PAR-Q</u>: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT _____ WITNESS _____
or GUARDIAN (for participants under the age of majority)

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Supported by: Health Canada Santé Canada

continued on other side...

APPENDIX C

DATA COLLECTION FORMS

Treadmill-modified Balke protocol

Name:_____ Subject #:_____

Birthdate: _____(M/D/Y) Age:_____years

Height:_____in Height: _____cm

Weight:_____lb Weight:_____kg

Testing Session Date: _____ Time: _____

Speed: _____mph

Time	Grade	RPE	HR	VO_2
Rest	-			
0:00-2:00	0.0%			
2:00-4:00	2.5%			
4:00-6:00	5.0%			
6:00-8:00	7.5%			
8:00-10:00	10.0%			
10:00-12:00	12.5%			
12:00-14:00	15.0%			
14:00-16:00	17.5%			
16:00-18:00	20.0%			
18:00-20:00	22.5%			
20:00-22:00	25.0%			
22:00-24:00	27.5%			
24:00-26:00	30.0%			

Comments:

BODYJAM FINAL SESSION RPE COLLECTION:

TIME	SUBJECT #	SUBJECT #	SUBJECT #	SUBJECT #	SUBJECT #
5:18					
8:05					
12:17					
15:08					
16:40					
18:55					
23:22					
26:40					
31:09					
34:10					
37:21					
40:38					
45:05					
47:40					
50:00					
55:20					
58:44					

APPENDIX D

BORG RPE SCALE

Rating	Perceived Exertion
6	No exertion
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

APPENDIX E

PICTURE OF BODYJAM EXERCISE

APPENDIX F

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The purpose of this review of literature is to analyze various concepts in relation to BODYJAM, a dance program, and the effects it has on cardiorespiratory fitness including energy expenditure (EE), relative exercise intensity, rating of perceive exertion (RPE), metabolic equivalents (METs), and heart rate.

Background of Les Mills and BODYJAM

Since 1968 Les Mills has been a well-known company for creating a variety of group fitness classes. Les Mills bases their group classes off the concept of the "group effect". The group effect means "by exercising with others it will encourage people to motivate each other to work out harder, and push themselves just a little more" (Les Mills International LTD, 2015). Currently, Les Mills has created countless styles of group classes seemingly based on the components of fitness (ACSM, 2018). These classes include BODYJAM, BODYPUMP, BODYBALANCE, BODYATTACK, HIIT, and youth training, just to name a few. BODYJAM, a combination of dance and music, specifically focuses on the cardiorespiratory endurance component of physical fitness. BODYJAM offers 30-55 minute dance sessions with today's Club and Hip-Hop music that incorporates the latest dance moves. The program releases new routines every three months with varying intensities and new styles. Each session includes a 5 minute warm-up and cool-down. After the warm-up is the rehearsal phase where the instructor will introduce dance combinations. The combinations begin with moves such as toe taps, heel taps, step touch, etc.. The group fitness trainer then incorporates layering which can be done by adding arm motions, turns, adding bouncing or rocking of the hips, etc.. After the dance combinations are taught the class then performs a double time "bust out

performance" where the participant can adjust the intensity as they feel appropriate. Intensities can easily be increased or decreased depending on the individual's limitations. There are many modifications available for each move therefore the dance can be curtailed for almost any skill level. Following the bust out portion of the routine is the cool-down portion where the intensity of the dance decreases in order to recover the heart rate. Even though there is not data to support this, Les Mills claims BODYJAM can be done every day to improve coordination/balance, burn calories, and get fit.

To our knowledge, no research has been completed on BODYJAM itself. On the Les Mills website there is a linked study examining dance vs. traditional aerobic workout which looks at the effects that both types of training can have on the hippocampus (HC) volume (Rehfeld et al., 2017). The HC is responsible for memory, emotions, learning, and spatial navigation. The study was performed over 18 months and involved healthy elderly seniors that were separated into two groups. The first group was the dance group which involved 90 minute dance sessions, twice a week for the first 6 months of the study. The last 12 months of the study the participants completed a 90 minute session only once a week. The dances were altered in terms of style in order to force the participants to memorize several different routines. The second group, the sport group, completed 90 minute sessions which entailed endurance training, strength-endurance training, and flexibility training. The first six months the endurance training was on a cycle ergometer, the last 12 months entailed a Nordic Walking program. In terms of frequency, both groups exercised the same amount. After the 18 month study both the dance and sport group showed increased HC volume. Only the dancers showed notable improvements in the balance score and increased volume in the subiculum. The

subiculum is a portion of the HC which is responsible for balance. Therefore this study attributes dance as being an important modality in slowing the progression of age-related decline in physical and mental abilities.

Our hypothesis is BODJYJAM will meet ACSM's guidelines for improving cardiorespiratory fitness and be a viable option for individuals looking for an alternative exercise regimen.

History of Aerobic Dance

In 1969, Jacki Sorensen was asked to create a fitness program at a military base in Puerto Rico for Air Force wives (Jacki Sorensen's Fitness Classes, 2018). Jacki developed a fitness routine based on her own regimen which entailed the combination of aerobic exercise and dance. She created the concept of "aerobic dancing" by merging choregraphed routines to upbeat music.

Over the years, many studies have been completed to evaluate the physiological responses to aerobic dance. Foster (1975) evaluated 4 female subjects who performed an aerobic dance routine while oxygen consumption (VO_2) was monitored. It was found that the subjects were exercising at an average of 77% of estimated VO_2max during the routine. It was concluded that aerobic dance could improve cardiorespiratory fitness and was a viable option for individuals looking for an alternative to traditional exercise training.

Milburn and Butts (1983) compared the training responses to aerobic dance and jogging in 46 untrained female subjects. The subjects were divided into three groups: dancers, joggers, and control (who participate in bowling). Both the jogging and aerobic dance group exercised for 30 min/day, 4 days/week for 7 weeks while HRs were

recorded. It was found that the relative VO_2max of dancers increased by 10.2% and the joggers increased by 8.2%. This data suggests that both jogging and aerobic dance can increase cardiorespiratory fitness to a similar degree if performed at the same frequency, duration, and intensity.

Rixon, Rehor, and Bemben (2006) analyzed whether there was a significant difference in caloric expenditure between Bodycombat, RPM (spinning), step aerobics, and Pump aerobic dance. Twenty-eight female subjects participated in one session of each of the four types of classes while HR was continuously monitored. It was found that during Pump, Bodycombat, step, and RPM subjects exercised between 60-74% of HRmax. In terms of energy cost, all of the classes (with the exception of Pump) elicited a similar degree of caloric expenditure, even when compared to jogging at a speed of 8.05-8.37 km/hr. In conclusion RPM, Bodycombat, and step aerobics offers are more attractive, yet still effective, form of cardiovascular training.

Petrofsky et al. (2008) studied the effects of a 10-day aerobic dance and diet program on cardiovascular fitness, body composition, and weight loss in women. Subjects completed a 1- hour aerobic dance video every day for 10 days and followed a caloric-restrictive diet. After the 10-day program, subjects lost an average of 1.78 kg, reduced systolic blood pressure by 4 mmHg and diastolic blood pressure by 6 mmHg, reduced resting HR by 14 bpm, and had an average reduction in waist girth of 3.7 cm. This data suggests that the combination of aerobic dance and a caloric-restrictive diet can result in improved cardiovascular fitness and improved body composition.

Physical Activity Recommendations

The American College of Sports Medicine and American Heart Association (ACSM-AHA) have established guidelines for the frequency and intensity that healthy adults should accumulate in order to improve their cardiorespiratory fitness. All healthy adults should participate in moderate intensity aerobic physical activity for a minimum of 30 minutes on 5 days per week or vigorous intensity aerobic activity for a minimum of 20 minutes on 3 days per week (ACSM, 2018). Physical activity recommendations were also created from the 2008 Physical Activity Guidelines Advisory Committee Report. Those recommendations are all Americans should participate in approximately 150 minutes per week of moderate intensity aerobic activity or 75 minutes per week of vigorous intensity aerobic intensity aerobic activity or a combination of the two (ACSM, 2018).

Moderate intensity and vigorous intensity have different values attributed to both. Different methods of quantifying relative intensity includes looking at the volume of oxygen consumption and percentage of maximal oxygen consumption (VO_2 & %VO_2max), heart rate max and percentage of heart rate max met (HRmax & %HRmax), and RPE. Another way to categorize a workload or intensity is by METs which is the absolute intensity of an exercise. American College of Sports Medicine sets moderate intensity at 64-76% of HRmax, 46-63% of VO_2max, 12-13 “fairly light to somewhat hard” on the 6-20 RPE scale. The METs range is 3.0-5.9 METs for moderate intensity. Vigorous intensity is defined by 77-95% of HRmax and 64-90% of VO_2max, an RPE of 14-17 or “somewhat hard to very hard”, or 6.0-8.7 METs (ACSM, 2018).

In order for weight loss to occur it is recommended by ACSM that an individual should expend ≥2,000 kilocalories (kcals) per week. This comes to 400 kcals per session

when exercising five days per week. In order to achieve lower rates of cardiovascular disease and premature mortality energy expenditure of 1,000 kcal per week is required which is 200 kcals when exercising five days per week (ACSM, 2018).

Based on a reported from the Centers for Disease Control and Prevention (CDC) it was found that only 51.7% of adults met the Physical Activity Guidelines for aerobic activity (CDC, 2017). The other half of the country is not meeting the guidelines even though the benefits of physical activity are well known. There could be many reasons for this statistic but the common theme includes the population becoming uninterested or too busy for their exercise sessions. Many fitness companies try to combat this behavior by creating various styles of new exercise fads to make people "addicted" to working out or making the exercise itself entertaining.

Findings of Various Group Exercise Classes

Jazzercise

Martin, Price & Butts (1985) assessed whether or not Jazzercise was effective in producing positive body composition and cardiovascular responses in women during a 7 week training study. Twenty-one females participated in either a 2-day or 3-day Jazzercise routine of 50 minutes each session for 7 weeks. After statistical analyzes were completed, it was found that both groups trained at the same relative intensity which was about 75% of HRmax. It was found that both relative and absolute VO_2max showed significant improvement in the 2-day and 3-day group. This shows when working at the same relative intensity, an individual could see increases in cardiorespiratory benefits in both a 2-day and 3-day per week program. In terms of body composition, researchers found a significant different in percent body fat pre and post training period in both the 2-

day and 3-day groups. This study indicates that Jazzercise can elicit improvements in both cardiovascular fitness and positive changes in body composition when completed two or three times per week.

Aqua Cycling

Aqua cycling is a new fitness class that includes cycling underwater. The water level is up to the xiphoid process. Aqua cycling first started as a technique used in a rehabilitation setting but is now a fitness class. Water exercises offer a low impact option for individuals who need an effective workout but with low strain on the body. Johnson et al., (2018) determined the relative exercise intensity and EE during an aqua cycling class and evaluated if aqua cycling met ACSM's guidelines for exercise prescription. The subjects were eight males and eight females that completed an aqua cycling workout on a DVD. The researchers monitored heart rate and VO_2 every minute. Rating of perceived exertion (RPE) was taken at the end of each portion of the workout.

The session of Aqua Cycling consisted of a 50 minute program with five minute cool- down, and warm-up and different sections of interval 1 (10 minutes), arms (6 minutes), interval 2 (10 minutes), and legs (10 minutes). They included 2 minutes of rest in between the sections. On average it was concluded that subjects were working at 5.8± .90 METs. It was found that this exercise would be categorized between a moderate and a vigorous intensity range based on percentage of heart rate reserve (%HRR). Researchers found similar results when looking at percentage of oxygen uptake reserve (%VO_2R). The amount of calories expended during this session was 363± 65.5 kcals. The subjects were exercising at 49% of HRR and 47% of VO_2R during the aqua cycling session. The ACSM guidelines were met in order to achieve cardiorespiratory benefits. All in all, this

study found that aqua cycling is a good alternative for individuals looking to increase their cardiovascular endurance. This is viable option for people who need a low impact exercise due to orthopedic issues or any other issues that would make weight bearing exercises difficult.

Pound®

Pound® is a drumming-based exercise program that combines drumming and Pilates to create a total body exercise. Ryskey et al., (2017) evaluated the relative exercise intensity and EE of a Pound® workout. This study included six males and 16 females who were considered “recreationally active”.

An incremental treadmill test was performed in order to establish a baseline of the individual’s VO_2max to then compare to the %VO_2max exerted while they were wearing the portable metabolic equipment during the Pound® session. During the Pound® session VO_2 and HR were monitored every minute and RPE was recorded every 4 minutes. Ryskey et al. (2017) found that subjects exercised at an average of 72% of HRmax and 41% of VO2max which fall into the moderate-intensity range. Subjects on average were at a workload of 5.1 METs. The average RPE was “somewhat hard”. Subjects burned about 238 kcals during the 38 minute Pound® session. This makes Pound® a viable option for individuals that would like to find an alternative to traditional exercise regimens.

Krav Maga

Krav Maga is a fitness class made of self-defense moves from many disciplines to create a full body workout. Krav Maga includes techniques from kickboxing, karate, jujitsu, and judo.. Putnam, Porcari, Doberstein, Emineth & Foster (2018) examined the

relative exercise intensity and EE in order to evaluate if it met ACSM's guidelines for increasing cardiorespiratory fitness. The study involved six males and ten females.

Each participant completed a maximal exercise treadmill test in order to establish a HRmax and VO_2max. Heart rate and VO_2 was measured every minute during the test, whereas RPE was taken every 2 minutes. Individual HR/VO_2 regression equations were developed using the HR and VO_2 responses during the treadmill test. Subjects practiced Krav Maga until deemed proficient. The Krav Maga session was 60 minutes which includes a warm-up and a cool-down portion. Some of the moves include sequences of kicks, punches, and other moves that would be used in a combat situation. The subjects completed the Krav Maga workout while heart rate was recorded each minute and RPE was taken every five minutes. The heart rates gathered were then plugged into the regression equations to predict VO_2 minute-by-minute during the workout session.

Researchers discovered the participants maintained 78±2.0% of HRmax and 66±17.0% of VO_2max labeling Krav Maga as a moderate-vigorous intensity exercise. Subjects were at a workload of 8.8±1.97 METS. This workout resulted in 616±216.7 kcal burned on average for the 60 minute Krav Maga session. All in all, Krav Maga met ACSM's guidelines for exercise prescription in order to improve cardiorespiratory fitness and managing body weight. This is a viable option for individuals seeking an alternative exercise routine as well as teaching the public self-defense moves.

Hooping

Holthusen, Porcari, Foster & Doberstein (2010) evaluated the relative exercise intensity and caloric expenditure of Hooping. Hooping hoops are not the traditional hula hoop in the sense that the weight of the hoops and the diameter of the hoops can vary.

With these differences in the hoops it makes the action of hooping require more muscle exertion than the traditional hula hooping style. Sixteen females aged 16-59 years were recruited from the Hooked on Hooping studio in Green Bay, Wisconsin. All subjects were skilled in hooping as they had participated in hooping classes prior to this study. Participants completed a 35 minute hooping video twice for practice. During test the subjects wore the portable oxygen analyzer (Jaeger Oxycon Mobile Unit, San Diego, CA) and a HR monitor in order to measure VO_2 and HR every minute, whereas RPE was recorded every 5 minutes.

Participants met 84 ±9.0% of HRmax and VO_2 was 20.6 ± 3.31 ml/kg/min ranking the intensity as vigorous. Subjects burned 210 ± 43.3 kcals during the 30 minutes session. The average RPE was 13 or "somewhat hard". Hooping met ACSM's guidelines for exercise prescription in order to increase cardiorespiratory fitness. Hooping is another viable option for individuals seeking a fun alternative to traditional aerobic exercise.

QiDance

QiDance is type of aerobic dance class and utilizes pre-choreographed routines. QiDance covers many styles including hip-hop, disco, Latin, jazz, and Bollywood. Buermann, Porcari, Gillette, & Foster (2012) researched the relative exercise intensity and caloric expenditure of QiDance to evaluate if it met ACSM's guidelines. Researchers recruited 20 college-aged females who were familiar with the structure of an aerobic dance class.

The females completed a graded exercise test which followed a modified Balke protocol. The portable metabolic equipment could not be used in this study due to vigorous movements in the dance therefore the researchers had to create individual

HR/VO_2 regression equations. After the treadmill test, subjects performed QiDance workouts of different intensity levels from easy-intermediate-hard routines. Subjects were given a QiDance DVD to practice the routine at least three times before the actual QiDance test. During each 52 minute QiDance session HR was recorded every minute and RPE was taken at the end of the class.

Average heart rate values during the QiDance session were between 68-95% of HRmax, average predicted VO_2 was between 46-91% of VO_2max which met ACSM's guidelines under vigorous intensity. Subjects were at a workload of 8.1 METS on average and average RPE was 12-16. Subjects burned 306-591 kcals during the 52 minute QiDance session. QiDance could improve cardiorespiratory fitness based on caloric expenditure, %HRmax and %VO2max. Buermann created a bar chart of different aerobic exercises and evaluated which ones met ACSM's guidelines which includes Qidance, Zumba®, NIA (Neuromuscular Integrity Activity), Cardio Kickboxing, Step Aerobics, and Popmobility. NIA was the only group fitness class that didn't meet the guidelines in terms of %HRmax. All in all, QiDance could be another viable option for improving cardiorespiratory fitness and adds variety into an exercise routine.

Zumba®

Zumba® is a Latin dance workout created by Beto. This workout gives the feel of a dance party while exercising. Luettgen, Foster, Doberstein, Mikat & Porcari (2012) performed a study in order to evaluate the average exercise intensity and energy expenditure during a Zumba® class. Nineteen female volunteers took part in this study. All subjects had taken a Zumba® class before therefore were somewhat rehearsed in the class structure. Each participant completed an incremental protocol maximal treadmill

test where the HR and VO_2 were monitored. The researchers then took the information from the maximal treadmill test and created individual linear regression equation for each subject that way they could predict VO_2. Subjects attended one class led by an ACE certified Zumba® instructor. The subjects wore a heart monitor then after the Zumba® session the data was inserted into the HR/VO_2 regression equation to approximate VO_2 and EE. Subjects reached 79% of HRmax & 66% of VO_2max. Participants burned about 369 kcal per 39 minute session. Subjects exercised at a workload of 8.8 METS on average. This categorized Zumba® a vigorous intensity exercise. This study found that there was enough EE from the subjects to create a change in body composition as well as increase aerobic capacity. Zumba® is a viable alternative option for individuals looking for a vigorous intensity exercise.

Conclusion

With ACSM's established guidelines the population should be able to increase or maintain their cardiorespiratory fitness. By creating new fitness programs such as BODYJAM it attracts people to exercise by having fun and potentially lead more people to meet the current guidelines. Evaluating this program will allow others to observe if this is an effective option based on EE and exercise intensity.

REFERENCES

American College of Sports Medicine. (2018). *ACSM's Guidelines for Exercise Testing and Prescription* (10th edition). Philadelphia, PA: Wolters Kluwer Health.

Borg G. (1982). Psychophysical bases of perceived exertion. *Medicine Science Sports Exercise, 14*(5), 377-381.

Borg, G. (1998). *Borg's perceived exertion and pain scales*. Champaign, IL: Human Kinetics.

Buermann, M., Porcari, J., Gillette, C. & Foster, C. (2012). Turn it on!: the relative exercise intensity and caloric expenditure of qidance. *Journal of Sports Science and Medicine 11*, 771-772.

Centers for Disease Control and Prevention. (2017). Early release of selected estimates based on data from the national health interview survey, 2016. Retrieved from https://www.cdc.gov/nchs/data/nhis/earlyrelease/earlyrelease201705.pdf

Donnelly, J., Blair, S., Jakicic, J., Manore, M., Rankin, J., & Smith, B. (2009). Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults, *Medicine Science Sports Exercise, 41,* 459-471.

Foster, C. (1975). Physiological requirements of aerobic dancing. *The Research. Quarterly, 46*, 120-123.

Holthusen, J., Porcari, J., Foster, C. & Doberstein, S. (2010). Hooping: effective workout or child's play? *Ace Certified News*, 1-3.

Ickler, J., Battista, R. & Porcari, J. (2008). *Physiological and psychological benefits consequent to 8 weeks of NIA training.* Unpublished graduate thesis. University of Wisconsin – La Crosse, Department of Exercise and Sport Science.

Jacki Sorensen's Fitness Classes. (2018). *Team Sorenson Bios.* Retrieved from https://www.jackis.com/about/team-sorenson-bios

Johnson, K., Porcari, J., Snustead, M., Doberstein, S., Emineth, K., & Foster, C. (2018). Cardiorespiratory responses during an aqua cycling class. *International Journal of Research in Exercise Physiology. 13*(2), 10-20.

Les Mills International LTD. (2015). *The Group Effect.* Retrieved from http://w3.lesmills.com/israel/en/classes/bodyjam/the-group-effect/

Luettgen, M., Foster, C., Doberstein, S., Mikat, R. & Porcari, J. (2012). Zumba: is the "fitness party" a good workout. *J Sports Sci Med, 11*, 357-358.

Martin, S., Price, S., & Butts, N. (1985). Jazzercise as a training mode in women.

Milburn, S. & Butts, N. (1983). A comparison of the training responses to aerobic dance and jogging in college females. *Medicine and Science in Sports and Exercise, 15*(6), 510-513.

Petrofsky, J., Batt, J., Berk, L., Collins, K., Yang, T., LeMoine, M., Bains, G., Gunda, S., Raju, C., Vanarasa, D., Kim, Y., Beard, C., Broussard, K., Christensen, J., Ellstrom, C., George, I., Holland, M., Vallabhaneni, P., & Brown, J. (2008). The effect of an aerobic dance and diet program on cardiovascular fitness, body composition, and weight loss in women. *The Journal of Applied Research, 8*(3), 179-188.

Putnam, A., Porcari, J., Doberstein, S., Emineth, K., & Foster, C. (2018). Relative exercise intensity and energy expenditure of krav maga workout. *International Journal of Research in Exercise Physiology. 13*(2), 33-42.

Rehfeld, K., Müller, P., Aye, N., Schmicker, M., Dordevic, M., Kaufmann, J., Hökelmann, A. & Müller, N. (2017). Dancing or fitness sport? The effects of two training programs on hippocampal plasticity and balance abilities in healthy seniors. *Frontiers in Human Neuroscience.* 11:305. doi: 10.3389/fnhum.2017.00305

Ryskey, A., Porcari, J., Radtke, K., Bramwell, S., Lee, T. & Foster, C. (2017). The energy expenditure and relative exercise intensity of pound. *International Journal of Research in Exercise Physiology. 13*(1), 39-47.