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Investigation of the Cardiovascular Endurance of Dance Majors

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INVESTIGATION OF THE CARDIOVASCULAR ENDURANCE OF DANCE MAJORS

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A doctoral project submitted in partial fulfillment

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ABSTRACT

Background: College dancers have demonstrated low levels of cardiovascular endurance compared to other athletes, which could be one of the factors that leads to more fatigue and injuries during performance. The effects of an education session on cardiovascular endurance and on college dancers' attitudes towards cardiovascular exercise outside of dance class have not been previously studied.

Purpose: The purpose of this study was to use the accelerated three-minute step test to compare lower level and upper level college dancers' cardiovascular endurance before and 2 months after an education session emphasizing fitness and exercise. Additionally, assessed were the dancers' attitudes towards cardiovascular activities outside of dance class and the amount of physical activity that they performed.

Subjects: There were 25 subjects, 2 male and 23 female dancers between the ages of 18-30 who were declared as a Bachelor of Fine Arts (BFA) Dance Major or had the intent to declare a BFA Dance Major.

Methods: The subjects were divided into the lower level group and the upper level group based on the dance level into which the university dance program placed them. The subjects participated in the accelerated three-minute step test and were grouped into a cardiovascular fitness category based on their heart rate recovery ($HR_{recovery}$) ranging from 0 (excellent) to 6 (very poor). The results of the three-minute accelerated step test were presented during an education session along with guidelines to improve cardiovascular endurance. The subjects were retested using the accelerated three-minute step test two months after the education session. The Theory of Planned Behavior (TPB) questionnaire and the International Physical Activity Questionnaire (IPAQ) were administered both before and after the education session. The pre- and post-education results were compared using a 2-way repeated measures ANOVA and post-hoc tests were performed.

Results: From the originally recruited 38 subjects, 1 was unable to complete the initial step test and 12 others were unable to complete the second half of the study. A total of 25 dance majors were able to complete the entire study (7 lower level, 18 upper level). Of the initial 37 subjects who completed the step test, only 37.8% were in the recommended fitness categories for dancers of 0-2 (excellent to above

average) and 62.2% were in fitness categories 3-6 (average to very poor). Two-factor repeated measures ANOVAs revealed a trend towards a significant interaction between dance level and $HR_{recovery}$ ($F(1)=3.338$, $P=0.081$), and a main effect of time on $HR_{recovery}$ with $HR_{recovery}$ before the education session being 117.92± 19.28 bpm and $HR_{recovery}$ after the education session being 109.64 ± 20.57 bpm ($F(1)=4.540$, $P=0.044$). Post hoc t-tests reported that the mean $HR_{recovery}$ before the education session was similar between the lower level and upper level dancers, but that it was significantly lower for the upper level after the education session ($P=0.040$). There was no significant interaction of time on the IPAQ ($F(1)=0.003$, $P=0.960$), and there was no significant main effect of time ($F(1)=0.224$, $P=0.641$), or dance level ($F(1)=0.069$, $P=0.795$) on the IPAQ scores. For the TPB Questionnaire, there was a significant main effect of dance level on past behavior with the upper level dancers scoring higher than the lower level dancers ($F(1)=5.750$, $P=0.025$). There was no significant interaction of dance level on BMI ($F(1)=0.385$, $P=0.541$), but there was a significant main effect of time on BMI ($F(1)=0.385$, $P=0.028$).

Discussion: At initial testing, almost two-thirds of the subjects had fitness levels that were below the recommendation, indicating that many university dancers have lower cardiovascular endurance and may benefit from increasing it. The subjects showed a statistically significant improvement in their cardiovascular endurance as indicated by their $HR_{recovery}$ two months after an education session. Specifically, the upper level dancers showed more improvement in their cardiovascular endurance than the lower level dancers. A single education session may be an efficient way to increase college dancers' cardiovascular endurance, but more research is needed to further evaluate the effects of an education session. Finally, this study continues to support the need for college dance majors to be educated regarding cardiovascular endurance.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Previous research has suggested that dance classes and rehearsals do not adequately prepare dancers for the high intensity and continuous cardiovascular requirements of performance.[1–4] It has been illustrated that college dancers consume significantly less oxygen, have lower peak heart rates, and have a lower percentage of work time in class compared to performance.[1] Research has also shown that dancers have lower levels of cardiovascular endurance than other athletes, with ballet dancers showing similar endurance to healthy sedentary individuals[4] and non-endurance athletes.[3] However, college-age dancers can train 18-21 hours per week in class as well as 12 hours per week in rehearsal.[5,6]

These lower levels of cardiovascular endurance can be due to the structure of dance classes. Classes typically begin with a warm-up involving low to moderate intensity exercise.[3] The rest of the class focuses on high intensity center work and jumps lasting for 1-3 minutes at a time,[3,4] which do not last long enough to produce enough stress on the cardiovascular system to increase endurance levels.[2,4] Therefore, multiple studies have recommended that dancers perform supplemental cardiovascular training,[1,4,7–9] with one specific study reporting only 34-39% of pre-professional and 30-60% of professional dancers participated in cardiovascular training outside of dance.[8] Cardiovascular endurance may also be affected by dance levels;[10] however, one study found no significant difference between the cardiovascular endurance of more versus less advanced dancers based on their VO_2 max.[11] More research is needed to determine if this is consistent in other university programs.

Addressing low cardiovascular endurance levels and supplemental training is important as it could be related to injury risk. One study found a correlation between low cardiovascular endurance and higher injury rates in dancers,[12] and a systematic review showed associations between poor physical endurance and higher injury rates in male soccer players, male and female military recruits, and the general

population.[13] Furthermore, fatigue has been reported as a self-perceived factor for injuries in dancers,[14,15] and addressing cardiovascular endurance could decrease fatigue.[8]

A validated tool, that is both cost and time efficient, to measure dancers' cardiovascular endurance based on heart rate recovery($HR_{recovery}$) is the accelerated three-minute step test.[6] This test was used to assess the fitness of college dancers, and was categorized using criteria established by the YMCA[6]. In one study, incoming college dancers were found to have low endurance levels.[8] These levels significantly improved as they progressed through the program,[8] which may have been the result of receiving a wellness class in the curriculum. By continuing to gather more information on the cardiovascular endurance of college dancers, norms will develop that could aid dance teachers in developing supplemental programs to minimize injury risk and adequately prepare dancers for the rigorous demands of performance.

Dance conditioning programs such as non-specific supplementary cardiovascular training, one hour circuit training and vibratory training have been shown to be effective in increasing college dancers' cardiovascular endurance.[9,16] However, the effect of a single education session on cardiovascular endurance has not been demonstrated. If determined to be effective, this would be an efficient, convenient, and cost-effective way to educate college dancers and influence their cardiovascular endurance.

Likewise, dancers' attitudes towards supplemental cardiovascular endurance training have not been investigated. Collecting information about dancers' intentions to perform cardiovascular exercise can be useful in determining if an education session changes their intentions to perform this behavior, and if attitudes towards supplemental training vary by dance level. This information could be gathered using a questionnaire based on the Theory of Planned Behavior (TPB).[17]

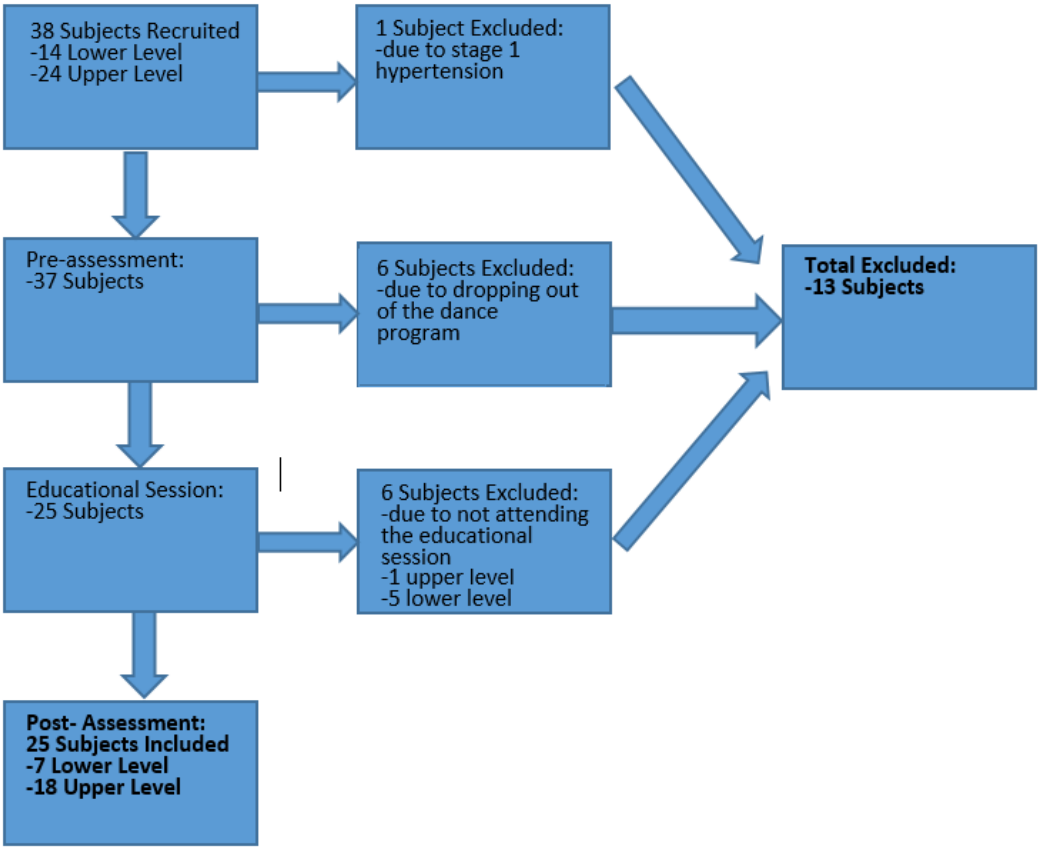
The purpose of this study was to fill the void in previous research by using the accelerated three-minute step test to compare lower level and upper level college dancers' cardiovascular endurance, as well as the cardiovascular endurance of college dancers before and two months after a single education session.

METHODS

Subjects

This study took a sample of convenience by recruiting subjects from university dance classes and posting research flyers. For subjects to be considered, the inclusion criteria consisted of being a current dance BFA major or have the intent to declare a dance BFA major, current enrollment in the designated number of technique classes required by the UNLV Dance Department during the fall and spring semesters, and must be between the age of 18-30. The exclusion criteria included having any lower extremity injuries within the last 2 weeks prior to testing that would prevent weight bearing or ability to stair step, the presence of Stage 1 hypertension or higher, or an abnormal resting heart rate of greater than 100 beats per minute. The subjects were required to be enrolled in the designated number of dance technique classes as determined by the dance department, which included 3 types of dance technique classes meeting 2 times per week, for a total of 6 classes. The same inclusion and exclusion criteria were utilized for the step re-test the following spring semester. The reason to exclude those with stage 1 hypertension or higher or abnormal resting heart rate was for safety purposes, minimizing the risk of any cardiovascular complications during testing. The study initially recruited a total of 38 subjects with 5 male and 33 female dancers, and 1 female subject was excluded due to having Stage 1 hypertension (Figure 1). Dancers were already placed through an audition by the dance program into one of four ballet and modern dance levels ranging from beginner to advanced. For the purposes of this study, the dancers in levels 1 and 2 were grouped into the lower dance level group, and the dancers in levels 3 and 4 were grouped into the upper dance level group. There were 13 subjects in the lower level and 24 in the upper level. We used G*Power 3.1 to calculate 13 as the minimum number of subjects needed to have a power of 0.95.[8]

Figure 1. Subject recruitment and retention.



Questionnaires

The TPB questionnaire used for this study was created, based on the standard published questionnaire, to assess the amount of activity performed outside of dance class. The TPB has been shown to have a 23.9% variance of predictive value for physical activity, which is considered to be strong, keeping in mind that multiple factors influence behavior. [17] The TPB contains five categories; intention, past behavior, control beliefs and power of control, injunctive normative beliefs and motivation to comply, and behavioral beliefs and outcome evaluations. Subjects indicated on a scale of 1 (strongly disagree) to 7 (strongly agree) how strongly they agreed with statements corresponding with each of the categories. There were thirteen standardized questions broken down into five categories. The standard method was used to calculate the average score per category calculated for each subject. The defined behavior for the TPB was based on the American College of Sports Medicine (ACSM) guidelines for cardiovascular exercise.

The ACSM recommends that most adults engage in moderate-intensity cardiorespiratory exercise training for at least 30 minutes per day on at least 5 days a week for a total of at least 150 minutes per week, or vigorous-intensity cardiorespiratory exercise training for at least 20 minutes per day on at least 3 days per week (at least 75 min per week), or a combination of moderate- and vigorous-intensity exercise to achieve a total energy expenditure of at least 500–1000 metabolic equivalent-minutes (MET-min) per week.[18] The cardiovascular exercise must be carried out in one continuous session or multiple shorter sessions of at least 10 minutes. Since these guidelines are the minimum recommendations to improve cardiovascular endurance, they are a good baseline for dancers outside of dance classes. The example TPB which was administered to subjects is included in Appendix A.

The (International Physical Activity Questionnaire) IPAQ is a questionnaire that has been determined to have acceptable measurement properties across many different populations, with reliability intraclass correlations around 0.80 and criterion validity correlations around 0.30.[19] The IPAQ was utilized in this study to determine the amount of exercise in MET-min per week that dancers performed in the past seven days based on self-reported activity. The IPAQ has demonstrated measurement properties that were at least as good as other established self-report physical activity measures.[19]

Procedures

A flow of the study design is provided in Figure 2. The methods will be broken down into three chronological sections; pre-assessment, education session, and post-assessment.

Pre-Assessment

During the initial session at the beginning of the fall semester, subjects were given the IPAQ to assess their physical functions and dance intake form to record their personal histories of dance performance, exercise, and injuries. The first session required 35 minutes from each subject. A TPB questionnaire was initially collected during the first session. However, due to researchers' error of improper formatting

when creating the original TPB, it was thrown out and reformatted. The newly formatted TPB was collected at the beginning of the education session and was used as the initial TPB for the purpose of this study.

During the first session, the dancers' weights and heights were measured and later calculated as BMI during data analysis. Their heart rates were taken using the Polar 7 heart rate monitors and secured around the dancers' chests. The dancers rested in a seated position for at least two minutes to bring their heart rates to baseline.[20] Resting blood pressure was taken while measuring resting heart rate. The subjects then performed the accelerated three-minute step test. Two subjects were tested simultaneously by the same two examiners. The test required a timer, a metronome set to 112 beats per minute and two steps with four levels each to reach a height of 30.5 centimeters.[6] The accelerated three-minute step test was adapted from the YMCA three-minute step test, and the speed was changed from 96 beats per minute (bpm) to 112 bpm based on Bronner and Rakov's protocol.[6] The speed was increased to prevent a ceiling effect from occurring with dancers since they may require higher levels of cardiovascular endurance than the typical population.[6] Then the protocol of up-up-down-down on the steps was explained and demonstrated to the dancers. The timer was set, and the dancers began the accelerated three-minute step test. At three minutes, the dancers' peak heart rates were recorded, and the dancers immediately sat down. After sitting for one minute, the dancers' heart rates were taken through the heart rate monitors to get their one minute $HR_{recovery}$. Each subject was classified into a fitness category based on their one minute $HR_{recovery}$, gender, and age.[6]

Education Session

Upon completion of initial data collection, three upper level and one lower level dancers were randomly recruited from a pool of volunteers to wear heart rate monitors during a ballet class and a modern dance class to evaluate if the heart rate reached an aerobic training zone and if that heart rate was held in the zone consistently throughout class. They also wore the monitors during dress rehearsals for upcoming

performances to determine if there was a large difference between the cardiovascular workload required in dance classes versus performances.

A single education session was developed using the results of the three-minute step test and the data collected from the heart rate monitors. The education session also highlighted the dancers' previously reported amount of exercise that the dancers performed outside of dance class, determined by the IPAQ.

The participants were guided through a PowerPoint lecture, which focused on the importance of the dancers incorporating cardiovascular endurance training into their cross-training regimens, including the health benefits of regular cardiovascular activity and injury prevention for dancers during practice and rehearsal. The dancers were educated on the current research about dance and cardiovascular endurance, including the current evidence that dance classes alone do not improve cardiovascular endurance. They were presented with two different graphs comparing heart rates, from the volunteers who wore the heart rate monitors, during classes (both modern and ballet) versus performances; this indicated that although the amount of time spent during performance was shorter than during class, the peak heart rates during performance were much higher. Many performances involve being on stage for even longer periods, so class alone does not prepare dancers for long, high intensity performances. The education session also covered moderate- versus high-intensity cardiovascular exercise, and the minimum requirements per week for each type based on recommendations from the ACSM. The dancers were informed how to determine the intensity of their cardiovascular activity through Rate of Perceived Exertion (RPE) and heart rate monitoring and were given advice on developing and implementing an endurance training program. A sample high-intensity interval training (HIIT) program that included a combination of typical HIIT components as well as dance-specific movements was demonstrated. Details of the education session are provided in Appendix B. Ultimately, the dancers were advised to explore different types of cardiovascular exercise and to participate in exercises that they enjoy to facilitate participation and habit forming behaviors.

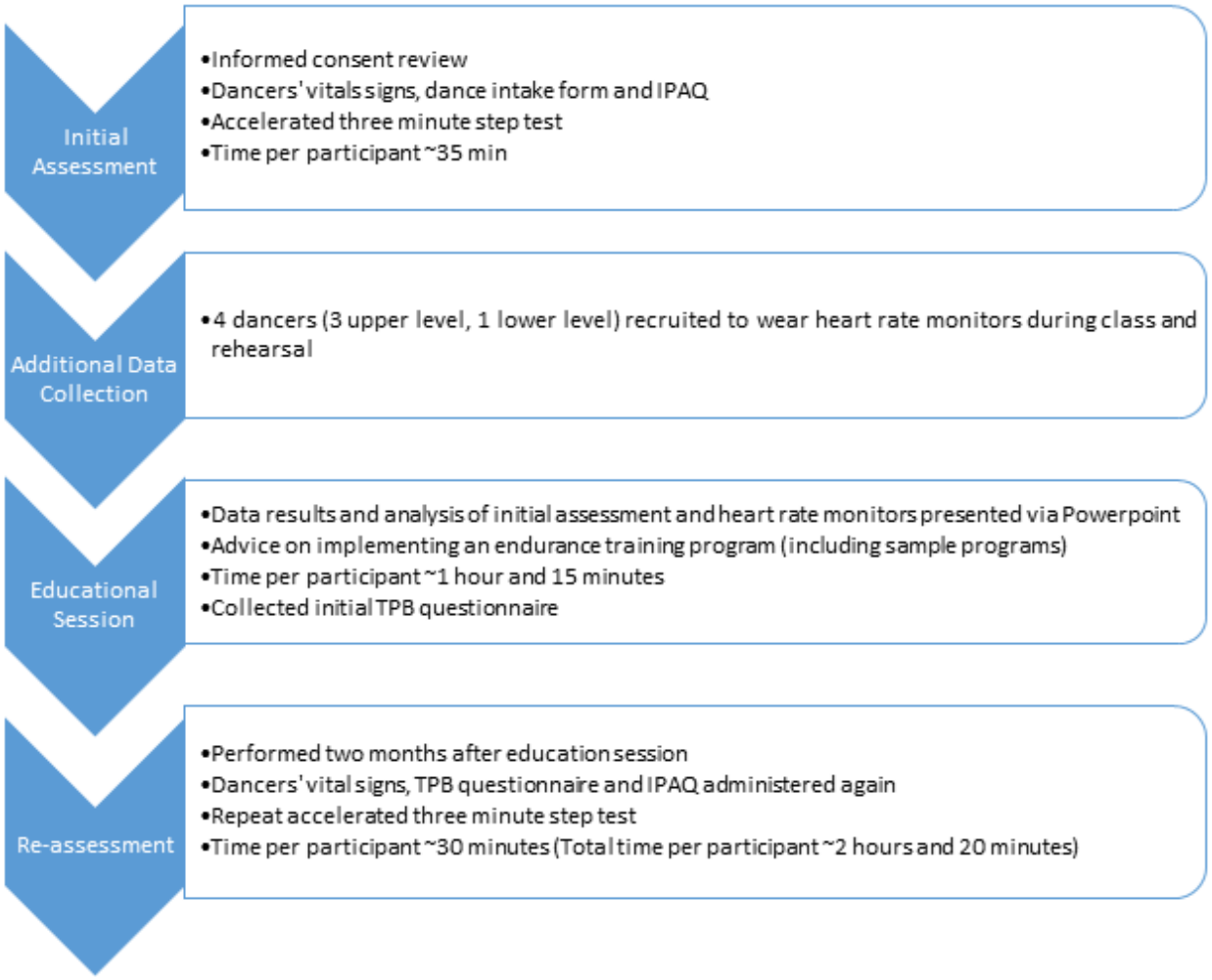
Post-Assessment

The dancers were re-assessed at the end of the spring semester, two months after the education session, which followed the same procedure as the pre-assessment. The TPB questionnaire and the IPAQ were re-administered at the beginning of this assessment. The dancers' weights, resting heart rates, and resting blood pressures were measured before the performance of the three-minute step test. $HR_{recovery}$ after one minute was measured after the administration of the test. The pre- and post-education results were later compared during statistical analysis.

Timeline

Due to the structure of the UNLV Dance Department, all performances were scheduled at the end of the semester. In order to obtain all necessary data, including the heart rates during dress rehearsal, the initial data was collected in the fall semester. The education session was given during the first week of the spring semester. To allow time for the dancers to incorporate changes into their endurance exercise regime based upon the information provided in the education session and accordingly demonstrate a measurable difference in endurance level, the post-assessment was completed at the end of the spring semester.

Figure 2. Study design flow.



Data Analysis

The tests and measures utilized in this research study include the accelerated three-minute step test, Theory of Planned Behavior (TPB) and the International Physical Activity Questionnaire (IPAQ). Dancers were placed into one of seven categories based on their heart rate recovery, age, and gender. The seven-categories were 0=excellent, 1=good, 2=above average, 3=average, 4=below average, 5=poor, and 6=very poor. Bronner and Rakov have made recommendations that if a dancer has a fitness level of 3-6 (average to very poor endurance), he or she should perform cardiovascular training outside of class.[8] The accelerated three-minute step test has demonstrated high correlations to the treadmill test in dancers

(ICC=0.73),[6] and step tests have demonstrated reliability in multiple populations ranging from r=0.82-0.92.[21]

Statistical Analysis

The outcome variables of this study included the difference in fitness categories, reflected as cardiovascular endurance, between the lower level and upper level dance groups; the difference in fitness categories, reflected as cardiovascular endurance, of both dance level groups from before and after the education session; the difference in the scores on the TPB questionnaire, reflected as the intent to exercise, before and after the education session; and the difference in the scores on the IPAQ, reflected by the amount of self-reported activity the dancers performed, before and after the education session in MET-min per week. Based on the accelerated three-minute step test, the subjects were placed into fitness categories. Subsequently, the percentage of dancers in each category was calculated, and the mean fitness categories for both the upper level and lower level dancers were calculated. The IPAQ was used to calculate the average MET-min per week of physical activity both before and after the education session. A two-way repeated measures ANOVA was run with the between-subject factor being dance level and the within-subject factors including pre- and post-assessments for BMI, weight, IPAQ MET-min per week, score of each TPB category, and one-minute $HR_{recovery}$ after the accelerated three-minute step test. Where the Mauchley's test violated sphericity, we reported the more conservative Greenhouse-Geisser corrected values. All statistical analyses were performed on SPSS Version 23.0 statistical software (IBM Corporation, Armonk, NY) using a significance level of 0.05.

RESULTS

Demographic characteristics

At initial-assessment, data was collected from 37 subjects (32 females, 5 males). Of the initial 37 subjects, the mean $HR_{recovery}$ was 116.54±20.52 bpm, and the mean fitness category was 3.41±1.83. Only 37.8% of the subjects were in the recommended fitness categories of 0-2, and 62.2% were in the poorer fitness categories of 3-6. Six subjects were unable to attend the education session, and six subjects dropped out of the UNLV dance program, so a total of 25 subjects (7 lower level and 18 upper level) completed the post assessment (Figure 1).

Table 1. Demographics of 25 college dance students before education session on cardiovascular endurance.

Dance Level	Number of subjects	Age (years)	Years of Dance experience	Fitness category
Lower	7	18.43±0.79	11.71±4.86	4.00±1.41
Upper	18	20.17±1.58	12.44±4.13	3.33±1.75
Total	25	19.68±1.60	12.24±4.26	3.52±1.66

Among the 25 subjects who completed both assessments, two were male and 23 were female. Their average age was 19.68±1.60 years old with a mean dance experience of 12.24±4.26 years (Table 1). A two tailed t-test revealed that there was no significant difference in years of dance experience between the lower and upper level dancers (F=0.253, *P*=0.619). There was as a trend towards the dancers in the upper level being older than the dancers in the lower level (F=4.065, *P*=0.056). The average weight of subjects was 139.92±22.45 pounds (lb) and the average BMI was 23.339±3.79 kg/m^2, with no significant difference between the lower and upper level dancers.

Figure 3. Body mass index (BMI) of the lower level dancers, upper level dance levels, and of all of the subjects before and after the education session.

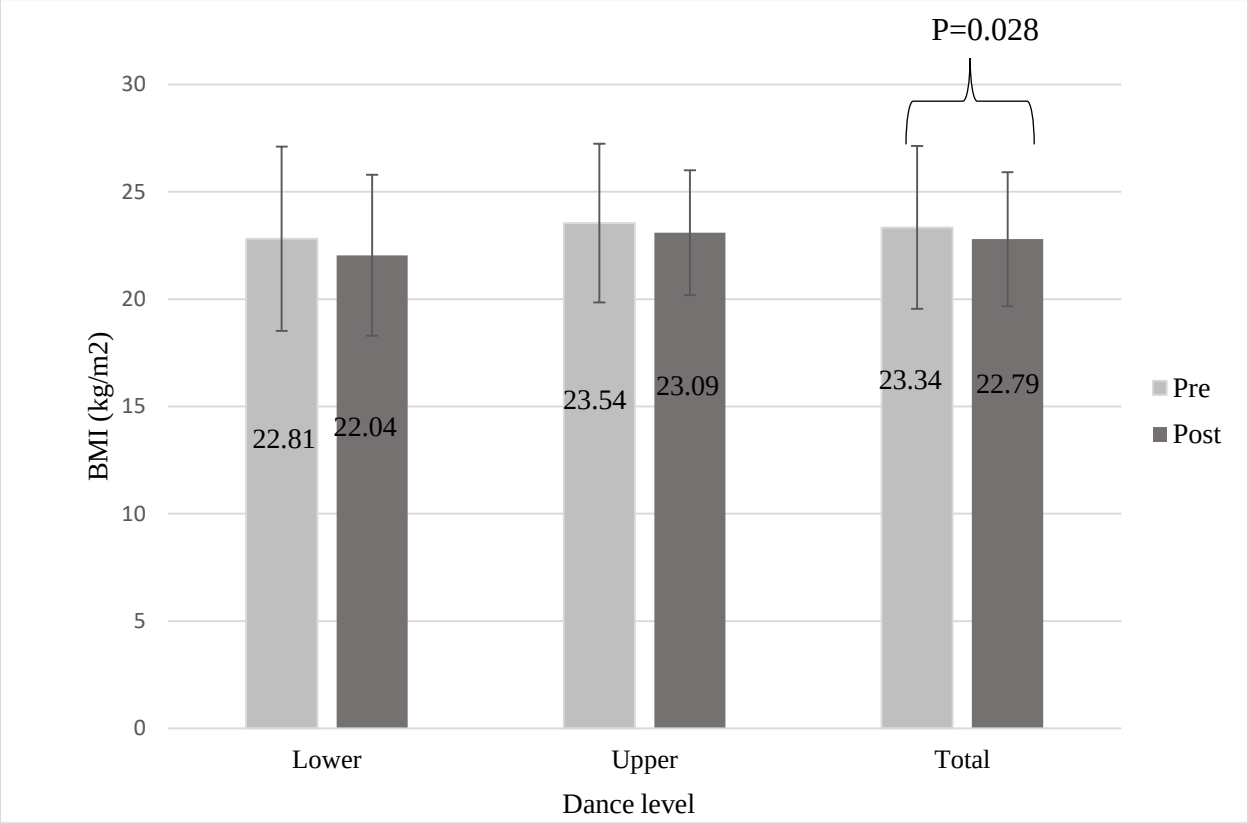
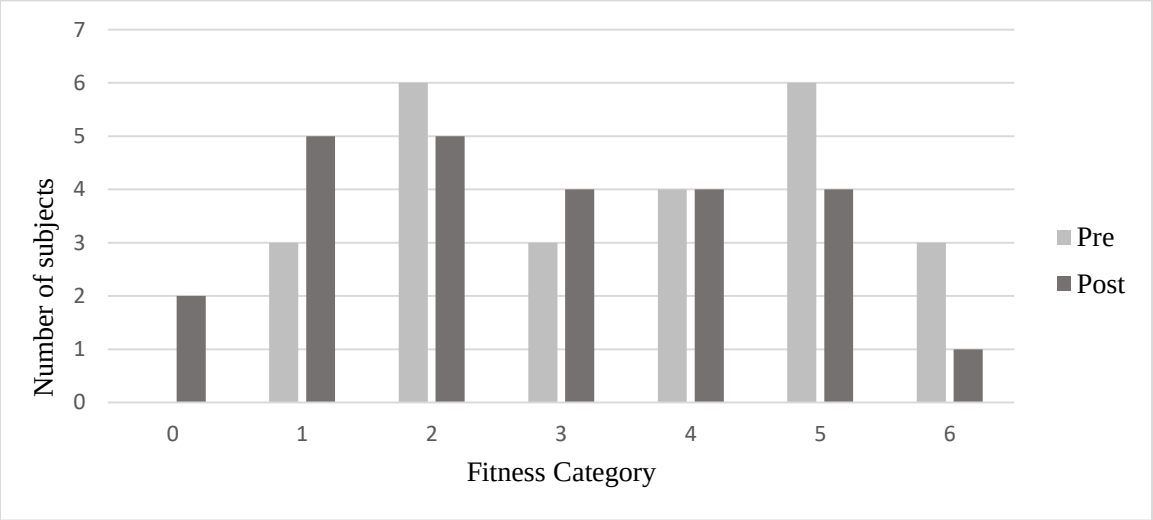


Figure 4. The number of subjects in each fitness category before and after the education session.



Scale: 0 Excellent, 1 Good, 2 Above Average, 3 Average, 4 Below Average, 5 Poor, 6 Very Poor.

Figure 5. The mean $HR_{recovery}$ before and after the education session for the lower and upper level dancers.

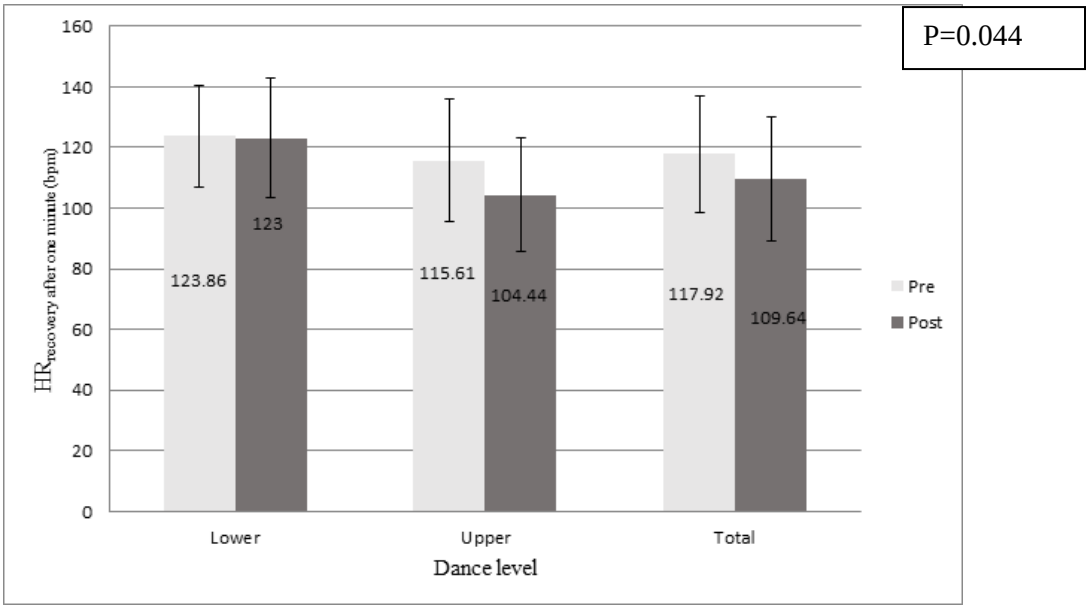


Table 2. Subjects' mean data from before and two months after education session on cardiovascular endurance (Weight P=0.026).

Dance Level	Fitness Category PRE	Fitness Category POST	Weight (lbs) PRE	Weight (lbs) POST
Lower	4 ± 1.41	3.71 ± 1.60	137.43 ± 21.09	133 ± 19.74
Upper	3.33 ± 1.75	2.39 ± 1.65	139.76 ± 23.51	137.06 ± 19.15
Total	3.52 ± 1.66	2.76 ± 1.72	139.10 ± 22.45	135.92 ± 18.99

Changes pre- and post-education session

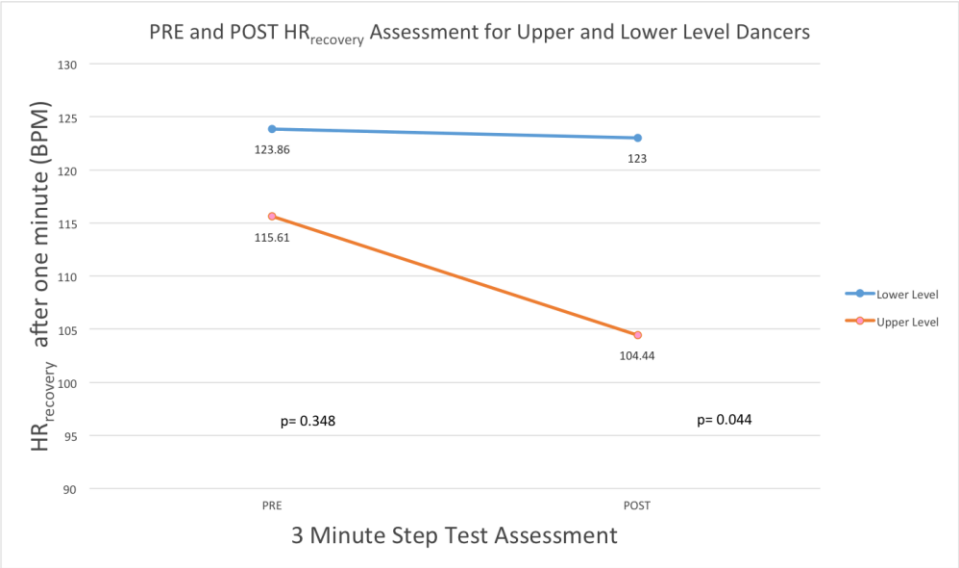
Among the 25 subjects that completed the study, the 2-factor repeated measures ANOVA revealed that there was no significant interaction of dance level on BMI (F(1)=0.385, *P*=0.541), but there was a significant main effect of time on BMI (F(1)=0.385, *P*=0.028), with BMI before the education session

being 23.34 ± 3.79 and BMI after the education session being 22.79 ± 3 (Table 2). However, there was no significant main effect of dance level on BMI ($F(1)=0.333$, $P=0.569$).

We calculated the mean fitness level to allow comparison between previous literature, and the mean fitness category for all subjects was 3.52 ± 1.66 before the education session and 2.76 ± 1.72 after (Figure 4). There was a trend towards a significant interaction between $HR_{recovery}$ and dance level ($F(1)=3.338$, $P=0.081$). There was a main effect of time on $HR_{recovery}$ ($F(1)=4.540$, $P=0.044$) with $HR_{recovery}$ before the education session being 117.92 ± 19.28 bpm and $HR_{recovery}$ after the education session being 109.64 ± 20.57 bpm (Figure 5). There was no significant main effect of dance level on $HR_{recovery}$ ($F(1)=2.747$, $P=0.111$). The post hoc independent t-test comparison showed the mean $HR_{recovery}$ before the education session between the upper and lower dance levels was similar ($F(23)=1.370$, $P=0.348$). However, the mean $HR_{recovery}$ after the education session for the upper level was significantly lower ($F(23)=0.959$, $P=0.040$) (Figure 6). Since $HR_{recovery}$ is descriptive of the dancer's fitness category, it is assumed that the overall fitness category of the dancers decreased, which is indicative of an improved endurance level.

The mean $HR_{recovery}$ for the two male subjects was 96.50 ± 6.36 bpm before the education session and was 79.00 ± 14.14 bpm after the education session, while the mean $HR_{recovery}$ for the female subjects was 119.78 ± 18.93 bpm before the education session and was 112.30 ± 18.97 bpm after the education session. Further statistical tests were not performed due to the small number of male subjects.

Figure 6. Significant difference of $HR_{recovery}$ values after education session**.**



In regard to the TPB questionnaire, there was no significant interaction of time on intent to perform cardiovascular exercise (F(1)=0.391, *P*=0.538), and no significant main effect (F(1)=0.781, *P*=0.386). There was also no significant interaction of time on perceived behavioral control of cardiovascular exercise (F(1)=0.678, *P*=0.419) or significant main effect (F(1)=0.081, *P*=0.778). There was no significant interaction of time on subjective norms about cardiovascular exercise (F(1)=0.336, *P*=0.568), and no significant main effect (F(1)=2.177, *P*=0.154). There was also no significant interaction of time on attitudes towards performing cardiovascular exercise (F(1)=0.179, *P*=0.677), or significant main effect (F(1)=1.467, *P*=0.238). There was no significant interaction of time on past behavior (F(1)=0.780 *P*=0.386), and no significant main effect (F(1)=1.847, *P*=0.187) (Table 3).

There was also no significant main effect of dance level on any of the TPB questionnaire categories, except there was a trend towards dance level having a significant main effect on subjective norms (F(1)=4.249, *P*=0.051) with the lower level dancers scoring higher than the upper level dancers (Table 3). There was also a significant main effect of dance level on past behavior with the upper level dancers scoring higher than the lower level dancers (F(1)=5.750, *P*=0.025) (Table 3).

Table 3. Theory of Planned Behavior (the mean score for each specific predictor variable) for lower level and upper level dancers. (*2-factor repeated measures ANOVAs show significant main effect of dance level on past behavior (F(1)=5.750, P=0.025).

Predictor Variables	PRE Lower Level	POST Lower Level	PRE Upper Level	POST Upper Level
Past Behavior*	4.71 ± 1.11	3.93 ± .93	5.56 ± 1.34	5.39 ± 1.51
Perceived Behavioral Control of Cardiovascular Exercise	4.29 ± .53	4.14 ± .14	4.50 ± 0.62	4.57 ± .55
Attitudes Towards Cardiovascular Exercise	5.68 ± 1.34	6.20 ± .71	5.43 ± 1.38	5.68 ± .92
Intention to Perform Cardiovascular Exercise	5.52 ± .88	5.57 ± .99	5.39 ± 1.30	5.67 ± 1.23
Subjective Norms about Cardiovascular Exercise	5.32 ± .61	5.50 ± .82	4.13 ± 1.24	4.54 ± 1.55

The 2-factor repeated measures ANOVAs revealed no significant interaction between time and dance level on the IPAQ scores (F(1)=0.003, *P*=0.960). There was no significant main effect of time (F(1)=0.224, *P*=0.641) or dance level (F(1)=0.069, *P*=0.795) on the IPAQ scores (Table 4).

Table 4. IPAQ (mean score for MET-min per week) † Differences in MET-min per week from before and after the education session (F(1)=0.224, p=0.641).

IPAQ	PRE	POST
MET-min/week Lower Level	5153.43 ± 3439.72	6061.50 ± 3231.50
MET-min/week Upper Level	5686.92 ± 5972.50	6418.31± 6028.70
Total†	5537.54 ± 5318.32	6318.40 ± 5327.47

DISCUSSION

In this study we assessed the effects of a single education session on the cardiovascular endurance of college-aged dancers. Cardiovascular endurance was determined using $HR_{recovery}$ following a three-minute accelerated step test to compare baseline endurance levels of lower level dancers to upper level dancers. It was hypothesized that first, there would be no difference between the two class levels initially, which was supported by the results. Second, it was expected that all dancers would demonstrate improved cardiovascular endurance two months after the education session, which was supported by the results as well. Finally, it was hypothesized that the dancers would indicate they were more likely to perform cardiovascular exercises after the education session, which was not supported by the results.

The non-significant difference between the dance skill levels in terms of cardiovascular endurance prior to the education session aligned with previous literature.[11] However, the results of one question on the TPB questionnaire pertaining to performing cardiovascular exercise in the past four months illustrated that the upper level dancers were more likely to indicate that they performed the recommended levels of cardiovascular exercise outside of dance class than the lower level dancers. Despite upper level dancers indicating that they performed the recommended levels of cardiovascular exercise, this was not reflected by their responses on the IPAQ nor by the cardiovascular endurance levels before the education session. The upper level dancers may have been performing cardiovascular activities outside of dance class but were not performing it in sufficient amounts or at high enough intensities for it to be reflected in their $HR_{recovery}$. At initial testing, almost two-thirds of all dancers were at the level recommended to need supplemental cardiovascular activity outside of class. These results are consistent with previous studies, indicating that many college-aged dancers should incorporate more regular cardiovascular activity into their lives.[8]

Two months after the education session, the upper level dancers trended towards having a greater improvement in cardiovascular endurance, possibly indicating that dancers care more as they advance in

the dance program and invest extra time to improve their endurance and peak performance potential. However, the TPB questionnaire did not indicate that the upper level dancers had greater intention or felt more social pressure to perform cardiovascular exercise outside of dance class.

Additionally, the advanced dancers may have demonstrated improved cardiovascular endurance due to being in more rehearsals and performances. Those with higher skill levels may be more likely to be selected during auditions for performances. However, the dance department only produces two separate shows each semester and performs each show three times, which is likely not enough to improve cardiovascular endurance by itself.

Among all dancers, we observed a statistically significant decrease in BMI and $HR_{recovery}$ after the education session compared to baseline testing. It was initially hypothesized that the dancers would report they are more likely to perform cardiovascular exercise after the education session, but no changes of intention were seen after the session. Six months passed between the pre- and post-assessments. The New Year and new spring semester began within this time period, during which dancers may have set weight loss goals. This may have influenced their activity levels and subsequent improvement in endurance and weight. Based on past literature, the improvement seen would not have been due to increased demands from tougher classes, as upper level dancers have not demonstrated statistically significantly higher cardiovascular endurance than lower level dancers in the college setting.[11] The education session was conducted two months prior to post-assessment. There is a possibility that the session was a contributing factor in the greater improvement of the upper level dancers' post-assessment performances because six weeks of high intensity interval training may be enough time to see significant changes in cardiovascular endurance.[22] However, more research is needed to determine the education session's role in the significant weight loss and improved $HR_{recovery}$ of all dancers.

There are several limitations to the present investigation to consider. The first limitation was the lack of a control group consisting of dancers who did not attend the education session. A control group would allow comparison to determine if the changes seen in cardiovascular endurance, weight, attitudes, and self-reported exercise could be attributed to the education session.

Second, the number of male dancers compared to female dancers was small. Only 2 male dancers completed the study, which is reflective of a limited number of males in the UNLV dance program, so analysis to compare male and female dancers could not be performed. Further research is needed to determine if an education session has similar effects with both genders.

Third, the dancers' ability to determine amounts of physical activity may have been limited by their understanding of "moderate" and "vigorous" exercise as defined by the ACSM. The IPAQ relied on these terms and the subjects' abilities to determine what activities belong in which category. It has been suggested that the majority of young adults underestimate the correct intensity of physical activities.[23] So while the IPAQ has been shown to be a reliable tool used to quantify weekly energy expenditure in previous literature, it may not have been the case in this study due to the subjects' limited understanding of the correct intensity of physical activities. Multiple subjects left sections blank or expressed difficulty providing exact times spent on specific activities, which may explain the lack of difference seen between before and after the education session. Furthermore, we did not control for or record the amount of dance classes, rehearsals, and performances the subjects performed compared to the amount of activity they performed outside of dance, and this may have influenced our results.

Lastly, a potential selection bias may exist, as a sample of convenience was used in coordination with the UNLV dance department. This department may not be representative of all college dance programs.

CONCLUSION

This study adds to the current literature suggesting that many college dancers do not have the recommended endurance levels to be prepared for dance performances. Furthermore, an education session may be more effective with upper level dancers because they may have greater intention to perform activities to enhance their dance performance. More research is needed to determine if this is consistent across college dance programs and if the improvement in cardiovascular endurance that was observed was due to the education session or occurred due to other factors during the school year.

APPENDIX A

Theory of Planned Behavior

Instructions: Please circle the number on the scale that corresponds with how you feel about the statement regarding vigorous intensity* or moderate intensity* aerobic exercise.

*For the purposes of this questionnaire vigorous aerobic activities are defined as aerobic exercise that causes a large increase in heart rate and breathing and is performed for at least 20 minutes per day on at least 3 days per week.

> When rated on a scale from 6 (being very light activity such as sitting in a chair) to 20 (being extremely vigorous) it is a 14 or higher.

*Moderate aerobic activities are defined as aerobic exercise that causes a noticeable change in heart rate and breathing and is performed for at least 30 minutes per day on at least 5 days per week.

> When rated on a scale from 6 (being very light activity such as sitting in a chair) to 20 (being extremely vigorous) it is between 12-13.

1. I expect to perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class.

> Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

2. Performing vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class is

> Harmful: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Beneficial
>
> Good: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Bad
>
> Pleasant: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Unpleasant
>
> Worthless: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Useful

3. I want to perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class.

> Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

4. Most people who are important to me think that I should perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class

> Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

5. It is expected that I perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class.

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

6. For me to perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class is

Easy : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Hard

7. I expect to perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class.

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

8.People who are important to me want me to perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next four months outside of dance class.

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

9. I am confident that I can perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class if I wanted to

False : 1 : 2 : 3 : 4 : 5 : 6 : 7 : True

10. I feel under social pressure to perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next four months outside of dance class.

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

11. My performing vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class is beyond my control

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

12. Whether I perform vigorous intensity aerobic exercise or moderate intensity aerobic exercise for the next 4 months outside of dance class is up to me

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

13. In the past 4 months, I have performed vigorous intensity aerobic exercise or moderate intensity aerobic exercise outside of dance class.

Strongly Disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly Agree

APPENDIX B

Education Session Powerpoint Presentation

Cardiovascular Endurance for Dancers

Objectives

Education on the importance of cardiovascular endurance:

- Health benefits
- Injury prevention
- Parameters

Background

- Cardiovascular activity:
    - Regular, purposeful exercise that involves major muscle groups and is continuous and rhythmic in nature
- Cardiovascular endurance:
    - The ability of the circulatory and respiratory system to supply oxygen during sustained physical activity
    - Monitored by heart rate and blood pressure

Benefits of cardio training for the general population

- Improvements in cardiovascular and respiratory function
- Reduce heart disease risk and death rates from heart disease
- Reduce risk of health conditions such as diabetes, cancer, and stroke
- Other benefits include decreased depression and anxiety

Cardiovascular endurance and dance

- Dance classes do not prepare dancers' cardiovascular systems for performance
    - May be due to structure of dance class
    - Dancers have lower fitness levels and heart structures compared to other athletes
- Low fitness levels may be related to increased injury risks
- Dancers at another university dance program had an average fitness level of between average to below average

American College of Sports Medicine (ACSM) Guidelines

Minimum requirements to increase aerobic endurance according to ACSM:

- Moderate-intensity cardio training
    - >30 min/day on at least 5 days/wk for a total of >150 min/wk
- Or vigorous-intensity cardio training
    - >20 min/day on at least 3 days/wk for a total of >75 min/wk
- Or combination
- In one continuous session or multiple sessions of >10 min

Purpose of the study

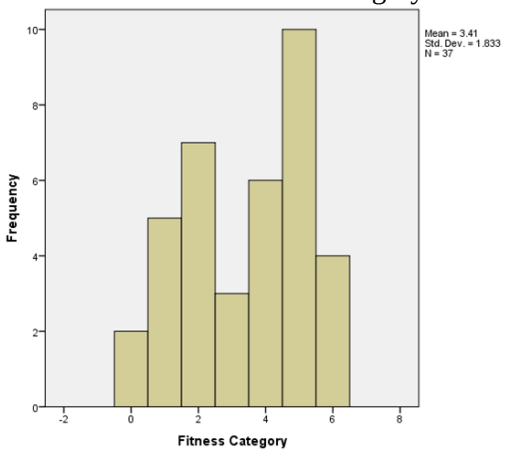
- To determine the fitness level of college dancers
- To determine if dance classes and rehearsals meet the minimum requirement to increase cardiovascular endurance

Procedure

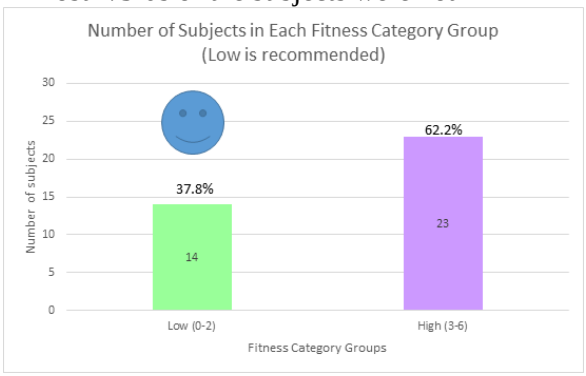
- Use the step test to assign fitness levels based on heart rate recovery
- Fitness categories from 0-6 with 0 being excellent and 6 being poor
- Categories of 0-2 is recommended for dancers

Data and results

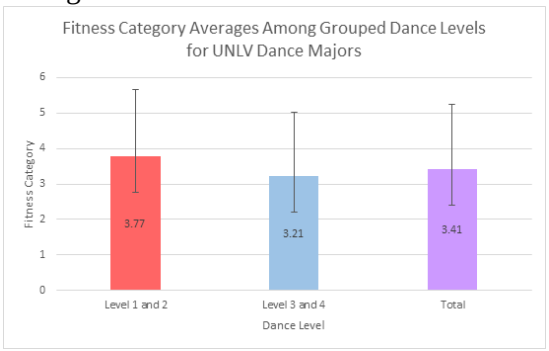
- Mean fitness category
  - (37 subjects)=3.41±1.83
- Median=4 (below average)
- So the mean fitness category was average

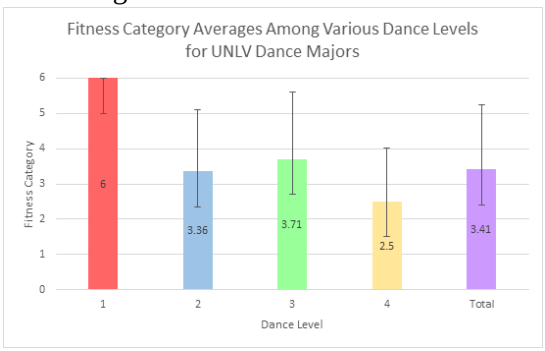


- 14 (37.8%) of the subjects were in the recommended fitness categories
- Almost 2/3rds of the subjects were not



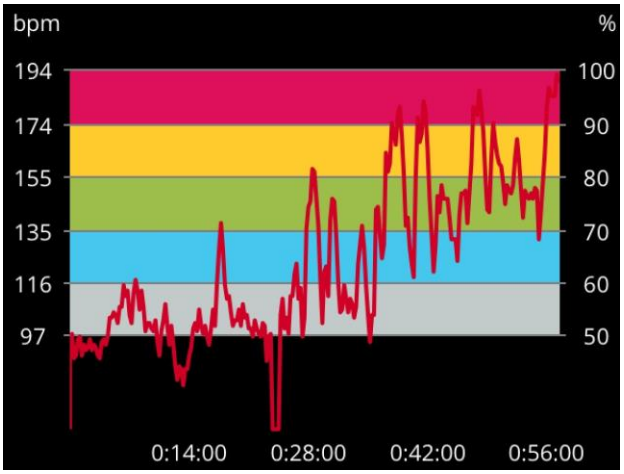
- No significant difference between levels and fitness categories



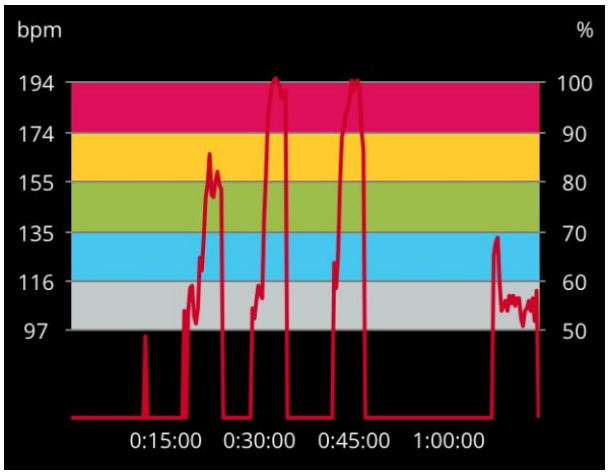


- Although the amount of time spent performing (during the student show) was short, the heart rate was much higher than in class. Many performances involve being on stage for longer. Class does not prepare you for long, high intensity performances.

Modern class



Performance



Moderate Intensity, Long Duration

- Typical "cardio" exercises: running/jogging, walking, cycling, rowing
- Make sure to warm up (jumping jacks, marching in place) and then stretch beforehand
- Increase time spent performing the activity by 10-20%
- Work up to at least 30 minutes a session 5 days per week
- If you have not performed much cardiovascular activity do not immediately start this amount. Work your way up.
- Ex.
    - Week 1: 3x 10-15 min light jog (if need to walk, do it for 60-90 sec before restarting the jog).
    - Week 2: 3x 12-17 min same pace as week 1 (again, if need to walk, do it for 60-90 sec).
    - Week 3: 3x 14-19 min, same pace, but attempt to increase pace for 1 min and slow down to baseline pace for 2-3 min and repeat (If need to walk, do it for 30-60 sec before resuming slow pace)
    - Week 4: 3x 16-21 min, increased pace for 1.5 min, jog for 3-4 min and repeat (walk for 30-60 sec before resuming slow pace)

High Intensity Interval Training (HIIT)

- Can be done with typical exercises, but also includes bodyweight exercises
- Periods of high intensity followed by periods of low intensity
- If cardiovascular activity is new for you, ideally start with a few weeks of low intensity, long duration exercises before incorporating HIIT.
- Push yourselves during the high intensity periods (However, maintain proper form!)
- Ex.
    - Week 1: aim for 3x/wk. 30 seconds high, 30 seconds low. <u>2 rounds.</u>
        - High intensity exercises: jumping jacks, jump squats, burpees, shuffle steps, ballet jumps.
        - Low intensity: butt kicker, high knees, jog in place.
        - Take a 15-60 sec break as needed every 2 rounds

- Weeks 2-3: aim for 3x/wk. 30 seconds high, 30 seconds low. 3 rounds. Add/substitute 1-2 high intensity exercises for variation.
    - Consider adding 5 seconds to the high as you get more comfortable.

How to determine exercise intensity

Rate of Perceived Exertion Scale

- Moderate: 12-13
- Vigorous: 14 or higher

6	No exertion
7	
8	
9	
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	
20	Maximal exertion

Resources

- Plentiful resources outside
- For HIIT
    - https://www.youtube.com/user/FitnessBlender/videos - Excellent channel (or visit their website) that has uploaded TONS of videos to follow (and not just interval training ones)
        - Have used it myself when I didn't have access to a gym :)
    - Or create intervals/timers if you want to train independently
        - http://www.intervaltimer.com/timers/7068854-hiit-home
        - https://itunes.apple.com/us/app/interval-timer-pro/id395652793?mt=8 (cost $)

Strategies

- Find an activity you enjoy and that is exciting for you.
    - For example, try classes at the SRWC
- Schedule time for it into your day. It only has to take 20 minutes a session.
    - Take out your phones or planners and do this now.
- Do it with a friend to motivate each other and keep each other accountable.
- Create an exercise log or use a fitness app to track your activity
- Change up the workouts to keep it more interesting.

Conclusion

- Dance classes are not enough to increase cardiovascular endurance
- Cardiovascular endurance is important for performances and overall health
- About 2/3rds of UNLV dance students are under the recommended fitness levels
- Need a minimum of three 20 minute sessions a week of vigorous exercise
- Find something you ENJOY

Subjects were given reference handouts to take home with the information on example moderate and high-intensity activities, resources, and strategies.

Sample HIIT Workout

- Alternate between butt kickers, jogging, and arm swings and mini squats in place for 2 minutes for warm up (30 sec each)
- Jumping jacks 30 sec and butt kickers 30 sec
- Plank toe taps into pike 30 sec and jogging 30 sec
- Jump squats 30 sec and high knees 30 sec
- 30 sec rest
- Burpees 30 sec and butt kickers 30 sec
- Side lunges 30 sec and jogging 30 sec
- Mountain climbers 30 sec and plank twists 30 sec
- 30 sec rest
- Forward lunges 30 sec and butt kickers 30 sec
- Shuffle steps back and forth 30 sec and jogging 30 sec
- Modern dance rolls to jump 30 sec and high knees 30 sec
- Mountain climber 30 sec and 30 sec plank twist

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