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Clinical Outcomes of Different Tempos of Music During Exercise in Cardiac Rehabilitation Patients

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ABSTRACT

International Journal of Exercise Science 10(5): 681-689, 2017. This study examined the effects of stimulating and sedative music on ratings of perceived exertion (RPE), heart rate (HR), blood pressure (BP), and feeling status during exercise in cardiac rehabilitation (CR) patients. Twenty-two male and female older adults age 64 ± 8.0 y currently enrolled in phase III CR completed the study. Repeated measures crossover designs guided data collection. The manipulated independent variable was music condition (sedative, stimulating, and non-music control). The dependent variables were RPE, BP, HR, and feeling status with each represented by four repeated measures ANOVAs over time via SAS 9.3. Data analysis indicated significant differences for all exercise related variables besides BP. While standardizing the exercise, we observed that sedative music is the best choice to manipulate for decreases in RPE ($p=.0019$), increases in feeling status ($p=.0192$), and decreases in HR ($p<.0001$). While standardizing the exercise, sedative music is the best choice to observe decreases in RPE, increases in feeling status, and decreases HR. Stimulating music would only be the correct choice to observe increases in HR, and does not have as much of a beneficial effect on RPE and feeling status as sedative music. There were no significant effects of either type of music on BP.

KEY WORDS: Cardiac rehabilitation, music tempo, exercise

INTRODUCTION

Cardiac Rehabilitation (CR) specialists could expand upon the benefits of phase III CR programs by incorporating music into their patient's exercise routine. Current research suggests listening to music may enhance physical activity during sport and exercise (8, 9, 10). Current research focuses on the effects of music on exercise performance within high school to college-aged populations. Few studies exist observing the impact of music on exercise-related variables within CR populations (5, 14, 16). The clinical setting warrants further examination of more clinical outcomes of listening to music during exercise (blood pressure [BP], heart rate [HR]) as well as more subjective outcomes (rating of perceived exertion [RPE], and feeling status).

Previous clinical trials have attempted to use music to reduce RPE and increase feeling status during exercise in CR populations. The rationale is that compliance with an exercise program depends on the degree of pleasure associated with the exercise. The more pleasure perceived, the more likely the exercise will be repeated to promote exercise compliance (16). Therefore, improvement in feeling status during exercise should also enhance compliance to the exercise program. Similarly, Murrock (16) states that "if a patient's perceived exertion is lowered while exercising to music, exercise may be done more effortlessly, which can lead to physiological improvements."
(16).

There is a lack of consensus concerning the effects of music on RPE, feeling status, HR, and BP during exercise in CR patients. If music tempo can positively affect these variables and improve a patient's physiological adjustments, the addition of music to programming may be beneficial. To our knowledge, no clinical study has examined the effect of music tempo on those variables during exercise.

The purpose of this study was to examine the effects of stimulating and sedative music on RPE, feeling status, HR, and BP during exercise in Phase III CR patients.

METHODS

Participants

A convenience sample of 22 male and female older adults age 64 ± 8.0 y currently enrolled in phase III CR at a local CR program completed the study (Table 1). Inclusion criteria required that subjects be willing to exercise on a treadmill at a speed of 3.0 mph for 10 minutes. Prior to the experiment, subjects signed a written consent and gained permission from their primary care physician for participation. Participants were instructed to continue medications as usual on study days. The university's Institutional Review Board and the hospital's Review Board approved the study.

Table 1. Subject mean age, HR, BP.

	Age	HR	BP Systolic Diastolic
Male (n=17) 12 on ß blockers	66±7.1	68±9	114±10 68±6
Female (n=5) 3 on ß blockers	56±7	74±6	117±9 71±6

HR - resting heart rate average of three sessions, BP – resting blood pressure average of three sessions

Protocol
Participants completed the exercise protocol on three separate visits to the clinic. Music condition (sedative, stimulating, and control) was randomly assigned to avoid ordering effects. Each participant's exercise session consisted of a 10-minute treadmill exercise at 3.0 mph, where they were exposed to the music condition throughout the entire protocol. Participants were asked to sit quietly for 10 minutes, and HR and BP were measured. Exercise was begun, and RPE, feeling status, HR, and BP were taken at minutes 5 and 10 during exercise. Once exercise was complete, participants were again seated, and HR and BP were taken 10 minutes after exercise. Pre and post measurements were taken 10 minutes before and 10 minutes after exercise to ensure proper resting and recovery periods occurred. Each exercise session was separated by 48 hours to ensure adequate recovery and a reasonable washout period for the crossover design.

BP was monitored using Welch Allyn brand blood pressure cuffs (Welch Allyn Inc., Skaneateles Falls, NY) and a 3M Littman Quality Stethoscope (Owens and Minor Inc., Mounds View, MN). HR was monitored using a Series C M2601a telemetry transmitter. The Borg RPE scale was used to assess RPE (2). The Borg scale ranges from 6-20 with each unit increasing linearly with a qualitative effort description (e.g., 7/very very light, 9/very light, 11/light, 13/somewhat hard, 15/hard, 17/very hard, and 19/very very hard). We assessed feeling status (measure for how a person feels during exercise) using a scale ranging from +5 to -5 with verbal anchors of +5 (very good), +3 (good), +1 (fairly good), 0 (neutral), -1 (fairly bad), -3 (bad), and -5 (very bad) (8). Subjects were also required to rate their enjoyment of each of the musical tracks via a Likert scale rating from (-2) really didn't like, (-1) didn't like, (0) indifferent, (1) liked, and (2) really liked.

Table 2. Music tracks selected.

Sedative music tracks	BPM
She's Leaving Home-Beatles	94
Unchained Melody – Righteous Brothers	90
My Girl – Temptations	94
Imagine – John Lennon	75
Stimulating music tracks	BPM
Oh, Pretty Woman – Ray Orbison	128
Roll Away the stone – Leon Russell	148
House of the Rising Sun – The Animals	128
It Don't Come Easy – Ringo Starr	141

Stimulating music indicates fast-pace and uplifting music approximately 130-140 beats per minute (bpm). Sedative music represents slower-paced and more relaxing music approximately 70-100 bpm.

Musical tracks were selected by participants from an arrangement of over 50 popular stimulating and sedative oldies songs. Participants individually selected eight of their preferred songs, four from each tempo category, with the top four sedative and top four stimulating tracks chosen (Table 2). Subjects listened to music through Sony MDR-

ZX100/WHI stereo headphones attached to a 4th generation iPod touch (Apple Inc., Cupertino, CA). Music tracks were played through Tempo Magic Pro downloaded from Apple Inc. application store.

Statistical Analysis

A crossover design was used to guide data collection. The manipulated independent variable was music condition (sedative, stimulating, and non-music control). The dependent variables were RPE, BP, HR, and feeling status with each represented by four repeated measures over time. Separate ANOVAs assessed differences in the four dependent variables over time. Rough sample size calculations based on paired t-tests were used to obtain sample size estimates (18). A-priori analysis suggested that a sample size of 12 would result in power =.8 for within subjects effects. Statistical significance was determined by $p<0.05$.

RESULTS

The means and standard deviations for variables tested are listed in Tables 3-6. ANOVA analysis revealed significant differences in RPE (Table 3-4), feeling status (Table 3-4), and HR (Table 5-6) exercise related variables during exercise at both 5-minute, and 10-minute time points. Systolic and diastolic blood pressures (Table 5-6) were the only variables where significance was not found at 5 minute (p=.3040) or 10 minute (p=.8512) measurements.

Table 3. Exercising data and adjusted significant differences for ratings of perceived exertion (RPE) and Feeling status (FS) at 5 minutes.

	RPE	FS
No music	10.6±2.2	3.5±1.2
Sedative	9.5±1.9 [a]	4.0±1.0 [c]
Stimulating	10.2±2.0 [b]	3.9±1.1

a – compares RPE no music to sedative- p=0.0015, b – compares RPE sedative to stimulating – p=0.0466, c – compares FE no music to sedative – p=0.0155

Table 4. Exercising data and adjusted significant differences for ratings of perceived exertion (RPE) and Feeling status (FS) at 10 minutes.

	RPE	FS
No music	11.3±2.5	3.6±1.1
Sedative	9.9±2.0 [a]	4.0±1.0
Stimulating	10.5±1.9	3.9±1.1

a – compares RPE no music to sedative – p=0.0002

RPE measurements were only recorded during exercise as they are a measurement of perceived exertion and there is no exertion at rest. Differences were observed for RPE during the 5 minute (Table 3) $F(2,40)=7.33$, p=.0001, and 10 minute (Table 4) recordings $F(2,40)=9.74$, p=.0004. Tukey-Kramer post-hoc analysis for the adjusted p-value at 5 minutes showed that RPE was higher under the no music condition than sedative (p=.0015), and that the stimulating music condition was higher than sedative (p=.0466) (Table 3). Sedative music presented the lowest RPE recordings with stimulating music being slightly higher, and no music presenting the highest RPE recordings. The same sequence of results held true for the 10 minute recordings as well (*p*=.0004). However, at 10 minutes the adjusted p-values revealed that only the no music condition was significantly higher than the sedative condition (*p*=.0002) (Table 4).

The ANOVA revealed significant differences for feeling status (Table 3-4) during the 5 minute (Table 3) $F(2,40) = 4.37$, $p = .0192$ and post recordings $F(2,40) = 4.49$, $p = .0174$, but not initially at 10 minutes (Table 4) $F(2,40) = 3.04$, $p = .0590$.

The adjusted p-value at 5 minutes showed higher feeling status scores under the sedative music condition compared with no music (*p*=.0155). Participants also continued to experience higher feeling status scores from sedative music over no music after the exercise was completed (*p*=.0131). At 5 minutes and 10 minutes there were no differences between no music and stimulating, or sedative and stimulating conditions.

Significant differences for HR were observed during both the 5 minute (Table 5) $F(2,40) = 19.53$, $p < .0001$, and 10 minute $F(2,40) = 16.51$, $p < .0001$ analysis (Table 6). Tukey-Kramer post-hoc analysis of 5 minutes showed that HR under the stimulating music condition was higher than both the no music (adjusted *p*=.0005), and sedative music conditions (adjusted $p < .0001$). Very similar adjusted p-values were observed at 10 minutes (*p*=.0056, $p < .0001$ respectively).

Table 5. Exercising data and adjusted significant differences for HR and BP at 5 minutes.

	HR (bpm)	Systolic BP (mmHg)	Diastolic BP (mmHg)
No music	95.1±13.2	133.4±12.0	71±6.4
Sedative	91.7±14.3 [a]	130.7±12.9	69.4±6.9
Stimulating	101.7±13.1 [b]	132.8±11.1	70.0±6.1

a – compares HR no music to sedative – p=0.0005, b – compares HR sedative to stimulating - p<0.0001

Table 6. Exercising data and adjusted significant differences for HR and BP at 10 minutes.

	HR (bpm)	Systolic BP (mmHg)	Diastolic BP (mmHg)
No music	96.6±14.1	134.7±11.6	70.7±6.1
Sedative	92.5±14.2 [a]	133.6±11.2	70.1±7.0
Stimulating	102.5±12.5 [b]	135.9±12.3	70.4±7.0

a – compares HR no music to sedative – p=0.0056, b – compares HR sedative to stimulating – p=<0.0001

DISCUSSION

Previous clinical trials have attempted to use music to reduce RPE and increase feeling status during exercise in CR populations, but it was unclear as to whether music tempo was a viable component for the lack of consensus. While standardizing the exercise, sedative music is the best to observe decreases in RPE, increases in feeling status, and decreases HR. Stimulating music would be the choice to observe increases in HR, and does not have as much of a beneficial effect on RPE and feeling status as sedative music. There were no significant effects of either type of music on BP.

Researchers have found that music plays a key role in lowering RPE during exercise: (3, 17, 20). Each researcher has suggested that music does lower RPE, but only significantly lowers RPE at low to moderate intensities. An explanation for this effect could be that participants may only react to the effects of music as a passive distractor during treadmill exercise (1). Once the exerciser reaches high workloads or high intensities the individual may not pay attention to the music anymore and focus their attention back towards the task, therefore eliminating effects of the music on RPE. With this information, researchers could expect that when music is used at low intensities as a distractor, it may lower RPE, but once the physiological effects of the exercise reaches a higher intensity (which is variable to each individual) the distractor may not be beneficial anymore.

In addition to using lower exercise intensities, for best results in lowering RPE during exercise, we have also observed that it is vital that the tempo of music be sedative. This correlates with researchers who found that the use of music during exercise sessions could decrease RPE when the style of music was easy listening/slow (4).

Consequently, in the current study, actual RPE means varied between 9.5 ± 1.9 (very light) under the sedative music condition and 11.3 ± 2.5 (light) under the no music condition. RPE scores that are reported this low during exercise would call for a change to the participant's exercise routine, having them exercise at a higher intensity for that day. At our local facility the rule of thumb is to have patients exercise between 11 (light) and 15 (hard) on the RPE scale. While standardizing the exercise, we concluded RPE decreases under sedative music conditions more than both stimulating and no music conditions (Table 3). However, this may only be applicable in the case that the exerciser was >15 as to bring them back down to ≤15 without changing the exercise routine. In that case, sedative music may be the answer. This assumption should be tested at higher intensities.

The feeling status scale is a measure for how a person feels during exercise (6). Hardy and Rejeski (6), suggest that although RPE represents *what* an individual feels during exercise, it does not reflect *how* a person feels. Rejeski's (17) parallel information processing model suggests that sensory and emotional information are processed in parallel through focal awareness. Therefore, our perception of effort (sensory information) or apprehension of exercise (affective information) form the object of attention and determine how we feel during exercise (17). They further propose that RPE is insensitive to whether the reported exertion is based on informational or emotional cues, and relies on physiological input of how hard a person thinks they're working. For example, two individuals may report an RPE score of 15. One may be under a considerable amount of physiological and emotional distress whereas the other may be feeling physiologically strained but feels no emotional distress. The feeling scale takes this into account and relies on a more emotional state of feeling.

Improvement in feeling status during exercise should also enhance compliance to the exercise program. Exercise related feelings can be changed by altering participants' expectations (7,11). Helfer et al. (7) demonstrated this by exposing 59 men and 89 women to an affective expectation manipulation as well as an elaboration manipulation and then had subjects complete 10 min of light intensity exercise on a stationary bicycle. The demonstration showed that expectations about positive exercise affect be manipulated to increase exercise related feelings, and even exercise related intentions. Along the same theory, Kiviniemi et al. (12)

examined whether affective associations with exercise predicted individuals (N=443) activity behavior and, if so, how they interfaced with other decision-making constructs to influence behavior. They found that associations with more positive feelings about the exercise predicts greater activity behavior than cognitive variables.

It is especially important in a cardiac rehabilitation program to know how a patient feels in accordance with how hard a patient thinks they are working due to possible clinical complications during exercise. In respect to that, it is of utmost importance that the participants experience a sense of pleasure from the music. One way to be sure of this was to employ a Likert scale rating of how participants felt about the music. After each exercise session subjects rated how much they liked the music condition on a scale of really liked (+2) down to really didn't like (-2). Out of 22 subjects, 19 really liked (+2) all music conditions and only 3 subjects presented ratings of liked (+1), 2 were for sedative and 1 was for stimulating music. No participants presented ratings from neutral (0) to really didn't like (-2). We have assumed that the Likert scale plus our gathering methods for musical selection represented music that was preferred by patients.

The current study presents that use of music may also induce exercise related feelings, possibly leading to increased exercise adherence and intention to exercise. Sedative music produced the highest feeling status scores at 5 minutes and 10 minutes when compared to no music. Stimulating music also increased feeling status scores but not significantly at 5 or 10 minutes when compared to no music. Future research will need to be done to determine why sedative music claimed the best outcomes on feeling status.

At both the 5-minute and 10-minute time observations we detected an increase in HR in response to stimulating music, and a decrease in HR in response to sedative music. By comparison, researchers report that listening to stimulating music at rest results in increased HR and respiratory rate when participants get the chance to select their own piece of stimulating music (13). This response could be due to a feeling of joy, and elated mood and energy while listening to stimulating music (13). In the same study, when individuals select their own piece of sedative music, it induced feelings of calmness and relaxation which lowered HR. Previous findings are consistent with our results of the effect of music on HR with the addition of exercise.

On the contrary, HR, much like stroke volume and cardiac output, increases in a linear fashion with increases in the intensity of aerobic exercise. No matter if music is present during exercise we would expect an increase in HR with the rise in exercise intensity. Yamashita et al. (20) concluded that the influence of music on HR was minimal and not significant, when eight healthy adult males exercise to their favorite musical piece at 40% and 60% VO2 max. In fact, the authors concluded that differences in autonomic activity were affected only by the exercise intensity and not by music (20). However, the researchers used tempos of music ranging from 98-162 bpm. In our population of older adults, the tempo of music affected HR during exercise. It is possible that even at high intensities that the tempo of music should be of interest when analyzing HR data, as the outcome may vary with respect to sedative and stimulating music conditions. The only practical approach may be to standardize the intensity of exercise. During standardized exercise stimulating music increases HR, and sedative music decreases HR when analyzing with a within subjects control.

Although this may be true, observations of CR patients show that certain medications such as beta blockers put a ceiling on subject's HR. Fifteen of the 22 subjects (3 female and 12 male) were found to have been on a beta blocker. Nevertheless, we still observed significance at lower exercise intensities, and have presented other possible pathways to increase or decrease HR without altering the exercise routine. It is not clear how our results could be generalized over populations and at higher exercise intensities.

No effect on blood pressure was observed and these results are consistent with previous findings. As with HR however, BP medications could be limiting factors while observing CR patients. It is not clear how the observed effects of our study may generalize to healthy older adults outside of our setting.

At present, no clinical study has examined the effect of music tempo on these variables during exercise in CR patients. The intensity and duration of the exercise play into how music affects the exerciser. Similarly, intensity and duration of the exercise may help control the use of medications that may alter BP and HR. To observe changes in RPE and feeling status, some have suggested that these variables may only be affected at lower intensities, which was observed in the current study. Also, the choice of music must be sedative/slow paced for optimal results. It is unknown as to whether these conclusions will hold true at higher intensities of exercise. It is clinically meaningful that CR programs be aimed at improving heart health measures. To recommend that further research be directed to lower intensities of exercise for experiencing more positive effects of music, may be to oppose the recommendations of phase III CR programs for those who seek gradual improvements in exercise intensity, MET level, etc.

REFERENCES

1. Bharani A, Sahu A, Mathew V. Effect of passive distraction on treadmill exercise test performance in healthy males using music. Int J Cardiol 97(2): 305-306, 2004.

2. Borg GAV. Psychophysical bases of perceived exertion. Med Sci Sports Exerc 14(5): 377-381, 1982.

3. Boutcher SH, Trenske M. The effects of sensory deprivation and music on perceived exertion and affect during exercise. J Sport Exerc Psychol 12(2): 167-176, 1990.

4. Copeland BL, Franks BD. Effects of types and intensities of backround music on treadmil endurance. J Sports Med Phys Fitness 31(1): 100-103, 1991.

5. Emery CF, Hsiao ET, Hill SM, Frid DJ. Short-term effects of exercise and music on cognitive performance among participants in a cardiac rehabilitation program. Heart Lung 32(6): 368-373, 2003.

6. Hardy CJ, Rejeski WJ. Not what, but how one feels: The measurement of affect during exercise. J Sport Exerc Psychol 11(3): 304-317, 1989.

7. Helfer SG, Elhai JD, Geers AL. Affect and exercise: positive expectations can increase post-exercise mood and exercise intentions. Ann Behav Med 49:269-279, 2015.

8. Karageorghis CI, Priest DL. Music in the exercise domain: A review and synthesis (Part I). Int Rev Sport Exerc Psychol 5(1): 44-66, 2012.

9. Karageorghis CI, Priest DL. Music in the exercise domain: A review and synthesis (Part II). Int Rev Sport Exerc Psychol 5(1): 67-84, 2012.

10. Karageorghis CI,Terry PC. The psychophysical effects of music in sport and exercise: A review. J Sport Behav 20(1): 54, 1997.

11. Klaaren KJ, Hodges SD, Wilson TD. The role of affective expectations in subjective experience and decision-making. Soc Cogn 12:77-101.1994.

12. Kiviniemi MT, Voss-Humke AM, Seifert AL. How do I feel about the behavior? The interplay of affective associations with behaviors and cognitive beliefs as influences on physical activity behavior. Health Psychol 26:152-158, 2007.

13. Lingham J, Theorell T. Self-selected "favourite" stimulative and sedative music listening -- how does familiar and preferred music listening affect the body? Nord J Music Ther 18(2): 50-166, 2009.

14. MacNay SK. The influence of preferred music on the perceived exertion, mood, and time estimation scores of patients participating in a cardiac rehabilitation program. Music Ther Perspect 13(2): 91-96, 1995.

15. Mohammadzadeh H, Tartibiyan B, Ahmadi A. The effects of music on the perceived exertion rate and performance of trained and untrained individuals during progressive exercise. Facta Universitatis: Series Phys Educ Sport 6(1): 67-74, 2008.

16. Murrock CJ. The effects of music on the rate of perceived exertion and general mood among coronary artery bypass graft patients enrolled in cardiac rehabilitation phase II. Rehabil Nurs 27(6): 227-231, 2002.

17. Rejeski WJ. Perceived exertion: An active or passive process? J Sport Psychol 7(4): 71-378, 1985.

18. SAS Institute Inc. SAS/STAT® 9.3 User's Guide. Cary, NC: SAS Institute Inc; 2011.

19. White JM. Music Therapy: An intervention to reduce anxiety in the myocardial infarction patient. Clin Nurse Spec 6(2): 58-63, 1992.

20. Yamashita S, Iwai K, Akimoto T, Sugawara J, Kono I. Effects of music during exercise on RPE, heart rate and the autonomic nervous system. J Sports Med Phys Fitness 46(3): 425-430, 2006.