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Is listening to music while exercising effective in reducing stress?

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

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In

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Philadelphia College of Osteopathic Medicine
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ABSTRACT

Objective: The objective of this selective evidence based medicine (EBM) review is to determine whether or not listening to music while exercising is effective in reducing stress.

Study Design: Review of three English language randomized control trials published in 2011 and

2013 Data Sources: The double-blind placebo-controlled randomized control trials were obtained via PubMed.

Outcomes Measured: Pretest-posttest surveys included the SF-36 Health Survey to assess self-reported health-related quality of life, the Activation- Deactivation Adjective Check List (AD-ACL) to measure mood, and a 9-item measure to assess emotion.

Results: Listening to music while exercising increased pleasant emotions in all 3 studies.

Significant findings of relaxation and being able to handle stress were seen in the 2013 study and a decrease in feeling anxious was found in the Lane et al 2011 study. However, reduction in perceived stress and increased calmness were significantly seen only when exercising alone indoors in comparison to listening to an Ipod while exercising in either setting in the Plante et al 2011 study.

Conclusions: Two out of three studies showed an association with listening to music while exercising and a reduction in stress. Although there is evidence showing that listening to music while exercising can reduce stress, the duration of this effect and to what degree in comparison to pharmacology therapy still needs to be explored.

Key Words: Music, Exercise, Stress

INTRODUCTION

Stress-related disorders result from abnormal responses to acute or prolonged anxiety.¹ Stress represents the effects of anything that seriously threatens homeostasis. Anxiety is defined as the stress that remains after the stressor is gone.² Stress and anxiety are a normal part of life, but anxiety disorders, which affect 40 million adults, are the most common psychiatric illnesses in the U.S.²

Various situations tend to elicit different patterns of stress responses, and there are also individual differences in stress responses to the same situation.³ Effects of stress on the regulation of immune and inflammatory processes have the potential to influence depression; infectious, autoimmune, and coronary artery disease; and some cancers.⁴ Some symptoms of stress include frequent headaches, grinding teeth, diarrhea, neck ache, difficulty sleeping, weight change, feeling overwhelmed, and an inability to concentrate.

Physician Assistants should be able to diagnosis and treat stress-related disorders for multiple reasons. One of the reasons for concern is the epidemiology of this disease. Statistics show that 60-90% of visits to health care providers are stress-related.³ These statistics demonstrate the importance of awareness by Physician Assistants. Additionally, Physician Assistants need to be aware of current treatment recommendations, as patients often present first to their primary care provider seeking treatment for mental illness before reaching out to mental health specialists.

Another point of importance is the cost of care for this specific patient population. For the more than 30 million U.S. adults who do not receive the mental health services they need, 45% cite cost as a barrier to mental health care.⁵ The cost of one standard session (between 45 and 55 minutes) of talk therapy generally runs between \$80 and \$120.⁵ At even one session per week at these rates, the costs can add up faster than patients are able to pay.

Like many other mental illnesses, the exact etiology of stress-related disorders is unknown; however, there have been multiple studies that link certain genetic abnormalities, as well as various environmental changes, to the root cause.¹ There are a number of treatments designed to reduce the symptoms experienced by those afflicted with stress-related disorders. The mainstay of treatment as approved by the FDA for this disorder is pharmacological treatment with anxiolytics or antidepressants. Alternative treatments include cognitive behavioral therapy, healthy eating, getting the proper amount of sleep, and relaxation techniques such as massages, deep breathing, meditation, yoga, music, and exercising.

Recently, the focus on exercise has shown a variety of mental health benefits, including improving mental focus, memory, cognitive flexibility, and helping the brain cope better with stress.³ However, on a global scale, one out of every five adults is physically inactive.⁶ Physical inactivity is prevalent and associated with poor health outcome, including a higher risk for mortality.⁷ The price of a good pair of running shoes usually starts around \$50, which will last on average 500 miles, and the average gym membership is \$35 per month.⁸ Methods for exercise are numerous, and include indoor or outdoor environments. Compare the cost and availability of exercise to scheduling a therapy appointment, and exercise seems like a favorable outlet. Additionally, the alternative use of music in reducing stress has also been found to improve the body's immune system and brain function.⁹ Music therapy has been utilized as a systematic process to help the patient promote health using music experiences and the relationships that develop through them as a behavioral strategy used to regulate emotions.¹¹ Its low cost, ease of administration, and minimal (if any) adverse side effects make it an ideal treatment option.¹¹

Though there is no cure for stress-related disorders, effective control of the symptoms is an attainable goal.³ Despite the existence of effective treatments for stress-related symptoms,

there continues to be an effort to find alternatives with lower side-effects and higher rates of symptom alleviation. Lifestyle modification recommendations have been highly beneficial options when available; however, the combining of alternative treatments to determine if they have a synergistic affect in reducing stress has clearly not yet been utilized in all scenarios. It is for this reason that several randomized control trials have been carried out in an attempt to scientifically show the effectiveness of reducing stress when listening to music while exercising.

OBJECTIVE

The objective of this selective EBM review is to determine whether or not listening to music is effective in reducing stress.

METHODS

The three studies analyzed in this review all met the following criteria. Studies are randomized controlled trials (RCTs), all of which included a pretest-posttest analysis. The population comprises of men and women between the ages of 17 and 65 listening to music while exercising. The comparison groups included living sedentary lifestyles, listening to specialized formulated music, exercising indoors or outdoors, and exercising with a friend or alone. The outcomes of measurement include: stress, anxiety, and mood changes.

A detailed search of the PubMed database was completed by the author between November 2014 and February 2015 using the keywords “music”, “exercise”, and “stress”. Review articles, meta-analyses, and systematic reviews crosschecked on COCHRANE database that answered the same question were excluded. Articles were selected based on their relevance to practice and importance to patient-oriented outcomes (POEMs: Patient Oriented Evidence that Matters). Inclusion criteria for article selection were as follows. All articles were RCTs published in an English language peer-reviewed journal published after 1996.

A summary of statistics reported or used include p-values as calculated by paired t-tests, standard deviations (SD), ANOVA, and Tukey's HSD (Honestly Significant Difference) scores.

Table 1 below displays the demographics and characteristics of the three selected articles.

Table 1: Demographics table and characteristics of included studies

Study	Type	#Pts	Age (yrs)	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Lane ¹² (2011)	RCT	65	Median age 41 (did not provide specific age range)	Listened regularly to music while running. Completed running course.	Did not fulfill inclusion criteria.	5	Self-selected music-based on motivational qualities of tracks
Plante ¹³ (2011)	RCT	Experiment #1: 128 Experiment #2: 101	17-23	Maintained heart rate at 140 beats per minute. Were able to bike or walk for 20 minutes.	Did not fulfill inclusion criteria.	0	Experiment #1: (indoors) exercising with a friend or alone Experiment #2: (outdoors) exercising with a friend or alone
Madison ¹⁴ (2013)	RCT	146	18-65	Participants were between 18-65 years of age. Did not exercise more than once a week during the previous 12 months.	Participants with chronic pain or illnesses were excluded	38	4 music exercise groups, each with a different formation of music

OUTCOMES MEASURED

Outcomes were measured largely on the basis of patient reporting. Pre- and post-exercise questionnaires were given to the participants in all three studies. These surveys included the SF-36 Health Survey, AD-ACL, and a 9-item emotion measure. As mentioned above, outcomes used for analysis include stress, anxiety, and mood changes.

The Madison et al study used the Swedish version of the SF-36 Health Survey to assess self-reported health-related quality of life both pretest and posttest. The questionnaire contained

36 items and addresses 8 health domains including role limitations due to emotional problems (RE) and mental health (MH). The domains vary from 1 to 100, with a high value representing a positive health.

The extent to which the training also affected participants' mental health in the Madison et al study was assessed posttest with 12 items of states deemed relevant for general psychological well-being (KoRT_F) including: "I am relaxed," "I can deal with unexpected events," "I am worried," and "I can handle stress and demands." Each item had 7 response alternatives ordered on a bi-directional scale: "Large negative change" (coded -3), "Moderate negative change" (-2), "Small negative change" (-1), "No change" (0), "Small positive change" (1), "moderate positive change" (2), and "large positive change" (3).

The Plante et al study used a brief self-report AD-ACL to measure mood states pre-exercise and post-exercise. Sample items included "calm...tense...relaxed... vigorous...sleepy," which were rated on a 4-point Likert scale with scores totaled for measuring energy, tiredness, calmness, and tension. Several 10-point Likert scales were also developed by the authors to measure each participant's current level of perceived stress during exercise. The value of 1 indicated low stress, low closeness, and slow music whereas a value of 10 indicated high stress, much closeness to their exercise partner during exercise, and fast or peppy music.

The Lane et al study used a 9-item measure to assess emotion pretest-posttest, with items being selected from previously-validated scales. Items assessed pleasant emotion ('Calm', 'Happy', and 'Energetic'), unpleasant emotion ('Gloomy', 'Guilty', 'Sluggish', and 'Downhearted'), and unpleasant emotion associated with high activation ('Anxious' and 'Angry'). Items were rated on a 7-point scale (1 = not at all, 7 = a great extent).

RESULTS

The following results from the three studies presented below contain continuous data. As a result, the analysis of risk reduction (RRR), absolute risk reduction (ARR), and numbers needed to treat (NNT) could not be calculated. In respect to safety, no adverse events or tolerability issues were reported in any of studies.

Madison et al designed a RCT containing a pretest-posttest component assessing health related quality of life. Participants were recruited by an invitation sent out through mailing lists targeting employees at the University of Umeå and Umeå University Hospital. Inclusion criteria included being a healthy adult between 18 and 65 years of age who did not exercise more than once a week over the past 12 months, and who was willing to participate in aerobic exercise sessions for 11 weeks. Participants with chronic pain or illnesses were excluded. A total of 23 men and 123 women were enrolled at the beginning of the study; 38 left during the study due to work conflicts; leaving data for 16 males and 92 females at the time of analysis. The intervention consisted of 4 different formations of music exercise groups lasting for 60 minutes in duration, biweekly for 11 weeks.

Statistics showed a significant difference between pretest-posttest ratings in the SF-36 domains for role limitations due to emotional problems and mental health. Mean ratings of the participants' perception of their change in mental state, including relaxation and their ability to handle stress and demands, were also statistically different from zero, according to .995 confidence intervals. Furthermore, all participants reported a positive change in how much they could cope.

Table 2. Pretest-posttest means (SD) of SF-36 domains and paired T-test analysis

SF-36 domains	Pretest Mean (SD)	Posttest Mean (SD)	Paired T-tests (T)	P value (p)
Role limitations due to emotional problems	72.9 (35.6)	75.0 (39.4)	-2.299	0.024
Mental health	73.9 (16.2)	78.0 (22.0)	-2.451	0.007

Plante et al designed a two-part RCT containing a pretest- posttest component assessing mood states and stress. Male and female undergraduate college students at Santa Clara University were asked to exercise alone for 20 minutes on a stationary bike indoors (in Experiment I) or walk outdoors (in Experiment II) while maintaining an average heart rate of approximately 140 beats per minute. The first part of the experiment included 59 males and 69 females; leaving data for 128 at the time of analysis. The first part of the experiment's intervention consisted of exercising with a friend or with an Ipod indoors. The second part of the experiment included 40 males and 61 females; leaving 101 at the time of analysis; and repeated the same interventions except for changing the setting and the type of exercise.

The data showed a significant main effect for calmness and perceived stress in part one of the experiment. Post hoc analysis using Tukey's HSD test revealed that control participants exercising alone experienced higher levels of calmness and lower levels of perceived stress relative to the two experimental groups (See Table 3. below). There were no significant main effects or interactions for stress or enjoyment measures in part two of the experiment.

Table 3. (Experiment 1) Pretest-posttest means (SD) of AD-ACL findings and ANOVA analysis

AD-ACL Scale	Male Pretest Mean (SD)	Female Pretest Mean (SD)	Male Posttest Mean (SD)	Female Posttest Mean (SD)	ANOVA (F)	P value (p)
Perceived Stress	5.56 (2.09)	5.28 (2.23)	5.68 (1.80)	6.07 (2.09)	7.96 (1,126)	<0.05
Calmness	12.09 (2.72)	12.07 (2.67)	5.68 (1.80)	6.07 (2.09)	4.20 (1, 176)	<0.05

Lane et al designed a RCT containing a pretest-posttest component assessing emotions. Participants identified a running goal that they wanted to achieve with two attempts to attain this goal pre and post music intervention. Participants attempted to achieve this running goal on two different occasions separated by a two-week period, using the same course. Inclusion criteria included participants already using music as an aid to running due to reasons such as participants owning a personal music player and potential safety concerns. A total of 65 participants voluntarily enrolled online at the beginning of the study; five declined to provide age and gender information; leaving data for 19 men and 41 women at the time of analysis. The intervention consisted of self-selected music based on motivational qualities of tracks or listening to Audiofuel, which is music designed specifically for running based on intended speed.

Descriptive statistics from the 9-item measure showing significant changes in emotion before and after the intervention of music are contained in Table 4 below. There were no significant main effects for changes in emotion within each run or for differences in emotion by intervention group. Repeated-measures MANOVA results revealed that emotions differed significantly between pre-post intervention ($p < 0.001$). Follow-up univariate results indicated an increase in pleasant emotions and a reduction in unpleasant emotions.

Table 4. Pretest-posttest means (SD) of emotional states and MANOVA analysis

Emotional states	Self-selected Music Pretest Mean (SD)	Audiofuel Pretest Mean (SD)	Self-selected Music Posttest Mean (SD)	Audiofuel Posttest Mean (SD)	MANOVA (F)	P value (p)
Pleasant emotions (calm, happy, energetic)	3.57 (.62)	3.85 (.75)	3.87 (.63)	3.87 (.63)	5.9	<0.02
Unpleasant emotions (Gloomy, guilty, sluggish, and downhearted)	1.90 (.99)	1.79 (.91)	1.79 (.99)	1.60 (.88)	11.80	<0.001

DISCUSSION

As the results above indicate, two of the three studies validated that listening to music while exercising was effective at reducing stress. Although one of the studies has contradicting findings, it is reasonable to suggest that a clinician recommend listening to music while exercising as an adjunct to traditional pharmoco- or psychotherapy. In a time where mental health issues can be stigmatizing, music and exercise are feasible and cost-effective options, since many major insurance companies offer discounts of up to 30% on monthly fees on select gyms, and some employers also offer discounts or even reimbursements for gym memberships.¹⁵ Additionally, this alternative treatment can offer people a sense of control over their stress and anxiety, while at the same time allowing them to learn new strategies to coping with their illness on their own.

Limitations include small sample size. Although it can be difficult to obtain willing, consented patients for this study, a larger sample size may have resulted in higher or lower percentages of effect. Another argument could be made about 2 out of the 3 studies utilizing healthy homogeneous undergraduate students from a single university, which could have altered the types of responses gathered during the study. Furthermore, students motivated by reward of a credit for their psychology course could have influenced their responses to the self-reported data in the Plante et al study and similarly with the Lane et al study, where they were offered feedback incentive for participation.

An additional limitation includes the age restriction of 17-65 years of age between all three studies. Patients younger than 17 and older than 65 who are able to exercise listening to music, could perhaps benefit from this intervention. For this reason, the age selection from these studies can be considered a limiting factor to the use of this information.

Self-report limitations include bias, misinterpretation, and to some extent participants are limited in introspectively assessing themselves accurately. Also, none of the studies mentioned if the participants had a past or current diagnosed psychiatric history, which would have been valuable information and may be a limiting factor to the use of this data.

CONCLUSION

The reviewed studies established that listening to music while exercising may be a complementary way to reduce stress, as it is cost effective and noninvasive. It is also an intervention that can be modified to meet the needs of the individual patient.

Future studies would benefit from utilizing participants with a diagnosed psychiatric history, a longer intervention period, determining if the reduction varies with different types of music, and investigating whether this intervention or pharmacology plays a larger role in stress reduction. Moreover, given that the duration of this effect and the long-term effects of listening to music while exercising and reducing stress are unknown, further research developed around this effect may help promote acceptance and its use as a primary therapy.

Additionally, further studies should investigate varying ethnicities and gender responses to ensure that this is an effective treatment for any person. Clinicians can recommend this as a component of a treatment plan; however, patients must be made aware that clinical evidence showing the efficacy of this as a treatment has not yet to be determined.

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