

Musical exercise: A novel strategy for advancing healthy aging

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Abstract

Regular physical activity is associated with lower death rates for adults at any age, even when the physical activity is moderate. It also decreases the risk of heart disease, diabetes, cancer, high blood pressure, and falls, which can lead to debilitating fractures, regardless of health status. Physical activity is also a universally accepted and highly important component of rehabilitation. The objective of this review was to examine the latest research on the impact of music, specifically musical exercise, in the context of optimizing the health status of the elderly. Thus, literature on the topic of exercise and music, located in the Academic Search Complete and PubMed databases and published over the last 25 years, were located and analyzed, and categorized into key themes using a narrative approach. Healthy adults, as well as adults with chronic diseases, can benefit from listening to music while exercising. Music is also helpful for rehabilitation purposes among those with chronic diseases. The data indicated that musical exercising may be useful for advancing healthy aging and for decreasing medical costs in a society that has become increasingly sedentary and where obesity, osteoarthritis, diabetes, osteoporosis, cancer, injuries caused by falls, and cardiac diseases are a significant problem.

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Introduction

Exercise is a form of bodily exertion undertaken for the sake of developing and maintaining physical fitness. It is something performed or practiced in order to develop, improve or display a specific power or skill [1]. Regular physical activity throughout life is critically important for maintaining a healthy body, psychological well-being, preventing certain diseases, improving life quality, and for preventing premature death [2].

The purpose of this paper is to inform readers of the latest research concerning music and exercise, its benefits and implications and possible areas of related future research. By reviewing the latest research on the topic, it is hoped that clinicians working with adults with chronic diseases, as well as with healthy adults, will become more aware of, more confident

and more motivated to consider applying musical exercise in efforts to allay preventable disability. It is also hoped that through musical exercise clinicians will be able to optimize the rehabilitation of those with one or more disabling health challenges.

Relevant materials accessed from the Academic Search Complete and PubMed databases were located and analyzed. Publications spanning the years 1990-2014, including the key terms *aging*, *exercise*, *music*, *musical exercise*, and *physical activity* were selected. No formal systematic analysis was conducted due to the diversity of the material, and the limited numbers of well-designed and controlled studies on any particular topic or health condition. The material was however, categorized into key themes, regardless of study design, and the most salient facts were extracted from the existing research base as reported below in narrative form.

Regular physical activity

A large volume of diverse research shows that participation in regular physical activity is associated with lower death rates for adults at any age, even when the physical activity level is moderate. Most notably, as outlined in Table 1, regular physical activity decreases the rate of heart disease, diabetes, various forms of cancer, musculoskeletal conditions, obesity, and high blood pressure. Additional benefits of regular physical activity include helping to improve muscle and bone strength, increase lean muscle mass, decrease body fat, enhance psychological well-being, and improve immune system functioning. According to several sources, including Healthy People 2020 - a decade long national health initiative - regular physical activity also helps children and adolescents to develop a healthy body weight, and for older adults, it helps improve or maintain strength and agility, reduces the risk of falling and incurring disabling fractures, and optimizes their ability to perform basic activities of daily living [3-10].

Unfortunately, although regular physical activity is a key factor in fostering a healthy aging process, the continued pervasive lack of regular physical activity has affected our society dramatically and adversely, and according to data located on the Healthy People 2020 website, shows no signs of improving despite national objectives in this regard for more than 15 years [3]. This is surprising since the literature is now replete with evidence that obesity, heart disease, cancer, diabetes and asthma among others, are due, in part, to a lack of adequate physical activity participation. The potential impacts of physical activity on social, emotional, mental, as well as physical health, when adopted consistently, are unrivaled by any other health-related intervention.

Physical activity is also especially vital for optimizing life quality and longevity among those older adults with one or more chronic health conditions. In addition to maximizing well-being across the lifespan, consistent participation in physical activity can help to prevent the onset of preventable health problems stemming from excess sedentary behavior, retard the rate of progressive disabling health conditions such as arthritis, and help adults to maintain independence and self-worth.

Table 1. Selected benefits of performing regular exercise in the context of healthy aging

Helps maintain flexibility of the joints
Increases metabolism
Increases lung capacity
Increases fat loss
Increases volume of lean muscle mass
Increases energy level
Decreases depression and anxiety
Decreases joint pain in arthritis patients
Increases self-esteem
Improves cardiac health
Decreases build up of toxins
Stimulates the immune system
Helps reduce stress levels
Lowers risk of developing osteoporosis
Lowers risk of developing diabetes
Helps diabetes patients to manage their disease
Helps people to rehabilitate after an injury or surgery
Helps to reduce health care costs
Helps to improve quality of life
Helps to reduce signs of aging
Helps to reduce the amount of prescription drugs consumed
Helps individuals to sleep more soundly
Helps individuals function at their optimum level
Lowers risk of chronic disease
Can help to relieve the pain of tension headaches
Improves physical appearance
Helps to improve short-term and long-term memory function
Improves the likelihood of survival from heart attack
Slows the rate of joint degeneration in people with osteoarthritis
Helps people resist upper respiratory tract infections
Improves ability to recover from physical exertion
Helps to preserve lean body tissue
Helps to speed recovery from chemotherapy treatments
Increases the ability to supply blood to the skin for cooling
Increases the thickness of the cartilage in the joints
Provides more energy to meet the demands of daily life and unexpected emergencies
Increases level of muscular endurance
Increases the density and breaking strength of ligaments
Improves posture
Reduces the risk of breast, prostate and colon cancer
Increases tissues' responsiveness to the action of insulin, which helps to better control blood sugar
Helps to relieve constipation
Expands blood plasma volume
Helps to alleviate lower back pain
Helps to reduce the amount of insulin required to control blood sugar levels in Type I diabetes
Reduces the risk of developing Type II diabetes
Reduces the likelihood of developing low-back problems
Helps individuals maintain an independent lifestyle
Reduces the level of abdominal obesity
Maintains neuromuscular junction physiology, and can foster repair of nerve injury

Source: Adapted from [4-10]

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Table 2. Selected adverse effects of suboptimal exercise approaches and adherence levels in terms of healthy aging

Can cause injuries if not performed correctly or dosage is excessive
Can increase chances of being dehydrated if liquids lost during physical activities are not replaced
If exercise dosage is low or ceases altogether, this increases the chances of weight, and increased appetite
Lack of adequate exercise can foster the risk of incurring debilitating depression and anxiety
Inadequate exercise can heighten stress levels
It can also increase the risk of cardiovascular disease, diabetes, and osteoporosis
It can increase the possibility of developing cancer
It can lower the immune system's capacity to fight disease
It can increase joint pain
It can increase the probability of acquiring infections
If exercise stops, this can decrease joint flexibility
It can decrease lung capacity
It can decrease oxygenated blood levels
Lack of exercise can lower general energy levels
It can adversely affect, long and short-term memory
Mental alertness may decrease
Muscle strength may decrease
Self-esteem may be diminished, along with self-regulation ability

Source: Adapted from [4-10]

Music and its health effects

It has been reported that listening to music, even in the absence of physical activity, has cognitive benefits, and can cause favorable cognitions, as well as physiological effects, due to its positive impact on brain circuitry [11]. In movement rehabilitation settings, it is widely used to cue disordered movement patterns beyond its motivational aspects [12].

Meditative music may also help to reduce anxiety, which increases activation of the sympathetic nervous system (SNS). Unsurprisingly, many health care institutions such as hospitals, doctors' offices, dentists' offices, and clinics, use music to promote relaxation and to lower a patients' anxiety level before a consultation [6]. Ferguson and Voll [6] also demonstrated that patients undergoing rehabilitation of burns lowered their level of pain and anxiety by listening to music.

In a highly interesting study examining the effects of music on well-being, Chen and colleagues [13] explored perceptions of group musical therapy among elderly nursing home residents in Taiwan. In studying 17 wheelchair-bound elderly patients, the benefits they reported included enhanced life quality, distraction from suffering, a sense of energy, and a greater motivation to exercise. Although the sample size was small, the immense benefits perceived by the patients at six months must be acknowledged as evidence of the potent effects of music as an independent form of therapy, even among the most physically and emotionally challenged individuals.

Exercising and music

Exercise accompanied by some form of music is potentially favorable to both able-bodied and disabled adults. For example, adding music to exercise has been found to reduce feelings of fatigue when exercising aerobically, and to significantly heighten feelings of vigor compared to the control condition without music [14]. Exercising to music can also impact sedentary adults physiologically and in multiple beneficial ways as outlined by Madison et al. [15]. This group assessed the physical and psychological effects of an 11-week music exercise intervention among 146 sedentary adults. Four exercise groups were formed, each utilizing different styles of music. Results showed increased performance in oxygen uptake, and flexibility and blood pressure were decreased as a whole, regardless of exercise group.

In other research, studies of adults with chronically disabling health disorders who are exposed to musical exercise or music to facilitate health outcomes in rehabilitation settings have shown that music can be

employed to support movement rehabilitation, most commonly during exercise. Here, it used as an auditory cue to foster movement coordination in post-stroke, Parkinson's or Huntington's disease patients [12].

Moffett et al. [16] evaluated the feasibility of an eight-week-long modified dance-based exercise program designed to place very little impact on the joints of persons with severe disabling rheumatoid arthritis. They used a four-phase program during each session, which were all accompanied by music. Results showed high program compliance over the eight-week period, with no increase in disease status over this time period. Patients were able to train efficiently at moderate intensity for up to 25 minutes at a time, and their locomotor abilities were found to improve. Although other factors may have influenced the positive outcome, these results were taken as affirmative for the benefits of a gentle musical dance-based exercise for promoting the health of adults with severe rheumatoid arthritis.

Emery et al. undertook another interesting landmark study of the efficacy of musical exercise, using a cohort of 33 cardiac patients [5]. This study revealed that participants who completed one exercise session accompanied by music, and a second exercise session without music, showed differential results in favor of music, even when the order of these conditions was assigned randomly. The protocol required participants to complete a brief pre and post-test assessment of depression and anxiety, and a cognitive test of verbal fluency. Based on these survey results, the researchers reported that their subjects demonstrated increased cognitive functioning, but only under the music and exercise condition, not that without musical accompaniment. They proposed this might be due to favorable neurological changes associated with stimulation of the central nervous system by the application of music. In addition, music also accompanied improved performance on a test of verbal fluency, showing subjects had greater cognitive organizing and sequencing information skills after exposure to the musical exercise.

In addition to recent findings by Shaeffer et al. [12], which have shown that movements carried out in response to music appear to increase activation in the left cerebellar region, Brown and de Bruin [17] found

that a music-based program of exercise improved gait, balance, and risk of falls among a group of community-dwelling elders. The multiple exercise tasks that made up the program were also adhered to more effectively than anticipated as a result of the music-based exercise component. More recently, de Bruin et al. [18] found that walking with music in an exercise program carried out at home offered a safe form of gait training for people with Parkinson's disease, and that the group exposed to music improved their walking ability and motor symptoms more effectively than the control group who were not exposed to music

Hars et al. [19] conducted a secondary analysis of a randomized controlled trial that investigated whether six months of music-based multitask training had beneficial effects on cognitive functioning and mood in older adults. The experiment involved 134 community-dwelling older adults who attended weekly one-hour supervised group classes of multitask exercises, accompanied by piano music, or a control group with delayed intervention who were followed for six months. Baseline and six-month mental health status showed that six months of once-weekly music-based multitask training improved cognitive function and decreased anxiety to a greater extent in the experimental group.

In a study of stroke patients carried out by Hayden et al. [20], rhythmic auditory stimulation-enhanced gait training was tested on patients aged between 55 and 80 years taking part in 30 sessions of conventional physical therapy gait training. Participants were assigned to one of three conditions of varying duration from 10 to 30 treatments. Cadence and balance outcomes improved across time in all conditions for one-limb stance, cadence, velocity, stride length, and posture head tilt. Statistically significant gains were made in the one-limb stance and cadence with earlier implementations of the auditory stimuli, suggesting this is a powerful form of intervention to consider in the rehabilitation of this patient population.

Similarly, Shimuzu et al. [11] found that movement music therapy applied among elderly females had a beneficial effect on blood pressure, pulmonary function, and balance. The immunological profile of the experimental group also remained significantly elevated after exercise. Although these authors found

no distinctive effect of the music component on the measured psychosocial indices, the application of music during a prescribed exercise activity may help to minimize any unpleasant emotions arising from the monotony and boredom of performing the same physical activity on a regular basis. Listening to music during exercise can also help to minimize distractions due to environmental noise, and improve task-associated concentration. As outlined by Ruscello et al. [21], it can reduce perceived exertion, improve mood, decrease anxiety and depression, and moderate one's feelings during high intensity exercise in a positive way [22].

Verrusio et al. [23] reported the outcomes of a randomized controlled study of subjects in a pharmacotherapy group in which participants received either a therapy with antidepressant drugs, or exercise/music therapy involving physical exercise training combined with listening to music. The effects of interventions as assessed by differences in changes in mood state between the two groups showed a significant improvement in anxiety only for the pharmacologically treated group at six months. The exercise/music therapy group showed both a reduction in anxiety and in depression at three months and at six months. It was concluded that the physical training and music therapy in mild to moderately depressed subjects was worthy of further study.

It should be noted however, that the type and quality of the music may produce different effects and therefore it should be carefully chosen. For example, listening to slow rhythmic music is found to decrease the plasma norepinephrine concentration, while listening to fast rhythmic music increases the plasma epinephrine [24]. This is important in the context of promoting healthy aging because the plasma catecholamine concentration affects sympathoadrenergic activation [25], and is also a mediator of stress-release hormones [24]. In other research, Yamamoto et al. [10] and Mockel et al. [24] suggested that the application of slow rhythm and meditative music will depress any excess sympathetic activation, and will consequently have a stress-lowering effect; this is not the goal in all instances and target populations, so careful selection of music type and tempo are indicated.

Interestingly, another noteworthy benefit of music accompaniment during exercise is in the context of diagnostic treadmill exercise. With its positive psychobiological effects it is proposed that this approach may improve the sensitivity of the test and reduce the rate of false negative or inconclusive results, thus potentially influencing diagnoses and treatment selection [4]. As well as having implications for physicians and their clients, in the context of diagnosis, elderly people who carry out physical activity combined with music are more likely to have positive cognitive benefits in visual-spatial functions than when they exercise without music, which may have far reaching health benefits, including falls injury prevention [26].

According to Tomporowski et al. [27] the positive effects of exercise on cognition are physiological and related to an associated increase in heart rate and blood flow. Satoh et al. [26] however, attributed this form of improvement to the multifaceted nature of combining physical exercise with music. In this regard, the use of music during exercise programs and its cognitive and physical benefits has been observed to impact favorably, even among institutionalized senior citizens. In particular, those who participated in a musical exercise program experienced significant improvements in balance, joint flexibility, cognitive abilities, behavioral ratings, and life satisfaction [7].

Regardless of mode of delivery, O'Konski et al. [28] - who also studied long-term care residents - found that music enhanced exercise performance and enjoyment. A noteworthy finding by Metzler-Baddeley et al. [29] in this regard, is that rhythm exercise can not only result in cognitive enhancement, but it can also improve callosal white matter structure, as outlined in recent pilot work. Unfortunately, even though additional work by Satoh et al. [26] and others [30-32] shows that physical exercise combined with music produces more beneficial impacts on cognitive function than exercise alone, these types of programs are not widespread or generally available in the community or the institutional setting.

According to Kattenstroth et al. [33], aging, which is associated with a progressive decline of mental and physical abilities, can be positively affected by musical exercise such as dancing to music; this can foster enriched opportunities for enhancing physical

performance across the lifespan. In particular, this group argued that maintaining a regular schedule of this type of activity into old age could preserve cognitive, motor and perceptual abilities, and prevent excess degradation. Moreover, the far-reaching beneficial effects of musical exercise, including promoting balance and posture, suggest this type of activity can be most helpful in efforts to preserve the everyday life competence and safety of elderly individuals.

Findings

Exercise can clearly yield a multitude of positive results, as can music in its own right, but enjoying and listening to music while exercising can potentially create even more positive results than either of these strategies alone. Since people who are physically active early in life will tend to be more active throughout their lives, forging this association early on may be helpful for promoting healthy aging at all stages of the life course.

Chen et al. [13] outlined findings that group music therapy was of great benefit for wheelchair-bound residents. This group felt the therapy added variety to their lives, gave them a sense of autonomy (since individuals selected the musical activities), and improved their cognitive function. Since physical exercise combined with music produces greater cognitive benefits than exercise alone, even among those with dementia [35], it is possible that musical exercise might foster better levels of physical and psychological function among senior citizen populations; consequently fewer will need to be institutionalized and more can age in the comfort of their own homes. Institutions that serve senior citizens can also offer programs such as musical exercise to encourage these seniors to be active, thus potentially prolonging and improving their quality of life.

However, these laudable and highly significant performance gains in community-based or nursing home studies, or indeed in other contexts, are often not sustained or translated into clinical practices, even if positive outcomes are demonstrated. Moreover, significant declines may occur after these programs cease, potentially causing more harm than good. This is unfortunate because musical exercise is a safe, cost-

effective therapeutic strategy that can produce more profound long-term benefits in physical and cognitive function than regular exercise programs alone; it can clearly impact all persons, including the healthy, the physically challenged, or those who are wheelchair-bound. This may be due to the notion that western society perceives senior citizens negatively because they are no longer productive to society, or because myths of aging continue to suggest that the associated degradative processes of aging are inevitable, rather than amenable to intervention or retardation. Perhaps costs associated with the failure to maximize healthy aging for all are not clearly recognized.

To maximize the application of musical exercise, which appears to be a highly amenable and suitable approach for fostering life-long physical activity, as well as movement strategies in physically challenged individuals, cognitive well-being, and independence, we suggest that clinicians make greater effort to recommend musical exercise to their clients or patients. In this regard, however, it is important to remain cognizant of the role of personal preferences, culture, type of music, and its mode of delivery in order to optimize any effort to encourage and support adults - especially sedentary older adults - to exercise routinely [21]; not all musical stimuli produce the same results [34]. In addition to utilizing music more readily in community-based fitness, and movement rehabilitation programs, to extend its impact on quality of life, musical exercise programs can be offered early on in life at youth centers, schools, and gyms, as well as later on in elder living facilities, and in nursing homes as preventive programs.

Recommendations

Since musical exercise can enhance motor and emotional responses by combining movement and stimulation of different sensory pathways [36], we believe researchers interested in maximizing their positive findings in this realm need to encourage institutions to continue translating the evidence gleaned from their research after completion of these studies. They also need to continue to monitor these programs and participant outcomes over time, employ carefully construed research designs, and collect data using valid assessment tools to evaluate existing programs and new approaches. It is equally important

for primary care providers to recognize that programs such as musical exercise can not only help to minimize the onset or severity of certain diseases, prolong healthy life styles, extend life and improve quality of life, but that the financial implications are also likely to be highly significant as well. In the interim, discerning which adults may benefit from listening to music while exercising, choosing the appropriate musical strategy, and offering a variety of musical alternatives to choose from is more likely than not to help an aging individual to achieve maximum positive life quality and long term health outcomes.

Considering how such programs can be adapted for hearing impaired adults, it is also a potentially useful area of research and clinical practice for healthy aging.

Future Research

As stated above, most studies on musical exercise have only observed participants on a short-term basis [38-39]. In light of these favorable results as a whole, examining the effects of well-designed, carefully tailored programs of musical exercise - in both the community and health care institutions - on a long-term basis are strongly indicated. Moreover, it may also be helpful to continue to study the use of musical exercise for advancing disease-specific health conditions, physical correlates of health, and its emotional, cognitive, and social benefits. Furthermore, it may be interesting to examine the effect of musical exercise on the younger population - the use of the iPod in the gym is extremely popular and can be used to avoid boredom and apathy toward exercising, thus encouraging children and adolescents to be more consistently involved in physical activities in early life. In a society that has become increasingly sedentary, and where obesity is becoming a significant problem that seriously threatens healthy aging advances, more research on the impact of various musical approaches and genres is recommended, as well their application for obesity prevention, and for advancing Healthy People 2020 aging goals [40].

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