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Study on the Effects of Sound and Music as Medicine on Cardiovascular Health

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ABSTRACT

This paper explores the dual impact of Sound frequencies and music on cardiovascular health, analyzing how sound frequencies and musical interventions influence cardiovascular risk factors and outcomes. While environmental factors have been linked to an increase in cardiovascular diseases due to stress-related mechanisms, Sound frequencies and music therapy offer potential benefits through their calming effects on the autonomic nervous system.

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Introduction

The influence of auditory experiences, such as certain sound frequencies and music, on health, especially cardiovascular health, has been a significant focus of both environmental studies and therapeutic research. Certain sound frequencies and music are increasingly recognized for their therapeutic potential, influencing bodily systems beneficially.

The Cardiovascular Benefits of Sound and Music

Certain sound frequencies and music have been used since ancient Indian and Greece civilizations to restore balance within the body and treat ailments. In contemporary settings, Sound frequencies and music therapy have gained recognition for their ability to alleviate symptoms and improve the quality of life in patients with various health conditions, including those affecting the cardiovascular system.

Although Sound frequencies and music are mostly used for religious, recreational, or entertainment purposes, they are slowly emerging as viable non-pharmacological interventions for improving health outcomes in both healthy and ill populations, particularly those with cardiovascular disease. Certain Sound frequencies and Music of various genres and kinds have been suggested to have elements that stimulate or inhibit the autonomic nervous system, resulting in varying impacts on cardiovascular function.

However, due to a lack of substantial trials using high-quality methods, Sound frequencies and music intervention have not been thoroughly investigated as a cardiovascular therapy modality. Thus, the intent of this periodic review is to examine the existing literature on the influence of music on the cardiovascular system, analyze the limits of the present research, and propose future approaches to this topic.

Biological Mechanisms

Certain sound frequencies and Music affect the cardiovascular system through modulation of the autonomic nervous system, enhancement of heart rate variability, and reduction of stress hormone levels. These changes indicate improved parasympathetic activity and reduced cardiac stress.

Research Findings

Clinical studies have demonstrated that certain Sound frequencies and listening to music can significantly lower blood pressure, reduce heart rate, and enhance overall cardiovascular health. For example, structured music therapy has been shown to reduce systolic blood pressure by up to 8 mmHg and heart rate by 6 beats per minute.

Music is a universal art form that is pervasive in every society globally and has mainly been a cultural tool used for entertainment and religious purposes. However, music does have its historical basis in medicine, dating back to the 6th century at least.

Pythagoras, an ancient Greek philosopher, used music to treat bodily and psychological ailments. Ancient Indian vedic systems used mantras, bells, drums, classical music as preventive and healing medicine in their regular lifestyles.

Pythogoras proposed that by listening to Sound frequencies and music, one could comprehend and retrace the outer "physical" harmony of the universe, which would lead to a state of inner "mental" harmony, thus reestablishing harmony in the body and enabling it to cure mental disorders. He was thought to be the first person to prescribe music as medicine. Around 400 BC, Hippocrates, the father of clinical medicine, was known to play music for his patients with mental illness.

As far back as the Paleolithic ages, music was adopted for therapeutic purposes due to the belief that music would have positive effects on body systems, including the cardiovascular system. These music therapies were mostly based on theory, rather than pragmatic evidence.

The early 20th century advocated for the validation and implementation of Sound frequencies and music for therapeutic purposes using the same methodological rigor as any other clinical practice in modern medicine. In 1914, the American Medical Association first acknowledged the possible benefits of Sound frequencies and music in hospital treatments through Dr. Evan O'Neill Kane's letter in the Journal of the American Medical Association, documenting successful phonograph use in the operating room to calm patients before general and local anesthesia.

In 1918, Columbia University introduced the first course on music therapy, entitled "Musicotherapy". Because of its low cost, accessibility, ease of use, and minimal risk, music has the potential to be a universal mode of therapy. While music therapy has the potential to benefit all ages and a variety of disease processes, this review focuses on the cardiovascular system. It is thought that music may exert cardiovascular benefits through complex interactions between respiratory activity and autonomic cardiovascular control.

Heart rate variability (HRV) is the beat-to-beat variation in heart rate. HRV includes respiratory sinus arrhythmia (RSA), a normal phenomenon relating to the acceleration of heart rate during inhalation and deceleration during exhalation. The HRV reflects the complex interplay of the sympathetic and parasympathetic branches of the autonomic nervous system, and measurements of HRV have proved to be powerful predictors of cardiac morbidity and mortality.

Several studies we describe here assess changes in HRV as an outcome measure. Additional studies evaluate the impact of Sound frequencies and music on the electrocardiogram (ECG), blood pressure (BP), heart rate (HR) respiratory rate (RR), ventilatory efficiency, exercise performance, cortisol levels, and endothelial function.

We will consider the subjects and outcomes studied, the types of Sound frequencies and music interventions and modalities (music listening, singing, instrument-playing) utilized entrainment (synchronization of music tempo to biological variables such as heart rate), and the overall quality of the currently available evidence.

The Sound of Healing

Historically, Sound frequencies, music and healing were deeply intertwined. The Chinese character for medicine even includes the character for music. In ancient Greece, music was used to alleviate stress, promote sleep, and soothe the pain. Similarly, Native American and African cultures incorporated singing and chanting into their healing rituals.

However, in Western medicine, the connection between Sound frequencies, music and healing weakened as the art of medicine was overshadowed by the science of medicine. Recently, this connection has been revived, thanks to Sound and music therapists who have demonstrated the benefits of Sound frequencies and music in treating various conditions, including Alzheimer's disease, chronic pain, and substance abuse.

Since the 1980s, researchers have been examining Sound frequencies and music's impact on the cardiovascular system. Most studies have focused on individual variables, such as changes in blood pressure, heart rate, or arterial blood flow. Some studies, however, have explored more comprehensive effects. For instance:

- At a hospital, a nurse-led team found that heart patients limited to bed who listened to music for 30 minutes experienced lower blood pressure, slower heart rates, and reduced distress compared to those who did not listen to music.
- Another nurse-led team found that heart attack survivors who listened to calming music in a quiet setting for just 20 minutes felt less apprehensive about their health than those who relaxed in a silent room without music.
- Researchers measured blood flow through the forearm (an indicator of blood vessel health) as volunteers listened to either music or relaxation tapes. Blood flow increased significantly while listening to joyful music or relaxation tapes and decreased when listening to anxiety-inducing music.
- In a study conducted, older volunteers who listened to Sound frequencies and relaxing music for 25 minutes daily for four weeks lowered their systolic blood pressure (the top number in a blood pressure reading) by 12 points and their diastolic pressure (the bottom number) by 5 points. In contrast, a control group that did not listen to music showed no change in blood pressure.

One of the biggest challenges in studying Sound frequencies and music's effects on the heart is the diversity of music itself. Unlike a single, repeatable therapy like a statin or stress-reducing breathing exercises, the music varies greatly. Soothing pieces such as Debussy's "Clair de lune" or George Winston's "Moon" can evoke different responses in different people. has distinct effects on the heart and body than something more compelling, like "Seventy-Six Trombones" from The Music Man, Puccini's "Nessun Dorma," or almost anything from the ": Red Hot Chili Peppers. Music is also highly personal — what you find soothing might sound to someone else like fingernails on a blackboard.

One thrust of current research in Sound frequencies and music therapy is to see if specific sounds or tempos affect the heart regardless of the listener's musical preferences. Finding a relaxing melody that slows the heart rate, reduces blood pressure, and improves blood flow for opera buffs and rock-and-roll fans alike would make it easier to offer music therapy.

At a hospital study, men and women who listened to certain soothing sounds and music soon after undergoing cardiac surgery were less anxious and reported having less pain than those who just rested quietly.

Study

There were previous studies on physiological responses to music and sound have shown their impact on the autonomic nervous system. Heart rate variability (HRV) is often used to assess the activation of the sympathetic and parasympathetic nervous systems.

This study aimed to examine HRV in response to four sine-wave pure tones (20 Hz, 50 Hz, 2 kHz, and 15 kHz) in an environment where the sound intensity exceeded 65 dB (A-weighted). The participants, 20 adolescent girls, were in a supine position during an exposure protocol divided into six periods, with generated sounds in the first half and without sounds in the second half.

In the protocol without sound exposure, the low-frequency band of the HRV spectrum increased compared to the basal state before the examination (period_1: 6.05±0.29 ms² compared to period_5: 6.56±0.20 ms², $p<0.05$).

There was a significant increase in the root mean square of successive differences (rMSSD, period_1: 4.09±0.16 s compared to period_6: 4.33±0.12 s, $p<0.05$) and a prolongation of the R-R peak interval (RR interval, period_1: 889±30 ms compared to period_5: 973±30 ms, $p<0.001$) in the protocol without sound exposure. In contrast, only bradycardia was observed in the protocol with sound exposure.

Our pilot study suggests that exposure to sounds at the given frequencies affects heart rate variability and cardiac autonomic regulation, contrary to the rather mixed data found in the literature.

Methods

Participants: Twenty adolescent female patients were selected for the study. Exclusion criteria included any medical conditions or medications affecting HRV.

Protocol: Participants were exposed to four pure tones (20 Hz, 50 Hz, 2 kHz, and 15 kHz) at a sound intensity exceeding 65 dB in six periods: four with sound exposure and two control periods without sound.

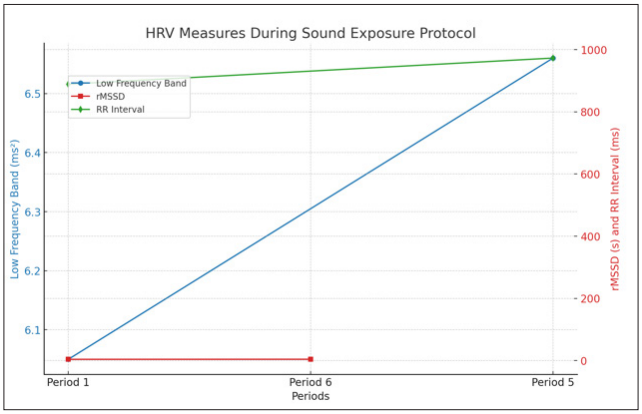
Figure 1: Diagram of the Protocol with Sound Exposure

Generalized HRV Parameters

Period	RR Interval (ms)	rMSSD (s)	LF-HRV (ms²)	HF-HRV (ms²)
1	888	4.2	5.91	7.42
2	909	4.18	5.82	7.3
3	937	4.22	6.2	7.37
4	944	4.17	6.26	7.26
5	952	4.21	6.14	7.36
6	938	4.23	6.29	7.4

Here is the table image showing the generalized HRV parameters during the sound exposure protocol.

HRV Measurement: HRV was measured using one-lead electrocardiography, and parameters such as RR intervals and root mean square of successive differences (rMSSD) were analyzed.

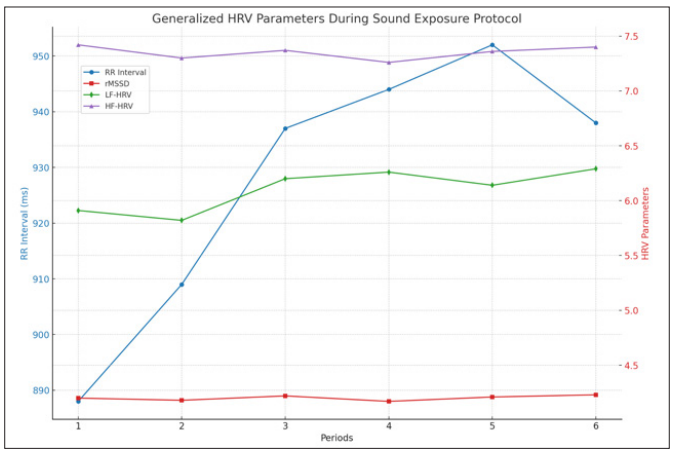


Here is a graph illustrating the Heart Rate Variability (HRV) measures during the sound exposure protocol. The graph shows the changes in the low-frequency band, rMSSD, and RR interval across different periods of the protocol. The low-frequency band and RR interval are plotted for periods 1 and 5, while rMSSD is plotted for periods 1 and 6.

Results

Physiological Parameters: Heart rate decreased, particularly during both sound exposure and control protocols. No significant changes were observed in respiratory rate.

HRV Parameters: The RR intervals prolonged greatly during both protocols, indicating a bradycardic response. The study found a significant impact of pure tone sound exposure on cardiac autonomic regulation as indexed by HRV parameters. These findings suggest that the specific frequencies used affect HRV in healthy adolescents.



Graph showing the generalized HRV parameters during the sound exposure protocol. The graph includes the RR Interval, rMSSD, LF-HRV, and HF-HRV across different periods.

Limitations: The small sample size and the inclusion of only female participants limit the generalizability of the results. Additional studies with more considerable and more diverse populations are needed.

Conclusion: Exposure to pure sine-wave tones at frequencies of 20 Hz, 50 Hz, 2 kHz, and 15 kHz mildly impacts the heart rate variability or cardiac autonomic regulation in adolescent girls. This study contributes to understanding the relationship between sound exposure and ANS activity.

Conclusion

This review underscores the importance of auditory environment management as a significant factor in cardiovascular health. Listening to Sound frequencies and music is a complex phenomenon, involving psychological, emotional, cardiorespiratory, and likely other body system changes. Individual responses to music can be influenced by personal preferences, familiarity with music, environment, prior music experience, and other health factors.

This review highlights the need for well-controlled randomized clinical trials in subjects with preexisting medical conditions and appropriate controls. Comparison of exposure to certain sound frequencies and individualized music sessions to preferred or random music selections, and duration of therapies needed for therapeutic benefit, are important variables for future studies. The promising effects of sound and music interventions on cardiovascular physiology, coupled with their low cost and a high degree of safety, warrant further exploration in both healthy populations and especially those with cardiovascular disease [1-3].

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