Research summary on the " Effect of 528 Hz Music on the Endocrine System and Autonomic Nervous System written by Kaho Akimoto, Ailing Hu, Takuji Yamaguchi, Hiroyuki Kobayashi, published by Health, Vol.10 No.9, 2018"

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Introduction to the Study and its Significance

Music has long been recognized for its ability to reduce stress and influence emotional states. However, the specific effects of different musical frequencies on the human body, particularly on the endocrine system and autonomic nervous system, have not been thoroughly explored. This study, conducted by Akimoto et al., focuses on the impact of music with a frequency of 528 Hz—a frequency often referred to as "healing" or "solfeggio" music—on stress-related biomarkers and physiological responses. The study's findings provide new insights into how this specific frequency may offer unique benefits in stress reduction compared to the more commonly used 440 Hz frequency, which is the standard reference tone in most modern music.

Background and Rationale

Previous research has established that listening to music can alleviate stress and alter mood states, with various elements of music, such as melody, rhythm, and tempo, contributing to these effects. However, the role of frequency—an aspect that defines the pitch of sound waves—in these stress-reducing effects has been less studied. Some animal studies have suggested that different frequencies of music can lead to varying physiological responses. For instance, exposure to high-frequency sounds (e.g., 16 kHz) has been shown to decrease blood pressure in rats more effectively than lower frequencies (e.g., 4 kHz). These findings suggest that high-frequency music might stimulate dopamine synthesis and suppress the activity of the sympathetic nervous system, thereby promoting relaxation and stress relief.

Building on this knowledge, the current study aims to explore the effects of 528 Hz music on human participants, focusing on both the endocrine system and autonomic nervous system. The 528 Hz frequency, often associated with healing properties in alternative medicine and music therapy, is not part of the standard musical scale but can be achieved by tuning the reference tone to 444 Hz. Despite its popularity in wellness and spiritual practices, there is limited scientific evidence supporting the purported benefits of 528 Hz music, making this study particularly relevant.

Methods and Experimental Design

The study involved nine healthy adult participants, including one man and eight women, aged between 26 and 37 years. The participants were recruited as volunteers and were not selected based on any specific musical background or education. The researchers ensured that participants abstained from caffeine and smoking for at least one hour before the experiment to avoid confounding effects on the physiological measures. The study was conducted in a controlled

environment, with room temperature and humidity kept within specific ranges to ensure consistency.

Participants were exposed to two different musical conditions on separate days: one involving 528 Hz music and the other involving standard 440 Hz music. The music used in both conditions was soothing piano music, with the only difference being the frequency. Participants were unaware of which frequency they were listening to in each session. Each session began at 2 PM to minimize the influence of circadian rhythms on the physiological measures, as cortisol and chromogranin A levels are known to fluctuate throughout the day.

The researchers collected salivary samples from participants at five time points: immediately before music exposure, immediately after exposure, and at 15, 30, and 45 minutes post-exposure. These samples were analyzed for cortisol, chromogranin A, and oxytocin—three biomarkers associated with stress and relaxation. Additionally, the researchers continuously recorded participants' autonomic nervous system activity using electrocardiograms (ECGs) and assessed their mood states using the Japanese short version of the Profile of Mood States, 2nd edition (POMS 2) questionnaire.

Results and Key Findings

The study's results indicated significant differences in the physiological and psychological responses to 528 Hz music compared to 440 Hz music.

1. **Salivary Biomarkers**:
    - **Cortisol**: After exposure to 528 Hz music, participants' cortisol levels—an indicator of stress—decreased significantly over time, with the most substantial reduction observed 30 minutes after exposure. In contrast, there was no significant change in cortisol levels after listening to 440 Hz music, suggesting that the 528 Hz frequency has a unique ability to reduce stress.
    - **Chromogranin A**: While chromogranin A levels, another stress-related biomarker, did not show a significant decrease in either condition, there was a noticeable trend towards reduction in the 528 Hz music condition, whereas levels tended to increase following exposure to 440 Hz music. This trend further supports the stress-reducing potential of 528 Hz music.
    - **Oxytocin**: Oxytocin, often referred to as the "love hormone" due to its association with social bonding and stress reduction, increased significantly immediately after participants listened to 528 Hz music. Although oxytocin levels also rose slightly after exposure to 440 Hz music, the change was not statistically significant. This finding suggests that 528 Hz music may enhance feelings of well-being and relaxation through its impact on oxytocin levels.
2. **Autonomic Nervous System Activity**:
    - **Low Frequency (LF) to High Frequency (HF) Ratio**: The ratio of LF to HF, which reflects the balance between sympathetic (stress-related) and parasympathetic (relaxation-related) nervous system activity, decreased significantly after exposure to both types of music. However, the reduction was

more pronounced following 528 Hz music, indicating a stronger shift towards parasympathetic dominance, which is associated with relaxation and stress relief.
    - **Coefficient of Variation of R-R Intervals (CVRR)**: CVRR, a measure of heart rate variability that reflects autonomic nervous system flexibility, decreased significantly only after exposure to 528 Hz music. This suggests that 528 Hz music has a more substantial impact on autonomic nervous system activity than 440 Hz music, further supporting its stress-reducing effects.
3. **Mood States (POMS 2)**:
    - After listening to 528 Hz music, participants reported significant reductions in tension-anxiety and total mood disturbance scores, along with improvements in positive mood states. These changes were not observed after exposure to 440 Hz music, where some negative mood scores, such as anger-hostility, even slightly increased. This suggests that 528 Hz music not only reduces physiological markers of stress but also has a positive impact on subjective mood states.

Discussion and Implications

The findings of this study suggest that 528 Hz music has a more potent effect on stress reduction than standard 440 Hz music, as evidenced by significant changes in both physiological biomarkers and subjective mood assessments. The decrease in cortisol levels, increase in oxytocin, and shifts in autonomic nervous system activity all point to the potential of 528 Hz music as a powerful tool for managing stress and promoting relaxation.

The study's results align with previous research indicating that high-frequency music can stimulate parasympathetic nervous system activity and reduce stress. However, the specific impact of the 528 Hz frequency, as demonstrated in this study, provides new evidence supporting its use in music therapy and other stress-management interventions. The unique ability of 528 Hz music to lower cortisol and increase oxytocin suggests that it may be particularly effective in environments where stress reduction is a primary goal, such as in healthcare settings, wellness programs, or personal relaxation practices.

While the study's sample size was small, limiting the generalizability of the findings, the consistent and significant effects observed across multiple measures suggest that the results are robust. Future research with larger and more diverse samples could further validate these findings and explore additional aspects of 528 Hz music's impact, such as its effects on different populations (e.g., individuals with chronic stress or anxiety disorders) or its long-term benefits.

Conclusion

In conclusion, this study by Akimoto et al. provides compelling evidence that 528 Hz music has a stronger stress-reducing effect on the endocrine system and autonomic nervous system than standard 440 Hz music. The findings highlight the potential of 528 Hz music as a therapeutic tool for stress management and underscore the importance of considering musical frequency in the design of interventions aimed at promoting relaxation and well-being. As interest in alternative and holistic approaches to health continues to grow, the use of specific musical

frequencies, such as 528 Hz, may become an increasingly valuable component of comprehensive wellness programs.

This research opens the door to further exploration of the mechanisms underlying the effects of 528 Hz music and its potential applications in various therapeutic contexts. Whether used in clinical settings, wellness retreats, or personal self-care routines, 528 Hz music offers a promising avenue for enhancing mental and emotional health through the power of sound.