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Cardiovascular effects of Mozart's music: a systematic review

Efeitos cardiovasculares da música de Mozart: uma revisão sistemática

Efectos cardiovasculares de la música de Mozart: una revisión sistemática

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RESUMO

Ao longo dos séculos, a música tem sido utilizada para elevar o espírito das pessoas. As composições de Mozart, comparadas com as de diversos outros autores clássicos, como Brahms, Bach e Haydn, possuem uma frequência média muito superior. Logo, as modulações no domínio da frequência da música de Mozart podem ter maior influência na atividade neurofisiológica, com efeitos parassimpáticos comprovados pela literatura. Assim, esta revisão objetivou avaliar a eficácia da música de Mozart na melhoria das funções cardiovasculares, bem como identificar um padrão nas obras que possuem efeito mais acentuado. Foi realizada uma revisão sistemática de ensaios clínicos randomizados, de caráter exploratório e cunho qualitativo, nas bases de dados PubMed, LILACS, SciELO e BVS. Os efeitos dos arranjos de Mozart foram comparados com os do silêncio, das canções pop, de arranjos de outros compositores eruditos e com o "white noise". Nesse sentido, as melodias de Mozart testadas pelos estudos apresentaram um efeito redutor da pressão arterial sistólica e diastólica mais acentuado em todos os ensaios clínicos. Também foram constatadas alterações na frequência cardíaca, no duplo produto e no nível de cortisol sérico. A terapia com música tem mostrado-se cada vez mais eficiente no tratamento de pacientes com desordens cardiovasculares e pode ser uma alternativa de baixo custo e acessível para o tratamento da Hipertensão Arterial Sistêmica. Assim, Wolfgang Amadeus Mozart destaca-se perante outros compositores por características únicas de suas composições e mais estudos são necessários, com melhorias metodológicas, para que se aprimorem a terapia musical e seu uso na Cardiologia.

Descritores: cardiologia; frequência cardíaca; musicoterapia.

ABSTRACT

Over the centuries, music has been used to uplift people's spirits. Mozart's compositions, compared to those of several other classical authors such as Brahms, Bach and Haydn, have a much higher average frequency. Therefore, modulations in the frequency domain of Mozart's music may have a greater influence on neurophysiological activity, with parasympathetic effects proven by the literature. Thus, the present review aimed to assess the effectiveness of Mozart's music in improving cardiovascular functions, as well as identifying a pattern in works that have a greater effect. A systematic review of randomized controlled trials of an exploratory and qualitative nature was carried out in the PubMed, LILACS, Scielo and BVS databases. The effects of Mozart's arrangements were compared to those of silence, pop songs, arrangements by other classical composers and 'white noise'. In this sense, Mozart's melodies tested by the studies had a more pronounced lowering effect on systolic and diastolic blood pressure in all clinical trials. Changes in heart rate, in the double product and in the level of serum cortisol were also observed. Music therapy has been shown to be increasingly efficient in the treatment of patients with cardiovascular disorders and can be a low-cost and affordable alternative for the treatment of Systemic Arterial Hypertension. Thus, Wolfgang Amadeus Mozart stands out before other composers, due to the unique characteristics of his compositions, and further studies are needed, with methodological improvements, in order to improve musical therapy and its use in cardiology.

Descriptors: cardiology; heart rate; music therapy.

RESUMEN

A lo largo de los siglos, la música se ha utilizado para levantar el ánimo de las personas. Las composiciones de Mozart, en comparación con las de varios otros autores clásicos, como Brahms, Bach y Haydn, tienen una frecuencia promedio mucho más alta. Por tanto, las modulaciones en el dominio de la frecuencia de la música de Mozart pueden tener una mayor influencia en la actividad neurofisiológica, con efectos parasimpáticos confirmados por la literatura. Por lo tanto, esta revisión tuvo como objetivo evaluar la efectividad de la música de Mozart para mejorar las funciones cardiovasculares, así como identificar un patrón en las obras que tienen un efecto más fuerte. Se realizó una revisión sistemática de ensayos clínicos aleatorios, exploratorios y cualitativos en las bases de datos PubMed, LILACS, SciELO y BVS. Se compararon los efectos de los arreglos de Mozart con los del silencio, las canciones pop, los arreglos de otros compositores eruditos y con el "white noise". En este sentido, las melodías de Mozart probadas por los estudios mostraron un efecto reductor de la presión arterial sistólica y diastólica más acentuado en todos los ensayos clínicos. También se observaron cambios en la frecuencia cardíaca, el doble producto y los niveles de cortisol sérico. Se ha demostrado que la musicoterapia es cada vez más eficaz en el tratamiento de pacientes con trastornos cardiovasculares y puede ser una alternativa económica y accesible para el tratamiento de la hipertensión arterial sistémica. Así, Wolfgang Amadeus Mozart se distingue de otros compositores por las características únicas de sus composiciones y se necesitan más estudios, con mejoras metodológicas, para mejorar la musicoterapia y su uso en Cardiología.

Descriptores: cardiología; frecuencia cardiaca; terapia musical.

Introduction

Over the centuries, music has been used to lift people's spirits. The power of music to bring about physical and mental well-being was already recognized by the ancient Greeks. Pythagoras was intrigued by the fact that people appreciate consonant sounds: he discovered that harmonic music is capable of calming people and healing diseases of the spirit, body and soul. Pythagoras believed that the mathematical nature of music influenced the mind and body and called this "musical medicine" (1). Recent studies confirm that leisure music listening is related to an elevation of emotional arousal (2-3). In this sense, music has a positive effect on psychological well-being. Thus, music not only influences health psychologically, but its overall improving effects have ample support in the scientific literature. It is reported that the greatest health benefits come from chamber music composers (so-called classical) such as Bach, Mozart, Haydn and Händel (4).

Research with rats has shown that the frequency of music is directly related to their cardiological improvement. Thus, high-frequency music (4kHz to 16kHz) has been shown to have a markedly greater systolic blood pressure reducing response when compared to low-frequency music (32-125Hz) (5). In addition to the decrease in blood pressure levels, other studies have also found a decrease in heart rate and serum cortisol (6). Mozart's music, compared to the music of several other classical composers, such as Brahms, Bach and Haydn, has a much higher average frequency. Thus, the frequency domain modulations of Mozart's music may have a greater influence on the neurophysiological activity (7), being important in the treatment of epilepsy (8). Hughes and Fino (9) indicated, in their analysis of 402 pieces of music and 59 composers, that frequency plays a key role in separating Mozart's music from the music of other composers.

Mozart's music has proven parasympathetic effects (10) and enhances dopaminergic neurotransmission, with beneficial effects on the regulation of body homeostasis (11). One of the distinctive characteristics of Mozart's music is the frequent repetition of the melodic line; this determines the virtual lack of elements of "surprise", which can distract the listener's attention from rational listening, in which each element of harmonic (and melodic) tension finds a resolution that confirms the listeners expectations. Thompson (12) and Husain (13) advanced the theory that these periodicities are in accordance with a general theme, which is a characteristic of Mozart's music, which is highly organized, presumably echoing the organization of the cerebral cortex. Thus, this paper aims to evaluate the effectiveness of Mozart's music in improving cardiovascular functions, as well as to identify a pattern in the music that has the most pronounced effect.

Methods

This work is a qualitative exploratory systematic review, carried out in the PubMed, LILACS, SciELO, and VHL databases. In the PubMed database, a search was initially made with the descriptors "Mozart," "Cardiovascular," and "Cardiology" in which the Boolean operators "AND" and "OR" were used. Inclusion criteria were: randomized clinical trials; up to five years from study publication (January 2015 to December 2020); humans and adults. In this search, three articles were found, two of which were selected for further study. Combined with the use of the Boolean operator "AND" and the same filters of "ten years" and "humans", through the "PubMed Advanced Search Builder" mechanism, the descriptors resulted in two articles. However, one had already been selected for the study and the other was not interesting for the objective of the study.

In the VHL, the Health Sciences Descriptors (DeCS) were used to reach the descriptors: "Mozart" and "Cardiology". Combined with the Boolean operator "AND", seven articles were found; applying the inclusion criteria and excluding the duplicates, one article was found. In LILACS, using the descriptors "Mozart" and "Cardiovascular", combined with the Boolean operator "AND" and the inclusion criteria, three articles were found; excluding the duplicates, zero articles were found. In the SciELO database, using the descriptors "Cardiovascular", "Cardiology", and the word "Mozart" combined with the Boolean operators "AND" and "OR" and applying the inclusion criteria, no randomized clinical trials were found.

Results and Discussion

In charts 1 and 2, the three articles selected for writing the review and the main information in these articles are listed.

Chart 1 - Articles selected for qualitative analysis.

Articles	Titles	Methodology	Main information
GRUHLKE, 2015.	*Mozart, but not the Beatles, reduces systolic blood pressure in patients with myocardial infarction.*	Sixty patients who suffered myocardial infarction were divided into three groups: those whothose who listened to Mozart, those who listened to Beatles, and those who listened to TV news. A intervention lasted 60 minutes. Heart Rate (HR),Systolic Pressure (SP), Diastolic Pressure Pressure (DP) and Double Product(DBP) were checked twicebefore the intervention and once every 15 minutes during the intervention. Data were analyzed using SPSS software.	In patients allocated to the Mozart-listening group, the mean PS decreased from 111.6 +- 17.3 mmHg to 104.4 +- 14.7 mmHg and the mean SD decreased from 7,942.3 +- 1534.8 to 7,273.8 +- 1,427.27. In the other groups, there was no significant significant change in parameters evaluated.

TRAPPE, 2016.	*The Cardiovascular Effect of Musical Genres*	One hundred and twenty participants divided into two groups: 60 listened to music and 60 did not listen. Inclusion criteria inclusion criteria: men and women from 25 to 75 years old, cardiologically healthy and not taking medications. Hypertensive patients were excluded from the excluded from the study. For data analysis, the Shapiro-Wilk test was performed.	Of the three compositions different compositions (Mozart, Strauss, and ABBA) to which the study group was introduced, Mozart, in his symphony No. 40, had the greatest beneficial effect, lowering blood pressure and HR. The songs by the ABBA group had no effect.

Chart 2 - Songs used in the clinical trial of the analyzed articles.

Articles	Mozart's music used in the clinical trial
GRUHLKE, 2015.	Piano Sonata Nº. 11 in A major, K. 331; Piano Concerto N° 21 In C major, K. 467: II. Andante; Clarinet concerto in A major, K. 622 Allegro; Piano Concerto Nº 11 in F major, K.413: II. Larghetto; The Magic Flute, K. 620, act II; Clarinet quintet, K. 581 in A major: Allegro; Serenade Nº 13 in G major, K. 525: I. Allegro e Klavierkonzert Nº 26 D-dur, KV 537 Krönungskonzert: II. Larghetto
TRAPPE, 2016.	Symphony Nº. 40 in G minor, KV. 550
KISHIDA, 2019.	Sonata for Two Pianos in D major, K. 448

In Gruhlke's (14) study, The inclusion criteria were: elevated serum cardiac enzymes (troponin and creatine kinase) or ST-segment elevation on the electrocardiogram. Patients with hearing loss, atrioventricular block, severe hypotension, or shock were excluded from the study. There was no explanation of how the selection of Mozart's songs occurred. The choice of songs for the group that listened to the Beatles seems not to have taken into account the frequency of the songs, the rhythmicity, and the predictability.

In the inclusion of patients, there was no clear distinction between hypertensive and normotensive patients, which may have influenced the final results of the study. Moreover, it was not made explicit in the methodology whether the patients with comorbidities, taking medication, or clinical findings were excluded. In this sense, the article by Gruhlke (14) could obtain different results by using a song selection based on the frequency, rhythmicity and predictability of the Mozartian compositions, besides that it is important, for the quantitative analysis, to differentiate hypertensive from normotensive subjects. Therefore, methodological changes in order to obtain greater accuracy in the results are suggested.

In Trappe's (6) study, 120 healthy, non-patient volunteers were examined, selected from an initial group of 139 of whom 19 had to be excluded because they had high blood pressure, an unfavorable heart condition, or were taking medication. Of the total 120 subjects allocated to the study, 60 constituted the control group and remained silent and at rest during the test, while the other 60 were introduced to a 25-minute music session whose sequence was previously randomized by computer.

When the subjects were exposed to Mozart and Strauss, there was a reduction in systolic pressure, with Mozart's being the most significant, showing a mean drop of 4.7 ± 8.6 mm Hg. In quiet conditions, the control group also showed a reduction in systolic pressure, with a mean drop of 2.1 ± 7.5 mm Hg. The same pattern was followed in the observation of diastolic pressure, with Mozart's music showing a mean drop in pressure of 2.9 ± 7.8 mm Hg and the control group of 2.6 ± 7.7 mm Hg. In the same sense, the most beneficial effect on heart rate was found in Mozart's music, which presented a mean decrease of 5.6 ± 9.8 bpm compared to the mean heart rate of the participants, which was 70.9 ± 12.3 bpm. In the control group, RR showed a decrease of 5.4 ± 8.1 bpm (6).

The same study also evaluated the level of serum cortisol, and in view of this, the male subgroup reacted much better in the tests with the three music genres compared to the female subgroup, and a notable difference was observed between the control group and the intervention group. Although it is natural that the hormone level drops during rest periods (the control group's state of silence), the results of the intervention group were more significant. Although a clear drop in cortisol level was observed in all three genders, Strauss and Mozart presented the most significant, and the difference in results between these two genders was minimal (6).

Nevertheless, Trappe's (6) study could obtain better results if it expanded the musical content applied to the volunteers within the findings listed in its conclusion, proposing a broader comparison. In conclusion, the article pondered that music with a higher degree of periodicity, skillful composition, little variation in volume and rhythm, harmonic sequences, and other similar factors appeared to be the most likely to cause a positive effect.

The primary objective of Kishida's (15) study was to

evaluate the effectiveness of music therapy to relieve pain during cannulation in hemodialysis. As a secondary objective, Blood Pressure (BP), Heart Rate (HR), and salivary amylase enzyme activity were checked before and immediately after the procedure. This was a multi-facility, double-blind, randomized and controlled study. In the experiment, the authors played the Sonata for Two Pianos in C major (K. 448), famous for the 'Mozart Effect', and eight minutes after that they started the procedure, and the volunteer kept listening to the music until the end. The reason for starting the music eight minutes before the caning was for two reasons: the modulation from the first movement (with a faster tempo) to the second movement (with a slower tempo) of the sonata takes about eight minutes, and in this change of modulation a relaxing effect is expected. The second reason is that in previous studies the participants listened to the music for ten minutes.

The study took place over a period of four weeks and the patients were tested three times a week. First, BP, HR and amylase were measured, then the patients used headphones connected to a computer and proceeded to listen to music, white noise or silence. Immediately after cannulation, HR and BP were measured again. The most important feature of this study was the use of white noise as a comparative control. This "white noise" is defined as a sound that contains the same intensity of all frequencies audible to the human ear (1-22kHz) and it must have melody, harmony, rhythm, and pitch. Since several other previous studies have used the "no sound" condition as a control, but have not looked at the potential placebo effect of the musical intervention, the effectiveness of previous therapeutic musical interventions may be misleading. Previous studies have proven that noise does not have musical properties, but does have relaxing properties. The study is still ongoing (15).

Conclusion

Music therapy has proven to be increasingly efficient in the treatment and relaxation of cardiovascular patients or even non-patients. However, not all music has this therapeutic quality and this characteristic has been credited to certain aspects that the music may present, such as the skillful composition of the song, its high degree of periodicity, few changes in rhythm and volume, or even the maintenance of a high frequency in its execution.

In this respect, Mozart's songs not only present perfect harmony with these required characteristics but also, empirically, present excellent results in this above average therapeutic process in relation to the other songs compared to them. Nevertheless, it is necessary to have a greater variability in the comparative processes that employ songs qualified as those that supposedly have a beneficial effect. It is also necessary to test the average frequency of the songs being analyzed and to establish a control group subjected to white noise instead of silence to challenge the supposed placebo effect attested in this second case, and also to involve hypertensive individuals in the intervention group to analyze the possible achievement of even more significant results.

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